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October 31, 2024

Mr. Joshua Fontaine
U.S. Environmental Protection Agency, New England Region
Five Post Office Square
Suite 100
Boston, MA 02109

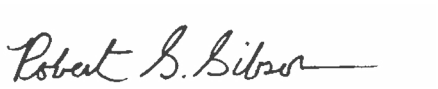
Re: GE-Pittsfield/Housatonic River Site
Rest of River (GECD850)
Baseline Restoration Assessment Report for Reach 6

Dear Mr. Fontaine:

In accordance with Section II.H.12 of the Revised Final Permit issued by EPA for the Rest of River, Section 4.2.1.5 of the *Final Revised Rest of River Statement of Work*, and an August 30, 2024 proposal by GE as approved by EPA on September 12, 2024, GE is submitting herewith for EPA's review and approval a *Baseline Restoration Assessment Report for Housatonic Rest of River Reach 6*, prepared for GE by AECOM.

Please let me know if you have any questions about this report.

Sincerely yours,



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AECOM

Baseline Restoration Assessment Report For Housatonic Rest of River Reach 6

October 2024

Prepared for General Electric Company
Pittsfield, Massachusetts

Baseline Restoration Assessment Report For Housatonic Rest of River Reach 6

October 2024

Prepared for
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ABBREVIATIONS

BANCS	Bank Assessment for Non-Point Source Consequences of Sediment
BEHI	Bank Erosion Hazard Index
BMP	Baseline Monitoring Plan
BRA	Baseline Restoration Assessment
CD	Consent Decree
cfs	cubic feet per second
CMS	Corrective Measures Study
Confluence	Confluence of the East and West Branches
CRA	Cultural Resources Assessment
dbh	diameter at breast height (of trees)
EA	Exposure Area
EFDC	Environmental Fluid Dynamics Code
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act (Federal)
FEMA	Federal Emergency Management Agency
Final Accessibility Report	*Final Morphology and Accessibility Survey Report*
Final Revised OSS	*Final Revised Overall Strategy and Schedule for Implementation of Corrective Measures*
Final Revised SOW	*Final Revised Rest of River Statement of Work*
GE	General Electric Company
GIS	Geographic Information System
GPS	global positioning system
HEC-RAS	Hydrologic Engineering Center River Analysis System (USACE)
HHA	Hydrologic/Hydraulic Analysis
HHRA	EPA's *Human Health Risk Assessment*
IPaC	Information for Planning and Consultation (USFWS)
IPANE	Invasive Plant Atlas of New England
LGS	Low Gradient Stream
LiDAR	Light Detection and Ranging
MassDFW	Massachusetts Division of Fisheries and Wildlife
MESA	Massachusetts Endangered Species Act
mg/kg	milligram per kilogram
MGS	medium-gradient Stream
MIPAG	Massachusetts Invasive Plant Advisory Group
MNHESP	Massachusetts Natural Heritage and Endangered Species Program
NAVD88	North American Vertical Datum of 1988

NGVD29	National Geodetic Vertical Datum of 1929
PCBs	polychlorinated biphenyls
PDI	pre-design investigation
PSA	Primary Study Area
RBP	EPA Rapid Bioassessment Protocol
RCRA	Resource Conservation and Recovery Act
RCMS	Revised Corrective Measures Study for Housatonic Rest of River
RD/RA	Remedial Design/Remedial Action
Revised BMP	Revised Baseline Monitoring Plan
Revised Permit	Revised Final RCRA Permit Modification
RFI	RCRA Facility Investigation
RMS	Red Maple Swamp
ROR	Rest of River
RU	Remediation Unit
SAV	submerged aquatic vegetation
SOP	Standard Operating Procedure
SOW	Statement of Work
UAV	unoccupied aerial vehicle
UDF	Upland Disposal Facility
USACE	U.S. Army Corps of Engineers
USDA NRCS	U.S. Department of Agriculture Natural Resource Conservation Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WMA	Wildlife Management Area
Woodlot	Woodlot Alternatives, Inc (now Stantec)
WSE	water surface elevation
YOY	young-of-the-year
YSI	Yellow Springs Instrument

1.0 Introduction and Objectives

1.1 Background

On December 16, 2020, pursuant to the 2000 Consent Decree (CD) for the GE Pittsfield/Housatonic River Site (EPA and GE 2000), the U.S. Environmental Protection Agency (EPA) issued to the General Electric Company (GE) a final revised modification of GE's Resource Conservation and Recovery Act (RCRA) Corrective Action Permit (Revised Permit) for the Housatonic Rest of River (ROR) (EPA 2020). The ROR is defined as that portion of the Housatonic River and its backwaters and floodplain (excluding Actual/Potential Lawns as defined in the CD) downstream of the confluence of the East and West Branches of the Housatonic River (the Confluence) in Pittsfield, Massachusetts. The Revised Final Permit set forth a Remedial Action selected by EPA to address polychlorinated biphenyls (PCBs) in the ROR. The ROR is shown on **Figure 1-1**.

The Revised Final Permit required GE to develop and submit a Statement of Work (SOW) specifying the deliverables and activities that GE will conduct to design and implement the ROR Remedial Action. In accordance with that requirement, GE submitted a Final Revised Rest of River Statement of Work on September 14, 2021 (Final Revised SOW; Anchor QEA et al. 2021), and EPA approved it on September 16, 2021. Subsequently, as also required by the Revised Permit GE submitted a *Final Revised Overall Strategy and Schedule for Implementation of the Corrective Measures* on July 5, 2022 (Final Revised OSS; Anchor QEA 2022), and EPA approved it on July 6, 2022. As described in that document, the ROR has been segmented into six separate Remediation Units (RUs), corresponding to various reaches of the river, to manage workflow and schedule for the ROR Remedial Action.

Section II.B.1.c.(2)(a) of the Revised Permit requires GE to conduct and submit a work plan for a Baseline Restoration Assessment (BRA) of areas that will be affected by the ROR Remedial Action. Sections 4.2.1.4 and 4.2.1.5 of the Final Revised SOW describe the work plan and report on the BRA in more detail.

On December 22, 2021, GE submitted a Baseline Restoration Assessment Work Plan (initial BRA Work Plan) to meet the above requirements. On March 31, 2022, EPA issued a conditional approval letter for that initial BRA Work Plan. Among other conditions, that letter required GE to submit a focused BRA Work Plan for Reach 5A of the ROR (the first RU to be addressed under the Revised Permit) and then to submit a separate general revised BRA Work Plan that would cover Reaches 5B through 8. GE submitted a Revised Reach 5A BRA Work Plan on July 14, 2022 (AECOM 2022), and EPA approved that Work Plan on July 18, 2022. GE subsequently initiated data collection for the Reach 5A BRA, which was conducted from July 2022 through June 14, 2023. On February 19, 2024, GE submitted the Revised Reach 5A BRA Report (AECOM 2024a), which EPA approved on March 5, 2024.

In accordance with EPA's March 31, 2022 conditional approval letter of the initial BRA Work Plan, GE submitted a Revised BRA Work Plan for Rest of River Reaches 5B through 8 on August 2, 2022, covering the RUs in those reaches, including both site-wide conditions applicable to those RUs and the RU-specific conditions in them. On December 22, 2022, EPA issued a conditional approval letter for that work plan, requiring modifications to be addressed in a further Revised Work Plan for Reaches 5B through 8. That Revised BRA Work Plan for Reaches 5B through 8 was submitted by GE on February 20, 2023 (Revised Reach 5B-8 BRA Work Plan; AECOM 2023), and EPA issued its approval for that Work Plan on March 8, 2023. That Revised BRA Work Plan noted that, upon completion of the BRA survey activities described therein, GE would submit a BRA Report for Reaches 5B-8.

The Final Revised OSS provided that the sediment removal in Reach 6, which includes Woods Pond, as well as floodplain soil removal in Reach 6, will be conducted in parallel with sediment/soil removal in Reach 5A such that sediment/soil removal in both reaches will be completed at approximately the same time, although capping in Reach 6 will be delayed until after all remedial activities have been completed in all upstream RUs. As a result, GE advanced the performance of the pre-design investigation (PDI) of Reach 6 before the PDI for Reaches 5B and 5C, and conducted that PDI in accordance with a Revised Reach 6 PDI Work Plan submitted to EPA on May 1, 2023 (Anchor QEA 2023b) and conditionally approved by EPA on June 20, 2013. The results of that PDI have been provided in a PDI Summary Report for Reach 6 (Anchor QEA 2024), and a Conceptual Remedial Design/Remedial Action (RD/RA) Work Plan has been developed for Reach 6 (Anchor QEA et al. 2024), both of which are being submitted concurrently with this report on October 31, 2024. Similarly, the BRA for Reach 6 was advanced prior to the other work provided for in the Revised Reach 5B-8 BRA Work Plan; and on August 30, 2024, GE submitted a formal request to submit a separate BRA Report for Reach 6 concurrently with the PDI Summary Report and Conceptual RD/RA Work Plan for Reach 6. EPA approved that request by letter dated September 12, 2024. Accordingly, GE is submitting this separate BRA Report for Reach 6.

1.2 Description of Reach 6 and Scope of this BRA Report

Reach 6, which is located in the towns of Lenox and Lee, Massachusetts, begins approximately 10 miles downstream of the Confluence and extends through Woods Pond, an impounded waterbody formed by the construction of Woods Pond Dam in the late 1800s (**Figure 1-1**). In addition to Woods Pond proper, Reach 6 includes an approximately 700-foot portion of the headwaters leading into Woods Pond, which is also referred to herein as the transition zone because it is transitional between the riverine habitat of Reach 5C and the impounded habitat of Woods Pond proper. Further, the southwestern end of Woods Pond consists of a four-acre channel area that terminates at the southern end at the dam. This area is referred to in this report as the outlet channel; it contains deeper (up to 15 feet deep) conditions and more riverine-like surface flow but remains dominantly

influenced by the impounded flow from the dam. Finally, Reach 6 includes the floodplain associated with these aquatic areas, as described below and shown on **Figures 1-2 and 1-3**.

The existing dam at Woods Pond is a concrete overflow weir dam (constructed in 1989) that consists of a 140-foot-long concrete overflow spillway, a concrete non-overflow gravity section with sloped downstream face at the west abutment, and a concrete and steel sheetpile raceway closure structure at the east abutment (GZA 2019). Water can bypass the dam via the raceway, and a portion of that bypass enters a downstream pond area, known as Valley Mill Pond, via a culvert. The spillway has a crest elevation of 948.3 feet National Geodetic Vertical Datum of 1929 (NGVD29), and the top elevation of the west abutment is 954.0 feet NGVD29 (GZA 2019).[1]

Woods Pond is approximately 0.2 mile in length and has a surface area of approximately 53.6 acres; the headwaters transition area encompasses an additional 12.6 acres, and the outlet channel covers an additional 3.7 acres. Collectively, these three zones comprise approximately 70 acres in area. Water depths (as measured from the crest of the dam) over much of the pond generally range from one to three feet; however, a deeper portion on the southeastern side of the pond has a maximum depth greater than 14 feet. There is also a relatively pronounced channel through Woods Pond, which provides a primary flow pathway. The water depth in the channel is deeper than the surrounding areas, and water velocity in the channel area is typically greater under average flow conditions than in other areas of Woods Pond. The water in most of Woods Pond is relatively slow-moving and contains aquatic habitat characteristics of a standing, shallow-water environment. The pond has dominant macrophyte and periphyton communities during the growing season that have strong influence on the pond system. The banks of the pond provide extensive cover, such as overhanging vegetation, woody debris, rock piles, and submerged macrophytes (EPA 2005).

Reach 6 contains a variety of aquatic habitats, which are influenced in various ways by the impounded conditions created by Woods Pond Dam. Woods Pond itself is characterized principally as an impoundment, while the transition zone in the headwaters of Woods Pond and the outlet channel just upstream of the dam have a transitional habitat between the impoundment habitat and riverine habitats upstream and downstream of those areas. The transition zone and outlet channel are part of Reach 6 but are discussed herein separately from the main impoundment that comprises Woods Pond because flow and habitat conditions are different from those of the pond proper. Valley Mill Pond is a 4.6-acre shallow pond south of Woods Pond Dam and is hydrologically connected to the raceway which extends along the eastern side of the Housatonic River starting at the Dam.

[1] The vertical datum being used for data collection and the remedial design is the North American Vertical Datum of 1988 (NAVD88). Using that datum, the Woods Pond Dam spillway crest elevation is 947.7 feet NAVD88.

Within Reaches 5 and 6, the CD defines the ROR site boundary as the floodplain area extending laterally to the 1 milligram per kilogram (mg/kg) PCB isopleth, which corresponds approximately to the 10-year floodplain. The floodplain in Reach 6 directly bordering Woods Pond is relatively narrow, generally extending no more than 50 to 150 feet from the pond shoreline. Much of the vegetation in this portion of the Reach 6 floodplain consists of red maple swamp and shrub swamp, with some more limited areas of emergent marsh and wet meadow habitat.

EPA's *Human Health Risk Assessment* (HHRA; EPA 2005) divided the ROR floodplain into 90 Exposure Areas (EAs) for the assessment of direct human contact with floodplain soils.[2] Of the 90 EAs identified in the HHRA, five are located wholly or partially within Reach 6 (EAs 56 through 60), as shown on **Figure 1-2**. EAs 56 and 57 are located partially within Reach 5C but were fully characterized as part of the Reach 6 PDI, and therefore were included in this Reach 6 BRA. There are two vernal pools identified in EA 57. For consistency between the Reach 6 Summary Report PDI and this Reach 6 BRA Report, this BRA Report covers the entirety of Reach 6 (**Figure 1-2)**.[3]

In addition, as discussed in the Conceptual RD/RA Work Plan for Reach 6, GE has elected to include Valley Mill Pond, located on the eastern side of the river immediately south of Woods Pond Dam, in the conceptual design for Reach 6 because it is hydraulically connected to Reach 6 through a diversion channel that bypasses the dam. As a result, GE has expanded the Reach 6 BRA to cover Valley Mill Pond.

Further, as also discussed in the Conceptual RD/RA Work Plan, GE has identified three areas to serve as support areas for the Reach 6 remediation: (1) a shoreline support facility situated on the southern shore of Woods Pond; (2) the route for an hydraulic pipeline for conveying dredged material from the shoreline support facility to the on-site Upland Disposal Facility (UDF) outside the floodplain near Woods Pond; and (3) a rail spur and rail loading and unloading area, referred to as the Woods Pond Spur, situated along the western side of Woods Pond near the Lenox Rail Station. This BRA Report also includes a brief discussion of the habitats in these anticipated support areas.

1.3 Restoration Performance Standards

The Performance Standards for restoration of disturbed areas in the ROR, as provided in Section II.B.1.c.(1) of the Revised Permit and summarized in Section 2.1.3 of the Final Revised SOW, are to: (1) implement a comprehensive program of restoration measures to address the impacts of the

[2] Although those EAs were initially defined by EPA starting with property boundaries, the EAs included in Reach 6 are limited to the portions of the floodplain between the edge of the Housatonic River and the ROR floodplain boundary (i.e., the 1 mg/kg isopleth).

[3] As discussed in the separate Conceptual RD/RA Work Plan for Reach 6, that conceptual design does not include the Woods Pond headwaters transition zone, the conceptual design for which will be addressed in a subsequent addendum to the Final RD/RA Work Plan for Reach 6. However, like the PDI Summary Report for Reach 6, this BRA Report does include that area.

remediation and support activities on affected ecological resources, species, and habitats; and (2) return areas disturbed by remediation activities to pre-remediation conditions (e.g., the functions, values, characteristics, vegetation, habitat, species use, and other attributes) to the extent feasible and consistent with the remediation requirements. Under Section II.B.1.c.(2) of the Revised Permit, these Performance Standards will be achieved through a program designed to address the potential impacts of remediation, which will be specified in the following series of documents: (1) a BRA Work Plan; (2) a Restoration Performance Objectives and Evaluation Criteria Report; (3) Restoration Corrective Measures Coordination Plans; and (4) Restoration Plans. Each of those documents was described further in the Final Revised SOW. As noted above, this document constitutes a BRA Report for Reach 6.[4]

1.4 Reach 6 BRA Objectives

The Reach 6 BRA is intended to provide a detailed baseline ecological inventory and assessment of pre-remediation conditions and functions of the affected habitats within Reach 6 and thus to serve as the foundation for meeting the restoration Performance Standards set forth in Section II.B.1.c.(1) of the Revised Permit as applicable to this reach. The conditions and features identified in this BRA Report are also to be used in concert with engineering considerations in an effort to site access roads and staging areas in areas with lower habitat values where practicable. That information has also been taken into account in the preparation of GE's Conceptual RD/RA Work Plan for Reach 6 being submitted concurrently with this BRA Report.

1.5 Reach 6 BRA Requirements

Section II.B.1.c.(2)(a) of the Revised Permit and Section 4.2.1.4 of the Final Revised SOW set forth the requirements for the BRA Work Plan. Those requirements and the requirements in Section 4.2.1.5 of the Final Revised SOW indicate that the BRA for each RU, including Reach 6, is to include the following elements:

- Identification of the presence and location of specific habitat types, including delineation of existing wetlands;
- Identification of the presence, location, abundance, and condition of federal or state-listed threatened or endangered species or other state-listed species and their habitats, as well as other representative species;
- Identification of the presence, location, abundance, and condition of invasive species;
- Evaluation of vernal pool locations, hydrology, and species use; and

[4] In addition, GE has prepared the required Restoration Performance Objectives and Evaluation Criteria Report on a site-wide basis. The Revised Restoration Performance Objectives and Evaluation Criteria Report was submitted to EPA on April 15, 2024, and was conditionally approved by EPA on July 15, 2024.

- Characterization of physical/biological attributes of affected habitats (e.g., substrate characteristics, water depth, velocity, temperature, elevation/bathymetry, species composition, density, percent cover, and structural components).

In addition, EPA's prior conditional approval letters dated March 31, 2022 and December 22, 2022 include requirements that were addressed in the Revised Reach 5B-8 BRA Work Plan and are thus required to be part of the Reach 6 BRA.

1.6 Reach 6 BRA Organization

Consistent with Revised Reach 5B-8 BRA Work Plan, this Reach 6 BRA Report is organized according to the major habitat types which occur in Reach 6. Section 2 provides an overview of the approach taken for this report. Sections 3 through 5 provide baseline ecological descriptions of the aquatic habitats, floodplain habitats and vernal pool habitats in Reach 6, respectively. Section 6 provides general descriptions of the habitats in the anticipated support areas. Following those habitat assessments, Section 7 presents information on federally listed and state-listed species in Reach 6, and Section 8 addresses invasive species identified in the different habitats. Section 9 presents information obtained during the BRA on: (a) floodplain areas with disturbed or degraded habitats that were considered for support areas for the Reach 6 remediation; and (b) potential restoration opportunities in Reach 6. Finally, Section 10 lists the references cited herein.

2.0 Overview of Approach for Reach 6 BRA

The general approach for conducting the BRA for each major habitat type in Reach 6 has been consistent among the habitats. For each habitat type, the initial step was to consolidate and summarize prior reports and investigations that included characterization of that habitat and ecological conditions of or applicable to Reach 6. The relevant prior investigations through 2022 were described in Section 2 of the Revised Reach 5B-8 BRA Work Plan. In addition, consideration was given to relevant information from the PDI conducted in Reach 6 in 2023 in accordance with GE's May 2023 Revised PDI Work Plan for Reach 6, as well as other existing information from other sources.[5] For example, super habitat mapping in Reach 6 was updated based on field surveys of habitat cover types conducted by AECOM between April 20 and June 29, 2023. These updated super habitat boundaries were used to determine updated floodplain soil PCB sampling locations for the Reach 6 PDI. The updated super habitat mapping and revised floodplain soil sampling locations were submitted to EPA for review and approval on July 31, 2023. EPA approved those revisions on August 28, 2023.

This information was supplemented with the results of the specific habitat investigations conducted in 2023 and 2024 in accordance with the Revised Reach 5B-8 BRA Work Plan.

The habitat-specific sections of this BRA Report describe the pertinent information from prior investigations described in Section 2 of the Revised Reach 5B-8 BRA Work Plan, pertinent information from the Reach 6 PDI and other existing sources, the results of the specific BRA investigations conducted for the subject habitat in Reach 6, and a comprehensive assessment of the habitat and the functions provided by that habitat, based on the referenced information.

[5] As noted above, the PDI Summary Report for Reach 6 is being submitted concurrently with this Reach 6 BRA Report, and has been prepared interactively with this report.

3.0 BRA of Reach 6 Aquatic Habitats

This BRA is focused on aquatic habitats associated with Woods Pond, which forms the central feature of Reach 6. As noted in Section 1.2, Reach 6 encompasses a variety of aquatic habitats which are influenced in various ways by the impounded conditions created by Woods Pond Dam. Woods Pond itself has been characterized principally as an impoundment, and therefore this BRA or ecological characterization has implemented the Impoundment Habitat Inventory Procedure described in the Revised Reach 5B-8 BRA Work Plan (Section 3.4). However, portions of this RU, notably the headwaters area and the outlet channel just upstream of the dam, are somewhat transitional between impoundment and riverine habitats; these areas are therefore described herein separately from the main impoundment that comprises Woods Pond, although the conditions in these areas are not clearly "riverine" in nature so as to warrant implementing riverine and riverbank inventory procedures as defined in the Revised Reach 5B-8 BRA Work Plan.

Consequently, putting defined limits on the "impoundment," especially at the upstream end, is subject to interpretation. The Revised Permit defines "impoundment" (in part) as "any area of sediment, soil, or water subject to the influence of a dam or dam component." Since Woods Pond Dam strongly influences the hydrologic regime throughout this RU (especially surface water depth and flow), the impoundment classification is paramount. However, the occurrence of channels preferentially conveying surface flow within bed and bank morphology in the headwater and outlet channel areas distinguishes the habitat conditions in these areas from that in the main impoundment, and is consistent with the transitional status of these areas between the more riverine conditions upstream in Reach 5C and the impounded conditions of Woods Pond.

Accordingly, this section addresses the overall "aquatic habitat" conditions of this Reach 6 RU, principally using the impoundment inventory parameters, but also noting the riverine and riverbank characteristics in the transitional portions. Also, despite the close proximity of backwater conditions to the Reach 6 RU, no backwater areas are included in that RU and thus backwaters are not evaluated in this BRA Report.[6] However, Valley Mill Pond is being evaluated as part of Reach 6, and thus the aquatic and bordering habitat of that pond is included (but discussed separately) in this BRA Report (see Section 3.5).

Table 3-1 provides a summary of the parameters that were incorporated into the assessment of baseline aquatic habitat conditions in Reach 6. These include a broad range of impoundment characteristics related to geomorphology, hydrology, floodplain connectivity, bank conditions, benthic habitat, aquatic biota, and bordering vegetative conditions.

[6] Although backwaters are not included as an evaluated habitat in this BRA Report, they are occasionally referred to in this report since, in some parts of Reach 6, they form a boundary along the floodplain or the aquatic habitats that are included in this Reach 6 BRA Report.

The aquatic habitat inventory process for Reach 6 included consolidating and incorporating existing information on aquatic habitats that are specific or applicable to Reach 6. The aquatic habitat characterization for Reach 6 also included site-specific inventories and data collection during a physical aquatic habitat survey which included a side-scan sonar survey to record benthic habitat features such as rocks and large wood debris. During these surveys, information was also collected on the presence of aquatic plants and use of the aquatic habitats by wildlife observed incidental to the data collection.

3.1 Background Ecological Information on Reach 6 Aquatic Habitats

As noted in Table 3-1, some of the aquatic habitat assessment parameters were based on information consolidated from the sources cited previously in Section 2 of the Revised Reach 5B-8 BRA Work Plan. In other cases, the parameters were based on information drawn from other tasks or steps in the remedial investigation process, notably the Reach 6 PDI. Still other information, such as hydrologic/hydraulic data, was obtained from other available sources, as also noted in **Table 3-1**.

3.1.1 Woodlot Ecological Characterization (2002)

On behalf of EPA, Woodlot Alternatives, Inc (Woodlot, now Stantec) conducted an ecological characterization of the Housatonic River and presented its findings in two documents (Woodlot 2002a, 2002b). The first document (Woodlot 2002a) includes information on the Primary Study Area (PSA), which comprises Reaches 5 and 6. The pertinent information on Reach 6 is summarized below.

The ecological characterization study carried out by Woodlot included a variety of biological investigations which addressed rare plants, natural communities, dragonflies, freshwater mussels, reptiles, amphibians, raptors, waterfowl, forest birds, marsh, wading birds, and mammals. In this section of the BRA Report, only findings from Woodlot's study which pertain specifically to the aquatic habitats in Reach 6 will be discussed. The Woodlot ecological characterization also included a discussion of hydrologic influences in Reach 6.

Fish populations were qualitatively and quantitatively sampled by Woodlot within the PSA during 1998-2000. Woodlot characterized the results of the fish species collected by feeding strategies (predator species, bottom feeders, forage fish). Sixteen species of fish were collected from Woods Pond. In Woods Pond, five species accounted for more than 75% of the biomass, including bluegill (forage fish), yellow perch (predator), brown bullhead (bottom feeder), largemouth bass (predator), and goldfish (bottom feeder). Although not within Reach 6, the backwaters just upstream of Woods Pond (in Reach 5C) contain six species of fish, which accounted for more than 75% of the biomass in Reach 5C: common carp (bottom feeder), yellow perch (predator), goldfish (bottom feeder), bluegill

(forage fish), brown bullhead (bottom feeder), and largemouth bass (predator). No rare, threatened, or endangered fish species were confirmed to exist in the PSA.

In an extensive listing of wildlife species associated with the various classified habitats, Woodlot specifically broke out medium-gradient and low-gradient stream habitat as distinct classes, and listed wildlife species associated with these habitats. However, the species compositions for these habitat classes did not specify those found in Reach 6, but rather were more broadly listed for the entire PSA. In addition to the information cited above on fisheries, specific points provided by Woodlot on habitat and/or species use of Woods Pond include the following:

- The Woods Pond natural community is characterized by slow-moving water, often with abundant submersed vegetation, and is considered to be a moderately alkaline lake/pond. This relatively shallow impoundment has a similar flora as the downstream portions of the Housatonic River in the PSA.
- Woods Pond is a broad, shallow impoundment of the Housatonic River formed by the construction of the Woods Pond Dam in the late 1800s. The remnant river channel on the eastern and southern shores of Woods Pond is considerably deeper than the shallower depths of the remnant floodplain that is characterized by stands of submerged and emergent macrophytes and dense surface algal mats. A deep hole, characterized by a depth of 4.8 meters (m), is located in the southeastern area of the remnant stream channel. This hole is further characterized by a thick deposit of soft silt-clay sediments that has accumulated over the past +/-100 years or so since construction of the Woods Pond Dam. In the shallow remnant floodplain areas of Woods Pond, the sediments are characterized as silt with a high organic content. Although the broad, shallow areas of Woods Pond are well mixed, the region defined by the hole exhibits thermal stratification during the summer.
- Most of the specific wildlife observations cited by Woodlot in Woods Pond were of birds. These included observations of osprey (*Pandion haliaetus*), bald eagles (*Haliaeetus leucocephalus*), mallards (*Anas platyrhynchos*), wood duck (*Aix sponsa*), great blue heron (*Ardea herodias*), and common gallinule (*Gallinula galeata*).[7] A single northern water snake (*Nerodia sipedon*) was observed swimming in Woods Pond near the footbridge during the summer of 2000. This was the only sighting of this species despite the presence of suitable habitat.

3.1.2 RCRA Facility Investigation Report (2003)

GE's 2003 RCRA Facility Investigation Report (RFI Report; BBL and QEA 2003) provided substantial information characterizing ecological resources in the ROR area, including the riverine habitats in

[7] In this report, the scientific name for each animal and plant species mentioned is only given once.

Reaches 5-6. The focus of the RFI Report was on documenting the extent of PCBs in the river, which will not be summarized herein. However, in depicting PCB distribution, some relevant information pertaining to aquatic habitat information in Reach 6 was provided.

The RFI Report documented previous biota sampling activities that involved fish, plants, invertebrates, reptiles, amphibians, birds, and small mammals, providing ancillary information on faunal and floral species composition. Much of the habitat information in the RFI Report was excerpted from Woodlot (2002a), as reported previously. Other information in the RFI pertinent to aquatic habitat conditions in Reach 6 are summarized below:

- Water depths in Woods Pond range from about 3 feet to 15 feet, with a relatively deep hole in the southeastern portion of the pond.
- The decrease in river gradient in the Woods Pond headwaters area has a significant impact on hydrodynamics and transport processes. Spatial changes in current velocity and bed properties are related to the spatial variation in River gradient, and the extent of meandering increases as gradient decreases.
- Sediment thickness in Woods Pond ranged from 16 feet in the southeastern deeper pool to minimal thickness near the dam.

3.1.3 EPA Modeling (2006)

EPA's documentation of its modeling efforts for the ROR (EPA 2006), notably its hydrodynamic, sediment transport, and contaminant fate modeling using the Environmental Fluid Dynamics Code (EFDC), provides information on specific functions, such as riverine hydrodynamics, that can be used in characterizing riverine ecological functions, at least partially applicable to Reach 6.

The EFDC modeling conducted by EPA provided calculations about the Housatonic River's continuous time series of flow, water depths, shear stresses, water surface elevations, and velocities, all of which affect habitat suitability to varying degrees. The EFDC report noted that Woods Pond is differentiated from the free-flowing river reaches by the "quiescent water" (p. ES-7), resulting in primarily depositional rather than erosional conditions in Reach 6. The EFDC also provided some characterization of biological conditions in Reach 6, noting that Woods Pond contains "relatively dense macrophyte beds throughout most shallow (i.e., less than 1.5-m deep) areas, [but that,] because of its depth, the deep hole in Woods Pond is largely devoid of macrophyte growth" (p. 2.3-4). The dense macrophyte growth was cited as promoting the deposition of sediment in Woods Pond and accordingly was factored into the fate and transport modeling. The EFDC report also discussed seasonal movements of fish into and out of Woods Pond and the upstream backwaters based on factors such as water temperature and dissolved oxygen levels. It noted that

Woods Pond "exhibits significant habitat complexity and is capable of supporting local bass populations" (p. 2.4-9).

3.1.4 Corrective Measures Study Reports (2008-2010)

In 2008, GE issued a Corrective Measures Study (CMS) Report, which provided detailed evaluations of remedial alternatives for the ROR (Arcadis and QEA 2008). During those evaluations, the CMS Report presented substantial information on ecological baseline conditions in the ROR, including Reach 6, some of which pertain to the aquatic habitat conditions. In October 2010, GE issued a Revised Corrective Measures Study (RCMS) Report, which included additional remedial alternatives, provided an updated evaluation of the remedial alternatives, and responded to comments on the 2008 CMS Report (Arcadis et al. 2010). The RCMS Report included a substantially expanded description of the affected habitats in the ROR, including Reach 6 aquatic habitats, and the ecological impacts and potential for restoration associated with the remedial alternatives.

Specific summary information in the RCMS Report on aquatic habitats in Reach 6 included the following:

- Some of the more commonly found plants in Woods Pond are coontail *(Ceratopyllum demersum)*, naiad (*Najas sp*.), Canada waterweed *(Elodea canadensis)*, water celery *(Valisneria americana)*, long-beaked water crowfoot *(Ranunculus longirostris)*, and various species of pondweed *(Potamogeton)*. Moderately alkaline pond communities like Woods Pond are highly susceptible to some of the more invasive aquatic plant species, such as water chestnut *(Trapa natans),* Eurasian watermilfoil *(Myriophyllum spicatum),* and curly-leaf pondweed *(Potamogetan crispus)*. All of these invasive species are found in at least Woods Pond and water chestnut is prevalent there. Aquatic plant growths can become very dense, affecting ecology and human uses.
- The aquatic macroinvertebrate community associated with the impoundments of the Housatonic River, including Woods Pond, is extensive. A substantial number of dragonfly and damselfly species are typically found in these impoundments. Other typical invertebrates include a variety of true bugs (Hemiptera), beetles, caddisflies, a wide range of true flies (Diptera), and freshwater shrimp (Amphipoda).
- Many species of fish utilize Woods Pond. Woods Pond was surveyed in 1997 and 1998 and was shown to contain landlocked alewife, common carp, spottail shiner, golden shiner, white perch, largemouth and smallmouth bass, bullhead catfish, and several species of sunfish. Bluegill sunfish, pumpkinseed sunfish, yellow perch, chain pickerel, and brown bullhead were also recorded in Woods Pond.

- Other wildlife use of Woods Pond includes reptiles (snapping turtles [*Chelydra serpentina],* and painted turtles [*Chrysemys picta]*), northern water snakes, pickerel frogs *(Lithbates palustris)* and northern leopard frogs *(Lithobates pipiens)*, and numerous birds such as several swallow species *(Hirundinidae)*, great blue herons, green herons *(Butorides virescens)*, American bitterns *(Botaurus lentiginosus)*, wood ducks, mallards, Canada geese *(Branta canadensis)*, osprey, and bald eagle. Mammals in the Woods Pond area include beavers *(Castor canadensis)*, muskrat *(Ondatra zibethicus)*, river otter *(Lontra canadensis)*, minks *(Mustela vison)*, long-tailed weasels *(Mustela frenata)*, and several bat species *(Chiroptera)*.

Finally, the RCMS Report provided extensive detail on state-listed species mapping and habitats in Reach 6, including many that use aquatic habitats, at least for certain life cycle requirements. See also Sections 3.3.2 (last paragraph) and 7.2 of this BRA Report

3.1.5 Massachusetts Natural Heritage Information (2000-2022)

Investigations, data, mapping, and reports from the Massachusetts Natural Heritage and Endangered Species Program (MNHESP) of the Massachusetts Division of Fisheries and Wildlife (MassDFW) have been ongoing for at least the last two decades. These efforts included designation of Priority Habitats of state-listed threatened, endangered, and special concern species (referred to herein collectively as rare species). This information described habitat conditions of state-wide significance and detailed the state-listed rare species that were documented within the Priority Habitat limits delineated. In 2008-2009, MNHESP conducted rare species field surveys over thousands of hours to identify populations of state-listed rare species within the Upper Housatonic River Valley (MNHESP, 2010). As of 2010, this research confirmed the presence of at least 20 state-listed species in Reaches 5-6 and resulted in the preparation of updated Priority Habitat mapping for each of these species, which was included in the 2010 RCMS Report. Based on Priority Habitat mapping as of 2010, eight of these state-listed species are associated with aquatic habitat in the Housatonic River, at least during some of the species' life stages. MNHESP also published two documents summarizing much of its investigations (MNHESP 2010, 2011).

The 2010 MNHESP report described rare species and natural community surveys in the Housatonic Watershed. Aquatic habitats in Reach 6 were occasionally referenced. In particular, the dense growth of water chestnut covering the surface of Woods Pond was specifically referred to and depicted. Summaries were provided of investigations documenting rare species with habitat requirements found within Reach 6 aquatic habitat and included in the Priority Habitat mapping discussed above (MNHESP, 2010). In 2011, MNHESP concluded that "the project saw the updating of records and the discovery of many new occurrences of rare species and priority natural communities that were recently or historically known from the watershed, and also included the identification of several rare species never before documented in the watershed" (MNHESP 2011, pp. 30-31).

In July 2012, MassDFW issued a letter to EPA reporting on the designation of Core Habitat Areas within the ROR that were based upon the MNHESP state-listed species data and analyses (MassDFW 2012). That letter, which was attached to the Revised Permit, included maps depicting the locations of the different types of Core Areas, designated Core Area 1, 2, and 3, and presented the criteria for the designations.[8] All three types of Core Areas include some aquatic habitats, although only Core Area 2 overlaps substantially with the aquatic habitats in Reach 6, while the Core Area 1 limits extend along the margins of the aquatic habitat area in Reach 6. One of the designated Core Area 2 state-listed species, the mustard white butterfly *(Pieris oleracea*), has mapped habitat overlapping with Reach 6 aquatic habitats. In addition, two of the Core Area 1 plant species, wapato (*Sagittaria cuneata*) and bur oak (*Quercus macrocarpa*), have mapped habitats which overlap with Reach 6 aquatic habitats.

In October 2022, MNHESP provided GE with updated digital information that included Species Habitat mapping of the state-listed species in the ROR, including Reach 6.[9] As described in Section 3.3 and further in Section 7, four of these species utilize habitats consistent with those present in the Reach 6 aquatic habitats and have mapped Species Habitat that includes the Reach 6 aquatic habitat areas.[10]

3.1.6 Pre-Design Investigations of Reach 6

The PDI conducted in Reach 6 collected a range of information on riverine conditions that contribute to habitat characteristics and is described in GE's PDI Summary Report for Reach 6, which is being submitted concurrently with this BRA Report. The PDI included detailed topographic and bathymetric surveys of the aquatic habitats in Reach 6 to support the remedial design, and this information contributes to the characterization of aquatic habitat conditions.

As described in the PDI Report, between December 2021 and May 2022, GE conducted detailed topographic and bathymetric surveys of the riverbed and floodplain over all of Reaches 5 and 6 (i.e., from the Confluence to Woods Pond Dam), extending laterally to include the approximate 100-year floodplain and including nearby infrastructure (e.g., roads). These surveys included a bathymetric

[8] Cores Areas 1, 2, and 3 are discussed further in Sections 4.1.4 and 7.2.2 of this report.

[9] As discussed further in Section 7.1.2, Species Habitat Maps are species-specific maps prepared by MNHESP using the "best scientific evidence available," examining individual occurrence records and other set criteria to delineate the anticipated habitat area for an individual state-listed species. MNHESP also provides on-line, publicly available mapping of Priority Habitats of state-listed species, which is a regulatory layer consisting of combined Species Habitat Maps with "supporting habitat" added, where applicable.

[10] Two additional state-listed species (the northern long-eared bat and the tricolored bat, which are federally-listed and proposed for federal listing, respectively) may also use these aquatic habitats for feeding. MNHESP did not include these latter two species in the Species Habitat mapping for ROR, but the IPaC results indicate these two species as potentially occurring in Reach 6.

survey of Woods Pond, the transition zone, and the outlet channel. Specifically, in late April and early May 2022, a single-beam sonar bathymetric survey was conducted in Reach 6 areas where water depth was sufficient to conduct such a survey. In areas where single-beam sonar could not be deployed due to limited water depth, such as some shallow portions of the Reach 6 survey area, bathymetry was surveyed using conventional survey methods from a shallow draft vessel or on foot by survey personnel wearing waders.

To provide additional resolution in those areas where single-beam survey could not be performed during the 2022 survey, Spicer Group (on behalf of GE) performed additional single-beam survey during a period of higher river flows on October 31 and November 1, 2023. Figure 2-1 of the PDI Report shows the discrete locations where single-beam sonar soundings and conventional survey data were collected during the 2022 survey and locations of the additional single-beam sonar soundings collected in 2023. The contiguous digital elevation model of topography and bathymetry in Reaches 5 and 6 developed previously by Spicer Group was updated in Woods Pond to include the 2023 single-beam sonar data.

Sediment sampling (along with water depth data) was also conducted in Reach 6 as part of the PDI surveys, and this information contributes to the habitat characterization. Sediment sampling was conducted in Reach 6 from August 17 through September 15, 2023. That sediment sampling was conducted on a 200-foot grid with sampling locations sited in the middle of the 200-foot grid cells or off-center to avoid existing landforms, to target shallower water (deeper sediment sample thicknesses). In addition to the 200-foot grid sampling, sediment sampling was conducted between the 200-foot grid nodes where there were larger data gaps between the historical and PDI grid sampling locations. Also, three sediment core sample locations (left, center, and right of the channel) were established at each of four transects spaced at approximately 250 feet within the outlet channel. In total, sampling targeted the collection of sediment cores at 108 locations, including 78 locations within Woods Pond itself, 18 locations in the transition zone between the downstream end of Reach 5C and Woods Pond, and 12 locations in the outlet channel.

3.1.7 Hydrologic/Hydraulic Analysis

In addition to the PDI, a hydrologic/hydraulic analysis (HHA) of the watershed for Reaches 5 and 6 was performed to evaluate the statistical characteristics of flows within the ROR, and this information forms a part of the understanding of hydrologic conditions in Reach 6 which strongly influences habitat. The hydraulic model used for this project was the U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center – River Analysis System (HEC-RAS) version 6.3.1 modeling software (USACE 2022). A summary of the HHA was provided as Appendix G of the Reach 5A Conceptual RD/RA Work Plan (Anchor QEA 2023c).

The HHA indicates that the drainage area at the Woods Pond headwaters is 169.42 square miles, with a flow increment ratio (to relate measured flow at the Coltsville gage station to this downstream location) of 2.94. Resulting flow values at the Woods Pond headwaters were determined to be 18,338 cfs for a 100-year event, 9,049 for a 10-year event, 4,254 cfs for a two-year event, and 1,449 cfs for a one-year event. For calibration purposes, the reported FEMA water surface elevation (WSE) profile was compared to the HEC-RAS model outputs. The results showed good agreement between the model and the FEMA Flood Insurance Study, particularly in the more downstream portion of the model domain where Woods Pond Dam controls water levels. Accordingly, the model is capable of reasonably predicting WSEs, water depths, average flow velocities, and inundation extents under various flow events, including in the Reach 6 area. The 2023 HHA is a 1D model, suitable to support conceptual remedial design, but will be expanded to a 2D model for final design to more effectively evaluate flow patterns and velocities at locations with complex stream geometry.

3.1.8 Other Existing Information

U.S. Geological Survey (USGS) Gage Station Data

USGS maintains two flow monitoring stations (gages) along the Housatonic River that provide information on the hydrology of the Reach 6 aquatic habitats. The first gage is located along the East Branch of the Housatonic River in Coltsville, Massachusetts (Station 01197000—East Branch Housatonic River at Coltsville, Massachusetts); this gage is located approximately 15 miles upstream of Reach 6. The dataset for the USGS Coltsville gage includes the daily stream flows from 1936 to present. A second gage was installed by USGS in September 2022 (in coordination with GE) along the Housatonic River in the vicinity of Woods Pond Dam (Station 01197145—Housatonic River at Lenoxdale, Massachusetts), accessed at: Housatonic River at Lenoxdale, MA - USGS Water Data for the Nation. Data pertinent to this gage include drainage area (171 mi^2), discharge, stage, and stage elevation.

Fisheries and Aquatic Ecology Surveys in 1992 and 1993 by Chadwick & Associates

On behalf of GE, Chadwick & Associates conducted fisheries survey of the Housatonic River (including Woods Pond) in 1992 and 1993, including benthic invertebrates in the 1993 survey (Chadwick & Associates, 1993 and 1994). The 1992 survey rated Woods Pond habitat as good for species such as largemouth bass and bluegill, noting that Woods Pond had deep pool habitat and abundant cover in the form of submerged aquatic plants and woody debris, and overall that Woods Pond contained a "healthy balanced community with game, rough, and forage fish present" (p. 46).

The 1993 fisheries survey noted that the fish community of Woods Pond was "relatively stable" over the two years of sampling (p. 32). Fourteen of the 16 species collected from the pond were collected during both years. Sunfish and white suckers were the most abundant groups in both years.

Benthic macroinvertebrates were also sampled in Woods Pond in 1993. This benthic community was indicated to exhibit the "typical lentic species assemblage" (p. 55). Dipterans were dominant with oligochaetes also common. Kick samples in the edges around the pond found other taxa, although "because of the relatively deep water and habitat type, the diversity and number of species in Woods Pond are lower than at the Housatonic River sites" (p. 59). Overall, the study concluded that the Woods Pond invertebrate populations are "relatively diverse, healthy and balanced" (p. 63).

Revised Supplemental Phase IA Cultural Resources Assessment (CRA) (March 2023)

GE's 2023 revised CRA report (AECOM 2023b) included an Appendix (Appendix D) entitled "Analysis of Housatonic River Channel Movements for Reaches 5 and 6 of the Housatonic Rest of River," which provides a review of historic conditions in Reach 6 between the mid-1800s and 1942. The historic conditions, especially the construction of the Woods Pond Dam (circa 1880), are instrumental in the initiation of riverine flow changes through Reach 6 which ultimately effectuate aquatic habitat conditions. This report charts the estimated location of river channel flow through Reach 6 since 1854, and documents the presence of a separate pond off the southeastern side of the Housatonic River channel prior to the construction of the Woods Pond Dam. The location of this formerly separate pond is indicated in current updated bathymetry mapping of Reach 6. The pre-impoundment channel location through the headwaters transition zone remains apparent in the current bathymetry mapping as a slightly deeper zone extending from the northeast to the southwest across the transition zone and the central part of the impoundment. Several other remnant or historic channeled flow paths are apparent in the historic channel mapping and correlate to current flow paths through the headwater area.

3.2 2023-2024 Aquatic Habitat Investigations

3.2.1 Overview of Approach and Methods

The consolidation and assimilation of the information described above were supplemented by additional field surveys of the baseline aquatic habitat conditions in Reach 6 in September to November of 2023 and in August and September of 2024.[11] **Table 3-1** provides a listing of the parameters that were incorporated into the assessment of impoundment habitat conditions and the sources for such information. Some of these parameters consist of information drawn from other tasks or steps in the PDI process; these include physical descriptions and measurements from the proposed updated topographic and bathymetric surveys of the PSA (described in the Reach 6 PDI Report) as they relate to the aquatic habitats in and around Woods Pond. Other information was obtained from existing sources such as the various inspection reports on the Woods Pond Dam

[11] These surveys and investigations did not include Valley Mill Pond, which was visited separately in October 2024 and is discussed separately in Section 3.5 below.

under the Revised Permit, the topographic and bathymetric surveys conducted at Woods Pond Dam in 2021-2022, the 2002 Woodlot Ecological Characterization, and the RCMS Report. Finally, site-specific surveys were conducted to inventory overall impoundment habitat conditions, including benthic habitats, fisheries, aquatic macrophytes, and incidental wildlife use. The compilation of parameters that affect and reflect the ecological functions of the impoundment include hydrologic conditions, sediment/benthic habitat, aquatic biota (vegetation, fish and wildlife, including benthic organisms), rare species habitat, and invasive species occurrence, as listed in **Table 3-2.**

Impoundment Habitat Characterization

In addition to the consolidation of the information described above, a more detailed field inventory of the habitat within the Reach 6 impoundment was conducted. The parameters inventoried were documented on **Form IMP-1** (provided in **Appendix A-1**), which includes documentation on impoundment hydrology/flow regime, sediment composition, aquatic biota, rare species habitat, invasive species presence, incidental wildlife observations, the presence of specific habitat features, and surrounding habitat conditions.

Side-Scan Sonar Survey for Benthic Habitat Characterization

To assist in the benthic habitat mapping and characterization in the impoundment, GE conducted side-scan sonar surveys in Reach 6. Side-scan sonar methods were employed consistent with the Revised Reach 5B-8 BRA Work Plan. This survey was conducted from October 31 to November 2, 2023; this time period was specifically selected to survey the impoundment after the dense aquatic macrophyte growth (dense water chestnut growth in particular) had senesced. The following points summarize the approach, which are further described in **Appendix A-2**:

- The objective of the side-scan sonar survey was to identify the percent of habitat types underwater within subsections of the aquatic habitats in Reach 6, particularly where the habitat cannot be observed from above the water. The survey was performed on a small jon boat during fall to avoid navigation and sonar conflicts with submerged aquatic vegetation (SAV), particularly water chestnut.
- The side-scan sonar has capabilities to display habitat features while the boat is moving and while stationary using a rotating transducer mount and advanced image processing. A subsample of georeferenced images was obtained to document special features and to document methods for reporting.
- Both traditional and rotating transducer side-scan sonar methods were employed.
- Habitat polygons were drawn onto paper maps in the field, then digitized to GIS for area calculations and display.

- The following habitat types were differentiated and identified: rock (gravel, cobble, boulder, ledge), wood (large and fine), debris, and manmade structures (e.g., rip rap, concrete). Silt/mud was considered the default substrate/habitat, and sand was differentiated where possible.
- Each observed habitat type with side-scan sonar was verified at 3 locations in the field using an underwater camera.

Fish Community Surveys

Data on the fish community in Reach 6 were obtained through the performance of fish community surveys conducted as part of the fish tissue collection tasks specified for the impoundments in GE's Second Revised Baseline Monitoring Plan (Revised BMP; Anchor QEA 2023a)). These surveys were conducted in 2023 and 2024 using the procedures described in the Revised BMP. The fish community composition sampling events in Reach 6 were performed in a similar manner in both 2023 and 2024 (September 27, 2023 and September 9, 2024) using an electrofishing boat along with the fish tissue sampling in the baseline monitoring program. This community survey occurred by boat for roughly one hour each year; a total of roughly 45 minutes of shocking occurred each year in Woods Pond. The survey area is shown in **Figure 3-1.** Each side of the main river channel, comprising approximately 2,100 feet of shoreline and open water, was surveyed prior to mobilizing along the thalweg and then investigating the remaining southern extent of Woods Pond, comprising approximately 1,400 feet of shoreline and open water. The transect started at the furthest downstream point that could be safely accessed within the survey area on the western shoreline of Reach 6 by the dam. The boat then proceeded upstream towards the furthest northern extent of the area before working back along the eastern shoreline. Upon completion of the main river channel, the southern extent of Woods Pond was characterized.

The sampling occurred in both years following a period of dry weather and low flow conditions. The surface water in Reach 6 was calm and mostly stagnant. Depths were on average less than five feet except when navigating along the thalweg. The main river channel was found with coarse underlying substrate and riprap along the water edge, while small boulders and cobble were more dominant in the upper parts of the reach. Deadfall was sparse and intermittent compared to more consistent emergent aquatic vegetation near the shorelines. A gravel alluvial shoal had been exposed from a small stream confluence on the western side due to the low water levels. A floating dock, walking bridge, and trails represent the recreational land usage nearby. A right-of-way borders the western limit of the survey area, while large forests contain the remaining extents of Reach 6.

Navigation was limited by dense and abundant water chestnut across Woods Pond. This was exacerbated by shallow depths and very soft silty sediment along the southern shoreline. Algal blooms were present and corroborated the low dissolved oxygen reading (2.64 mg/L) recorded on

September 10, 2024. Species and size class for each fish, as well as the number of each species, were recorded by an AECOM scientist as the fish were captured.

Aquatic Macrophyte, Secchi Disk and Incidental Wildlife Surveys

A survey of aquatic macrophyte growth in Woods Pond was conducted on August 28, 2024. This survey was accomplished by traversing the Woods Pond impoundment in a random course and using a rake to retrieve aquatic plants, tracking the results by location, species, and relative abundance by cover. A total of 17 plots were established (**Figure 3-1**) and plant species' relative abundance were estimated by percent cover. Water clarity was also measured using a standard Secchi Disk. A particular objective of this survey was to assess the overall dominance of water chestnut, and the relative abundance of this invasive plant species in relation to water depth.

During all aspects of the field surveys, incidental observations of all wildlife use of the Reach 6 area were recorded. Any observations of rare wildlife were included in this listing.

3.2.2 Results

Results of the aquatic habitat investigations are summarized below, noting where appropriate distinct habitat differences between the main Woods Pond impoundment and the headwaters transition zone as well as the outlet channel.[12]

3.2.2.1 Consolidation of Background Information

As noted in Section 3.1, several background sources have provided useful information on the aquatic habitat characteristics in Reach 6. In particular, the Woodlot Ecological Characterization and the RCMS documented conditions of the aquatic habitats in Reach 6 which have been incorporated into overall characterization presented in this BRA Report.

3.2.2.2 Impoundment Habitat Survey Inventory

Form IMP-1 was completed for the overall aquatic habitat in Reach 6, extending from the Woods Pond Dam to the upstream end of the headwaters transition area; the completed form is provided in **Appendix A-1**. Key summary information obtained from the form includes the following:

- Physical dimensions obtained of the overall aquatic habitat area indicate that the total distance across the northeastern edge of transitional zone through Woods Pond proper and down the outlet channel to the Woods Pond Dam is nearly one-half mile. The average distance across Woods Pond (east to west) is closer to 0.25 mile.

[12] As previously noted, these investigations did not include Valley Mill Pond, which is discussed separately in Section 3.5 below.

- Water depths range from 0.5 to 16 feet deep, with the average depth likely in the 2-3 foot range.
- Bordering habitats include several wetland cover types (deep and shallow marsh, shrub swamp, red maple swamp, and wet meadow). The primary upland habitats type bordering the impoundment include red oak-sugar maple transition forest and successional northern hardwood forest, with scattered areas of disturbed habitats.
- While water level fluctuations are an important habitat variable, the range in fluctuation is minimized compared to upstream areas, likely due to the dampening effect of the dam (especially during smaller, more frequent storm events).
- Riverine features such as bed and bank formation, bar development, bankfull features and low flow channels are not prominent or even not present due to the impounded conditions from the dam.
- Aquatic plant growth is a dominant feature in the main impoundment area of Woods Pond; overall aquatic vegetation cover in late summer is approximately 90%, with 70% coverage by floating leaved plant species, primarily the invasive water chestnut.
- Numerous habitat features are present in and bordering the edge of the impoundment, including aquatic food plants, large live trees for resting/nesting/hunting, tree cavities, large woody debris, and mammal burrows.

3.2.2.3 Side-Scan Sonar Benthic Survey Results

Figures 3-2a-b provide the track line showing the routes taken for the side-scan sonar survey in Reach 6, conducted from October 31 to November 2, 2023. As indicated, the entirety of the aquatic habitat was thoroughly covered, including both the main impoundment and the headwaters transition zone and outlet channel area. The side-scan sonar survey indicates that roughly 98% of the aquatic habitat area in Reach 6 contains a silty-mud benthic habitat. The remaining benthic habitat consists of small, fragmented areas of the following conditions:

- Large (or coarse) woody debris;
- Fine woody debris;
- Large boulders dominant with small boulders present;
- Small boulders dominant with larger boulders and cobbles present;
- Small boulders dominant with cobbles present;
- Small boulders; and
- Ledge and concrete.

The number of occurrences and amount of surface area recorded for each of these benthic habitat conditions have been separated out into the three sections of Reach 6 aquatic habitat, as shown in **Table 3-3**. While silty-mud benthic habitats predominate in Reach 6, woody debris was documented in 15 locations within the main Woods Pond impoundment, at 18 locations in the headwaters transition area, and at one location in the outlet channel. The outlet channel generally has a firmer benthic composition, with 11 locations documented with various assortments of boulders and cobbles, and four locations with ledge/concrete, as further described in **Appendix A-2**.

3.2.2.4 Assessment of Fish Species

As described in Section 3.2.1, data on the fish community in Reach 6 were obtained through the performance of fish community surveys conducted as part of the fish tissue collection tasks specified for the impoundments in GE's Revised BMP. These surveys were conducted in 2023 and 2024 using the procedures described in the Revised BMP. **Figure 3-1** indicates the location of the fish survey effort in Reach 6. **Table 3-4** presents the results of the 2023 fish survey, and **Table 3-5** presents the results of the 2024 fish survey.

In general, the data from the fish community surveys show the following:

- The fish species assemblage is indicative of a warm water impoundment.
- The presence of many juveniles and the dense water chestnut habitat indicate that the main pond is a juvenile rearing area.
- The high incidence of minnows in the main pond reflect the dense cover provided by the water chestnut and other aquatic vegetation.
- The cover next to deeper areas in the main channel, the outlet channel, and the middle of the eastern lobe provide habitat for larger predatory fish. However, few were found – only two pike. This is reflective of the lower populations of top predators in any fish community. Further, the effectiveness of electrofishing is limited to the top five to eight feet of the water column, so fish present deeper than that were not captured.
- Panfish were abundant in the main pond, likely due to many invertebrate forage opportunities populating the surface of SAV and abundant minnows (for larger panfish).
- There is likely a high population of plankton in Reach 6 as well, providing forage for juveniles, minnows, and larger plankton.

3.2.2.5 Aquatic Vegetation and Secchi Disk Survey Results

As described in Section 3.2.1, on August 28, 2024, a total of 17 plots were established in the Reach 6 aquatic habitat zones and plant species' relative abundance were estimated by percent cover. Plot locations are shown in **Figure 3-1**, **Table 3-6** provides a summary of results, and **Appendix A-3** contains the detailed plot data. Three vegetation plots were located in the outlet channel, two in the

headwaters transition area, and 12 plots were located in the main pond. The overall aquatic vegetative cover in the survey area was 90%, with 70% comprised of floating-leaved vegetation, 15% of submerged aquatics, and 5% of emergent plant cover. The aquatic macrophyte density is greatest in the shallower portions of the main Woods Pond impoundment. The invasive water chestnut was by far the most prevalent aquatic macrophyte, being recorded in 13 of the 17 plots at an approximate average of 78% cover (range 26-100% cover). Two other invasive aquatic species, Eurasian watermilfoil and curly pondweed, were also present. Other species included duckweed, duck-meal and water-meal (*Lemna, Spirodela* and *Wolffia*, respectively). Less prevalent aquatic plants mixed with the water chestnut and watermilfoil included coontail, waterweed, wild celery, and several pondweed species (**Table 3-6**).

In general, aquatic macrophyte abundance is far greater in the shallow portions of Woods Pond proper than in either the transition zone, outlet channel, or the deeper basin in the southeastern part of the Pond. Potential reasons for these differences are discussed in Section 3.2.2.

During the aquatic macrophyte survey, the clarity of the water in Woods Pond was assessed with the use of a Secchi disk. In many places, it was not possible to obtain useful data from this effort due to the shallow water conditions. However, at five locations readings were possible; Secchi disk readings at these locations ranged from 3'6" to 6'6", with an average reading of 5'7". Using a typical conversion of twice the Secchi disk reading to estimate the photic zone in Woods Pond yields a depth of 6'2" as a reasonable estimate for a photic zone in the pond. Since suspended sediment conditions vary between season and hydrologic conditions, water clarity will also vary and the photic zone may average different depths depending on these conditions.

3.2.2.6 Incidental Direct Wildlife Observations

During the course of the aquatic habitat surveys, field observers recorded all direct observations of wildlife species (including evidence of species presence, such as dens). **Table 3-7** provides a summary of these observations. Overall, a total of 25 species (or evidence of their use) were observed in or around the aquatic habitats in Reach 6. These include 14 bird species, nine species of herpetofauna, and two mammal species. In addition, four invertebrate groups were documented. Incidental observations of fish species are excluded from this listing, since these are covered by the separate fish surveys described above.

3.3 Description of Reach 6 Aquatic Habitats

Using the cumulative information compiled from background data and the current field surveys, a comprehensive description of the aquatic habitat within Reach 6 has been developed, ultimately directed at assessing the ecological functions of this portion of the ROR as required by the Revised Permit. The aquatic habitat characteristics are described in this section, and Section 3.4 assesses the

ecological functions based on these characteristics. Valley Mill Pond is discussed separately in Section 3.5.

Encompassed within Reach 6 are a variety of aquatic habitats, which are influenced in various ways by the impounded conditions created by Woods Pond Dam. As previously described, Woods Pond itself has been characterized principally as an impoundment, while the transition zone in the headwaters of Woods Pond and the outlet channel just upstream of the dam have a transitional habitat between the impoundment habitat and the more riverine habitats upstream and downstream of those areas. Accordingly, where appropriate the habitat conditions within the transition zone and outlet channel within Reach 6 are distinguished from those in the main impoundment that comprises Woods Pond proper. **Appendix A-4** provides photographs of the Reach 6 aquatic habitats.

3.3.1 Hydrology and Physical Features

Hydrologic and physical parameters strongly influence the characteristics and functions of the aquatic habitat conditions in Reach 6. The hydrologic controls afforded by the Woods Pond Dam is the primary feature regulating and determining water stages and flow regimes, and the impounded flow effects of the dam extend upstream through all of the Reach 6 area and likely to the upstream end of Reach 5C. While a dam has existed in the same general area of Woods Pond since 1880s (with a new dam constructed in 1989), the effects of the impounded conditions continue to exert changes in flow regimes, sediment dynamics, and water quality, all of which effect habitat conditions. The existing dam at Woods Pond is a concrete overflow weir dam constructed in 1989 that consists of a 140-foot-long concrete overflow spillway, a concrete non-overflow gravity section with sloped downstream face at the west abutment, and a concrete and steel sheetpile raceway closure structure at the east abutment (GZA 2019). Water can bypass the dam via the raceway, and a portion of that bypass enters Valley Mill Pond via a culvert. The spillway has a crest elevation of 947.7 feet (NAVD88), resulting in a "normal pool" elevation in Woods Pond of 948.2 feet (NAVD88).

While water depth (bathymetry) is a primary parameter determining habitat conditions in the Reach 6 aquatic impoundment, other parameters combine with and interrelate with water depth to affect habitat conditions; these include water velocity, submerged channel flow (historic and current), flood flows, water circulation, wind/fetch, sediment dynamics and sedimentation patterns, aquatic plant growth, and water quality. Water depths (using the "normal pool" elevation) over much of the pond are quite shallow, generally less than three feet; however, a deeper portion on the southeastern side of the pond has a maximum depth greater than 14 feet, and areas of channelized flow (typically submerged channels below the normal pool water level) result in deeper conditions in various locations in the impoundment. The deeper zone in the southeastern side of Woods Pond appears to be the remnants of a separate pond which occurred along the east side of the original Housatonic River channel prior to the impounded conditions created by the Woods Pond Dam circa 1880 (see

the last subsection in Section 3.1.7). This deep basin also has thick (>10 feet) soft sediments beneath it, suggesting that it may have been a kettle hole bog basin or is the site of more pronounced sedimentation since the dam was built.

There is also a relatively pronounced channel across Woods Pond, from northeast to southwest, which provides a primary flow pathway and appears to be in the location of the historic Housatonic River channel that existed prior to construction of the dam. The water depth in the channel is deeper than the surrounding areas, typically four to eight feet deep, and water velocity in the channel area is typically greater under average flow conditions than in other areas of Woods Pond. Overall, the water in most of Woods Pond is relatively slow-moving and contains aquatic habitat characteristics of an impounded, shallow-water environment. The main part of Woods Pond is fundamentally a shallow, eutrophic water body with high productivity reflected in the excessive aquatic macrophyte growth; several invasive aquatic plants are prevalent in the Pond, primarily water chestnut and Eurasian watermilfoil. The excessive growth of these plants in turn affect the ecology of the pond, including water quality, circulation, sedimentation patterns (and thus water depths), sediment type (more organic), and use by other biota.

Water depths and flow characteristics, and thus aquatic habitat conditions in the headwaters transition zone are distinctly different from those in much of the main ponded area, and reflect a complex history of variable channel flow patterns, differential sediment deposition, and aquatic plant growth, each of which in turn affects the dynamics of the other features. There are two main areas of submerged channel flow through the headwaters area, one in the northeastern portion of the headwaters area which extends to the southwest into and across Woods Pond toward the outlet channel, and one along the western side of the headwaters zone. These areas of channel flow support minimal aquatic macrophyte growth, possibly due to prevailing channel flow, as noted above through the main pond. Shallow peripheral zones in the headwaters transition into deep marsh habitat, particularly around the marshy floodplain islands.

The outlet channel area also contains deeper channel conditions (greater than seven feet deep) with sufficient flow to limit sedimentation of fine-grained deposits and aquatic plant colonization. Aquatic macrophyte growth in the outlet channel is greatly reduced from that in the main pond, and minimal water chestnut occurs in this area (although Eurasian watermilfoil appears more common).

Water depths and flows during flooding events also influence aquatic habitat conditions in Reach 6. As reported in the recently completed HHA in Appendix G to the Reach 5A Conceptual RD/RA Work Plan, a one-year storm event generates flow at the Woods Pond Headwaters of 1,449 cfs, while the 100-year storm event flow is roughly 13 times higher (18,338 cfs). Water depths in Woods Pond increase over the normal pool level by 1.84 feet in a one-year flow event, by 4.33 feet in a two-year event, and by seven feet during a 10-year flow event. A bankfull flow event is approximately 2.8 feet

above the normal pool event; this stage appears consistent with overbank flooding into the floodplain in Reach 6, although most of the floodplain areas in this reach contain numerous channels for more frequent flow between the river and the floodplain wetlands. Flood flows through Reach 6 are also likely to affect sediment transport and sedimentation, which ultimately affects habitat by influencing both benthic conditions and water depth. For example, the two-to-four feet of water depth during one and two year storm events might result in higher velocity flows in the submerged channels which transport sediment without settling in the pond bottom, whereas deeper, less frequent flood events may result in greater circulation of surface water into the southeastern basin of the pond. More detailed hydrologic analysis is in process as the HHA is expanded for final remedial design, and is anticipated to contribute further to the understanding of habitat conditions related to hydrology and hydraulics. For example, the current 1D HHA model will be expanded to a two-dimensional (2D) model to support the final design of the Reach 5A remediation. A 2D model will more effectively evaluate flow patterns and velocities at locations with complex stream and floodplain geometry, aiding in the assessment of relationships between flow parameters and habitat conditions.

Woody debris (including both large and fine woody debris) are important physical habitat features in the Housatonic River PSA. These habitat features provide physical structure, localized flow patterns, substrate features, and overall habitat value for many species. Because Reach 6 does not have the same active riverine dynamics as Reach 5A, woody debris is less abundant and less of a factor; however, woody debris is present but often submerged in this reach. While such debris may not be visible, it adds structure and affects depositional patterns, even within the impounded environment. Woody debris creates variation in habitat; old debris eventually decays, crumbles, and moves downstream, while newer debris replaces it, although not at a uniform rate and often not in the same locations. While silty-mud benthic habitats predominate in Reach 6, woody debris was documented in 15 locations within the main Woods Pond impoundment, at 18 locations in the headwaters transition area, and at one location in the outlet channel (**Table 3-3**). The outlet channel generally has a firmer benthic composition, with 11 locations documented with various assortments of boulders and cobbles, and four locations with ledge/concrete.

3.3.2 Biological Communities

The biological communities in the aquatic habitat in Reach 6 are interrelated with the surrounding habitats, including upstream and downstream along the ROR. Although affected by the impounded conditions, the river continues to serve as a pathway for nutrients, forage, and animals themselves. Observations of wildlife during the aquatic habitat survey effort (**Table 3-7**) include a variety of signs and direct observations of wildlife using the river. Many species of fish, birds, dragonflies, reptiles, amphibians, and mammals were observed using this habitat. While there are different habitat conditions among the headwaters, main pond, and outlet channel, typically related to the difference

in hydrology and physical characteristics discussed in the last section, the mobility of most biota is such that distinctions in use are not well-defined and therefore only some distinctions in habitat niches between the zones of Reach 6 are discussed below.

Aquatic Macrophyte Community

A dominant feature of the biota in the main part of Woods Pond is the aquatic macrophyte community. While both native and invasive floating-leaved and submerged aquatic plants are prevalent here, much of the pond is overwhelmed with the growth of the invasive water chestnut, with Eurasian watermilfoil also common. Woods Pond is densely choked with these species, particularly from the mid-summer to early fall time period. While there is habitat value to any submerged or floating-leaved plant growth, the excessive density of the water chestnut in particular adversely impacts habitat functions and water quality by depleting dissolved oxygen levels, blocking incident sunlight, and displacing other native submerged aquatic macrophytes with greater habitat value. The density of aquatic plant growth is reduced in the deeper portions of the southeastern basin, and especially in the areas of submerged channel flow, including through much of the headwaters zone and also in the outlet channel upstream of the dam. Due to the dominance of water chestnut in the Woods Pond aquatic habitat, and the need to consider the control and management of this species in connection with remedial activities, **Appendix F** provides additional focused information on the water chestnut, including summaries of other management efforts in southern New England.

Aquatic Macroinvertebrate Community

While not specifically surveyed for this current BRA, the aquatic macroinvertebrate community associated with the impoundments of the Housatonic River, including Woods Pond, was described in the 2002 Woodlot report as "extensive." According to the Woodlot surveys, mussels such as eastern floaters and eastern elliptio are found in most impoundments along the river. Also, a substantial number of dragonfly and damselfly species are typically found in these impoundments. Other typical invertebrates include a variety of true bugs (*Hemiptera*), beetles, caddisflies, a wide range of true flies (*Diptera*), and fresh water shrimp (*Amphipoda*). Benthic macroinvertebrates were sampled in Woods Pond in 1993 by Chadwick and Associates (1994), who concluded that the Woods Pond invertebrate populations are "relatively diverse, healthy and balanced." Due to the lack of variable flow regimes (e.g., riffles/runs/pools) as may be present in upstream reaches, benthic invertebrates requiring such lotic habitats are not anticipated within Reach 6.

Fish Community

As noted previously, the Woodlot surveys of Woods Pond found 16 species of fish; five species accounted for more than 75% of the biomass, including bluegill (forage fish), yellow perch (predator),

brown bullhead (bottom feeder), largemouth bass (predator), and goldfish (bottom feeder). In the backwaters just upstream of Woods Pond (which are proximal to the headwaters), six species of fish accounted for more than 75% of the biomass: common carp (bottom feeder), yellow perch (predator), goldfish (bottom feeder), bluegill (forage fish), brown bullhead (bottom feeder), and largemouth bass (predator). The 1992 Chadwick survey rated Woods Pond habitat as good for species such as largemouth bass and bluegill, noting that Woods Pond had deep pool habitat and abundant cover in the form of submerged aquatic plants and woody debris, and that overall Woods Pond contained a "healthy balanced community with game, rough, and forage fish present" (Chadwick & Associates 1993) Similarly, GE's fish surveys in 2023-2024 (conducted as part of the baseline monitoring program) found a total of 16 species of fish in the Woods Pond sampling. The most abundant species included bluegill (*Lepomis macrochirus)*, comley shiner (*Notropis amoenus*), largemouth bass (*Micropterus salmoides)*, pumpkinseed (*Lepomis gibbosus)*, spottail shiner (*Notropis hudsonius*, yellow perch (*Perca flavescens)*, and rock bass (*Ambloplites rupestris)*.

In general, fish surveys in Woods Pond over the past 30 years have been consistent, with fish species composition indicative of a warm water impoundment with a high incidence of minnows and juveniles reflecting juvenile rearing due to the dense cover provided by aquatic vegetation. The high abundance of panfish is likely due to the many invertebrate foraging opportunities within the SAV and likely a high plankton population that provides forage for larval and young-of-the-year fish. The deeper habitats in the channels and southeastern basin provide some of the habitat requirements for larger predatory fish such northern pike and largemouth bass. They also provide deep water refugia during mid-summer and mid-winter.

An unknown factor in the fish community is the extent to which Woods Pond Dam limits fish passage between Woods Pond and downstream areas of the Housatonic River. Brief visual inspections at relatively high, medium, and low flows and a review of the 2024 Woods Pond Dam Phase 1 Inspection/Evaluation Report (GZA 2024) indicate the following: Because of the ogee spillway design, the dam is likely traversable (passable) by fish in a downstream direction with minimal harm in most flow conditions. This allows fish populations in Woods Pond and above to traverse downstream to find refugia from competition, low food sources, water quality issues, and other unsuitable conditions. Upstream passage is likely more impaired but still possible due to the design of the spillway. Some strong swimming species of fish (e.g., white suckers, rainbow trout, brown trout, and smallmouth bass) could likely navigate over the spillway during stages of flow where there is enough water over the spillway for fish to sustain propulsion. Larger individuals are also more likely to be able to pass. However, due to the stronger flows experienced over the spillway at higher flow events, many weak swimmers would be precluded from passage over the dam. American eel juvenile passage is not likely impacted due to their ability to traverse over wet surfaces and avoid high flow areas.

Herptile, Avian, and Mammal Use of Reach 6 Aquatic Habitats

The aquatic habitats in Reach 6 also offer high-quality conditions for reptiles and amphibians. Reptiles associated with this habitat include snapping and painted turtles. They are largely associated with soft aquatic sediments. Northern water snakes are known to occur in lakes and have been observed in Woods Pond. Amphibians such as green frogs *(Lithobates clamitans)*, bullfrogs *(Lithobates catesbeianus)*, pickerel frogs, northern leopard frogs, American toads *(Anaxyrus americanus)*, and red-spotted newts *(Notophthalmus viridescens)* are also likely to be found.

Numerous avian species utilize this habitat type and have been observed or would be expected in Reach 6. These include several species of swallows, including tree swallows *(Tachycineta bicolor)*, bank swallows *(Riparia riparia)*, barn swallows *(Hirundo rustica)*, and northern rough-winged swallows *(Stelgidopteryx serripennis)*, which feed on insects over such ponds. They also include wading birds, such as great blue herons, green herons, and American bitterns (a state-listed species), which hunt for food in this habitat type. Several species of swans, geese, and ducks, including wood ducks, mallards, and Canada geese, have been observed in Woods Pond during the nesting period, and other species of waterfowl are expected during migration. In addition, various raptor species utilize such impoundment habitat for feeding, including osprey and bald eagle (a state-listed species), both of which nest near water and feed on fish.

Long-tail weasels, minks, river otter, raccoons *(Procyon lotor)*, and beaver commonly use this habitat type. Little brown bats *(Myotis lucifugus)*, which feed over open water, are also very likely to occur.

Rare Species of Reach 6 Aquatic Habitats

There are four state-listed plant and animal species that have MNHESP-mapped Species Habitat within Reach 6 and that could be found in the aquatic habitats in this reach based upon habitat conditions and requirements. The list consists of three bird species (bald eagle, American bittern, and common gallinule) and one plant (the wapato). Two other state-listed species – the northern long-eared bat (*Myotis septentrionalis*),, which is also federally listed, and the tricolored bat *(Perimyotis subflavus)*, which has been proposed for federal listing – could also utilize the aquatic habitats. These two bat species were not included in MNHESP Species Habitat mapping, but were indicated in the U.S Fish and Wildlife Service (USFWS) IPaC results.[13] These state-listed species are discussed further in Section 7. Further, as noted previously, aquatic habitat in Reach 6 is included in portions of Core Areas 1 and 2 as designated by MNHESP.

[13] IPaC refers to the USFWS on-line Information, Planning, and Consultation System for identification of federally listed rare species (USFWS 2024).

3.4 Reach 6 Aquatic Habitat Functional Assessment

This section presents an assessment of the ecological functions and services of the aquatic habitat in Reach 6. As stated above, assessment of the existing functions and services is based primarily on the information consolidated and collected on measurable and observable structural parameters that are known to give rise to the functions of the relevant habitat.

Hydrologic and hydraulic conditions in the Housatonic River in Reach 6 ultimately determine the physical and biological conditions which give rise to functions. Riverine flow into the headwaters, although influenced by impounded conditions, conveys the water and sediment supplied by the upstream watershed. The resulting hydrology and hydraulic processes provide the foundation for all other functions that are provided through this reach. The relationships among inflow, precipitation, runoff, infiltration, groundwater flow, and impoundment determine the amount of water that is conveyed at any given time, the energy of the water to move sediment, the physicochemical processes that affect water quality, and the biological processes that the aquatic habitat will support. In this respect, the watershed setting of Reach 6, particularly in relation to the location of the Woods Pond Dam, is a critical factor determining its form and function.

The consolidation of existing and PDI information along with the results of the recent field surveys described in Section 3.2 have served as the basis for the aquatic habitat functional assessment in Reach 6, focusing on the measurable and observable structural parameters derived from those activities. Aquatic functions are also qualitatively described in terms of the functional categories described in **Table 3-2** using the parameters or factors listed in that table for each functional category. While Reach 6 is not strictly a riverine setting due to its impounded conditions, the Stream Functions Pyramid developed by Harman (2009) and Harman and Starr (2011) provides a useful approach that organizes riverine functions in a pyramid form to illustrate goal setting for restoration assessments. These functions (listed from bottom to top) are: hydrologic/hydraulic, geomorphological, physiochemical, and biological. Within this hierarchical framework, higher-level functions are supported by lower-level functions. For example, hydraulic functions cannot occur without hydrologic functions, and these "water-based" functions drive geomorphology, which in concert determine physicochemical conditions, and the collective association of these foundational functions determine the stream's biology.

The intent of the assessment process is to use the inventoried structural parameters to describe the overall function of each category. **Table 3-2** shows, for each function, the parameters from **Table 3-1** that have been used to describe and assess that function. These parameters are primarily observable structural or physical measures, although some are actual functions (e.g., flood storage). The following summarizes the Reach 6 aquatic habitat functions using the functional categories presented in **Table 3-2**.

Hydrology/Hydraulic or Hydrologic Support Function

As a general matter, the hydrology of a river, even when impounded, is defined by the transport of water from the watershed through the channel or impoundment. The hydrologic processes (precipitation, infiltration, runoff, and evaporation) that occur at the watershed level determine water conveyance capacity and the energy of the water to move and deposit sediment, which ultimately influence the character and functions of the river, including its habitat. Hydrologic support functions include water conveyance and transport, watershed connectivity, floodwater dynamics (flood flow amelioration, flood storage and desynchronization, and peak rate control), base flow maintenance (groundwater discharge and recharge), and the broader ecological function as a migration and dispersal corridor. Construction of the Woods Pond Dam has altered these hydrologic processes in Reach 6, but the basic hydrologic support functions continue to be provided albeit in an altered way.

The aquatic habitats in Reach 6 are connected with their floodplains, attenuate flood pulses, and spread nutrients and organic matter during flooding events. Water stage rises and falls with precipitation and snowmelt events, resulting in a dynamic range of flows. This range of flow defines the channel form and creates the basic structure on which many other processes and functions rely. While the dam has altered the natural flow of the river and modified the channel form and other flow-related parameters, flood flow amelioration/storage/desynchronization is maintained or even enhanced. Groundwater is also both recharged and discharged along Reach 6, providing another hydrologic link between the stream channel and the landscape.

The hydrologic and hydraulic conditions prevailing in the aquatic habitat in Reach 6 create a dynamic environment that provides the characteristic elements described above to support hydrologic functions. Water conveyance and transport are apparent relative to the range in flow conditions, and this hydrologic regime also reflects a watershed connectivity function, although this connectivity is impaired by the Woods Pond Dam. Despite the disturbance that the dam impoundment has caused to the natural equilibrium of sediment transport and deposition (discussed below), the Reach 6 aquatic system maintains sufficient connectivity with the floodplain to promote flood storage and peak flow/stage desynchronization, particularly during storms less frequent than the two-year storm event.

Geomorphology Functions

The geomorphology functional category includes the following functions: channel formation and maintenance, floodplain connectivity, transport of organic and mineral sediment material, transport of woody debris, and transport of nutrients and food sources. The presence and effects of Woods Pond Dam are significant factors in the assessment of geomorphology functions in Reach 6. The impounded conditions have modified the flow regime for a large part of Reach 5C and through Reach 6. This modifies the channel-forming processes and the transport of sediment, woody debris,

and nutrients, generally reducing all of these processes in the creation of a more static or lentic environment. However, floodplain connectivity and flood flow functions are anticipated to be maintained or even enhanced with the presence of the dam.

Physicochemical Functions

Physicochemical functions include water quality maintenance, temperature and oxygen regulation, and processing of organic matter and nutrients. These functions are closely associated with, and largely determined by, the hydrologic and geomorphologic conditions. For example, the shallow water and impounded flow conditions in Reach 6 are likely to increase water temperature and decrease dissolved oxygen levels during the summer low-flow period of the year. These effects, along with the shallow, static water conditions, also support accelerated growth of phytoplankton, algae, and aquatic macrophytes, which in turn affect water chemistry, ecology, and human uses.

Biological Functions

Biology is located at the top of the Stream Functions Pyramid because the biological functions are dependent on all the underlying functions. Specific biological functions include biodiversity and sustaining life stages of aquatic and riparian life, habitat for aquatic and other water-using biota, and rare species habitat.

Despite the disturbed, impounded conditions in the aquatic environment of Reach 6, diverse habitat conditions for aquatic organisms are provided. Due to the range of substrate types, vegetative cover, and depth features, this area provides a range of functional uses for many fish and invertebrate species. Fish found in this reach are primarily warmwater species, including sunfish, various minnow species, and bass. These species forage throughout the river in this reach, taking advantage of complex habitat features to locate food resources and shelter, and providing a food source for piscivorous (fish-eating) mammals and birds. A wide range of aquatic invertebrates also utilize this area, but are predominantly those associated with a lentic environment.

Several locations within Reach 6 contain large and fine woody debris, which is largely embedded in the benthic habitat. This woody debris both above and below the water line provides structure for invertebrates, fish, amphibians, turtles, and several small mammals. Invertebrates seek out woody debris for shelter and for its linkage to food sources. Predatory fish seek out the same structures for food and shelter, particularly bass and sunfish. The deeper pool in the southeastern part of the pond likely provides cooler water during summer months. Most fish species will seek out this cooler water during summer months if it is available. This cooler, protected pool likely provides aquatic organisms with refuge from high velocities during flood and storm events, as well as thermal refuge during droughts and hot summer months. The ability to seek shelter in pool habitat to avoid high

velocity flows or elevated temperature is energetically beneficial to fish and other aquatic organisms which might otherwise be washed downstream or be metabolically stressed.

Finally, the Housatonic River, including in Reach 6, is the major migration corridor in the watershed. It provides opportunity for aquatic and semi-aquatic organisms to seek out and navigate into suitable habitat, and allows for transport of nutrients, sediment, and food items from upstream terrestrial and aquatic communities to downstream areas. The Woods Pond Dam has an adverse impact on many of the aquatic connectivity functions that occur through this migration corridor; however, other significant transport functions prevail even with the presence of the dam.

3.5 Valley Mill Pond Aquatic and Bordering Habitat

Valley Mill Pond is a roughly 4.6-acre ponded area situated along the eastern side of the Housatonic River just downstream (south) of the Woods Pond Dam (**Figure 3-3**). The pond is hydraulically connected to the raceway channel that extends off the eastern side of the dam. Just upstream of the structure that regulates the raceway discharge back to the Housatonic River is a culvert that connects the raceway to the northern end of Valley Mill Pond; that culvert appears to be capped at the current time, although it is unclear whether and to what extent water from the raceway is conveyed into Valley Mill Pond under current conditions and operations. There is a constricted outlet at the southern end of the pond that directs waters southwestward, beneath paved areas, and back into the Housatonic River. The pond was reportedly used for past hydropower (UASCE 1987).[14]

Based on a brief visual assessment conducted on October 10, 2024, Valley Mill Pond is characterized as a eutrophic, largely impounded, shallow ponded area that is largely man-made or at least highly modified by man for industrial purposes. While the bathymetry of the pond has not been fully determined, it appears to be shallow enough to support dense growth of submerged aquatic vegetation throughout much of the basin. Submerged aquatic macrophytes are visible from the shoreline; and based on the peripheral survey, the following species appear to be present: Eurasian watermilfoil, coontail, and Canada waterweed.

Emergent wetland conditions occur around the periphery of the pond in three locations. The northern part of the pond near the inlet contains an emergent wetland dominated by the invasive species common reed (*Phragmites australis*). Most of the western side of the pond supports a narrow fringe of wetland dominated by broad-leaved cattail (*Typha latifolia*) and great bur-reed (*Sparganium eurycarpum*). The southeastern part of the pond is bordered by a relatively short segment of emergent wetland dominated by great bur-reed, with a few broad-leaved cattails

[14] According to the USACE (1987), the raceway discharges into Valley Mill Pond where "the impounded water forming the pond was once used in a hydro-power installation. . . . [T]he hydro-power installation has been abandoned but water can still flow out of Mill Pond during periods of high water via a makeshift rubble spillway which returns water to the Housatonic River."

present. Other species in this wetland were wool-grass (*Scirpus cyperinus*), bearded sedge (*Carex comosa*), Canada clearweed (*Pilea pumila*), and soft rush (*Juncus effusus*). Some silky dogwood (*Cornus amomum*) shrubs were also present in the southeastern wetland area along with vines of riverbank grape (*Vitis riparia*).

Wildlife use of the pond is likely limited due to the man-made conditions and the surrounding development in close proximity along the western side of the pond. A great blue heron flew from the pond during the site survey, and several mallards remained in the pond. Two muskrat lodges were observed in the western emergent wetland at the water's edge.

The tree canopy in upland areas adjacent to the pond included red maple (*Acer rubrum*), Norway maple (*Acer platanoides*), eastern cottonwood (*Populus deltoides*), American basswood (*Tilia americana*), staghorn sumac (*Rhus typhina*), eastern white pine (*Pinus strobus*), eastern hemlock (*Tsuga canadensis*), and northern red oak (*Quercus rubra*), with a few others. Most of the trees were established along the eastern side of the pond, and the western side had sparse trees along the edge between the pond and paved drives and parking areas. Shrubs in the upland areas included European barberry (*Berberis vulgaris*), alternate-leaved dogwood (*Cornus alternifolia*), multiflora rose (*Rosa multiflora*), and Morrow's honeysuckle (*Lonicera morrowii*). Herbaceous vegetation in the upland areas included Christmas fern (*Polystichum acrostichoides*), hay-scented fern (*Dennstaedtia punctilobula*), colt's-foot (*Tussilago farfara*), white wood-aster (*Eurybia divaricata*), and heart-leaved aster (*Symphyotrichum cordifolium*). Eastern poison ivy (*Toxicodendron radicans*) and Asian bittersweet (*Celastrus orbiculatus*) were common vines in the uplands.

Several rubbish piles, old machinery components, brick rubble piles, and other signs of disturbance were noted in upland areas, especially east of the pond. The terrain rises steeply to the east and off-site toward an active quarry.

4.0 BRA of Reach 6 Floodplain Habitats (excluding Vernal Pools)

The Reach 6 floodplain areas as included in this BRA consist of five EAs (EAs 56 through 60), as shown on **Figure 1-2**. EAs 56 and 57 are located partially within Reach 5C but were fully characterized as part of the Reach 6 PDI, and therefore are included in this BRA Report. In total, these floodplain areas include approximately 50 acres of floodplain habitat between the aquatic habitat and the 1 mg/kg PCB isopleth (which approximates the 10-year floodplain). The BRA of the floodplain in Reach 6 involved: (1) review and consolidation of background ecological information from other sources; (2) generation of base mapping and classification of the habitats within the floodplain; (3) field assessment of baseline conditions in the floodplain wetland habitats; and (4) field assessment of baseline conditions in floodplain upland habitats.

4.1 Background Ecological Information

The floodplain habitat inventory process for Reach 6 was initiated by incorporating information from the sources referenced in Section 2 of the Revised Reach 5B-8 BRA Work Plan (where applicable to the Reach 6 floodplain), as well as from the Reach 6 PDI Report. A summary of information on floodplain habitats in Reach 6 from those investigations is provided below.

4.1.1 Woodlot Ecological Characterization (2002) and TechLaw (1998)

As described in Section 3.1.1, the ecological characterization carried out by Woodlot for the PSA included a variety of biological investigations. In the 2002 Woodlot report on the PSA, specific references to floodplain conditions within Reach 6 are infrequent. However, in the overall mapping of community types, Woodlot provided a baseline of the aerial distribution and extent of different floodplain habitat types that occur in Reach 6. For example, the Woodlot mapping includes 49.4 acres of floodplain habitat in Reach 6, with most of it (80%) consisting of wetland habitat, and most of the wetland habitat (38%) consisting of black ash-red maple-tamarack calcareous seepage swamp. Comparison of the Woodlot mapping with the current habitat mapping, as provided in the following sections, is useful to assess successional patterns and habitat changes in Reach 6. In addition to the ecological characterization described above, Woodlot also conducted a wetland assessment of the Housatonic River from Newell Street (in Pittsfield) to Woods Pond (TechLaw 1998). Reach 6 was incorporated into "Section Three" of the wetland assessment, which encompassed the Housatonic River from below New Lenox Road (approximating what is now the upper end of Reach 5C) to the Woods Pond Dam. In addition to presenting detailed information on the ecology of the wetlands in this area, the principal wetland functions and values of the wetlands were assessed using standard wetland evaluation methods in use at the time.

4.1.2 RCRA Facility Investigation Report (2003)

Although, as previously noted, GE's 2003 RFI Report was focused on documenting the extent of PCBs in the river, it did provide some relevant floodplain habitat information, some of it specific to Reach 6. In general, however, the RFI Report referred to the depiction of habitat conditions provided by Woodlot. For example, Figure 2-14 of the RFI Report provided mapping of floodplain vegetation that includes Reach 6, and the depicted community types are based on those presented in the Woodlot ecological characterization.

4.1.3 Corrective Measures Study Reports (2008-2010)

GE's 2008 CMS Report presented substantial information on ecological baseline conditions in the PSA, including the Reach 6 floodplain; and its 2010 RCMS Report included a substantially expanded description of the affected habitats. In particular, Section 5 of the RCMS Report described the habitat characteristics of each of the floodplain habitats in the overall PSA, including those in Reach 6. Other than describing potential impacts from remedial alternatives, however, there are few details specific to the floodplains in Reach 6, such as descriptions of floodplain habitat conditions which apply directly or only to this reach of the PSA.

4.1.4 Massachusetts Natural Heritage Information (2000-2022)

The MNHESP investigations, data, mapping, and reports on the Housatonic River watershed (described in Section 3.1.5) encompassed the habitats of the Reach 6 floodplain (MNHESP 2010, 2011). These efforts included targeted surveys to provide updated information on state-listed species within the floodplain habitats, as well as designation of Priority Habitats of such species. As noted in Section 3.1.5, as of 2010, this research confirmed the presence of at least nine state-listed species in Reach 6 and resulted in the preparation of updated Priority Habitat mapping for each of these species, which was included in the 2010 RCMS Report. All nine of these state-listed species are associated with floodplain habitat along the Housatonic River, at least during some of the species' life stages. As of 2010, mapped Priority Habitats for the following species overlapped the Reach 6 floodplain areas: three birds (American bittern, bald eagle, and common gallinule); three plants (bur oak, Gray's sedge [*Carex grayi*], and wapato), and three insects (mustard white butterfly, arrow clubtail [*Stylurus spiniceps*], and zebra clubtail [*Stylurus scudderi*]).

The 2011 MNHESP report did not specifically describe the conditions of Reach 6 but did characterize the "Upper Housatonic River Valley area at the lower ends of the East and West Branches" as containing "extensive floodplain wetlands and forests, and high-quality headwater streams that drain the western slopes of October Mountain" (p. 11). The report listed occurrences of state-listed turtle and amphibian target species, which may be encountered in Reach 6 floodplain habitats at certain stages of life.

As also discussed previously, MassDFW's July 2012 letter to EPA, which was attached to the Revised Permit, included maps depicting the locations of the different types of Core Habitat Areas, along with the criteria for the designations. Core Areas 1 and 2 include floodplain habitats in Reach 6.[15] Core Area 1 comprises 25.4 acres in the Reach 6 floodplain and includes five state-listed species with mapped Species Habitat in the Reach 6 floodplain (common gallinule, bald eagle, mustard white, bur oak, and wapato); and it also includes a floodplain forest community type that occurs in Reach 6 (the red maple-black ash-bur oak-hemlock swamp). Core Area 2 comprises 93.7 acres in Reach 6 and includes three state-listed species with mapped Species Habitat in the Reach 6 floodplain (American bittern, common gallinule, and mustard white). There is no Core Area 3 habitat in Reach 6.

Further, as previously noted, the updated digital information that MNHESP provided to GE in October 2022 included Species Habitat mapping of state-listed species in the ROR, including Reach 6. As described in Section 4.3 and further in Section 7, six of these species utilize habitats consistent with those present in the Reach 6 floodplain and have mapped Species Habitat in the Reach 6 floodplain. Two additional state-listed species (the northern long-eared bat, which is also federally listed, and the tricolored bat, which has been proposed for federal listing) may also use floodplain forested habitat in Reach 6; however, MNHESP has not provided a Species Habitat map for those species. Gray's sedge was mapped in the Reach 6 floodplain in the 2010 mapping, but was not mapped in this area in the 2022 mapping.

4.1.5 Pre-Design Investigations of Reach 6 Floodplain

The floodplain in Reach 6 was subject to further survey and identification in the 2023-2024 PDI, and that information has been considered in this current floodplain assessment process (Anchor QEA 2024). Part of that work pertained to identifying changes in floodplain cover types that could affect "super habitat" delineations and accessibility categories. The resulting information was obtained to provide updated super habitat mapping for Reach 6 for use in the Reach 6 PDI Work Plan and has been taken into account in this BRA.

[15] Core Area 1 is defined by MNHESP as the highest quality habitat for species that are most likely to be adversely impacted by PCB remediation activities – mainly non-mobile species such as plants. Core Area 2 is defined as the highest quality habitat for more mobile species that may be less vulnerable to remediation impacts, where the habitat is likely to be somewhat more easily restored, and where listed species that may be more of somewhat lower conservation concern given their state-wide distribution.

4.2 Baseline Mapping and Classification of Floodplain Habitats

4.2.1 Methods

In addition to consolidating information from the sources described in Section 4.1, updated base mapping of the Reach 6 floodplain was generated, including classification of floodplain natural communities, wildlife habitat features, and dense monoculture stands of invasive plant species. For this purpose, floodplain habitats have been divided generally into wetland habitats and upland habitats. Vernal pools in the floodplain are discussed separately in Section 5.

Characterization of floodplain habitats and natural communities along the Housatonic River in the PSA was originally performed by Woodlot and presented in its ecological characterization report (Woodlot 2002a). As part of that characterization, ecological community type mapping was produced for the PSA, including all floodplain habitats, and that work was incorporated into updated mapping of Reach 6.

The Woodlot 2002 ecological characterization followed natural communities as described in Swain and Kearsley's 2000 *Classification of Natural Communities of Massachusetts* (2000) and referred to wetland habitats as "palustrine communities" and to upland habitats as "terrestrial communities." **Tables 4-1** and **4-2** describe, respectively, the wetland and upland natural community types present in Reach 6, as characterized by Woodlot. Palustrine communities described in **Table 4-1** included cover types ranging from deep emergent marsh habitats to open wet meadow, shrub swamp, and forested habitats. Moderately alkaline ponds in the floodplain were classified as a lacustrine community with the Housatonic River and tributaries classified as low, medium, and high-gradient streams, as described by Weatherbee and Crow (1992). Upland habitats included two forest types as well as cultural grasslands, and other areas that are developed/disturbed areas (**Table 4-2**).

For purposes of the Reach 6 BRA, the updated natural community mapping was generally consistent with the Woodlot 2002 ecological characterization, The 2023-2024 field surveys and floodplain mapping for the BRA also included a review of the recently updated *Classification of Natural Communities of Massachusetts* (Swain 2020).

To prepare the updated mapping including the wetlands and natural community/cover types as described above, a combination of desktop analyses and field surveys, followed by aerial photographic-interpretation and heads-up digitizing in ArcGIS, was performed. In addition, these activities identified and mapped areas with 25% or greater invasive plant species cover and included an assessment of degraded habitats as potential areas for support facilities in the floodplain. Data layers compiled for the desktop analyses and subsequent mapping updates include:

- Existing community type classification mapping from the Woodlot 2002 ecological characterization;

- Aerial photography (from 2021 and earlier years) and related imagery (e.g., bare earth Digital Elevation Model imagery, which are particularly useful for delineating wetter areas of the floodplain based on microrelief) available from MassGIS, and other publicly available GIS data sources, as needed; and
- Surface topography generated from the Light Detection and Ranging (LiDAR) survey and other surveys conducted of the river and floodplain in the PSA in December 2021 and April-May 2022.

Prior to conducting field surveys, the above-listed mapping data were compiled and overlain to produce preliminary resource mapping and aerial images that include the natural community cover types, vernal pools, delineated hydrologic zones, and other features. The updated LiDAR mapping and 2021 MassGIS aerials were the primary baseline field resource maps with these other data layers added. These resource maps then had a 100-meter grid overlain across the limits of the Reach 6 floodplain for use in the field surveys of the floodplain.

Field surveys were conducted by walking transects along the 100-meter grid lines across the floodplain habitats in Reach 6; these surveys occurred during July through September of 2023 and 2024. Transect locations along with the resource base mapping were uploaded to ArcGIS Online and viewed in the field using the ArcGIS Collector application. When used in conjunction with an Arrow-100 GPS unit (capable of one-foot accuracy), real-time tracking of location and collection of highly accurate GPS data points were conducted. In addition, the lateral extent of certain features that are visible on the aerial photographs in ArcGIS Collector (e.g., dense stands of scrub-shrub habitat and a large patch of Japanese knotweed [*Fallopia japonica*]) were interpreted, field-verified, and digitized while in the field from one vantage point, as opposed to surveying individual points by GPS and connecting them later in GIS. This approach provided efficient field efforts and post-processing of field data. Representative photographs of different community types in Reach 6 are provided in **Appendix B-1**.

4.2.2 Results

Upon completion of the field surveys, surveyed GPS data points, polygons, and polylines were overlayed with existing site data in GIS for post-processing and mapping. The new ArcGIS data layers produced for Reach 6 are as follows:

- An updated version of the natural community mapping originally prepared as part of the Woodlot 2002 ecological characterization, including vernal pools, as shown on **Figures 4-1a through 4-1c**; and

- A polygon and a point data layer showing areas with 25% or greater cover of invasive plant species, with polygons and points identified with species observed (discussed further in Section 9).

Natural community mapping based on the 2022 field surveys and other recent investigations conducted in Reach 6 is presented on **Figures 4-1a-c**. There were some notable differences between the Woodlot natural community mapping and the latest (2023) mapping (i.e., changes in community type and spatial juxtaposition). Major changes are identified in **Table 4-3** and described further below. In the latest field survey, a total of 85 individual polygons representing 10 natural community and cover types were mapped over the approximately 148-acre Reach 6 survey area. They include:

- Two open water categories totaling 97.2 acres;
- Five wetland categories totaling 40.1 acres;
- Two forested categories totaling 7.8 acres; and
- One developed/disturbed category totaling 3.2 acres.

During the approximately 21-year period between the Woodlot 2002 surveys and the 2023-2024 AECOM surveys, there have been some substantial changes in the natural community cover types in Reach 6 (**Table 4-3**). In particular, the entire floodplain area along the western side of the river and east of the railroad tracks, which was previously mapped as black ash-red maple-tamarack calcareous seepage swamp, appears to have undergone some level of retrogressive succession. That is, previously forested wetland areas have been replaced by a relatively sparse canopy of red maple with dense shrub cover and shrub swamp areas dominated by speckled alder (*Alnus incana)*, buttonbush *(Cephalanthus occidentalis)*, red-osier dogwood *(Cornus sericea)*, and winterberry *(Ilex verticillata)*. The once forested wetland is now approximately 48% red maple swamp and 47% shrub swamp, with several narrow fringe areas of shallow emergent marsh (3.0%). In addition, nine vegetation plots were inspected while walking transects through this area and no black ash *(Fraxinus nigra)* or tamarack *(Larix laricina)* were documented.

In addition, there is a decrease in the amount of red maple swamp mapped along the eastern shoreline, resulting from a more accurate wetland delineation that was performed during the 2023-2024 surveys using a sub-meter accurate GPS. Areas that were previously mapped as red maple swamp have been confirmed to be upland forested habitats dominated by red oak and sugar maple *(Acer saccharum)* and currently constitute red oak-sugar maple transition forest.

4.3 2023-2024 Floodplain Wetland Habitat Investigations

In addition to the consolidation of existing information and the mapping and classification of floodplain habitats, an inventory was conducted of the floodplain wetland habitats, as described in this section.

4.3.1 Methods

The Reach 6 floodplain wetland habitat inventory characterization consolidated and incorporated information on a broad range of floodplain wetland parameters that collectively contribute to wetland functional capacity. These parameters consisted of wetland hydrology, vegetative conditions, soils, rare species habitat, invasive species, surrounding habitats, and juxtaposition with other wetland and surface water systems. **Table 4-4** summarizes the floodplain wetland parameters that were included in this characterization.

As described above for the baseline mapping procedures, field surveys were conducted by walking transects along the 100-meter grid lines across the floodplain habitats in Reach 6; these surveys occurred from July through September of 2023-2024. As noted, field surveys consisted of walking each transect and surveying points using GPS at changes in community/cover types, wetland and vernal pool edges, wetter/lower zones such as swales and depressions, and areas that are dominated by invasive plant species or are heavily disturbed/degraded. In addition, representative points along wetland edges between the transect lines were surveyed by GPS in areas where this boundary was difficult to photo-interpret, such as boundaries located under a coniferous tree canopy. At each 100-meter grid point (with possible adjustments where appropriate), a Floodplain Habitat Inventory Form (Form FP-1, a blank version of which is provided in **Appendix B-2** hereto) was completed in the field.[16] The form has eight sections (i.e., Section I through VIII) and provides site-specific information on wetland hydrology, soils, vegetation, specific wildlife habitat features (wolf trees, tree cavities, standing dead trees, large woody debris, mammal burrows, connectivity/juxtaposition with other habitat, etc.), and the presence of or habitat for listed rare species for each wetland cover type unit.

The first two sections (Sections I and II) were completed to document the conditions listed in those sections, including natural community types, plant inventory, estimates of percent vegetation cover, hydrology, and characterization of soils. In general, community cover type patches distinguished for mapping/data collection were greater than 0.5 acre in size (or roughly 25% of one grid in the 100-meter grid), except for previously delineated vernal pools, which were mapped independently of this size threshold.

[16] Due to the large number of survey points and the digital collection of information on the forms, the completed forms are not themselves included in this report, but the resulting information is presented in tabular form, as discussed in Section 4.3.2.

The remaining sections of Form FP-1 (Sections III-VIII) were completed, along with a compiled summary of the information collected for Sections I and II, at the 100-meter grid points within each wetland cover type unit larger than 0.5 acre. The habitat features listed in Section III of Form FP-1 were recorded by the field observers for each wetland cover type unit during the traversing of the grid lines and were used in the characterization of the overall cover type unit. In addition, as part of this assessment, the presence of Core Area habitats (as designated by MNHESP) in the Reach 6 floodplain wetland areas was incorporated into the mapping and inventory, as was the presence of any other designated habitat for any federally listed or state-listed rare species; and any direct observation of a federal or state-listed rare species was documented and surveyed by GPS. Form FP-1 contains a section (Section V) to document these observations. Further, other incidental direct wildlife observations were recorded, as provided in Section VI of Form FP-1.

In addition to the above data collection and survey procedures, other available information on habitat and wildlife observations was incorporated into the Reach 6 wetland assessments. As discussed further in Section 9, the field survey activities included the identification of degraded habitats that could potentially be used for support areas and observations on restoration opportunities that may be integrated with the remedial design and implementation. Sections VII and VIII of Form FP-1 provided for the documentation of such observations.

In addition to the characterization of wetlands by community type and physical and biological parameters, the Reach 5A floodplain wetlands were assessed for wetland functions

4.3.2 Results

The following text and **Tables 4-5** through **4-10** provide a summary of field data collected during the 2023-2024 Reach 5A floodplain surveys using Form FP-1. To be more efficient, the six-page Form FP-1 (i.e., six pages per sample location) was converted into a two-page table format with 17 rows (i.e., one for each data collection point) to be completed in the field and included all components of Form FP-1 that could not be determined through remote means (i.e., through interpretation of aerial photographs or inspection of GIS mapping data). These data were also collected digitally using ArcGIS Online Field Maps and are presented in tabular form rather than in a collection of completed forms. Vegetation and soils data were also collected in a tabular format that allowed for data from more than one sample location to be collected on one page. The following sections include discussion on plant community composition including invasive species, soil types mapped by the U.S. Department of Agriculture Natural Resource Conservation Service (USDA NRCS 2023) and observed in the field, physical features needed to support wildlife habitat (including access to food sources and suitable habitats for nesting, breeding, and escape cover), incidental wildlife observations, and rare species habitat.

4.3.2.1 Plant Community Composition

A total of 132 plant species were documented from 36 plots surveyed on the floodplains within Reach 6, as shown in **Table 4-5**. These included 86 species of herbs, forbs, and grasses or grass-like species (e.g., sedges and rushes) (hereafter "herbaceous" species), 22 shrubs, 20 trees, and four woody vines, and two groups of mosses. The frequency of species occurrence and total number of species per plot ranged considerably among each plant stratum. Observations of herbaceous species ranged from the identification of two to 17 species per plot, with 23 plots having between two and 10 herbaceous species. The most frequently encountered herbaceous species were purple loosestrife (*Lythrum salicaria*), sensitive fern (*Onoclea sensibilis*), and green arrow arum (*Peltandra virginica*). Eight species of woody shrubs occurred in only one plot while 28 plots had between one and five species plus three plots with no shrubs species observed. The most frequently encountered shrub species were silky dogwood, Morrow's honeysuckle, and speckled alder. Six species of trees occurred in only one plot, while 25 plots had between one and five tree species plus 10 plots with no trees species observed. The most frequently encountered tree species were red maple, and American hornbeam (*Carpinus caroliniana*). Finally, four species of woody vines were observed during the surveys with Asiatic bittersweet being the most frequently encountered species occurring in seven plots and 13 plots contained some type of moss cover (i.e., *Sphagnum spp.* and *Bryophytes*).

Data were collected on invasive species presence at the 36 plot locations across the floodplain. Invasive plant species were observed at 34 of these plots (94%). In 12 plots, greater than 25% cover of an invasive plant was documented; and in an additional seven plots, the cumulative cover of two or more invasive species was greater than 25%. As shown in **Table 4-5**, a total of 14 species listed as invasive or likely invasive were observed growing in the floodplain plots that contained such species (seven herbaceous species, five shrubs, one tree, and one woody vine). The most frequently encountered invasive plants were purple loosestrife and reed canary grass (*Phalaris arundinacea*) in the herbaceous layer, common buckthorn (*Rhamnus cathartica*) and Morrow's honeysuckle in the shrub layer, and Asian bittersweet in the woody vine layer. Only one invasive tree species, Norway maple, was observed on the floodplain and occurred in only two plots.

Based on mid-point of cover ranges, the estimated percent cover was typically low for each individual species (less than 3% for 59 observations), with the remaining 43 observations ranging from 10.5% to 98% cover (mean=28.3%). Species with the highest estimated percent cover (greater than or equal to 38%) included reed canary grass, purple loosestrife, water forget-me-not (*Myosotis scorpiodes*) and Morrow's honeysuckle. In several plots, reed canary grass exhibited near 100% cover. Of the 34 plots with invasive species, only seven plots had just one invasive plant, 18 plots had two to four and nine plots had five to six invasive plants. Although percent cover of individual plants were often low, the cumulative effect of multiple invasive herbs, shrubs and vines in one plot could be quite high. For plots with two or more invasive plants, percent cover ranged from 9% to 101% (mean=50.7%).

In addition, species considered non-native but not listed as invasive or likely invasive in Massachusetts were observed at nine of these plots (25%). There were three such non-native species (two herbaceous species and one tree). A total of 115 native plants (77 herbaceous species, 17 shrubs, 18 trees, and three woody vines) were observed on the floodplain. Mosses included two plants identified to species and two generalized groups (i.e., *Sphagnum spp.* and *Bryophytes*), all considered to be native.

Percent cover of mosses, herbs, shrubs, woody vines, and trees was also estimated at all 36 plot locations across the floodplain. Floodplain communities in Reach 6 included wet meadow, shallow emergent marsh, shrub swamp, and red maple swamp. The percent cover results are presented in **Table 4-6** for each cover type; no summary data are presented for wet meadow habitats because this community was limited (0.7 acre or 0.4% of the total area in Reach 6) and only one observation plot was characterized. Absolute cover (i.e., considering all overlapping vegetation layers combined) was typically well over 100%. As would be expected, tree cover on average was generally low or non-existent in shallow emergent marsh, shrub swamp, and wet meadow habitats. Tree cover in red maple swamps was greater than 50% on average. On average, shrub cover was highest in shrub swamp habitats, but was also relatively high in red maple swamps, likely due to the low tree cover observed in many of the red maple swamp observation plots allowing for the formation of a more dense shrub layer. Herbaceous cover also was generally high among the different community types, with shallow emergent marsh exhibiting the greatest cover on average. Cover of woody vines and mosses was typically low on average (less than 3-4%).

4.3.2.2 Soils

Floodplain surveys in 2023-2024 inspected and described soil profiles at 48 locations on the floodplain. Soil profile descriptions were generally completed down to approximately 24-inch depths and down to 48 inches in some cases.

The NRCS soil survey has mapped 10 different soil series in Reach 6, plus one mapping unit that represent disturbed conditions. These soil types are listed in **Table 4-7**. Three are very poorly drained wetland soils (Halsey, Natchaug and Catden) and seven are somewhat poorly drained to excessively drained soils found in uplands. The Natchaug and Catden soils are both formed in depressions on floodplains and typically have up to 18 and 60 inches of organic muck, respectively. The Berkshire and Marlow soils are formed in glacial till and are both well drained, while the Copake, Fredon, Groton, Hinkley, Hero and Halsey are all formed in glaciofluvial materials. In addition, soils that have been disturbed through cut and fill or smoothing or have been paved or built upon are mapped as Udorthents, smoothed.

In general, field conditions were comparable to those mapped by the NRCS. However, the information collected to describe soils and other components of the NRCS soil mapping units was

collected at scales ranging from 1:12,000 to 1:63,360 (USDA NRCS 2023). Mapping of natural communities was conducted at 1:400 using aerial photography and 2018-2019 LiDAR data. Therefore, discrepancies are to be expected when comparing the NRCS data to the observations of the detailed field investigation performed for the Reach 6 BRA. The largest discrepancies were primarily associated with areas where the NRCS mapping either lumped in large areas of wetland with upland (eastern and southern edges of Woods Pond), or upland with wetland (western side of the river, north of Woods Pond and along the railroad tracks).

4.3.2.3 Other Habitat Features

Form FP-1 includes a broad selection of other habitat features that were recorded for each plot location. These include wildlife food plants; a variety of cover, perching, basking, denning, and nesting habitat features; and specific features such as four-toed salamander (*Hemidactylium scutatum*) habitat, presence of vernal pools, and habitats specific to wading birds and waterfowl. These data are presented by observation plot in **Table 4-8** and summarized in **Table 4-9**.

In general, all plot locations contain wetland, upland, or some combination of wetland and upland food plants that provide food sources for wildlife. Other habitat features that were encountered with high frequency included shrub and herbaceous vegetation suitable for bird nesting (78%) and dense herbaceous cover suitable for small mammals, amphibians, and reptiles (67%). Habitat structures, such as standing dead or live trees with cavities and perches, large woody debris on the ground, rocks, crevices, logs or roots at the water's edge and areas with standing water at least part of the growing season, were all present in nearly half or more of the plots (range = 42%-67%).

4.3.2.4 Incidental Direct Wildlife Observations

During the course of the floodplain surveys, field observers recorded all direct observations of wildlife species (including evidence of species presence, such as tracks or scat). **Table 4-10** provides a listing of these observations. Overall, a total of 52 species (or evidence of their use) were observed on the floodplain. These include 30 bird species, 13 species of herpetofauna, five mammal species, and four invertebrate species.

4.3.2.5 Rare Species Habitat in Wetland Floodplains

A total of six state-listed plant and animal species have MNHESP-mapped Species Habitat that encompass the floodplain wetlands in Reach 6 and that could utilize those habitats based upon habitat requirements of each species and the floodplain habitat conditions documented to occur there. As previously noted, two additional state-listed species (the northern long-eared bat, which is also federally listed, and the tricolored bat, which has been proposed for federal listing) may utilize Reach 6 floodplain wetland habitats; these species were not included in MNHESP Species Habitat mapping but are indicated in the USFWS IPaC planning tool. These species are listed in **Table 4-11** and are further discussed in Section 7.

4.3.3 Description of Reach 6 Floodplain Wetland Habitats

Floodplain wetlands in Reach 6 are composed of five different plant community cover types. Floodplain habitats are dominated by red maple swamp and shrub swamp, followed by shallow marsh and wet meadow. Deep emergent marsh habitats are also present within the Reach 6 area. However, because they occurred as smaller inclusions within shrub swamp and shallow emergent marsh areas, deep emergent marsh areas were not mapped out separately. These habitats are described below.

Red Maple Swamp Habitats

Based upon the 2023-2024 community type mapping described herein, approximately 15 acres of red maple swamp (28% of the floodplain area) occur within Reach 6.

Red maple swamp habitats often occur in groundwater depressions within the floodplain or areas which are more poorly drained than higher elevation floodplain areas. In Reach 6, red maple swamps occur primarily as wetland fringes along the river and the edges of backwaters that border Reach 6, and Woods Pond, where surface water hydrology is controlled by and directly connected to the river. Red maple swamps are typically seasonally flooded to saturated and associated with higher organic content. Woody debris is abundant throughout these habitats in Reach 6. This debris is variable in length, width, and ground surface coverage, and is in various stages of decomposition. Standing dead snags with numerous cavities of variable sizes occur throughout these areas as well.

Along with the dominant red maple canopy coverage, other tree species in this habitat include silver maple *(Acer saccharinum)*, American elm *(Ulmus americana)*, box elder *(Acer negundo)*, and black willow (*Salix nigra*). Red maple swamp areas often have a dense shrub understory; in Reach 6, the more common shrubs in this habitat are silky dogwood, speckled alder and winterberry. Dominant herbaceous vegetation is composed of ferns such as sensitive fern, royal fern (*Osmunda regalis*), and cinnamon fern (*Osmundastrom cinnamomeum*); sedges such as hop sedge *(Carex lupulina)*, tussock sedge *(Carex stricta),* and lesser bladder sedge (*Carex vesicaria*); false water-pepper smartweed (*Persicaria hydropiperoides*); rice cutgrass (*Leersia oryzoides*); and marsh bedstraw (*Galium palustre*).

Shrub Swamp Habitats

After red maple swamp, shrub swamp is the most prevalent cover type mapped in the Reach 6 floodplain and accounts for approximately 37% (19 acres) of the total floodplain area. Shrub swamps in Reach 6 are seasonally flooded to seasonally saturated wetland systems that occur as very narrow to broad bands of habitat along the river, the bordering backwaters, and Woods Pond, in vernal pools, and in other depressions within red maple swamp habitats (**Figures 4-1a-c**). As with red maple swamp habitats in Reach 6, surface water hydrology within shrub swamps is controlled by and

directly connected to the river. The most extensive area of shrub swamp (approximately eight acres) occurs along the western side of the river and includes plots FP-14, FP-19, and FP-25. Other large patches of one and a half to four acres in size are located to the north and east.

Soils in the smaller depressions are typically hydric and consist of mineral or mucky-mineral textures at the surface underlain by silt loam, fine sandy loam and loamy sand soils. However, larger systems such as these in Reach 6 tend to have much deeper mucky mineral and organic soil horizons associated with them.

Variations in topography, soil texture, and hydroperiod in the shrub swamp habitats have resulted in a vegetation community dominated by dense shrub thickets and herbaceous cover that are, in most cases, associated with a completely open canopy, devoid of trees. However, expansive portions of areas mapped as red maple swamp have also developed a dense shrub layer because the trees are small to medium in size and occur at lower densities.

The most frequently encountered woody shrubs in these systems was Morrow's honeysuckle, silky dogwood, red-osier dogwood, and speckled alder. Although Morrow's honeysuckle was frequently encountered (observed in 65% of the shrub swamp plots) it was never identified as a dominant or subdominant plant whereas the other shrub species listed above, plus buttonbush, and winterberry were all identified as a dominant plant in three or more plots. In addition, multiflora rose was identified as dominant in one plot. Both Morrow's honeysuckle and mulitflora rose are listed as invasive species. Other invasive woody shrubs observed in shrub swamp habitats included glossy buckthorn (*Frangula alnus*) and common buckthorn. These invasive shrubs were typically observed around the periphery of the shrub swamps and along the edges of the river and Woods Pond, usually growing in slightly drier inclusions (e.g., on hummocks or other topographic features above the water table).

Shallow Emergent Marsh Habitats

Shallow emergent marshes in Reach 6 primarily occur as narrow to relatively broad bands along the edges of open water areas along the river, the bordering backwaters, and Woods Pond but may also occur in some small depressions and in one vernal pool. They also occur in a mosaic with shrub swamp and deep emergent marsh habitats; however, these areas are too small or complex to delineate at the mapping scales used on this project (**Figures 4-1a-c**). Shallow emergent marshes are typically seasonally flooded/saturated to semi-permanently flooded habitats and surface hydrology is directly controlled by river stage in most areas. Shallow emergent marsh habitat is the third most prevalent natural community mapped on the floodplain in Reach 6 and accounts for approximately 11% of the total area (51.2 acres).

Soils observed in shallow emergent marsh habitats are variable but tend to exhibit thicker mucky mineral and organic soils than are observed in some of the red maple swamp or shrub swamp habitats. The most frequently encountered species in the shallow emergent marsh habitats were purple loosestrife, American bur-reed *(Sparganium americanum*), small-spiked false nettle (*Boehmeria cylindrica*). Broad-leaved cattails*,* reed canary grass, and arrow-leaved tearthumb (*Persicaria sagittata*) were also identified as dominant at several plot locations. Other invasive plants (aside from purple loosestrife) observed in the shallow emergent marshes included reed-canary grass, water chestnut and Morrow's honeysuckle.

Deep Emergent Marsh Habitats

No specific areas of deep emergent marsh were mapped within Reach 6 because they typically occurred in a mosaic with shrub swamp and shallow emergent marsh habitats and were too small or complex to delineate at the mapping scales used on this project.

Deep emergent marshes are composed of herbaceous vegetation and form in saturated, mucky mineral soils that are seasonally inundated and permanently saturated. The substrate is flooded by waters that are not subject to wave action, with water depths ranging from six inches to six feet. Water levels may fluctuate seasonally, but the substrate is rarely dry, and there is usually standing water throughout the year. Deep emergent marsh habitats are quite variable. They may be co-dominated by a mixture of species or have a single dominant species. In Reach 6, dominant plant species within this natural community include sedges, rushes, purple loosestrife, smartweeds, floating pondweed (*Potamogetan natans*), arrowhead (*Sagittaria latifolia*), arrow arum, soft-stemmed bulrush (*Schoenoplectus tabernaemontani*), American bur-reed, and great bur-reed .

Wet Meadow Habitats

Wet meadow habitat occupies approximately 0.6 acre (1%) of the Reach 6 floodplain. Wet meadows are wetlands that often resemble grasslands and are typically drier than other marshes except during periods of seasonal high water. For most of the year, wet meadows are devoid of standing water, although a high-water table allows the soil to remain saturated. The wetland substrate consists of mineral soils with redoximorphic features, sometimes with a surface layer of well decomposed organic material. A variety of water-loving grasses, sedges, rushes, and wetland wildflowers typically proliferate in the fertile soil of wet meadow habitat. However, in Reach 6, areas mapped as wet meadow are nearly all covered by the invasive species reed canary grass, with lesser amounts of purple loosestrife, arrow-leaved tearthumb, broad-leaved cattail, and arrow arum. Wet meadows occur along the edges of the river, and on sediment berms located near the northern limits of Woods Pond proper (**Figures 4-1a-c**).

4.3.4 Reach 6 Floodplain Wetland Functional Assessment

This section presents an assessment of the ecological functions and values of the floodplain wetlands in Reach 6. This functional assessment utilized the information obtained in the wetland inventory described above. The assessment of the existing functions was based primarily on the consolidation and collection of data on measurable and observable structural parameters that are known to give rise to the functions of the wetland habitats.

The floodplain wetland functional assessment draws upon the criteria and functions described in the USACE New England District's *The Highway Methodology Workbook Supplement, Wetland Functions and Values, A Descriptive Approach* (USACE Wetland Workbook Supplement; USACE New England District 1995). This approach is a multi-disciplinary assessment of wetland functions, including the following: groundwater recharge/discharge; floodflow alteration; fish and shellfish habitat; sediment, toxicant, and pathogen retention; nutrient removal, retention, and transformation; production export; sediment and shoreline stabilization; wildlife habitat; recreation; education and scientific value; uniqueness and heritage; visual quality and aesthetics; and threatened or endangered species habitat. The assessment is a qualitative description of the physical characteristics of the wetlands, including a determination of the principal functions exhibited. This method is not based on quantitative metrics, but rather provides criteria for assessing whether a wetland's characteristics could contribute to providing the functions listed above.

Table 4-12, which has been developed and adapted from the USACE Wetland Workbook Supplement cited above, lists the functions assessed in this process. In addition to a description of each function, that table lists the characteristics or criteria from **Table 4-4** used in assessing the function. This functional assessment was conducted considering the entire area of floodplain wetland in Reach 6 as a single functional wetland unit (although in reality it is functionally connected with additional floodplain wetland in Reach 5C and beyond). The functional assessment process was documented on a Wetland Function Form (Form FP-2). This form lists each function and records the criteria considered in documenting the wetland characteristics that contributed to the functional assessment of the particular wetland functional unit.

The results of the floodplain wetland functional assessment are summarized in tabular form in **Appendix C**, which also includes the completed Form FP-2 for the wetland area in Reach 6. The results are discussed below. Although these results are discussed in this floodplain wetland section, the combined assemblage of the Reach 6 habitats has been incorporated into the functional assessment.

Groundwater Recharge/Discharge

Based upon landscape setting, soil conditions, and surficial geologic conditions, the floodplain wetlands in Reach 6 provide conditions suitable for interactions between ground and surface waters. Overbank flooding that is stored in the floodplain is at least partially infiltrated to the shallow groundwater table and moves laterally to discharge in the river. At other times, groundwater flow from the adjacent highlands may intersect the land surface within the floodplain of Reach 6 wetlands and discharge to the surface, contributing to base flow. The Housatonic River is a reflection of the regional groundwater table, and groundwater discharge to it provides base flow. Although groundwater functions are provided, they are not considered a principal function due to the hydrogeological setting.

Floodflow Alteration

Given the location and characteristics of Reach 6 within the 10-year floodplain of the Housatonic River, this area provides floodflow alteration functions. These include not only the general provision of flood storage capacity, but also the function of providing temporary attenuation of the floodwaters, followed by a delayed and gradual release of the floodwaters draining back into the river. The characteristics within the floodplain wetlands that contribute to the latter floodflow alteration function include the surface topography and varied microtopographic surface features, the sinuous surface flow paths, the presence of dense herbaceous cover and shrubs in some pockets, and the dense mature woody vegetation that produces large (or coarse) woody debris. For example, vegetation impedes surface water flow and reduces the energy of storm runoff, causing water to deposit sediment and debris. Heavy vegetation, including dense areas of herbaceous and shrub species and mixed age classes of trees, slows flow and provides areas of slack water, allowing more water to seep down through soil and be stored as groundwater. Microtopographic complexity increases the tortuosity of flow pathways, reduces average velocity, and increases the gradient of moisture conditions. Large/coarse woody debris, derived from large trees, blocks flows and modifies flow patterns. These characteristics create naturally produced roughness, which increases flow resistance on the floodplain. This flow resistance, in turn, enhances retention of floodwaters, reduces erosion, increases infiltration, increases retention of inorganic sediments and organic particulates, and diversifies both moisture gradients and microhabitats for biota. The impoundment formed by the Woods Pond Dam functions in concert with the wetland areas to store floodwaters, regulate the discharge, and contribute to floodflow desynchronization.

Water Quality Maintenance, Nutrient Processing, and Production Export

The separate but related functions of water quality maintenance, nutrient processing, and production export are generally related to the cumulative effects of hydrology, sediment transport and deposition, and plant productivity. Sediment is transported into and through the Reach 6 from

upstream sources, and bank erosion within this reach contributes further to this sediment load. When overbank or backwater flooding occurs from the main stem of the Housatonic River into the adjacent floodplains, inorganic sediment carried by the river is deposited within the floodplain, and adsorbed constituents (such as nutrients) settle out with the sediment; some sediment also settles within the quiescent pools of the river itself. This function maintains surface water quality by removing sediments, nutrients, and other pollutants from the water column. In addition, nutrients are processed within the floodplain as primary plant productivity converts inorganic forms into organic forms of nutrients. The floodplain then serves as a source of organic forms of nutrients back to the river, either during further flood flows or by direct deposition of leaves and related vegetative parts, and these contribute to sustaining the base food chain in the river and ultimately the entire biotic community. This is the production export function.

Wildlife Habitat

The Reach 6 floodplain wetland consists of varied wetland cover types interspersed throughout the floodplain; the specific cover type in a particular area is typically first and foremost related to the surface hydrology. The wildlife habitat value of the floodplain wetlands is ultimately related to the collective contribution of the habitat features in each cover type, discussed below.

The wetland floodplain forest habitat in Reach 6 contains numerous dead tree snags of varying diameter and height, which have resulted from periodic flooding, sediment deposition, and beaver activity. Standing dead timber provides foraging habitats for all the woodpecker species and provides summer roosting sites for bats such as the big brown bat *(Eptesicus fuscus*), northern long-eared bat, and little brown bat. Abundant live trees with greater than 12-inch diameter at breast height (dbh) are also present. Many of these trees are greater than 30 inches dbh. Both the dead standing trees and large living trees contain cavities ranging in size from less than six inches to 18 inches or larger and are used during the breeding season for nesting and as escape cover by a wide variety of birds such as wood duck, woodpeckers, tree swallow, owls, bluebird (*Sialia sialis)*, black-capped chickadee (*Poecile atricapillus*), hooded merganser (*Lophodytes cucullatus*), and common merganser (*Mergus merganser*). These cavities also provide habitat for several mammals, including mink, fisher (*Pekania pennanti*), raccoon, porcupine (*Erethizon dorsatum*, black bear (*Ursus americanus*), Virginia opossum (*Didelphis virginiana*), and flying squirrels. Larger live trees in the Reach 6 floodplain forest can be as tall as 100 feet with a fairly open understory, which can provide suitable foraging and nesting habitat for raptors such as the great horned owl (*Bubo virginianus*) and red-shouldered hawk (*Buteo lineatus*).

The dense herbaceous cover and other characteristic features of the wetland floodplain forest also play a role in providing non-breeding habitat for amphibians around the vernal pools in this area (the in-pool habitat functions of these vernal pools themselves are discussed further below).

Amphibian species, such as the wood frog (*Lithobates sylvaticus*) and northern spring peeper (*Pseudacris crucifer*), rely on the shade, deep litter, and woody debris in forested areas immediately surrounding the pools. Such areas within 100 feet from a vernal pool's edge, sometimes referred to as the vernal pool protection zone or envelope, protect the vernal pool amphibians, especially juveniles, from dessication and predation, protect the water quality in the pools from runoff and sedimentation, and provide shade and litter for the pool ecosystem.

In many parts of the Reach 6 floodplain, a system of fluvial worked swales, depressions, and meander scars directs flood flows across the floodplain and reduce water velocities, allowing the accumulation of very fine silt loams and formation of organic muck soils that perch and retain surface waters for extended periods. As a result, these areas have developed diverse vegetated cover of marshes and shrub swamp thickets, which can be used for a variety of foraging and nesting birds. Shrub swamp habitat also provides suitable conditions for earthworms and insects which are preyed upon by birds, small mammals, and bat species, including the big brown bat and little brown bat.

Shallow and deep emergent marsh habitats of the type present in the Reach 6 floodplain are typically used for early season forage by several reptile species and as breeding habitat for several amphibian species. Reptiles also often use these moist habitats to regulate body temperatures and rehydrate during the summer.

Finally, the Reach 6 wetland areas provide habitat for rare species, as described in detail in Section 7 and Appendix E of this report. Reach 6 is documented to potentially support habitat for eight state-listed species, one of which is also a federally listed species and one is a proposed federal species**.**

Other Functions and Values

As described in Appendix E, other principal functions and values of the Reach 6 wetlands, as indicated by the evaluation process, include recreation, educational/scientific, uniqueness/heritage, and visual quality/aesthetics.

Comparison with Earlier Functional Assessment

An earlier wetland functional assessment was conducted by Woodlot that included Reach 6 as well as areas upstream of this reach (TechLaw 1998). That effort also employed the ACOE Highway Method as well as other methods in use at the time. Reach 6 was incorporated into "Section Three" of the evaluation, which encompassed the Housatonic River from below New Lenox Road (approximating what is now the upper end of Reach 5C). TechLaw assessed the principal wetland functions and values to include (in order of importance): sediment/toxicant retention, floodflow alteration, nutrient removal, wildlife habitat, recreation, fish and shellfish habitat, production export, sediment/shoreline stabilization, uniqueness/heritage, and visual/aesthetics. Those results are consistent with the current wetland functional assessment.

4.4 2023-2024 Floodplain Upland Habitat Investigations

As noted in the Woodlot 2002 ecological characterization report

> "[V]ery little terrestrial or upland habitat is found in the PSA. Red oak–sugar maple transition forests are located in a few widely scattered locations. Cultural grasslands, which are open, upland habitats periodically disturbed by mowing or grazing, do occur near New Lenox Road. A few upland inclusions of northern hardwoods–hemlock–white pine forest also occur north of Yokum Brook. Most of the upland habitats occur adjacent to the PSA as cultural grassland, northern hardwoods–hemlock–white pine forest, and rich mesic forest." (Woodlot 2002a, page II-15.)

The 2002 Woodlot community type delineations indicated that less than 7% (9.6 acres) of the Reach 6 floodplain consisted of upland habitats. As described in Section 4.2, the updated floodplain habitat mapping and classification process identified these upland floodplain habitats. In addition, as with the floodplain wetland habitats, an inventory was conducted of the floodplain upland habitats, as described below.

4.4.1 Methods

The methods employed to survey conditions in the floodplain uplands of Reach 6 followed the same procedures as those described above for the wetland areas and were implemented along with those wetland surveys. The 100-meter grid described in Section 4.2 extended across the floodplain habitats, including both upland and wetland community cover types. Field observers traversed the grid lines using GPS location tracking and characterize/document conditions.

Table 4-13 summarizes the parameters considered in characterizing the floodplain upland habitats and indicates the information sources from which such information has been drawn. The relevant information includes information on flood frequency and depth, soil composition, vegetation, wildlife habitat features, identified rare species habitat, invasive species, and juxtaposition with surrounding habitats. That information was obtained from existing data sources (as specified in **Table 4-13**), supplemented by field surveys, again using the Floodplain Habitat Inventory Form (Form FP-1 in **Appendix B-2**). As described in Section 4.2, Sections I and II of Form FP-1 were completed as part of the natural community mapping at roughly 100-meter points in the Reach 6 floodplain (with adjustments as appropriate). For each discrete upland cover type unit larger than 0.5 acre, the remaining sections of Form FP-1 (Sections III-VIII) were completed, along with a compiled summary of the information collected for Sections I and II at the 100-meter grid points within that same cover type unit. As with the floodplain wetland assessment, the habitat features listed in Section III of Form FP-1 were noted and recorded by the field observers for each upland cover type unit during the traversing of the grid lines and were used in the characterization of the overall cover type unit.

In addition to the collection of this information, the same additional inventory information described in Section 4.3 for floodplain wetland habitats was collected in the floodplain upland habitats. This included the presence of Core Area habitats (as designated by MNHESP) or other designated habitats for federal or state-listed rare species, any observation of a listed rare species, incidental wildlife observations, and identification of items that could potentially be used in restoration.

4.4.2 Results

The Reach 6 floodplain within the 1 mg/kg isopleth includes 11.0 acres of upland consisting of two forested natural community types and one developed/disturbed category (which includes dirt/gravel and paved surfaces, manmade structures, maintained lawns and disturbed upland scrub-shrub areas such as powerline corridors and old field habitats). In addition, there are three high-gradient streams that flow westerly through these upland floodplains and into Reach 6 from the western slopes of October Mountain State Forest.

The most extensive upland cover type in Reach 6 is red oak-sugar maple transition forest, comprising 6.8 acres (61%) of the upland habitats within the 1 mg/kg isopleth. An additional 10% of upland is mapped as northern hardwood-hemlock-white pine forest, and the remaining 28% of upland areas is mapped as developed/disturbed open space.

As might be expected, these upland habitats are generally situated along the outer margins of the floodplain area (**Figure 4-1a-c**). Forested areas occur along the eastern and southern limits of the isopleth bordering on floodplain wetland habitats and open water. There is also a 3.3-acre stand of red oak-sugar maple transition forest along the railroad tracks west of Woods Pond that has a dozen or more large red oak trees that are 30-inch dbh or greater. Developed/disturbed open space includes upland scrub-shrub habitats associated with previously disturbed areas and a maintained powerline right-of-way, maintained lawns and buildings associated with a residential home and dirt-gravel road around the southern and eastern periphery of Woods Pond (i.e., Valley Road and Woodland Road).

The following summarizes the floodplain upland habitat surveys from data collected in 2023-2024.

4.4.2.1 Plant Community Composition

Table 4-14 provides a list of plants recorded in the upland natural communities with the frequency of occurrence. The upland forests contain a diversity of tree species (25 species). The most common tree species observed were northern red oak, sugar maple, white ash (*Fraxinus americana*) and American hornbeam. In addition, each of these species was often identified as the dominant plant in an observation plot. A total of 14 shrub species were recorded in the upland habitats, with Morrow's honeysuckle being the most frequently observed. Four species of woody vines were documented in upland communities, with Asiatic bittersweet being the most common species. Only two herbaceous

species appeared in more than five of the 12 upland plots, including sensitive fern, and white wood-aster. However, 38 additional herbs were observed in one to four plots. Although not frequently occurring, several species were identified as the dominant plant where they did occur, including Pennsylvania sedge (*Carex pensylvanica*), hay-scented fern and sensitive fern.

As shown in **Table 4-14,** a total of four woody shrubs listed as invasive or likely invasive were documented in upland plots: Morrow's honeysuckle common buckthorn, Japanese barberry (*Berberis thunbergia*) and burning bush (*Euonymus alatus*). In addition, one invasive vine, Asiatic bittersweet, was also observed. Invasive shrubs and vines were observed in nine of the 12 upland plots and ranged from one to four invasive shrubs per plot. Estimated percent cover was typically low for each individual species (less than 3%). However, estimated percent cover of Morrow's honeysuckle ranged from 10.5% to 85.5% (mean=43.5%, based on mid-point of cover ranges) in five of the 12 upland plots. In addition, the cumulative effect of multiple invasive shrubs and vines in one plot could be quite high. In plots where multiple invasive shrubs were present, the total estimated cover ranged from 6% to 91.5% (mean=30.6%).

Table 4-15 provides additional summary data of the vegetative cover in the different upland floodplain plant communities.

4.4.2.2 Other Habitat Features

A summary of the data on recorded biotic habitat features for the upland floodplain natural community cover types is provided in **Tables 4-16** and **4-17**. The most commonly occurring biotic habitat features (occurring in more than 50% of the plots) in these areas consisted of upland plant food sources, large woody debris on the ground, standing dead trees with cavities and perches, cavities in trunks of live trees, small mammal burrows, shrubs and/or herbaceous vegetation for bird nesting, and dense herbaceous cover used by small mammals, amphibians, reptiles.

4.4.2.3 Incidental Direct Wildlife Observations

Since the floodplain upland habitat surveys were integrated with the floodplain wetland surveys, wildlife observations incidental to the floodplain surveys are incorporated into the species listings in **Table 4-10**.

4.4.2.4 Rare Species

A total of three state-listed plant and animal species (bald eagle, bur oak, mustard white) have MNHESP-mapped Species Habitat that encompass the floodplain upland habitats in Reach 6 and could utilize these habitats based upon habitat requirements and the habitat characteristics identified during these surveys (**Table 4-18**). As in the Reach 6 wetland habitats, the northern long-eared bat and the tricolored bat (state-listed species that are also federally listed or proposed for federal listing) may utilize Reach 6 floodplain upland habitats. Again, as previously noted, these

species were not included in MNHESP Species Habitat mapping but are indicated in the USFWS IPaC planning tool as potentially occurring in Reach 6. These species are further discussed in Section 7.

4.4.3 Description of Reach 6 Floodplain Upland Habitats

Based upon the updated community type mapping conducted in 2023-2024, two different natural community cover types comprise the floodplain upland habitat areas in Reach 6. These are listed below along with a brief summary of each cover type and the area that each comprises within the Reach 6 floodplain:

Red-Oak Sugar Maple Transition Forest

This upland forest type comprises 6.8 acres within the Reach 6 floodplain (13% of the floodplain). The red oak-sugar maple transition forests are relatively level to sloping upland forests dominated by larger canopy trees of red oak, white ash, sugar maple, and American beech (*Fagus grandifolia*). This forest type typically includes a sparse subcanopy of American hornbeam as well as a sparse shrub layer of maple-leaved viburnum (*Viburnum acerifolium*) and witch-hazel (*Hamamelis virginiana*). The herbaceous layer is generally dominated by New York fern (*Parathelypteris noveboracensis*), and hay-scented fern, with lesser amounts of white wood aster, Christmas fern, and wild sarsaparilla *(Aralia nudicaulis*).

Northern Hardwoods-Hemlock-White Pine Forest

This upland forest type comprises 1.0 acre within the Reach 6 floodplain (2% of the floodplain). The northern hardwoods-hemlock-white pine upland forests are situated on relatively level to uneven ground vegetated with a mixture of broad-leaved and needle-leaved trees. Typically, the canopy layer is dominated by red oak, eastern hemlock, white pine, and sugar maple; and a poorly developed subcanopy is dominated by eastern hemlock and American beech. Shrub layer plants generally include hobblebush (*Viburnum lantanoides*) and striped maple (*Acer pensylvanicum*). The herbaceous layer, which is variable and dependent on canopy dominants, can include Christmas fern, shining firmoss (*Huperzia lucidula*), evergreen woodfern (*Dryopteris intermedia*), Canada mayflower (*Maianthemum canadense*), bracken fern (*Pteridium aquilinum*, winterberry, southern ground cedar (*Diphasiastrum digitatum*, and partridge berry (*Mitchella ripens*).

Other Developed/Disturbed Areas

Other developed/disturbed areas are present within the Reach 6 (right?) floodplain upland areas and account for 3.2 acres (6.3%) of the floodplain. These consist of areas that have been impacted by historical disturbances and includes upland scrub-shrub habitats associated with previously disturbed areas and a maintained powerline right-of-way, maintained lawns and buildings associated

with a residential home and dirt-gravel road around the southern and eastern periphery of Woods Pond (i.e., Valley Road and Woodland Road).

4.4.4 Reach 6 Floodplain Upland Habitat Functional Assessment

The information obtained for the inventory and characterization of floodplain upland habitats in Reach 6 has been incorporated into a qualitative assessment of the ecological functions that these habitats contribute to. In general, the floodplain uplands provide similar functions as those in the floodplain wetlands. Functions which have been assessed in this qualitative process are groundwater recharge, flood storage, wildlife habitat, rare species habitat, buffer capacity, and corridor connectivity, as listed in **Table 4-19**. The impact of invasive species in the floodplain upland habitats was also considered. The site-specific information collected for each floodplain upland in Reach 6, as documented on Form FP-1, forms the basis of the functional assessment, again considering the physical and hydrologic characteristics, substrate conditions, specific habitat features, connectivity with surrounding habitats, and the presence of both rare and invasive species habitats.

Groundwater Recharge

Based upon landscape setting, soil conditions, and surficial geologic conditions, the floodplain uplands in Reach 6 provide conditions suitable for interactions between ground and surface waters. Much of the upland floodplain forest contains floodplain soils that are sufficiently sandy to afford vertical and horizontal movement of surface and ground waters. As in the wetlands, overbank flooding that is stored in the floodplain is at least partially infiltrated to the shallow groundwater table and moves laterally to discharge in the river. Due to the greater differential vertical distance between the land surface and the water table in upland areas versus wetlands, the upland portions of the floodplain may actually have more significance for groundwater recharge than wetland areas. Groundwater flow from these uplands typically moves laterally to intersect the land surface within lower portions of the floodplain of Reach 6 (especially along the margins of vernal pools and other lower depressions) or along the river's edge and discharges to the surface, contributing to base flow.

Flood Storage and Floodflow Alteration

As with floodplain wetlands, the location and characteristics of Reach 6 uplands within the 10-year floodplain of the Housatonic River provide floodflow alteration functions. These include not only the general provision of flood storage capacity, but also the function of providing temporary attenuation of the floodwaters, followed by a delayed and gradual release of the floodwaters draining back into the river. Given their higher elevation and less frequent flooding than floodplain wetlands, the floodplain uplands would be expected to have an overall lesser floodplain function; however, they do provide storage and flood peak desynchronization functions during major flood events. As in the wetlands, the characteristics within the floodplain uplands that contribute to the latter floodflow

alteration function include the surface topography and varied microtopographic surface features, the sinuous surface flow paths, the presence of dense herbaceous cover and shrubs in some pockets, and the dense mature woody vegetation that produces large woody debris.

Wildlife Habitat

The structural components of the floodplain upland community cover types in Reach 6 are generally similar to those of the floodplain wetland community cover types, and therefore many of the wildlife species and functions provided are similar across the floodplain, whether wetland or upland. There are obviously some species which may be drawn to a slightly drier condition that the upland areas provide. For example, the upland habitat may provide sandier soils for turtle nesting, and the area is less prone to flooding of the nests of ground-nesting species. There is greater diversity in the tree stratum in the upland forest than in the wetland forest, so additional food sources and nesting opportunities may be available. However, the overall significance of the upland floodplain for wildlife habitat is not greatly different from that of the wetland areas in Reach 6.

5.0 BRA of Reach 6 Vernal Pool Habitats

Detailed vernal pool investigations within Reach 6 were initially conducted as part of the 2002 Woodlot ecological characterization of the PSA. As the initial effort to update this mapping, aerial photographs were utilized to delineate the areas indicated by Woodlot to support vernal pool conditions as well as to delineate any additional areas which could potentially support temporary pools for vernal pool breeding activity. As described below, this was followed by updated investigations of these potential vernal pools in in 2023 and 2024 in accordance with the Revised Reach 5B-8 BRA Work Plan. Those investigations are described below in Section 5.1.

5.1 2023-2024 Reach 6 Vernal Pool Investigations

5.1.1 Methods

For the vernal pools in Reach 6, the characterization activities in 2023 and 2024 consisted of the following, as provided in the Revised Reach 5B-8 BRA Work Plan: (1) compiling the existing information collected during the previous surveys (e.g., Woodlot 2002a) on relevant attributes of those vernal pools – namely, flora, topography, bottom sediment/soil composition, in-pool physical structure, surrounding land use, and relationship/proximity to other vernal pools; and (2) detailed field collection of additional information on those relevant attributes, as well as data on the general water and soil chemistry of the vernal pools, as described below.

Within the Reach 6 floodplain area, only one potential vernal pool area was indicated by past surveys or delineated by remote sensing of aerial photographs. Field investigations were conducted in 2023 and 2024 to assess the applicability of MNHESP vernal pool certification criteria to this previously identified potential vernal pool, as well as to any additional potential vernal pool areas encountered throughout the Reach 6 floodplain area. During the vernal pool breeding season, between late March and early June, the one potential vernal pool identified in the inventory process for the Reach 6 area was visited in the field, and detailed investigations were conducted to document the biological and physical criteria for MNHESP vernal pool certification. In addition, in searching the remaining floodplain area in Reach 6, one additional potential vernal pool was found in the floodplain and surveyed. Both pools were surveyed for biological evidence during the primary vernal pool breeding period in 2023, consistent with the seasonal conditions observed for that particular year. Representative photographs of each pool are provided in **Appendix D.**

The vernal pool surveys were first intended to address the biological criteria encompassed in the MNHESP guidelines, and additional field visits were conducted to assess the physical criteria for pools that meet the biological criteria (e.g., whether there is a “permanently flowing outlet” and/or reproducing fish population). This assessment required monitoring the hydrology in each such pool, assessing the presence or absence of fish, and establishing the hydrologic connectivity with the

Housatonic River or tributary streams, primarily in terms of the annual duration of a surface water connection. In general, the critical time period for assessing this hydrologic connection is the months of July through September. In performing this assessment for pools that meet the biological criteria, the relative meteorologic/hydrologic conditions during the monitoring period versus the long-term average conditions were considered (i.e., whether conditions are relatively dry or wet).

As part of the vernal pool surveys, in addition to surveying the two potential vernal pools mentioned above, the backwaters bordering Reach 6 and flooded shrub swamp/shallow emergent marsh habitats along the edges of the river and Woods Pond were surveyed for evidence of amphibian breeding and to assess the potential for any such areas of identified amphibian breeding to meet the vernal pool certification criteria. These investigations did identify areas of amphibian breeding in various locations such as along the flooded edges of the bordering backwaters. However, these flooded areas are hydrologically open to the backwaters and river, such that predatory fish can enter into these areas for most of every year. Thus, the surface water hydrologic connection between these areas and the river constitutes a "permanently flowing outlet," and these areas could have a reproducing fish population. As a result, these locations did not meet the vernal pool physical criterion of having "no permanently flowing outlet" and thus were not considered to constitute certifiable vernal pools.

The net result of the vernal pool survey process in Reach 6 was the identification of two certifiable vernal pools, both on the eastern side of the floodplain. Although both biological and physical criteria of these two vernal pools were met in 2023, additional site visits were conducted in 2024 to collect data on plant community composition and soil conditions. A Vernal Pool Characterization Form (Form VP-1), which was provided in Appendix F to the Revised Work Plan, was completed for each certifiable vernal pool; the data from Form VP-1 are presented in tabular format herein (see **Table 5-2** discussed below).

For the two vernal pool areas determined to meet the MNHESP certification criteria, estimates of percent cover of tree canopy, woody shrubs, herbaceous plants (including sedges, rushes, and grasses), and woody vines within each vernal pool were made using a line-intercept sampling procedure. This involved stretching a 100-foot tape across the pool from shoreline to shoreline and tallying the total length of each cover type that projects through that plane over the line. Percent cover was then calculated as a function of total length of a particular cover type divided by the total length of the transect. Two to three transects were measured across each pool and the dominant plant species within each of the various plant strata recorded, including observations of any invasive plant species.

A comprehensive list of plant species observed within each pool was collected and plant species were identified using accepted current taxonomic references (e.g., Native Plant Trust

(Gobotany.nativeplanttrust.org); the USDA NRCS Plants Data Base (USDA Plants Database) for the Massachusetts region (USDA NRCS 2022).

In accordance with the Revised Reach 5B-8 BRA Work Plan, water depths (or evidence of water depths depending upon the seasonal conditions) were measured or determined at two- to five-foot intervals (depending on how flat or steep the topography was) along the vegetation transect from shoreline to shoreline to map the relative topography within each pool. The start and stop location of each transect was surveyed by GPS and points with corresponding water depths plotted along that line in GIS. Significant topographic or physical features within the pool (e.g., large hummocks or windthrown trees) that were not intercepted by the transect were characterized and located by GPS.

Vernal pool sediment/soil composition was categorized in the field using a hand auger and/or tile spade shovel and generally inspected to a depth of 18-24 inches. One profile description per pool was documented between the outer edge and deepest part of the pool. The information collected for each soil profile included soil horizons, depth, texture, color, and the presence or absence of redoximorphic features (mottles and other features). Colors of the soil matrix and mottles were identified using Munsell Soil Color Charts (USGS 2014). Hydric soil determinations were based on criteria established in *Field Indicators for Identifying Hydric Soils in New England* (NEIWPCC, 2018) and guidance in the 2012 USACE Regional Wetland Delineation Manual (USACE 2012).

In-pool physical structure other than the plants measured during the line-intercept sampling described above was quantified within each pool. Observations of large woody debris, large boulders, or exposed root wads were located via GPS during the pool inspection with the approximate length, width, and/or diameter recorded in inches. Fine woody debris was estimated as a total percent cover of the entire pool area.

The habitat and land use conditions in the immediate vicinity of each vernal pool were characterized in the field, and percent of total area consisting of forest, development, open space, and scrub/shrub habitats in the broader landscape was quantified in GIS. The four habitat cover types are from Calhoun and Klemens (2002) and were quantified within both the 100-foot buffer around the vernal pool (the vernal pool envelope) and the 100-750 foot zone (the critical terrestrial habitat) using aerial photograph interpretation and ground-truthing. The landscape setting of the pool was also characterized, noting whether it is a discrete depression in the floodplain or part of a larger wetland, and also the juxtaposition with other vernal pools to assess the potential for vernal pool network factors.

5.1.2 Results

This section describes results of the 2022-2023 field surveys conducted in Reach 6. As noted, based on the detailed investigations described above, only two certifiable vernal pools (5C-VP-17 and

6-VP-1) were identified in Reach 6, as shown on **Figures 4-1a and 4-1b**. The following subsections provide relevant information on these two vernal pools from the investigations described in Section 5.1.1. The information consists of summary information, because, as shown in the Conceptual RD/RA Work Plan for Reach 6, neither of these vernal pools will require remediation or be affected by the remedial activities in Reach 6.

5.1.2.1 Description of Identified Certifiable Vernal Pools

Vernal pool 5C-VP-17 is located between the river and Woodland Road within a large area of shrub swamp habitat (**Figure 4-1a**). The pool is impounded behind an old "V" shaped beaver dam that contains overflow from a nearby perennial stream. This pool likely also has a groundwater component as it is situated low on the floodplain just upgradient from permanently flooded/intermittently exposed areas along the river. During the May 2023 surveys, a total of 22 spotted salamander (*Ambystoma maculatum*) egg masses and hundreds of wood frog tadpoles were observed in the pool (**Table 5-1**).

The pool is approximately 3,500 square feet in size and the maximum water depth is approximately 30-36 inches when flooded in early spring. The plant community consists predominantly of wet meadow with intervening shrub swamp habitats, relatively low cover of fine and large woody debris, and strong vertical structure in the form of large woolgrass tussocks (**Table 5-2**). Dominant plants include silky dogwood, woolgrass and false water-pepper smartweed. A complete list of plants observed is provided in **Table 5-3**. Soils in 5C-VP-17 are poorly drained and consist of a mucky fine sandy loam at the surface underlain by a low chroma loamy fine sand. Vernal pool 6-VP-1 is located between the open waters of Woods Pond and Woodland Road and is surrounded by deep shrub swamp and red maple swamp habitats (**Figure 4-1b**). While the seasonally flooded/saturated surface waters within the pool are tied directly to water levels within Woods Pond, there are sufficient obstructions between the pond and the vernal pool to restrict fish passage and to determine that there is no permanently flowing outlet. During the May 2023 surveys, a total of 16 spotted salamander egg masses were observed within the pool (**Table 5-1**).

The pool is approximately 3,800 square feet in size and maximum water depths are shallow at approximately 12 inches when flooded in the spring. The plant community consists predominantly of shrub swamp with red maple swamp habitats along the eastern margins of the pool. Moderate cover of fine and large woody debris was observed along with a strong vertical structure in the form of large hummocks supporting woody shrubs (**Table 5-2**). Dominant vegetation includes buttonbush, winterberry, pussy willow (*Salix discolor*) and red-osier dogwood. In addition, moneywort (*Lysimachia nummularia*) was a dominant plant in the herbaceous layer and is a Massachusetts-listed invasive plant species. A complete list of plants observed is provided in **Table 5-3**. Soils in 6-VP-1 are very poorly drained and consist of fully saturated organic deposit greater than 36 inches thick.

5.1.2.2 Habitat Characteristics in the Adjacent Landscape

As shown in Table 5-2, there are no developed areas within the vernal pool envelope (i.e., 0-100 feet from the pool edge) for either pool, and only a very small proportion of the critical terrestrial habitat (i.e., 100-750 feet from the pool edge) is disturbed by an approximately 14-foot-wide gravel/dirt road (Woodland Road). Suitable terrestrial habitats for vernal pool breeding amphibians are located primarily to the east of the pools along the slopes of October Mountain State Forest. Approximately 22% and 54% of the 100-foot vernal pool envelope is forested for pools 5C-VP-17 and 6-VP-1, respectively. Expanding further out into the adjacent landscape, the percent of the landscape within 750 feet of the pools edge that is forested increases to 43% for 5C-VP-17, but stays about the same for 6-VP-1 (53% forest cover).

Approximately 76% of the 100-foot vernal pool envelope zone for 5C-VP-17 is composed of shrub swamp. Approximately 46% of the vernal pool envelope zone for 6-VP-1 is composed of shrub swamp, shallow emergent marsh and open water areas (Woods Pond and the Housatonic River). Approximately 56% and 46% of the 750-foot critical terrestrial habitat zone are composed of shrub swamp, shallow emergent marsh and open water areas for pools 5C-VP-17 and 6-VP-1, respectively.

5.1.2.3 State-Listed Species

Five of the six state-listed species which have MNHESP-mapped Species Habitat in Reach 6 have their mapped habitat also overlapping at least one of the two vernal pools in this reach. Only the mapped habitat of the wapato does not cover either of the two vernal pools. None of the other five species, however, is a vernal pool-dependent species, although three of those species (American bittern, common gallinule, and bur oak) may occur in habitats that are consistent with the habitats of the two vernal pools in Reach 6.

5.2 Description of Reach 6 Vernal Pool Habitat

The vernal pools in Reach 6 consist of depressions in the wetland floodplain habitats which are capable of holding standing water through at least a portion of the amphibian breeding season. These depressions function as vernal pool breeding habitat for obligate vernal pool species, such as wood frog, spotted salamander, and fairy shrimp *(Eubranchipus vernalis)*, as well as breeding, foraging, and rehydration/thermoregulation habitat for other amphibians and reptiles, including northern spring peeper, northern leopard frog, green frog, snapping turtle, painted turtle, garter snake *(Thamnophis sirtalis)*, American toad, and bullfrog, all of which have been documented in the Reach 6 vernal pools. In addition, ribbon snakes (*Thamnophis sauritus*), wood turtles *(Glyptemys insculpta)*, and spotted turtles *(Clemmys guttata)* frequently forage and estivate in riparian pools.

5.3 Reach 6 Vernal Pool Functional Assessment

For the vernal pools in Reach 6, their functional assessment is based primarily on their status as vernal pools that meet the applicable MNHESP criteria. In short, since the two vernal pools in Reach 6 meet the biological and physical criteria for vernal pools, the primary function performed by each of these pools is to function as a vernal pool. More specifically, these vernal pools function to provide suitable breeding habitat for obligate vernal pool species, the most common being wood frogs and spotted salamanders that spend the majority of their annual life-cycle in the adjacent forested uplands associated with the October Mountain State Forest.

6.0 BRA of Reach 6 Support Areas

As noted in Section 1.2, the Reach 6 remediation will involve activities at three specific support areas, described in the Conceptual RD/RA Work Plan for Reach 6. These are:

- A shoreline support facility situated on the southern shore of Woods Pond to support the dredging and dredged material transport operations;
- The route for a hydraulic pipeline needed to convey dredged material from the shoreline support facility to the UDF; and
- A rail spur and rail loading and unloading area, referred to as the Woods Pond Spur, situated along the western side of Woods Pond near the Lenox Rail Station.

This section provides general habitat descriptions for these three support areas.

6.1 Shoreline Support Facility

The anticipated area for the shoreline support facility encompasses several different wetland and upland community types along the southern shoreline of Woods Pond (**Figure 6-1**). A thin fringe of shallow marsh vegetation occurs along the shallow side of the pond itself where the outer bulkhead of the shoreline support facility will be constructed. On the inland side of the emergent marsh fringe, there are two wooded wetland cover types within the footprint of the shoreline support facility: a small area of shrub swamp that grades into shallow emergent marsh habitat is located at the eastern limits of the facility footprint and red maple swamp extending along much of the remaining limits to the northwest. In addition, floodplain upland forested conditions, in the form of red oak-sugar maple transition forest, covers most of the remainder of the facility area out to the 1 mg/kg isopleth. This upland oak-dominated forest also extends over a small upland knoll outside of the isopleth which remains in the footprint of the shoreline support facility.

A detailed vegetative survey of the shoreline support facility area was conducted on September 23, 2024. One of the objectives of this vegetative survey was to assess the potential presence of any rare plant species within the footprint of the facility. However, no state-listed or federally listed plant species were recorded within the shoreline support facility area. **Table 6-1** presents the full list of plant species recorded within the footprint of the facility. More than 100 different plant species were recorded within the facility limits, consistent with the presence of five different habitat types within this relatively small area (shallow marsh, shrub swamp, red maple swamp, red oak-sugar maple upland floodplain transition forest, and red oak upland non-floodplain forest) (see **Figure 6-1**). Fifteen of the recorded plant species are invasive species, with an additional five species that are non-native, but not considered to be invasive.

Rare Species

There are no MNHESP-mapped state-listed Species Habitats that encompass the shoreline support facility area, nor does any MNHESP Estimated Habitats of rare (wetlands) wildlife or Priority Habitats of rare species occur in that area. The nearest Priority Habitat of rare species is located 0.15 mile to the north (extending across the middle area of Woods Pond). However, the USFWS IPaC mapping tool indicates that the shoreline support facility area could potentially provide habitat for the two state-listed bat species discussed above (the northern long-eared bat, which is also federally listed, and the tricolored bat, which has been proposed for federal listing), although these species were not included in MNHESP Species Habitat mapping.

6.2 Pipeline Route from Shoreline Support Facility to UDF

The proposed pipeline to convey dredged sediment from Woods Pond to the UDF will cross Woodland Road at the shoreline support facility, and then extend to the south along the western side of Woodland Road for just over 1,000 feet before turning southwest to cross into and through the UDF area (**Figure 6-2**). Most of the habitat along the pipeline route is mature woodland, and has been surveyed in detail and reported on in the *Second Revised Ecological Characterization and Habitat Assessment Report for the UDF Area* (UDF Habitat Report; AECOM 2024b). Vegetative cover types along Woodland Road which the pipeline route will pass along or through include, in decreasing order of prevalence. northern hardwood forest, eastern white pine forest, and palustrine swamp hardwood forest. The swamp hardwood forest borders the pipeline route for only a short distance at the southern end of the pipeline route as it turns west onto the UDF. It should also be noted that, to the extent practicable, the pipeline corridor will pass along the roadside of Woodland Road, and as such will largely border the adjacent woodlands rather than require clearing of the forest. The composition of these three forested cover types is summarized as follows:

Northern Hardwood Forest

Northern hardwood forest is the dominant forest cover type observed along the pipeline route adjacent to the western side of Woodland Road. This forest cover type along the proposed pipeline route contains sugar maple as the dominant tree species, with red oak, white ash, and black cherry as sub-dominants. Likely due to past disturbances in the region, the understory is dominated by Morrow's honeysuckle and garlic mustard, both listed as invasive plant species. The invasive species Asiatic bittersweet and common buckthorn were also observed in this cover type, but at much lower frequency and percent cover. Native species observed in the understory include white wood aster, wild sarsaparilla, hayscented fern (*Dennstaedtia punctilobula*), and partridge berry.

Eastern White Pine Forest

Eastern white pine forest is the next most common forested cover type along the pipeline route. This cover type is typical of sandy, gravelly or sandy loam soils throughout New England. A total of 39 plant species were observed within this cover type on the UDF property, and five of them are listed by Massachusetts Invasive Plant Advisory Group (MIPAG 2005) as invasive. White pine and sugar maple are the most common tree species, with black cherry and white ash as sub-dominants in the tree canopy. As with the northern hardwoods forest, the invasive Morrow's honeysuckle is a common woody shrub in the understory. Other understory species observed include Canada mayflower, spinulose wood fern (*Dryopteris carthusiana*), partridge-berry, and New York fern.

Palustrine (Wetland) Swamp Forest

The palustrine (wetland) swamp forest cover type located along the edge of the pipeline route where it turns onto the UDF property consists largely of a cover of mature red maple trees in the canopy with an understory of woody shrubs silky dogwood and speckled alder, with a co-dominance of sensitive fern observed in the herbaceous layer. A small, more open vernal pool is also located at the edge of the swamp adjacent to the pipeline route.

After turning southwest onto the UDF property from Woodland Road, the pipeline corridor will pass along the base of an upland forested slope, and then cross south over a small intermittent stream before extending into the main part of the UDF being graded for the disposal operation, to terminate at the sediment dewatering location. Habitat conditions along the UDF portion of the pipeline route are described in the 2024 UDF Habitat Report.

Rare Species

There are no MNHESP-mapped state-listed Species Habitats that encompass the pipeline corridor area, nor does any MNHESP Estimated Habitats of rare (wetlands) wildlife or Priority Habitats of rare species overlap the pipeline corridor. The nearest Priority Habitat of rare species is located 0.15 mile to the north. Once again, however, the USFWS IPaC mapping tool indicates that this area could potentially provide habitat for the northern long-eared bat and the tricolored bat (which are federally listed or proposed for federal listing), although these species were not included in MNHESP Species Habitat mapping.

6.3 Woods Pond Rail Spur and Loading/Unloading Area

The Woods Pond Rail Spur loading site is located along the western side of the existing rail line just north of the pedestrian bridge upstream of the Woods Pond dam near the terminus of Housatonic Street **(Figure 6-3)**. Much of the area of potential rail loading layout has been previously developed for industrial/commercial uses, and currently reflects that past usage in the form of an existing

building pad and gravel surface areas. Several scattered trees occur over the southern half of the site, with secondary growth woodland developing over portions of the northern half of the site. **Table 6-2** provides a list of plant species observed in this area based on a brief review on October 15, 2024. The current MNHESP Priority Habitat mapping does not include the proposed rail layout area, but is confined to the area to the east (encompassing the northern part of Woods Pond and its floodplain on the eastern side of the existing rail line). MNHESP has included the northern portion of this area within Core Area 2, but this may be a mapping/delineation issue rather than actually reflecting habitat conditions for Core Area 2 species. This area does not appear to provide habitat suitable for any of the Core Area 2 designated species (American bittern, common gallinule, mustard white butterfly, wood turtle), considering both existing habitat conditions and the long-term industrial use of the site along the railway. In any case, the layout of the rail spur loading/unloading area has avoided this Core Area 2 delineation.

7.0 Assessment of Rare Species in Reach 6

This section provides an assessment of the presence of federal and state-listed rare species and their associated habitats in Reach 6 and support areas. Federally listed rare species are those determined to be endangered or threatened under the Endangered Species Act (ESA: 16 U.S.C 1531 et seq.); "candidate species" under consideration for listing are also noted herein. State-listed species are those identified under the Massachusetts Endangered Species Act (MESA; M.G.L. c. 131A) and its implementing regulations (321 CMR 10.00) as endangered, threatened, or of special concern (MNHESP 2020). Under MESA, a particular species may be identified and listed as "endangered" (in danger of extinction throughout all or a significant portion of its range or in danger of extirpation), "threatened" (likely to become Endangered within the foreseeable future), or of "special concern" (a species which has suffered a decline that could threaten the species if allowed to continue unchecked, or that occurs in such small numbers or with such a restricted distribution or specialized habitat requirements that it could become threatened within Massachusetts) (321 CMR 10.03(6)). As previously noted, both the federally listed and state-listed species encompassed by these definitions are collectively referred to as rare species herein.

7.1 Methods

7.1.1 Federally Listed Species

The occurrence of any federally listed threatened or endangered species or their habitat in Reach 6 has been identified based on the USFWS IPaC. The IPaC online mapping tool was consulted in October 2024 to document the potential presence of federally listed rare species under the ESA within Reach 6 (including proposed and candidate species). In addition, the habitat requirements for such listed species were researched using appropriate source material, primarily that available from the USFWS (ECOS: Home (fws.gov) as well as MNHESP (List of Endangered, Threatened, and Special Concern species | Mass.gov). These habitat requirements were then assessed relative to the documented conditions in the Reach 6 habitats.

7.1.2 State-Listed Species

State-listed species and their habitats in Reach 6 have been determined based primarily on information provided by MNHESP. In October 2022, MNHESP provided GE with digital information presenting its delineation of state-listed species habitats in Reaches 5 through 8 of the ROR. These individual species maps are referred to as Species Habitat Maps. These maps are prepared by MNHESP using the "best scientific evidence available," examining individual occurrence records in the context of species listing status and applying a set of specified criteria. These criteria include the nature and/or significance of the occurrence as it relates to the conservation and protection of the species, including, but not limited to, evidence of breeding, persistence, life stages present, number

of individuals, extent of necessary supporting habitat, and proximity to other occurrences (321 CMR 10.12 (2)). Species observations in close proximity, grouped into occurrences (also known as "element occurrences"), indicate the geographic location presumably inhabited by a population of that species. MNHESP has advised GE that it will not allow public presentation of the Species Habitat Maps by individual species, but that GE may show the overall area in Reach 6 mapped for all state-listed species collectively, may report the overall acreage in Reach 6 mapped for each state-listed species individually, and may generally describe that area.

MNHESP also provides on-line, publicly available mapping of Priority Habitats of state-listed species. Priority Habitat mapping is a regulatory layer which consists of combined Species Habitat Maps with "supporting habitat" added, where applicable, and may exclude certain Species Habitat mapping of low-ranked occurrences, Species Habitats based on historic occurrence sources, and Species Habitats for listed species that are not regulated.

7.2 Results

7.2.1 Federally Listed Species

Based upon the IPaC review, the northern long-eared bat is the only federally listed species indicated to potentially occur in Reach 6. In addition, the tricolored bat, which has been proposed as a federal endangered species, was indicated in the IPaC review to potentially occur in Reach 6. Another candidate species (under consideration for federal listing), the monarch butterfly (*Danaus plexippus*), was also indicated to potentially occur in Reach 6. A brief summary of the habitat requirements for these three species is provided below, and **Appendix E** provides more extensive information on these species and the potential for their habitat requirements to be met in all or portions of Reach 6. This information will be used as guidance in the remedial design process to minimize impacts on habitats of federally listed species to the extent practicable.

Northern Long-Eared Bat (Endangered): This is a small, brown bat with unique large, long ears that distinguish it from other species in Massachusetts. The northern long-eared bat is found in forested habitats in the warm months of the year where it roosts in trees and forages. Although found in other tree roosts, it prefers roosts in large, tall cavities of large, live or dead trees in clustered hardwood stands. Northern long-eared bat populations, once common in the northern United States, have been devastated by the spread of the white-nose syndrome fungus. Infected hibernacula in caves in the Northeast have caused catastrophic population losses of 90-100% (USFWS, ECOS: Home (fws.gov)). The USFWS IPaC consultation indicates that potential habitat for northern long-eared bat occurs throughout all of Reach 6.

Tricolored Bat (Proposed Endangered): In September 2022. the USFWS proposed the tricolored bat for listing as federally endangered; this proposal is still under review. The tricolored bat (formerly

called the eastern pipistrelle) is a small bat with tricolored fur on its back. The habitat requirements of the tricolored bat, as well as its range in Massachusetts, are similar to those of the northern long-eared bat, and the impacts from the white-nosed syndrome are also similar and constitute the primary reason for the proposed listing USFWS, ECOS: Home (fws.gov)).

Monarch Butterfly (Candidate): The monarch butterfly migrates each year from as far as Canada and across the United States to a few forested overwintering sites in the mountains of central Mexico and coastal California (USFWS 2022). Over the last two decades, numbers have declined, and therefore this species is a candidate for listing by the USFWS. Primary threats to this species appear to be conversion of grasslands to agriculture, urban development, widespread use of herbicides, logging/thinning at overwintering sites in Mexico, unsuitable management of overwintering groves in California, drought, continued exposure to insecticides, and effects of climate change (USFWS 2022). The monarch butterfly is not currently a state-listed species in Massachusetts. Open meadows (both wetland and upland) in Reach 6 provide potentially suitable habitat for monarch butterflies. These habitats support several milkweed species which serve as the larval host plants for monarch butterflies.

7.2.2 State-Listed Species and Reach 6 Core Habitats

Based upon information provided by MNHESP in October of 2022, a total of six state-listed plant and animal species have MNHESP-mapped Species Habitat that encompass the various habitats in Reach 6. As previously noted, two additional state-listed species – the northern long-eared bat and tricolored bat – were indicated by the IPaC consultation as potentially occurring in Reach 6, but MNHESP did not include Species Habitat mapping for either of these bat species. All eight species are listed in **Table 7-1**, along with the acreage of mapped habitat for each species, the MESA status of each, and the taxonomic group that each species belongs in. Included in the list of state-listed species are two plants, one invertebrate, three birds, and two mammals. Since MNHESP did not provide Species Habitat Maps for either the northern long-eared bat or the tricolored bat, the entire Reach 6 area is included as the potential habitat for those species based upon the IPaC results.

As noted above, MNHESP has advised GE that it will not allow presentation of the Species Habitat Maps by individual species. The overall area mapped for all state-listed species collectively in Reach 6 encompasses all of Reach 6 except for the southern half of Woods Pond. Four species in particular encompass most of the mapped Species Habitat in Reach 6 – bur oak, mustard white, wapato, and common gallinule. American bittern and bald eagle have very small areas of mapped Species Habitat in Reach 6.

Figure 7-1 shows the limit of the latest Priority Habitat mapping from MNHESP in the Reach 6 area (along with certified vernal pools for informational purposes). As noted above, this is generated from publicly available mapping of Priority Habitats of state-listed species. As shown on **Figure 7-1**,

the Priority Habitat in Reach 6 extends from the upstream limits of the reach downstream to roughly halfway into Woods Pond (as well as laterally beyond the isopleth bounds that define the limits of Reach 6).

As previously discussed, MassDFW's July 2012 letter to EPA, which was attached to the Revised Permit, included maps depicting the locations of the different types of Core Habitat areas. **Figure 7-2** shows the areas in Reach 6 that were designated as Core Area 1 and Core Area 2. As also noted above, no Core Area 3 habitat was identified in Reach 6.

Each of the state-listed species with mapped habitat in Reach 6 (including IPaC mapping), along with its habitat requirements, the extent (acreage) of its mapped Species Habitat in Reach 6, and a general description of that area, are summarized briefly below, with more information provided in **Appendix E**. The general information on each species is largely taken from species-specific fact sheets prepared by MNHESP, as available on its website at List of Endangered, Threatened, and Special Concern species | Mass.gov, with additional information for some species based upon historical information and published literature. The extent of mapped Species Habitat for each species is taken from the Species Habitat maps provided by MNHESP where available, or the IPaC results if the Species Habitat mapping is not available.

American Bittern (*Botaurus lentiginosus*; Endangered): The American bittern is a wading bird that inhabits freshwater marshes, meadows, fens and bogs, spending most of its time secretly dwelling in marshland emergent vegetation such as cattails, bulrushes, sedges, and grasses (MNHESP 2015a). According to the 2022 MNHESP maps, Species Habitat for the American bittern in Reach 6 totals 0.06 acre, covering only a small area of floodplain in the northern portion of the Reach (in EA 56). Suitable marsh habitat occurs in this area along the Housatonic River, including in the mapped portion of Reach 6.

Bald Eagle (*Haliaeetus leucocephalus;* Special Concern): This species usually inhabits coastal areas, estuaries, and larger inland waters (MNHESP 2019a). It requires a high amount of water-to-land edge incorporating stands of forest for nesting and trees projecting above the forest canopy for perching, an adequate supply of moderate-sized to large fish, an unimpeded view, and little human disturbance. When available, fish (both marine and freshwater) are the bald eagle's preferred food. Birds, especially waterfowl, small mammals, and carrion, particularly dead fish, are also in the bald eagle's diet. The mapped Species Habitat of the bald eagle in Reach 6 extends into the northern portion of the floodplain area, covering 10.9 acres. However, site investigations in 2023 and 2024 observed bald eagles in the headwaters transition area of Reach 6, roosting in the larger trees of the marsh islands of this area. Suitable habitat conditions consistent with the above description occurs through this portion of Reach 6.

Bur Oak (*Quercus macrocarpa;* Special Concern): Bur oak occurs in several habitats including forested fens, forested swamps, floodplain forests influenced by calcareous (alkaline or basic) seepage water, and mesic to wet sites in shady areas subject to seasonal flooding. Current records (since 1980) for bur oak specimens in Massachusetts are confined to Berkshire County (MNHESP 2015b). MNHESP 2022 Species Habitat mapping for the bur oak extends throughout the floodplain of Reach 6 (covering 36.6 acres of Reach 6), including the larger marshy island in the east side of the headwaters transition zone and also along the east side of Woods Pond. Suitable habitat for this species occurs in these areas, however only one bur oak tree was positively identified within Reach 6 during the 2023-2024 habitat investigations.

Common Gallinule (*Gallinula galeata;* Special Concern): The common gallinule (previously called the common moorhen) is a marsh bird that generally keeps to the cover of dense vegetation and feeds by wading or diving at the edges of open water. Its preferred habitat consists of shallow bodies of water with dense stands of emergent vegetation interspersed with areas of open water. More specifically, MNHESP (2019b) specifies its preferred habitats as waterbodies with water at least one foot deep, with dense cattail beds and occasionally shrub swamps adjacent to open water with aquatic bed vegetation. Although common gallinules prefer emergent wetlands as foraging, breeding, nesting, and protective cover habitat, they also utilize margins of lakes, ponds, and slow-flowing rivers and streams as feeding areas. Its diet consists of plant material, mosquitoes, spiders, tadpoles, insect larvae, fruits, and seeds. MNHESP 2022 Species Habitat mapping of the gallinule extends throughout most of Reach 6, with the exception of the southern half of Woods Pond and its outlet channel. The Species Habitat mapping covers 87.9 acres of Reach 6, and suitable habitat occurs throughout this mapped area.

Mustard White (butterfly) (*Pieris oleraceae; Threatened*) is a medium-sized, white butterfly member of the Pieridae family. The mustard white is typically found in moist, rich (mesic) openings in woodlands and riparian floodplains, edges of fens, marshes and streams, and open wet meadows, fields, and pastures (MNHESP 2015c). Two herbaceous woodland plants are essential larval hosts: the native two-leaved toothwort (*Cardamine diphylla*) and cuckoo-flower introduced from Eurasia (*Cardamine pratensis*) growing in forests, floodplains, and meadows. Other larval hosts may include several species of the mustard family, as well as the invasive garlic mustard. The mapped Species Habitat of the mustard white butterfly in Reach 6 extends south contiguously throughout the reach except for the southern part of Woods Pond and its outlet channel, covering 83.8 acres.

Northern Long-Eared Bat (Myotis septentrionalis; Endangered--both state and federal): Discussed above.

Tricolored Bat (*Perimyotis subflavus*; *Endangered state, Proposed Endangered federal*): Discussed above.

Wapato (*Sagittaria cuneata; Threatened*) is an aquatic herbaceous perennial of the water-plantain or arrowhead family (Alismataceae), found in nearly neutral to slightly basic open-water habitats. In Massachusetts, wapato is found in very slow-moving or stagnant waters of riverine floodplain habitats in alkaline backwaters, oxbow ponds, and small shallow depressions with muddy substrate, with a few occurrences on pond shores (MNHESP 2015d). Wapato displays high variability in its growth form as an emergent and emersed plant, a floating plant, or entirely submerged plant depending on its growth conditions. Mapped Species Habitat of wapato in Reach 6 extends along the wetter floodplain borders with river/backwater aquatic habitats and over most of the headwaters transition area into the northern edge of Woods Pond proper, comprising 53.0 acres in Reach 6.

8.0 Invasive Species in Reach 6

Assessment of invasive species in Reach 6 was initiated by establishing a definition of "invasive species," including the plant and animal species that will be considered invasive. For plants, the definition of invasive species included those listed by MIPAG as "invasive" or "likely invasive" (MIPAG 2005; https://www.massnrc.org/mipag), those listed by the USACE New England District (USACE 2020) in its focused list of invasive species to be controlled at wetland mitigation sites, and those listed as invasive by the Invasive Plant Atlas of New England (IPANE 2007).[17]

For animals, guidance on what aquatic species are considered invasive was obtained from both the Massachusetts Department of Conservation and Recreation (e.g., List of Current and Potential Aquatic Invasive Species | Mass.gov) and the U.S. Geological Survey (e.g., Nonindigenous Aquatic Species (usgs.gov)). In this determination, it is important to distinguish "exotic invasives" from other non-native species (which may or may not be invasive).[18] Based on this assessment, the zebra mussel (*Dreissena polymorpha*) and Asian clam (*Corbicula fluminca*) have been identified as exotic aquatic invasive animals which could potentially occur in the Reach 6 area, although none have been observed. Non-native fish species documented in Reach 6 are addressed in this BRA, but are not considered invasive species. This is consistent with both the state and federal guidance referenced above.

8.1 Methods

The initial effort in identifying invasive species involved consolidating available information on the general occurrence of each invasive species in Reach 6. As with the habitat inventories described above, the identification and location of invasive species were then conducted using site base mapping and aerial photographs in combination with field verification. This work was conducted in conjunction with the associated surveys in the aquatic and floodplain habitats as described previously.

For Reach 6, as described in Section 4.1.2, an aerial photograph overlay provided an initial depiction of known areas of invasive species based on the available information and aerial photographic interpretation. The aerial photographic base mapping was then used during field surveys to document the location and extent of invasive species. For the purposes of this documentation, invasive plant species occurrence was ranked by relative abundance of foliage cover in a given plant stratum (e.g., canopy, understory, ground layer) on a scale of 1-5%, 6-15%, 16-25%, 26-50%, 51-75%,

[17] It should be noted that the USACE New England District's list of invasive plant species to be controlled does not include any species that are not listed as invasive or likely invasive by MIPAG or IPANE.

[18] Under the federal definition, "invasive" species "cause significant economic harm, ecological harm, or harm to human health. 'Native species' means, with respect to a particular ecosystem, a species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem" (Executive Order 13112).

76-95% and 95-100%. For instances of invasive plant species exceeding 50% cover in discrete contiguous units, GPS instrumentation was used to document their location**.** An exception to this procedure applies to extensive areas of ground cover foliage such as moneywort or garlic mustard, which are impractical to map across the floodplain forest floor; in such cases, the presence of the species was documented in the data collection form for the subject habitat. For areas where mapping the spatial extent of invasive plants was impractical, floodplain plots with greater than 25% cover or where two or more invasive plant species cumulatively exceeded 25% are presented on **Figures 4-1a-c**. Aquatic invasive species (both plant and animal) in the aquatic habitat areas were documented during the field surveys for that habitat, including location references in the base mapping.

8.2 Results

Data on the occurrences of invasive species were recorded in all habitats (aquatic, floodplain wetlands, floodplain uplands, and vernal pools) during the field investigations in 2023-2024. The results were reported in the above sections of this report addressing each of those habitats. However, for completeness, the primary findings on invasive species are summarized again in this section, as discussed below. Additional information on the field assessment of invasive species in Reach 6 is provided in **Appendix F**, along with general information regarding the primary invasive species identified in Reach 6 during the field investigations of 2023-2024. **Table 8-1** lists all the invasive plant species identified in all habitats survey in Reach 6 during the field investigations of 2023-2024.

Overall, among the Reach 6 habitats surveyed, only one invasive tree species was observed (Norway maple). Six invasive shrub species, one woody vine, and nine herbaceous species were observed (including three aquatic macrophytes). The following summarizes the primary findings on invasive species for each of the habitats.

Aquatic Invasive Species

- Water chestnut, Eurasian milfoil, and curly-leaf pondweed are the primary invasive aquatic macrophytes that cover much of Woods Pond in the summer months;.
- While Asian clams are suspected to be present in parts of Reach 5, they have not been identified in Reach 6.
- No zebra mussels were detected in Reach 6.

Floodplain Invasive Species (including Vernal Pools)

- Invasive plant species were observed at 34 of 36 floodplain plots (94%).

- A total of 15 species listed as invasive or likely invasive were observed growing in floodplain habitats (six herbaceous species, six shrubs, two trees, and one woody vine).
- Only one invasive tree species (Norway maple) was recorded in the observation plots, and occurred in only 1% of the plots.
- The most common invasive shrub species were Morrow's honeysuckle and common buckthorn.
- The most prevalent invasive herbaceous species encountered were purple loosestrife and reed canary grass.
- Two species listed as invasive were observed growing in the two vernal pools surveyed in Reach 6. These were moneywort and purple loosestrife, both herbaceous species.

Data were collected on invasive species presence at the 36 plot locations across the floodplain. Invasive plant species were observed at 34 of these plots (94%). As shown in **Table 4-5**, a total of 14 species listed as invasive or likely invasive were observed growing in the floodplain plots that contained such species (seven herbaceous species, five shrubs, one tree, and one woody vine). The most frequently encountered invasive plants included purple loosestrife and reed canary grass in the herbaceous layer, common buckthorn and Morrow's honeysuckle in the shrub layer, and Asian bittersweet in the woody vine layer. Only one invasive tree species, Norway maple, was observed on the floodplain and occurred in only two plots.

In addition to the overall data summary provided above on invasive species in Reach 6, reed canary grass is the one species of invasive plant within Reach 6 which has developed discrete areas of dominance in the floodplain that are large enough in area to map (i.e., > 0.5 acre). The limits of the discrete areas of dominance by reed canary grass were therefore mapped, as shown on **Figures 4-1a through 4-1c**. The other areas of invasive species do not present such discrete areas of dominance that afford an ability to map specific zones.

During the brief field survey of Valley Mill Pond, two invasive plant species were noted. The submerged aquatic macrophyte Eurasian watermilfoil was observed within the actual pond, and common reed was abundant in an emergent wetland near the northern inlet area (**Figure 3-3**).

The proposed shoreline support facility area on the southern shore of Woods Pond was observed to contain more than 10 invasive species, notably garlic mustard, reed canary grass, moneywort, and several other invasive herbaceous species, along with common buckthorn, Japanese barberry, Asiatic bittersweet, and several other invasive shrub species (see **Table 6-1**). The primary invasive plants noted along the proposed pipeline corridor from the shoreline facility to the UDF were garlic mustard and Morrow's honeysuckle.

9.0 Preliminary Identification of Degraded Habitats and Restoration Opportunities in Reach 6

The Revised Reach 5B-8 BRA Work Plan provided that, during the course of the BRA activities in floodplain areas, disturbed or degraded habitats would be identified that could be suitable for access roads or staging areas during remediation and restoration stages of the project with the objective of minimizing ecological impacts. It also provided that, during BRA activities, GE would evaluate restoration opportunities. GE conducted these activities during the BRA of Reach 6. Those activities and their results are described in this section.

It should be noted, however, that in Reach 6 the only access road anticipated for the remedial activities is the existing Woodland Road, so the identification of additional access road locations in disturbed or degraded habitats is not applicable. Further, the only staging area will be the shoreline support facility that will be constructed along the southern shoreline of Woods Pond (as described in Section 6.1). This facility has been sited based on an alternatives analysis that considered logistical considerations as well as habitat conditions, and has been determined to be the only practicable location to service the hydraulic dredging operation and conveyance operation to transport dredged material to the UDF south along Woodland Road. As part of that alternatives analysis, GE identified degraded and disturbed habitats in Reach 6, as described in Section 9.1.

9.1 Identification of Disturbed or Degraded Habitats

To assist in identifying disturbed or degraded floodplain habitat areas, Form FP-1 included a section (Section VII) for the recording of observations pertaining to habitat degradation. These included evidence of significant levels of dumping or of significant erosion or sedimentation, the relative abundance of invasive species, disturbance from roads or highway, evidence of fire, and evidence of other human disturbances.

In conducting the baseline restoration field investigations and habitat cover type delineations in Reach 6, three categories of disturbed/degraded habitats in Reach 6 were identified as follows:

- Areas with a strong dominance of invasive plant species: As discussed in Section 8, there are a number of invasive plant species that have been documented in the floodplains of Reach 6. However, the only invasive plant species in Reach 6 that has developed discrete areas of dominance in the floodplain that are large enough in area to map (i.e., > 0.5 acre) is reed canary grass. The discrete areas of dominance by this species were identified and located using GPS measures for depiction on the site mapping. Dense, nearly monotypic stands of reed canary grass were documented in a number of the marshy islands and peninsulas in Reach 6 and have been delineated and mapped on **Figures 4-1a-4-1c**. The primary invasive

aquatic plant species, water chestnut, is discussed separately in terms of management and restoration considerations in **Appendix F-3**.

- Disturbed cultural grassland land uses: This category consists of an area that is subject to ongoing mowing and related land management uses (i.e., cultural grasslands). The one location in Reach 6 where this condition exists in an area sufficiently large to map is along the western shoreline of Woods Pond just north of the pedestrian bridge (**Figure 4-1c**).
- Areas impacted by historical disturbances: This category consists of areas that have been impacted by historical (as well as ongoing) disturbances such as road and rail construction, land clearing, filling, grading, and overhead transmission line construction. **Figures 4-1b** and **4-1c** depict these locations, which include the gravel/dirt roads that extend alongside Woods Pond, the disturbed areas along the rail lines along the western side of the Pond, and the shoreline area under the overhead transmission line. These areas are mapped collectively as a "Developed/Disturbed" cover type on the community cover type mapping.

These delineated areas of specific degradation/disturbance were considered in the alternatives analysis for siting the shoreline support facility. Ultimately, the location selected for that facility was determined to be the only practicable location to support the hydraulic dredging and transport operations for Reach 6, as noted above.

9.2 Identification of Restoration Opportunities

In accordance with the Revised Reach 5B-8 BRA Work Plan, GE has also evaluated potential restoration opportunities during the course of surveying the ecological conditions in Reach 6. The identified restoration opportunities apply primarily to the aquatic habitats that will be subject to dredging. As described in the Conceptual RD/RA Work Plan, floodplain remedial activities are anticipated to be very minor, and thus the limited affected floodplain areas are not expected to warrant significant restoration actions. As noted in Appendix E of the Reach 6 Conceptual RD/RA Plan (submitted concurrently with this report), it is anticipated that the shoreline support facility will be subject to restoration activities upon final completion of the use of this facility (provided that alternative uses such as use for public access to Woods Pond are not agreed upon and approved by EPA for this location).

For the aquatic habitat areas, the field surveys included noting the presence of potential restoration resources that may be considered in the post-remediation restoration design, such as the presence of boulders, large trees or woody debris, root wad material, or plant propagation source materials. These are listed in Form IMP-1 (in **Appendix A**)**.** Restoration options within the aquatic habitat zones of Woods Pond also include consideration of managing the invasive aquatic macrophytes, primarily water chestnut but also Eurasian watermilfoil. The management of water chestnut, which by itself is a restoration measure to consider, includes potential actions prior to, during, and after

dredging. **Appendix F-3** provides discussion on such management considerations of water chestnut.

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Tables

Table 3-1: Impoundment Habitat Characterization

Parameter	Description of Parameter	Reach 6 BRA Inventory Approach*
Mapping and classification	Mapping of physical location and limits	Existing dam reports and mapping; updated LiDAR mapping and (if collected) sonar scan data for Reach 6; GIS-compiled mapped base for Reaches 7-8 with site reconnaissance.
Physical dimensions	Length, width, area, depth, and volume	Existing dam reports and mapping; updated LiDAR and bathymetry mapping for Reach 6; sonar scan data (if conducted); cross-sections; GIS mapping
Hydrology	Water regime (depth, water level fluctuation; exchange rate).	Consolidation of pre-existing information (from sources below); site reconnaissance and field surveys using Form IMP-1
Sediment composition	Relative % clay/silt/sand/gravel/cobble; boulder/bedrock; organic matter	Consolidation of pre-existing information (from sources below); field surveys using Form IMP-1
Aquatic plant community	Species composition and relative abundance; rare species habitat; invasive species	Consolidation of pre-existing information (from sources below); field surveys using Form IMP-1
Bordering habitat types	Species composition and relative abundance; rare species habitat; standing dead timber; surrounding habitat connectivity	Field surveys using Form IMP-1; rare species habitat from MNHESP investigations and designations and IPaC results
Large woody debris (LWD)	Size, relative abundance and density of LWD above and below water	Consolidation of pre-existing information (from sources below); field surveys using Form IMP-1
Water quality	Temperature, pH, TSS, turbidity, clarity, dissolved oxygen	Consolidation of pre-existing information (from sources below)
Presence of and habitat for aquatic and other water-using biota	Species composition and relative abundance of aquatic macrophytes, fish, benthic habitat/organisms, and other water-using biota	Consolidation of pre-existing information (from sources below); site reconnaissance and field surveys using Form IMP-1; fish community surveys; incidental wildlife observations
Rare species habitat	Priority Habitat/Core Area Habitat mapping; IPaC results from USFWS on-line data base	MNHESP investigations and designations; IPaC results; field surveys using Form IMP-1
Invasive species	Presence/relative abundance of designated invasive species	Consolidation of pre-existing information (from sources below); review of invasive species data from ACOE New England District and MIPAG; site reconnaissance and field surveys using Form IMP-1
Presence of special habitat features	Beaver/muskrat dens; otter slides	Consolidation of pre-existing information (from sources below); field surveys using Form IMP-1

* The pre-existing information used for the impoundment habitat characterization was consolidated from the following sources: the 2002 Woodlot Ecological Characterization, the 2003 RFI Report, the 2010 RCMS Report, and the MNHESP investigations of state-listed species through 2012 – all described and referenced in Section 3.1 of this report – as well as individual reports on, and mapping of, Woods Pond Dam.

Table 3-2: Impoundment Function Assessment Factors

Functional Category	Description of Functions	Parameters/Factors Considered in Assessing Function (see Table 3-1)
Hydrology/hydraulic	Floodwater dynamics (flood flow amelioration, flood storage and desynchronization, peak rate control)	Physical dimensions; hydrology (flood storage volume; inlet/outlet conditions; flow dynamics)
Geomorphology	Sediment dynamics (deposition/accretion/transport)	Hydrology (flow dynamics); sediment composition; aquatic plant community
Physicochemical	Water quality maintenance; temperature and oxygen regulation; processing of sediment, organic matter and nutrients	Water quality; hydrology (flow dynamics; water regime); aquatic biota (aquatic vegetation, including algae); sediment composition
Biological	Biodiversity and sustaining life stages of fish and other aquatic biota; habitat for aquatic and other water-using biota; rare species habitat	Habitat for aquatic biota (macrophyte, benthic macroinvertebrate, and; fish communities) and other water-using biota; rare species habitat (mapped Priority Habitat and Core Area habitat and IPaC results); special habitat features (including large woody debris); invasive species

Table 3-3: Reach 6 Benthic Habitats Recorded in Side-Scan Sonar Surveys

Habitat Type	Woods Pond Main Impoundment		Headwaters Transition Zone		Outlet Channel	
	Number*	SF**	Number*	SF**	Number*	SF**
Large woody debris)	15	890	10	1050	1	100
Fine woody debris	10	1050	8	600	0	0
Large boulders dominant with small boulders	0	0	0	0	4	11,000
Small boulders dominant with larger boulders and cobbles	0	0	0	0	1	25,000
Small boulders dominant with cobbles	0	0	0	0	4	43,900
Small boulders	1	200	0	0	2	1,000
Ledge and concrete	1	400	0	0	4	10,150

* Number of observations or distinct locations

** Total square feet of coverage

Table 3-4. Results of Fish Survey in Reach 6 on September 27, 2023

Species	YOY	Juvenile	Adult	Total
Black crappie	4	0	1	**5**
Bluegill	1	0	1	**2**
Bluntnose minnow	0	0	2	**2**
Comely shiner	0	0	36	**36**
Golden shiner	0	0	2	**2**
Largemouth bass	12	5	5	**22**
Northern pike	0	2	2	**4**
Pickerel	0	6	0	**6**
Pumpkinseed	24	8	14	**46**
Rock bass	0	0	3	**3**
Spottail shiner	0	0	237	**237**
White sucker	0	5	2	**7**
Yellow perch	5	18	7	**30**
Grand Total	**46**	**44**	**312**	**402**

Table 3-5. Results of Fish Survey in Reach 6 on September 9, 2024

Species	YOY	Juvenile	Adult	Total
Bluegill	37	2	7	**46**
Brown bullhead	0	2	1	**3**
Carp	0	2	4	**6**
Golden shiner	0	10	3	**13**
Largemouth bass	19	8	4	**31**
Northern pike	6	3	0	**9**
Pumpkinseed	1	3	8	**12**
Rock bass	1	2	20	**23**
Spottail shiner	0	0	30	**30**
White sucker	0	1	2	**3**
Yellow bullhead	0	0	1	**1**
Yellow perch	210	4	7	**221**
Grand Total	**274**	**37**	**87**	**398**

Table 3-6. Primary Aquatic Macrophyte Species Recorded in Reach 6 Aquatic Habitats, August 28, 2024

Scientific Name	Common Name
Ceratophyllum demursum	Coontail
Elodea canadensis	Canada Waterweed
Lemna minor	Common Duckweed
Potamogeton crispus	Curly Pondweed
Potamogeton epihydrus	Ribbon-Leaf Pondweed
Potamogeton natans	Broad-Leaf Pondweed
Potamogeton robbinsii	Robbins' Pondweed
Trapa natans	Water Chestnut
Valisneria americana	Water Celery
Wolffia columbiana	Columbus Water Meal

Table 3-7. Wildlife Observations Made During the 2023-2024 Aquatic Habitat Surveys in Reach 6

Common Name	Scientific Name
Amphibians and Reptiles	
Common snapping turtle	*Chelydra serpentina*
Painted turtle	*Chrysemys picta*
Bullfrog	*Lithobates catesbeiana*
Green frog	*Lithobates clamitans*
Pickerel frog	*Lithobates palustris*
Northern leopard frog	*Lithobates pipiens*
Northern water snake	*Nerodia sipedon*
Red-spotted newt	*Notophthalmus viridescens*
Spring peeper	*Pseudacris crucifer*
Invertebrates	
Caddisfly	*F: Limnephilidae*
Isopods	*O: Isopoda*
Darners	*O: Odonata F: Aeshnidae*
Damselfly	*O: Odonata S: Zygoptera*
Mammals	
Beaver	*Castor canadensis*
Muskrat	*Ondatra zibethicus*
Birds	
Spotted sandpiper	*Actitis macularius*
Wood duck	*Aix sponsa*
Mallard	*Anas platyrhynchos*
Great egret	*Ardea alba*
Great blue heron	*Ardea herodias*
Coopers hawk	*Astur cooperii*
Red-tailed hawk	*Beteo jamaicensis*
Canada goose	*Branta canadensis*
Green heron	*Butorides virescens*
Bald eagle	*Haliaeetus leucocephalus*
Belted kingfisher	*Megaceryle alcyon*
Osprey	*Pandion haliaetus*
Double-crested cormorant	*Phalacrocorax auritus*
Tree swallow	*Tachycineta bicolor*

Table 4-1: Reach 6 Wetland Community Types*

Community Type	Description
Wet meadow	Herbaceous emergent wetlands that are periodically disturbed by mowing or grazing or possibly sustained by hydrologic factors.
Shallow emergent marsh	Herb-dominated wetland community with saturated soils or inundated at some locations. Vegetation diverse, but lacking robust, grass-like herbs characteristic of deep emergent marshes.
Deep emergent marsh	Herb-dominated wetland community that often remains inundated with water through the growing season. Dominated by robust graminoids grass-like plants or aquatic, broad-leaved herbs.
Shrub swamp	Hydric shrublands lacking a closed canopy.
Red maple swamp	Hydric forests dominated by red maple.
Transitional floodplain forest	Riparian forests dominated by silver maple, box-elder, and American elm.
High-terrace floodplain forest	Riparian forests with a mixture of trees from wetter sites (e.g., silver maple, American elm) and trees from rich, upland sites (e.g., sugar maple, white ash, basswood). Herb layer with characteristic species of high-nutrient forests.
Black ash-red maple-tamarack calcareous seepage swamp	Hydric forests dominated by red maple, black ash, and bur oak. Occur in high pH groundwater discharge areas.
High-gradient stream	Steep slopes >1% with rapid water flow, often with bed materials including bedrock, boulders, cobbles, and coarse gravel.

* Adapted from Woodlot (2002a) Ecological Characterization

Table 4-2: Reach 6 Upland Community Types*

Community Type	Description
Red oak–sugar maple transition forest	Upland forest with well drained upland mineral soils. Species are transitional between southern and northern types and include red oak, white ash, sugar maple, American beech, eastern hemlock, black birch in the canopy with maple-leaved viburnum, witch hazel, Christmas fern, and wild sarsaparilla beneath.
Northern hardwoods–hemlock–white pine forest	Upland forest with well drained upland mineral soils. Plant species are a mixture of broad-leaved and needle-leaved trees including red oak, eastern hemlock, white pine, and sugar maple. Other species may include hobblebush, striped maple, Christmas fern, Canada mayflower, bracken fern, princess-pine, and partridge berry.
Developed and disturbed areas	Includes dirt/gravel and paved surfaces, manmade structures, maintained lawns and upland scrub-shrub areas that have been disturbed (e.g., powerline corridors and old field habitats).

* Adapted from Woodlot (2002a) Ecological Characterization

Table 4-3: Comparison of natural community cover types mapped in Reach 6 between 2002 and 2023

Natural Community / Cover Type	Woodlot 2002 (Acres)[1]	Natural Community / Cover Type	AECOM 2023 (Acres)[2]
Cultural grasslands	1.4	Cultural grasslands	0.0
Developed/Disturbed	0.0	Developed/Disturbed	3.2
Northern hardwood - hemlock white pine forest	0.1	Northern hardwood - hemlock white pine forest	1.0
Red oak-sugar maple transition forest	8.2	Red oak-sugar maple transition forest	6.8
High-gradient stream	0.1	High-gradient stream	0.1
Low-gradient stream (Woods Pond and river channel)	97.7	Impoundment (Woods Pond and river channel)	97.1
Wet meadow	0.0	Wet meadow	0.7
Shallow emergent marsh	4.6	Shallow emergent marsh	5.6
Deep emergent marsh	0.1	Deep emergent marsh	0.0
Shrub swamp	7.6	Shrub swamp	19.3
Red maple swamp	6.8	Red maple swamp	14.5
Black ash-red maple-tamarack calcareous seepage swamp	18.8	Black ash-red maple-tamarack calcareous seepage swamp	0.0
Transitional floodplain forest	1.9	Transitional floodplain forest	0.0
SUM:	**147.3**	**SUM:**	**148.3**

1. Natural community mapping based on Woodlot 2002 ecological characterization.
2. Natural community mapping based on AECOM 2023-2024 field surveys, and interpretation of available aerial photography and LiDAR data.

Table 4-4: Reach 6 Floodplain Wetland Habitat Characterization

Parameter	Description of Parameter	Reach 6 Inventory Approach*
Mapping and classification; watershed setting/factors	Mapping of physical location and limits; natural community cover type classification and delineation; wetland-watershed relationships (position in watershed; size of wetland relative to watershed; watershed factors)	Woodlot 2002 Ecological Characterization mapping and classification in Reach 6; aerial photograph interpretation and updated LiDAR mapping; 2023-2024 field surveys to confirm mapping and obtain data for Form FP-1
Hydrogeologic setting	Surficial geology	USGS surficial geology information; U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) soil survey mapping
Hydrology	Degree of surface flooding; connectivity to river or other surface water flow; water regime (mean water level, fluctuation/maximum water depth to lowest water level). Evidence of groundwater discharge (springs/seeps, etc.)	Consolidation of pre-existing information (from sources below); Federal Emergency Management Agency Flood (FEMA) Flood Insurance Study (FIS); 2023-2024 field surveys to obtain data for Form FP-1
Soil composition and characteristics	Soil profile description; soils series as mapped by the USDA NRCS	Consolidation of pre-existing information (from sources below); field surveys to obtain data for Form FP-1
Plant community	Plant species by community type	Consolidation of pre-existing information (from sources below); field surveys to obtain data for Form FP-1
Overall wildlife habitat/use	Wildlife use; habitat suitability; surrounding land uses; corridor connectivity	Consolidation of pre-existing information (from sources below); field surveys to obtain data for Form FP-1
Special habitat features	Wolf trees; standing dead timber; tree cavities; large woody debris; turtle hibernacula or nesting sites	Consolidation of pre-existing information (from sources below); field surveys to obtain data for Form FP-1
Rare species habitat	Priority Habitat/Core Area Habitat mapping; IPaC results from USFWS on-line data base	MNHESP investigations and designations (including updated outreach to MNHESP); IPaC results; field surveys to confirm mapping and obtain data for Form FP-1
Invasive species	Invasive plant species as designated by ACOE New England District or MIPAG	Review of invasive plant species lists from USACE New England District and MIPAG; consolidation of pre-existing information (from sources below); field surveys to map invasive species and obtain data for Form FP-1

* The pre-existing information used for the Reach 6 floodplain wetland habitat characterization included information from the following sources: the 2002 Woodlot Ecological Characterization reports, the 2003 RFI Report, the 2010 RCMS Report, and the MNHESP investigations of state-listed species through 2012 – all described and referenced in Section 4.1 of the Reach 6 BRA Report – as well as the USDA NRCS soil surveys, USGS surficial geology mapping, and FEMA FIS.

Table 4-5: Reach 6 Floodplain Wetland Plant Species Summary Data

Layer	Common Name	*Scientific Name*	Status[1]	Occurrence (Number of Plots N=36)
Tree Species	Norway maple	*Acer platanoides*	Invasive[A,B]	2
	Red maple	*Acer rubrum*	Native	13
	Silver maple	*Acer saccharinum*	Native	6
	Sugar maple	*Acer saccharum*	Native	1
	Yellow birch	*Betula alleghaniensis*	Native	2
	American hornbeam	*Carpinus caroliniana*	Native	9
	Bitternut hickory	*Carya cordiformis*	Native	1
	Fan-leaved hawthorn	*Crataegus flabellata*	Native	1
	Dotted hawthorn	*Crataegus punctata*	Native	1
	American beech	*Fagus grandifolia*	Native	2
	White ash	*Fraxinus americana*	Native	3
	Black ash	*Fraxinus nigra*	Native	2
	Green ash	*Fraxinus pennsylvanica*	Native	2
	Swamp white oak	*Quercus bicolor*	Native	3
	Northern red oak	*Quercus rubra*	Native	2
	White willow	*Salix alba*	Non-native	6
	Black willow	*Salix nigra*	Native	5
	American linden	*Tilia americana*	Native	2
	Eastern hemlock	*Tsuga canadensis*	Native	1
	American elm	*Ulmus americana*	Native	1
Shrub Species	Speckled alder	*Alnus incana*	Native	14
	Japanese barberry	*Berberis thunbergii*	Invasive[A,B,C]	1
	Buttonbush	*Cephalanthus occidentalis*	Native	9
	Alternate-leaved dogwood	*Cornus alternifolia*	Native	1
	Silky dogwood	*Cornus amomum*	Native	17
	Red-osier dogwood	*Cornus sericea*	Native	13
	American hazelnut	*Corylus americana*	Native	3
	Glossy buckthorn	*Frangula alnus*	Invasive[A,B,C]	1
	American witch hazel	*Hamamelis virginiana*	Native	2
	Winterberry	*Ilex verticillata*	Native	13
	Spicebush	*Lindera benzoin*	Native	2
	Morrow's honeysuckle	*Lonicera morrowii*	Invasive[A,B]	16
	Maleberry	*Lyonia ligustrina*	Native	1
	Common buckthorn	*Rhamnus cathartica*	Invasive[A,B,C]	4

Table 4-5: Reach 6 Floodplain Wetland Plant Species Summary Data (continued)

Layer	Common Name	*Scientific Name*	Status[1]	Occurrence (Number of Plots N=36)
Shrub Species	Eastern black current	*Ribes americanum*	Native	2
	Multiflora rose	*Rosa multiflora*	Invasive[A,B,C]	4
	Swamp rose	*Rosa palustris*	Native	7
	Silky willow	*Salix sericea*	Native	1
	Willow	*Salix sp.*	Native	1
	Elderberry	*Sambucus nigra*	Native	4
	White meadowsweet	*Spiraea alba*	Native	3
	Arrowwood	*Viburnum dentatum*	Native	9
Woody Vine Species	Asiatic bittersweet	*Celastrus orbiculatus*	Invasive[A,B,C]	7
	Virginia creeper	*Parthenocissus quinquefolia*	Native	6
	Poison ivy	*Toxicodendron radicans*	Native	4
	River grape	*Vitis riparia*	Native	6
Herb, Forb, Grass, Sedge and Rush Species	White snakeroot	*Ageratina altissima*	Native	1
	Roadside agrimony	*Agrimonia striata*	Native	1
	Southern water-plantain	*Alisma subcordatum*	Native	1
	Jack-in-the-pulpit	*Arisaema triphyllum*	Native	1
	Swamp milkweed	*Asclepias incarnata*	Native	1
	Nodding beggar-ticks	*Bidens cernua*	Native	1
	Purple-stemmed beggar-ticks	*Bidens connata*	Native	1
	Devil's beggar-tick	*Bidens frondosa*	Native	1
	Small-spiked false nettle	*Boehmeria cylindrica*	Native	14
	Bluejoint	*Calamagrostis canadensis*	Native	2
	Pond water-starwort	*Callitriche stagnalis*	Non-native	2
	Hedge false bindweed	*Calystegia sepium*	Native	1
	Pennsylvania bitter-cress	*Cardamine pensylvanica*	Native	1
	Bearded sedge	*Carex comosa*	Native	1
	Porcupine sedge	*Carex hystericina*	Native	1
	Hop sedge	*Carex lupulina*	Native	1
	Sedge	*Carex spp.*	Native	2
	Tussock sedge	*Carex stricta*	Native	5
	lesser bladder sedge	*Carex vesicaria*	Native	2
	White turtlehead	*Chelone glabra*	Native	5
	Sweet wood-reed	*Cinna arundinacea*	Native	1
	Common dodder	*Cuscuta gronovii*	Native	1
	Tall white-aster	*Doellingeria umbellata*	Native	3
	Needle spikesedge	*Eleocharis acicularis*	Native	3

Table 4-5: Reach 6 Floodplain Wetland Plant Species Summary Data (continued)

Layer	Common Name	*Scientific Name*	Status[1]	Occurrence (Number of Plots N=36)
Herb, Forb, Grass, Sedge and Rush Species	Blunt spikesedge	*Eleocharis obtusa*	Native	1
	Common eastern wild-rye	*Elymus virginicus*	Native	2
	Willow-herb	*Epilobium coloratum*	Native	2
	Field horsetail	*Equisetum arvense*	Native	1
	Boneset	*Eupatorium perfoliatum*	Native	1
	White wood-aster	*Eurybia divaricata*	Native	1
	Spotted joe-pye weed	*Eutrochium maculatum*	Native	3
	Climbing bindweed	*Fallopia scandens*	Native	2
	Rough bedstraw	*Galium asprellum*	Native	11
	Marsh bedstraw	*Galium palustre*	Native	5
	Northeastern manna grass	*Glyceria melicaria*	Native	1
	Fowl manna grass	*Glyceria striata*	Native	2
	Purple orpine	*Hylotelephium telephium*	Non-native	1
	Jewelweed	*Impatiens capensis*	Native	12
	Yellow iris	*Iris pseudacorus*	Invasive[A,B]	4
	Blue-flag iris	*Iris versicolor*	Native	1
	Soft rush	*Juncus effusus*	Native	1
	Canada wood nettle	*Laportea canadensis*	Native	3
	Rice cut-grass	*Leersia oryzoides*	Native	5
	Common duckweed	*Lemna minor*	Native	4
	Common water-primrose	*Ludwigia palustris*	Native	6
	American water-horehound	*Lycopus americanus*	Native	1
	Moneywort	*Lysimachia nummularia*	Invasive[A]	7
	Purple loosestrife	*Lythrum salicaria*	Invasive[A,B,C]	22
	Fasle Soloman's seal	*Maianthemum racemosum*	Native	1
	Ostrich fern	*Matteuccia struthiopteris*	Native	1
	Water forget-me-not	*Myosotis scorpioides*	Invasive[D]	7
	Sensitive fern	*Onoclea sensibilis*	Native	20
	Interrupted fern	*Osmunda claytoniana*	Native	1
	Royal fern	*Osmunda regalis*	Native	8
	Cinnamon fern	*Osmundastrum cinnamomeum*	Native	6
	New York Fern	*Parathelypteris noveboracensis*	Native	2
	Green arrow-arum	*Peltandra virginica*	Native	19
	Ditch-stonecrop	*Penthorum sedoides*	Native	1
	Halberd-leaved smartweed	*Persicaria arifolia*	Native	1
	False water-pepper	*Persicaria hydropiperoides*	Native	9

Table 4-5: Reach 6 Floodplain Wetland Plant Species Summary Data (continued)

Layer	Common Name	*Scientific Name*	Status[1]	Occurrence (Number of Plots N=36)
Herb, Forb, Grass, Sedge and Rush Species	Arrow-leaved tearthumb	*Persicaria sagittata*	Native	12
	Jumpseed	*Persicaria virginiana*	Native	1
	Reed canary grass	*Phalaris arundinacea*	Invasive[A,B,C]	13
	Clearweed	*Pilea pumila*	Native	1
	King Solomon's-seal	*Polygonatum biflorum*	Native	1
	Pickerelweed	*Pontederia cordata*	Native	1
	Swamp dock	*Rumex verticillatus*	Native	5
	Common arrowhead	*Sagittaria latifolia*	Native	2
	Woolgrass	*Scirpus cyperinus*	Native	2
	Leafy bulrush	*Scirpus polyphyllus*	Native	1
	Water parsnip	*Sium suave*	Native	2
	Carrion-flower	*Smilax herbacea*	Native	1
	Climbing nightshade	*Solanum dulmarcara*	Invasive[B]	5
	Zig-zag goldenrod	*Solidago flexicaulis*	Native	1
	Smooth goldenrod	*Solidago gigantea*	Native	1
	Rough-leaved goldenrod	*Solidago patula*	Native	1
	Great bur-reed	*Sparganium eurycarpum*	Native	8
	Bur-reed	*Sparganium sp.*	Native	2
	American aster	*Symphyotrichum lateriflorum*	Native	9
	New England American-aster	*Symphyotrichum novae-angliae*	Native	1
	Tall meadow-rue	*Thalictrum pubescens*	Native	1
	Marsh fern	*Thelypteris palustris*	Native	3
	Foam-flower	*Tiarella cordifolia*	Native	1
	Water-chestnut	*Trapa natans*	Invasive[A,B]	2
	Broad-leaved cattail	*Typha latifolia*	Native	10
	Blue vervain	*Verbena hastata*	Native	1

[1]Invasive Ratings: A= MIPAG Invasive; B=IPANE Invasive; C=ACOE Invasive; D=MIPAG Likely Invasive

Table 4-6: Percent Cover of Trees, Shrubs, Woody Vines, Herbs, and Mosses Estimated within each Reach 6 Floodplain Natural Community Cover Type

		Shallow emergent marsh	Shrub swamp	Red maple swamp
	Count	7	16	12
Trees	Min	0.5	0.5	10.5
	Max	3.0	38.0	85.5
	Mean	0.9	8.0	52.0
	±SE	0.4	3.2	6.4
Shrubs	Min	0.5	38.0	10.5
	Max	20.5	98.0	85.5
	Mean	10.5	75.7	58.0
	±SE	3.1	4.1	6.7
Woody Vines	Min	0.0	0.0	0.0
	Max	3.0	10.5	10.5
	Mean	0.4	1.6	2.5
	±SE	0.4	0.7	1.1
Herbs	Min	63.0	38.0	10.5
	Max	98.0	98.0	98.0
	Mean	81.2	78.6	71.3
	±SE	6.7	4.4	8.5
Mosses	Min	0.0	0.0	0.0
	Max	0.0	38.0	10.5
	Mean	0.0	3.1	4.5
	±SE	0.0	2.3	1.3

Table 4-7: Reach 6 NRCS Soil Series Mapping

Code[1]	Series	Area (Acres)	Percent of Reach 6
901E	Berkshire-Marlow association	0.12	0.1
267B,C,D	Copake fine sandy loam	0.87	0.6
34A	Fredon fine sandy loam	6.66	4.5
298E	Groton and Hinckley soils	4.55	3.1
35A	Halsey fine sandy loam	4.30	2.9
270A,B	Hero loam	11.71	7.9
58A	Natchaug and Catden mucks	20.50	13.8
651	Udorthents, smoothed	2.23	1.5
1	water	97.38	65.7
		148.32	**100.0**

1. Letters refer to percent slope of the mapping unit; A=0-3%, B=3-8%, C=8-15%, D=15-25%

Table 4-8: Reach 6 Floodplain Natural Communities –Biotic Habitat Features

	Wildlife Food[1]									Cover/Perches/Basking/Denning/Nesting Habitat[1]									
Plot_ID	Wetland and Aquatic Food	Upland Food	Shrub thickets with earthworm habitat	Live or Dead Trees >30" DBH	Standing Dead Trees with Cavities and Perches	Cavities in trunks or limbs of Live Trees	Small Mammal Burrows	Shrubs and/or Herbs for bird nesting	Sandy soils suitable for turtle nesting	Other Wildlife Dens/Nests	Dense Herb Cover	Large Woody Debris	Rocks, Crevices, Logs, Roots at Water Edge	Live or Dead Tall Veg. OH/Near Water	Persistent emergent wetland vegetation	Fine-leaved emergent vegetation	Depressions serving as vernal pools	Standing water present at least part of the growing season	Four -toed salamander habitat
FP-1	*	N/A	N/A	Ø	Ø	Ø	N/A	*	Ø	*	*	Ø	√	*	*	*	Ø	*	Ø
FP-2	*	N/A	N/A	Ø	√	Ø	Ø	*	Ø	√	*	√	√	*	*	*	Ø	*	Ø
FP-3	*	N/A	Ø	Ø	√	*	Ø	*	Ø	√	*	*	√	√	Ø	Ø	Ø	*	Ø
FP-4	*	N/A	Ø	Ø	√	√	Ø	*	Ø	√	*	√	Ø	√	*	√	Ø	*	Ø
FP-5	*	N/A	√	Ø	Ø	√	Ø	*	Ø	√	*	√	√	√	√	√	Ø	*	Ø
FP-6	*	N/A	√	Ø	√	√	Ø	*	Ø	√	*	√	√	*	*	*	Ø	√	Ø
FP-7	*	N/A	Ø	Ø	√	√	Ø	*	Ø	√	*	√	*	√	*	Ø	Ø	*	Ø
FP-8	*	N/A	Ø	Ø	Ø	Ø	Ø	*	Ø	√	*	Ø	*	Ø	*	√	Ø	*	Ø
FP-9	*	N/A	Ø	Ø	√	Ø	Ø	√	Ø	Ø	*	√	N/A	Ø	Ø	Ø	Ø	√	Ø
FP-11	*	N/A	Ø	Ø	√	Ø	Ø	√	Ø	Ø	*	√	N/A	N/A	Ø	Ø	Ø	√	Ø
FP-13	*	N/A	√	Ø	√	√	Ø	*	Ø	√	*	√	√	√	√	Ø	Ø	√	Ø
FP-14	*	N/A	Ø	Ø	Ø	Ø	Ø	*	Ø	√	√	√	√	√	√	√	Ø	*	Ø
FP-15	*	N/A	Ø	Ø	√	√	Ø	*	Ø	√	√	*	N/A	N/A	Ø	Ø	Ø	*	Ø
FP-18	*	N/A	Ø	Ø	√	√	Ø	*	Ø	Ø	√	Ø	N/A	N/A	Ø	Ø	Ø	*	Ø
FP-19	*	N/A	Ø	Ø	√	√	Ø	*	Ø	√	√	√	*	√	Ø	Ø	Ø	*	Ø
FP-20	*	N/A	Ø	Ø	Ø	Ø	Ø	*	Ø	Ø	Ø	Ø	√	Ø	Ø	Ø	Ø	Ø	Ø
FP-21	√	N/A	Ø	Ø	Ø	√	√	√	Ø	Ø	Ø	√	Ø	Ø	Ø	Ø	Ø	√	Ø
FP-23	*	N/A	Ø	√	Ø	Ø	Ø	*	Ø	Ø	*	√	√	Ø	*	*	Ø	*	Ø
FP-25	*	N/A	Ø	Ø	√	√	Ø	*	Ø	√	√	*	√	√	√	Ø	Ø	*	Ø
FP-26	√	N/A	Ø	Ø	Ø	Ø	Ø	*	Ø	Ø	*	Ø	Ø	*	*	*	Ø	Ø	Ø
FP-27	*	N/A	Ø	Ø	Ø	Ø	Ø	*	Ø	√	*	Ø	Ø	*	*	*	Ø	√	Ø
FP-28	*	N/A	N/A	Ø	Ø	Ø	Ø	√	Ø	Ø	*	√	*	√	*	Ø	Ø	*	Ø
FP-29	*	N/A	N/A	Ø	Ø	Ø	Ø	*	Ø	√	Ø	Ø	√	*	Ø	Ø	Ø	*	Ø
FP-31	*	Ø	N/A	Ø	Ø	Ø	Ø	*	Ø	Ø	*	Ø	Ø	Ø	*	Ø	Ø	*	Ø
FP-32	*	N/A	N/A	Ø	√	Ø	√	*	Ø	Ø	√	*	Ø	Ø	Ø	Ø	√	*	Ø
FP-33	*	N/A	Ø	Ø	√	Ø	Ø	*	Ø	Ø	*	Ø	√	√	*	√	Ø	*	Ø
FP-34	*	N/A	√	Ø	Ø	Ø	Ø	√	Ø	Ø	*	Ø	*	*	*	Ø	Ø	*	Ø
FP-35	*	N/A	N/A	Ø	Ø	Ø	√	√	Ø	Ø	√	Ø	√	√	*	Ø	Ø	*	Ø
FP-36	√	√	Ø	Ø	√	√	√	Ø	Ø	Ø	Ø	*	√	√	Ø	Ø	Ø	Ø	Ø
FP-37	√	√	Ø	Ø	√	Ø	√	Ø	Ø	Ø	Ø	Ø	√	√	Ø	Ø	Ø	√	Ø

[1]See Table 4-9 for wildlife associations with listed habitat features
*=Abundant; √=Present; Ø=Absent

Table 4-8: Reach 6 Floodplain Natural Communities –Biotic Habitat Features (continued)

	Wildlife Food[1]							Cover/Perches/Basking/Denning/Nesting Habitat[1]											
Plot_ID	Wetland and Aquatic Food	Upland Food	Shrub thickets with earthworm habitat	Live or Dead Trees >30" DBH	Standing Dead Trees with Cavities and Perches	Cavities in trunks or limbs of Live Trees	Small Mammal Burrows	Shrubs and/or Herbs for bird nesting	Sandy soils suitable for turtle nesting	Other Wildlife Dens/Nests	Dense Herb Cover	Large Woody Debris	Rocks, Crevices, Logs, Roots at Water Edge	Live or Dead Tall Veg. OH/Near Water	Persistent emergent wetland vegetation	Fine-leaved emergent vegetation	Depressions serving as vernal pools	Standing water present at least part of the growing season	Four -toed salamander habitat
FP-40	√	N/A	*	Ø	√	Ø	Ø	*	Ø	Ø	*	√	*	*	√	√	Ø	√	Ø
FP-43	*	N/A	√	Ø	Ø	√	Ø	*	Ø	Ø	*	Ø	*	*	*	√	Ø	*	Ø
FP-44	*	√	√	Ø	Ø	√	Ø	*	√	Ø	*	Ø	*	*	Ø	*	Ø	√	Ø
FP-46	*	N/A	√	Ø	√	Ø	Ø	*	Ø	√	*	Ø	√	*	*	*	Ø	*	Ø
FP-47	*	N/A	Ø	Ø	√	Ø	Ø	*	Ø	√	*	Ø	*	*	*	√	Ø	*	Ø
FP-48	*	Ø	√	Ø	√	√	Ø	*	Ø	Ø	*	√	*	*	√	Ø	Ø	*	Ø

[1]See Table 4-9 for wildlife associations with listed habitat features

*=Abundant; √=Present; Ø=Absent

Table 4-9: Reach 6 Floodplain Natural Communities: Summary of Biotic Habitat Features

Habitat Feature	Wildlife Use	% of Stations Abundant	% of Stations Present	% of Stations Absent
Wetland and aquatic food	Overall food	86	14	0
Upland food	Overall food	0	8	6
Shrub thickets with earthworm habitat	Game foraging habitat (e.g., American woodcock)	3	22	56
Live or dead trees >30” DBH	Cover/perching/nesting	0	3	97
Standing dead trees with cavities and perches	Cavities/perching/breeding/nesting/feeding	0	56	44
Cavities in trunks or limbs of Live Trees	Cavities/perching/breeding/nesting	3	39	58
Small mammal burrows	Hibernation/breeding/nesting/escape/cover	0	14	83
Shrub and/or herbaceous vegetation	Suitable for birds such as veery nesting	78	17	6
Open sandy to gravelly soils with sparse vegetation	Turtle nesting habitat	0	3	97
Other wildlife dens/nests	Hibernation/breeding/nesting/escape/cover	3	44	53
Dense Herb Cover	Voles, small mammals, amphibians, reptiles	67	19	14
Large woody debris on the ground	Small mammals, amphibians, reptiles, invertebrate emergence	14	42	44
Rocks, crevices, logs, roots at water edge	Turtles, snakes, frogs, invertebrate emergence	28	44	17
Live or dead vegetation overhanging and/or near water	Habitat offering good visibility of open water for, e.g., osprey, kingfisher, flycatchers, cedar waxwings. Vegetation closer to ground for turtles, snakes, frogs, wading birds, wood duck, mink, raccoon	36	36	19
Persistent emergent wetland vegetation at least seasonally flooded during the growing season	Habitat for American bittern, wood duck, green heron, black-crowned night heron, rails (sora, king, Virginia), moorhen, coot, pie-billed grebe, etc.	47	17	36
Fine-leaved emergent vegetation (Grasses and sedges) at least seasonally flooded during the growing season	Habitat for common snipe, spotted sandpiper, sedge wren, least bittern, common moorhen	22	22	56
Depressions serving as vernal pools	Turtles, snakes, frogs, invertebrate emergence	0	3	97
Standing water present at least part of the growing season	Amphibians, turtles, foraging waterfowl, non-breeding amphibians and reptiles (foraging, re-hydration)	67	25	8
Sphagnum hummocks or mats, moss-covered logs or saturated logs, overhanging or directly adjacent to pools of standing water in spring	Habitat for four-toed salamander	0	0	100

Table 4-10: Wildlife Observations Made During the 2023-2024 Floodplain Surveys in Reach 6

Common Name	Scientific Name	Common Name	Scientific Name
Amphibians and Reptiles		**Birds (cont.)**	
Spotted salamander	*Ambystoma maculatum*	Cedar waxwing	*Bombycilla cedrorum*
American toad	*Anaxyrus americanus*	Green heron	*Butorides virescens*
Grey tree frog	*Dryophytes versicolor*	Northern cardinal	*Cardinalis cardinalis*
Bullfrog	*Lithobates catesbeiana*	Turkey vulture	*Cathartes aura*
Green frog	*Lithobates clamitans*	Yellow shafted flicker	*Colaptes auratus*
Pickerel frog	*Lithobates palustris*	Eastern wood-pewee	*Contopus virens*
Northern leopard frog	*Lithobates pipiens*	American crow	*Corvus brachyrhynchos*
Wood frog	*Lithobates sylvaticus*	Common raven	*Corvus corax*
Red-spotted newt	*Notophthalmus viridescens*	Blue Jay	*Cyanocitta cristata*
Spring peeper	*Pseudacris crucifer*	Downy woodpecker	*Dryobates pubescens*
Eastern garter snake	*Thamnophis sirtalis*	Pileated woodpecker	*Dryocopus pileatus*
Invertebrates		Gray catbird	*Dumetella carolinensis*
Darners	*O: Odonata F: Aeshnidae*	Common yellow throat	*Geothypis trichas*
Damselfly	*O: Odonata S: Zygoptera*	Bald eagle	*Haliaeetus leucocephalus*
Mammals		Red-bellied woodpecker	*Melanerpes carolinus*
Coyote	*Canis latrans*	Wild turkey	*Meleagris gallopave*
Beaver	*Castor canadensis*	Song sparrow	*Melospiza melodia*
Muskrat	*Ondatra zibethicus*	Osprey	*Pandion haliaetus*
Chipmunk	*Tamias striatus*	Black capped chickadee	*Poecile atricapillus*
Black bear	*Ursus americanus*	Common grackle	*Quiscalus quiscula*
Birds		American Woodcock	*Scolopax minor*
Spotted sandpiper	*Actitis macularius*	Palm warbler	*Setophaga palmarum*
Red-winged blackbird	*Agelaius phoeniceus*	Yellow warbler	*Setophaga petechia*
Wood duck	*Aix sponsa*	American goldfinch	*Spinus tristis*

Table 4-10: Wildlife Observations Made During the 2023-2024 Reach 6 Floodplain Surveys (continued)

Common Name	Scientific Name	Common Name	Scientific Name
Birds (cont.)			
Ruby-throated hummingbird	*Archilochus colubris*	Tree swallow	*Tachycineta bicolor*
Great egret	*Ardea alba*	Carolina wren	*Thryothorus ludovicianus*
Great blue heron	*Ardea herodias*	American robin	*Turdus migratorius*
Coopers hawk	*Astur cooperii*	Red-eyed vireo	*Vireo olivaceus*
Red-tailed hawk	*Beteo jamaicensis*		

Table 4-11: State-Listed Rare Species Potentially Associated with Floodplain Wetland Habitats in Reach 6

Scientific Name	Common Name	State Status
Botaurus lentiginosus	American Bittern	Endangered
Haliaeetus leucocephalus	Bald Eagle	Special Concern
Quercus macrocarpa	Bur Oak	Special Concern
Gallinula galeata	Common Gallinule	Special Concern
Pieris oleracea	Mustard White	Threatened
Sagittaria cuneata	Wapato	Threatened
Myotis septentrionalis	Northern Long-Eared Bat	Endangered*
Perimyotis subflavus	Tricolored Bat	Endangered**

*Federally Listed Endangered
**Proposed Federally Endangered

Table 4-12: Reach 6 Floodplain Wetland Function Assessment Factors* (Functional Assessment Documented on Form FP-2)

Function	Description of Function	Parameters Considered in Assessing Function
Groundwater recharge/discharge	This function considers the potential for a wetland to serve as a groundwater recharge and/or discharge area. Recharge relates to the potential for the wetland to contribute water to an aquifer. Discharge relates to the potential for the wetland to serve as an area where groundwater can be discharged to the surface.	Hydrogeologic setting; soil composition and characteristics
Floodflow alteration (storage & desynchronization)	This function considers the effectiveness of the wetland in reducing flood damage by attenuation of floodwaters for prolonged periods following precipitation events.	Watershed setting/factors; hydrology; soil composition and characteristics; plant community
Sediment, toxicant, and pathogen retention	This function reduces or prevents degradation of water quality. It relates to the effectiveness of the wetland as a trap for sediments, toxicants, or pathogens.	Watershed setting/factors; hydrology; soil composition and characteristics; plant community
Nutrient removal, retention, and transformation	This function relates to the effectiveness of the wetland to prevent adverse effects of excess nutrients entering aquifers or surface waters such as ponds, lakes, streams, rivers, or estuaries.	Watershed setting/factors; hydrology; soil composition and characteristics; plant community
Production export (nutrient)	This function relates to the effectiveness of the wetland to produce food or usable products for humans or other living organisms.	Watershed setting/factors; hydrology; soil composition and characteristics; plant community; overall wildlife habitat/use
Sediment/shoreline stabilization	This function relates to the effectiveness of a wetland to stabilize streambanks and shorelines against erosion.	Watershed setting/factors; hydrology; soil composition and characteristics; plant community
Wildlife habitat	This function considers the effectiveness of the wetland to provide habitat for various types and populations of animals typically associated with wetlands and the wetland edge. Both resident and/or migrating species must be considered. Species lists of observed and potential animals should be included in the wetland assessment report.	Watershed setting/factors; hydrology; soil composition and characteristics; plant community; special habitat features; overall wildlife habitat/use; rare species habitat; invasive species; incidental wildlife observations
Fish and shellfish habitat	This function considers the effectiveness of seasonal or permanent waterbodies associated with the wetland in question for fish and shellfish habitat.	Watershed setting/factors; hydrology; soil composition and characteristics; plant community; special habitat features; overall wildlife habitat; rare species habitat; invasive species
Rare species habitat	This value relates to the effectiveness of the wetland or associated waterbodies to support threatened, endangered, or other rare species.	Rare species habitat (mapped Priority Habitat and Core Area habitat and IPaC results)

* Generally adapted from USACE New England District, 1995: *The Highway Methodology Workbook Supplement, Wetland Functions and Values, A Descriptive Approach*, NEDEP-360-1-30a

Table 4-13: Reach 6 Floodplain Upland Habitat Characterization

Parameter	Description of Parameter	Reach 6 Inventory Approach*
Mapping and classification	Mapping of physical location and limits; natural community cover type classification and delineation	Woodlot 2002 Ecological Characterization mapping and classification in Reach 6; aerial photograph interpretation and updated LiDAR mapping; 2023-2024 field surveys to confirm mapping and obtain data for Form FP-1
Hydrogeologic setting	Surficial geology	USGS surficial geology information; U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) soil survey mapping
Hydrology/drainage characteristics	Degree of surface flooding; connectivity to adjacent wetlands, river or other surface water flow	Consolidation of pre-existing information (from sources below); Federal Emergency Management Agency Flood (FEMA) Flood Insurance Study (FIS); 2023-2024 field surveys to obtain data for Form FP-1
Soil composition and characteristics	Soil profile description; soils series as mapped by the USDA NRCS.	USDA NRCS soil survey mapping; consolidation of other pre-existing information (from sources below); field surveys to obtain data for Form FP-1
Plant community	Plant species by community type; density/diversity and interspersion of plant community cover types	Consolidation of pre-existing information (from sources below); field surveys to obtain data for Form FP-1
Overall wildlife habitat/use	Wildlife use; habitat suitability	Consolidation of pre-existing information (from sources below); field surveys to obtain data for Form FP-1; incidental wildlife observations
Special habitat features	Wolf trees; standing dead timber; tree cavities; large woody debris; turtle hibernacula or nesting sites	Consolidation pre-existing information (from sources below); field surveys to obtain data for Form FP-1
Rare species habitat	Priority Habitat/Core Area Habitat mapping; IPaC results from USFWS on-line data base	MNHESP investigations and designations (including updated outreach to MNHESP; IPaC results; field surveys to obtain data for Form FP-1
Invasive species	Invasive plant species as designated by ACOE New England District or MIPAG	Review of invasive plant species lists from USACE New England District and MIPAG; consolidation of pre-existing information (from sources below); 2023-2024 field surveys to map invasive species and obtain data for Form FP-1

* The pre-existing information used for the Reach 6 floodplain upland habitat characterization included information from the following sources: the 2002 Woodlot Ecological Characterization reports, the 2003 RFI Report, the 2010 RCMS Report, and the MNHESP investigations of state-listed species through 2012 – all described and referenced in Section 4.1 of the Reach 6 BRA Report – as well as the USDA NRCS soil surveys, USGS surficial geology mapping, and FEMA FIS.

Table 4-14: Reach 6 Plant Species in Upland Natural Communities Summary Data

Layer	Common Name	Scientific Name	Status[1]	Occurrence (Number of Plots N=12)
Tree Species	Striped maple	*Acer pensylvanicum*	Native	1
	Red maple	*Acer rubrum*	Native	5
	Sugar maple	*Acer saccharum*	Native	9
	Yellow birch	*Betula alleghaniensis*	Native	1
	Sweet birch	*Betula lenta*	Native	2
	Paper birch	*Betula papyrifera*	Native	1
	American hornbeam	*Carpinus caroliniana*	Native	8
	Bitternut hickory	*Carya cordiformis*	Native	3
	Pignut hickory	*Carya glabra*	Native	1
	Shagbark hickory	*Carya ovata*	Native	1
	Fan-leaved hawthorn	*Crataegus flabellata*	Native	2
	American beech	*Fagus grandifolia*	Native	2
	White ash	*Fraxinus americana*	Native	9
	Green ash	*Fraxinus pennsylvanica*	Native	1
	Hop-hornbeam	*Ostrya virginiana*	Native	1
	Eastern white pine	*Pinus strobus*	Native	2
	Eastern cottonwood	*Populus deltoides*	Native	1
	Bigtooth aspen	*Populus grandidentata*	Native	1
	Black cherry	*Prunus serotina*	Native	7
	Choke cherry	*Prunus virginiana*	Native	2
	Northern red oak	*Quercus rubra*	Native	11
	American linden	*Tilia americana*	Native	3
	Eastern hemlock	*Tsuga canadensis*	Native	2
	American elm	*Ulmus americana*	Native	2
	Slippery elm	*Ulmus rubra*	Native	1
Shrub Species	Downy servicberry	*Amelanchier arborea*	Native	1
	Japanese barberry	*Berberis thunbergii*	Invasive[A,B,C]	2
	Alternate-leaved dogwood	*Cornus alternifolia*	Native	1
	Silky dogwood	*Cornus amomum*	Native	2
	American hazelnut	*Corylus americana*	Native	1
	Burning bush	*Euonymus alatus*	Invasive[A,B,C]	2
	American witch hazel	*Hamamelis virginiana*	Native	2
	Morrow's honeysuckle	*Lonicera morrowii*	Invasive[A,B]	9
	Common buckthorn	*Rhamnus cathartica*	Invasive[A,B,C]	3
	Eastern black current	*Ribes americanum*	Native	1
	Dwarf raspberry	*Rubus pubescens*	Native	1
	Maple-leaved viburnum	*Viburnum acerifolium*	Native	1

[1]Invasive Ratings: A= MIPAG Invasive; B=IPANE Invasive; C=ACOE Invasive; D=MIPAG Likely Invasive

Table 4-14: Reach 6 Plant Species in Upland Natural Communities Summary Data (continued)

Layer	Common Name	Scientific Name	Status[1]	Occurrence (Number of Plots N=12)
Shrub Species	Arrowwood	*Viburnum dentatum*	Native	3
	Nannyberry	*Viburnum lentago*	Native	1
Woody Vine Species	Asiatic bittersweet	*Celastrus orbiculatus*	Invasive[A,B,C]	5
	Virginia creeper	*Parthenocissus quinquefolia*	Native	2
	Poison ivy	*Toxicodendron radicans*	Native	2
	River grape	*Vitis riparia*	Native	1
Herb, Forb, Grass, Sedge and Rush Species	White baneberry	*Actaea pachypoda*	Native	1
	Red baneberry	*Actaea rubra*	Native	1
	American hog-peanut	*Amphicarpaea bracteata*	Native	1
	Wild sarsaparilla	*Aralia nudicaulis*	Native	2
	Jack-in-the-pulpit	*Arisaema triphyllum*	Native	3
	Eastern woodland sedge	*Carex blanda*	Native	1
	Bladder sedge	*Carex intumescens*	Native	1
	Pennsylvania sedge	*Carex pensylvanica*	Native	1
	Blue cohosh	*Caulophyllum thalictroides*	Native	1
	Tree-clubmoss	*Dendrolycopodium obscurum*	Native	1
	Eastern hay-scented fern	*Dennstaedtia punctilobula*	Native	4
	Silvery false spleenwort	*Deparia acrostichoides*	Native	2
	Woodfern	*Dryopteris carthusiana*	Native	1
	Evergreen wood fern	*Dryopteris intermedia*	Native	3
	Wood fern	*Dryopteris sp.*	Native	1
	Beech-drops	*Epifagus virginiana*	Native	1
	Broad-leaved helleborine	*Epipactis helleborine*	Non-native	2
	White wood-aster	*Eurybia divaricata*	Native	8
	Rough bedstraw	*Galium asprellum*	Native	1
	Fowl manna grass	*Glyceria striata*	Native	1
	Northern water-horehound	*Lycopus uniflorus*	Native	1
	Canada mayflower	*Maianthemum canadense*	Native	2
	Partridge berry	*Mitchella repens*	Native	2
	Two-leaf mitrewort	*Mitella diphylla*	Native	1
	Three-leaved rattlesnake-root	*Nabalus trifoliolatus*	Native	1
	Sensitive fern	*Onoclea sensibilis*	Native	9
	Interrupted fern	*Osmunda claytoniana*	Native	4
	New York Fern	*Parathelypteris noveboracensis*	Native	4
	King Solomon's-seal	*Polygonatum biflorum*	Native	2
	Hairy Solomon's-seal	*Polygonatum pubescens*	Native	2
	Christmas fern	*Polystichum acrostichoides*	Native	4

[1]Invasive Ratings: A= MIPAG Invasive; B=IPANE Invasive; C=ACOE Invasive; D=MIPAG Likely Invasive

Table 4-14: Reach 6 Plant Species in Upland Natural Communities Summary Data (continued)

Layer	Common Name	Scientific Name	Status[1]	Occurrence (Number of Plots N=12)
Herb, Forb and Grass Species	Bracken fern	*Pteridium aquilinum*	Native	1
	Elliptic-leaved shinleaf	*Pyrola elliptica*	Native	1
	Carrion-flower	*Smilax herbacea*	Native	1
	Blue-stem goldenrod	*Solidago caesia*	Native	2
	Smooth goldenrod	*Solidago gigantea*	Native	1
	American aster	*Symphyotrichum lateriflorum*	Native	3
	Tall meadow-rue	*Thalictrum pubescens*	Native	2
	Marsh fern	*Thelypteris palustris*	Native	1
	Foam-flower	*Tiarella cordifolia*	Native	1

[1]Invasive Ratings: A= MIPAG Invasive; B=IPANE Invasive; C=ACOE Invasive; D=MIPAG Likely Invasive

Table 4-15: Percent Cover of Trees, Shrubs, Woody Vines, Herbs, and Mosses Estimated within Upland Natural Community Cover Types

		Red oak-sugar maple transition forest	Northern hardwoods hemlock white pine forest
	Count	9	2
Trees	**Min**	63.0	85.5
	Max	85.5	85.5
	Mean	80.5	85.5
	±SE	3.3	0.0
Shrubs	**Min**	3.0	85.5
	Max	63.0	85.5
	Mean	23.0	85.5
	±SE	7.3	0.0
Woody Vines	**Min**	0.0	3.0
	Max	20.5	38.0
	Mean	3.3	20.5
	±SE	2.2	17.5
Herbs	**Min**	3.0	63.0
	Max	85.5	85.5
	Mean	38.8	74.3
	±SE	10.3	11.3
Mosses	**Min**	0.0	3.0
	Max	3.0	3.0
	Mean	0.7	3.0
	±SE	0.4	0.0

Table 4-16: Reach 6 Upland Natural Communities –Biotic Habitat Features

	Wildlife Food[1]					Cover/Perches/Basking/Denning/Nesting Habitat[1]													
Plot_ID	Wetland and Aquatic Food	Upland Food	Shrub thickets with earthworm habitat	Live or Dead Trees >30" DBH	Standing Dead Trees with Cavities and Perches	Cavities in trunks or limbs of Live Trees	Small Mammal Burrows	Shrubs and/or Herbs for bird nesting	Sandy soils suitable for turtle nesting	Other Wildlife Dens/Nests	Dense Herb Cover	Large Woody Debris	Rocks, Crevices, Logs, Roots at Water Edge	Live or Dead Tall Veg. OH/Near Water	Persistent emergent wetland vegetation	Fine-leaved emergent vegetation	Depressions serving as vernal pools	Standing water present at least part of the growing season	Four -toed salamander habitat
FP-10	N/A	*	Ø	√	√	Ø	Ø	Ø	Ø	Ø	Ø	*	N/A	N/A	N/A	N/A	Ø	N/A	N/A
FP-12	Ø	√	Ø	√	√	√	√	Ø	Ø	Ø	Ø	√	N/A	N/A	N/A	N/A	Ø	N/A	N/A
FP-16	N/A	*	Ø	√	√	√	√	√	Ø	Ø	√	*	N/A	N/A	N/A	N/A	Ø	N/A	N/A
FP-17	N/A	*	Ø	√	√	√	√	√	Ø	√	√	*	N/A	N/A	N/A	N/A	Ø	N/A	N/A
FP-22	N/A	√	Ø	Ø	Ø	√	√	Ø	Ø	Ø	Ø	√	Ø	*	Ø	Ø	Ø	Ø	Ø
FP-24	N/A	*	Ø	Ø	√	Ø	√	Ø	Ø	Ø	*	√	N/A	N/A	N/A	N/A	Ø	N/A	N/A
FP-30	N/A	*	√	Ø	√	√	√	√	Ø	√	Ø	*	N/A	N/A	N/A	N/A	Ø	N/A	N/A
FP-38	N/A	√	Ø	Ø	Ø	√	Ø	Ø	Ø	√	Ø	*	N/A	N/A	N/A	N/A	Ø	N/A	N/A
FP-39	N/A	*	Ø	Ø	√	Ø	Ø	Ø	Ø	Ø	*	√	N/A	N/A	N/A	N/A	Ø	N/A	N/A
FP-41	√	*	√	Ø	√	Ø	Ø	*	Ø	Ø	√	√	*	*	Ø	Ø	Ø	N/A	Ø
FP-42	√	√	*	Ø	Ø	Ø	Ø	*	Ø	Ø	*	*	*	*	Ø	Ø	Ø	Ø	Ø
FP-45	N/A	*	*	Ø	√	Ø	Ø	*	Ø	√	Ø	*	N/A	N/A	N/A	N/A	Ø	N/A	N/A

[1]See Table 4-17 for wildlife associations with listed habitat features
*=Abundant; √=Present; Ø= Absent

Table 4-17: Reach 6 Upland Natural Communities: Summary of Biotic Habitat Features

Habitat Feature	Wildlife Use	% of Stations Abundant	% of Stations Present	% of Stations Absent
Wetland and aquatic food	Overall food	0	17	8
Upland food	Overall food	67	33	0
Shrub thickets with earthworm habitat	Game foraging habitat (e.g., American woodcock)	17	17	67
Live or dead Trees >30" DBH	Cover/perching/nesting	0	33	67
Standing dead trees with cavities and perches	Cavities/perching/breeding/nesting/feeding	0	75	25
Cavities in trunks or limbs of Live Trees	Cavities/perching/breeding/nesting	0	50	50
Small mammal burrows	Hibernation/breeding/nesting/escape/cover	0	50	50
Shrub and/or herbaceous vegetation	Suitable for birds such as veery nesting	25	25	50
Open sandy to gravelly soils with sparse vegetation	Turtle nesting habitat	0	0	100
Other wildlife dens/nests	Hibernation/breeding/nesting/escape/cover	0	33	67
Dense herb cover	Voles, small mammals, amphibians, reptiles	25	25	50
Large woody debris on the ground	Small mammals, amphibians, reptiles, invertebrate emergence	58	42	0
Rocks, crevices, logs, roots at water edge	Turtles, snakes, frogs, invertebrate emergence	17	0	8
Live or dead vegetation overhanging and/or near water	Habitat offering good visibility of open water for, e.g., osprey, kingfisher, flycatchers, cedar waxwings. Vegetation closer to ground for turtles, snakes, frogs, wading birds, wood duck, mink, raccoon	25	0	0
Persistent emergent wetland vegetation at least seasonally flooded during the growing season	Habitat for American bittern, wood duck, green heron, black-crowned night heron, rails (sora, king, Virginia), moorhen, coot, pie-billed grebe, etc.	0	0	25
Fine-leaved emergent vegetation (Grasses and sedges) at least seasonally flooded during the growing season	Habitat for common snipe, spotted sandpiper, sedge wren, least bittern, common moorhen	0	0	25
Depressions serving as vernal pools	Turtles, snakes, frogs, invertebrate emergence	0	0	100
Standing water √ at least part of the growing season	Amphibians, turtles, foraging waterfowl, non-breeding amphibians and reptiles (foraging, re-hydration)	0	0	17
Sphagnum hummocks or mats, moss-covered logs or saturated logs, overhanging or directly adjacent to pools of standing water in spring	Habitat for four-toed salamander	0	0	25

Table 4-18: State-Listed Rare Species Potentially Associated with Floodplain Upland Habitats in Reach 6

Scientific Name	Common Name	State Status
Haliaeetus leucocephalus	Bald Eagle	Special Concern
Pieris oleracea	Mustard White	Threatened
Quercus macrocarpa	Bur Oak	Special Concern
Myotis septentrionalis	Northern Long-Eared Bat	Endangered*
Perimyotis subflavus	Tricolored Bat	Endangered**

*Federally Listed Endangered
**Proposed Federally Endangered

Table 4-19: Reach 6 Floodplain Upland Function Assessment Factors

Function	Description of Function	Parameters Considered in Assessing Function
Groundwater recharge	Infiltration/recharge of surface water to groundwater, especially during flood or high runoff events	Hydrogeologic setting; soil composition and characteristics; hydrology/drainage characteristics; plant community
Flood storage and desynchronization	Floodwater dynamics (flood flow amelioration, flood storage and desynchronization, peak rate control)	Hydrology/drainage characteristics; plant community
Corridor ecological connectivity	Capacity to contribute to ecological corridor connectivity along the riparian zone	Mapping and classification; plant community; overall wildlife habitat/use; rare species habitat
Buffer capacity	Capacity to buffer adjacent wetland and water habitats from nearby development	Soil composition and characteristics; plant community
Overall wildlife habitat	Habitat suitability for diverse wildlife at various trophic levels and all life stages	Plant community; presence of special habitat features; overall wildlife habitat/use; rare species habitat; invasive species; incidental wildlife observations
Rare species habitat	Designated rare species habitat per MNHESP and USFWS	Rare species habitat (mapped Priority Habitat and Core Area habitat and IPaC results)

Table 5-1: Data Collected during Vernal Pool Inspections in Reach 6

		Pool-ID[1]	
		5C-VP-17	6-VP-1
Historical Data	Obligate Species		Spotted Salamander
	Facultative Species		
	Permanency		Temporary
2023 Biological Data	Obligate Species (egg mass counts)	Spotted Salamander (20) Wood Frog (Larvae)	Spotted Salamander (24)
	Facultative Species		
	Other Species	Red-Spotted Newt (Adult) Green frog (Adult)	
	Fish Presence	N	Y (dead)
Physical Data (2023-2024)	Permanency	Temporary	Temporary
	Perm Flowing Outlet?	N	N

1. Obligate species listed consist of egg masses for amphibians except where adults and/or larvae are noted, or fairy shrimp

Table 5-2: Habitat Characteristics within Reach 6 Vernal Pools and the Adjacent Landscape

		Pool-ID	
		5C-VP-17	6-VP-1
Within-Pool Habitat Characteristics			
General Vernal Pool Characteristics	Discrete Depression in floodplain	N	N
	Pool Part of Larger Wetland	Y	Y
	Number of Pools within 1000 feet	0	0
	Cover Types[1]	SS/SEM	RMS / SS
	Substrate Type[2]		Mucky Mineral/SiL
	Area (Acres)	0.08	0.09
	Max Depth (inches)	32	12
	Average Depth (inches)	18	8
	Pool Hydrology[3]	Seasonally Flooded	Seasonally Flooded/Saturated
	Inlet/Outlet	Y	N
Vegetation Cover (%)[4]	Tree Canopy Cover	0	0
	Shrubs	53.8	100
	Herbs	78.8	78
	Mosses	0	0
	Woody Vines	0	7.5
In-Pool Physical Habitat Structure	Fine Woody Debris	10.5	10.5
	Large Woody Debris	10.5	20.5
	Windthrown Trees / Root Wads	0	3
	Hummocks (Sedge/Grass/Shrub)	63	63

Table 5-2: Habitat Characteristics within Reach 6 Vernal Pools and the Adjacent Landscape (continued)

		Pool-ID	
		5C-VP-17	6-VP-1
Surrounding Land Use (Percent of total area from edge of pool)[5]			
All Forest	**VPE 0-100**	21.9	53.8
	CTH 100-750	43.0	52.5
Shrub Swamp	**VPE 0-100**	76.1	26.9
	CTH 100-750	14.2	4.1
Shallow Emergent Marsh	**VPE 0-100**	0.0	13.2
	CTH 100-750	1.4	4.7
Wet Meadow	**VPE 0-100**	0.0	0.0
	CTH 100-750	0.4	0.6
Open Water	**VPE 0-100**	2.0	6.0
	CTH 100-750	40.1	36.7
Developed	**VPE 0-100**	0.0	0.0
	CTH 100-750	0.9	1.4

1. SS = Shrub Swamp, SEM = Shallow Emergent Marsh, DEM = Deep Emergent Marsh, TFF = Transitional Floodplain Forest, RMS = Red Maple Swamp, POW = Palustrine Open Water
2. Surface horizon / sub-surface soil textures
3. Hydrologic Regimes from FGDC (2013)
4. Percent cover of vegetation layers as measured from line-intercept transects across each vernal pool.
5. Percent cover of select habitats within the VPE = Vernal Pool Envelope (0-100 feet) and CTH = Critical Terrestrial Habitat (100-750 feet) from the edge of the pool.

Table 5-3: Reach 6 Plant Species Summary Data for Certifiable Vernal Pools.

Layer	Scientific Name	Common Name	Status	Present in Pool	
				5C-VP-17	6-VP-1
Herb, Forb and Grass Species	*Boehmeria cylindrica*	Clearweed	Native	X	
	Eleocharis palustris	Common spikesedge	Native	X	
	Impatiens capensis	Jewelweed	Native	X	X
	Juncus effusus	Soft rush	Native	X	
	Lysimachia nummularia	Moneywort	Invasive[A]		X
	Lythrum salicaria	Purple loosestrife	Invasive[A,B,C]	X	
	Onoclea sensibilis	Sensitive fern	Native		X
	Osmunda spectabilis	Royal fern	Native		X
	Persicaria hydropiperoides	False water-pepper smartweed	Native	X	
	Persicaria sagittata	Arrow-leaved tear thumb	Native	X	
	Scirpus cyperinus	Woolgrass	Native	X	
	Triadenum virginicum	Virginia marsh-St. John's-wort	Native	X	
Shrub Species	*Alnus incana*	Speckled alder	Native	X	X
	Cephalanthus occidentalis	Buttonbush	Native		X
	Cornus amomum	Silky dogwood	Native	X	
	Cornus sericea	Red-osier dogwood	Native		X
	Ilex verticillata	Winterberry	Native		X
	Salix discolor	Pussy willow	Native	X	X

[1]Invasive Ratings: A= MIPAG Invasive; B=IPANE Invasive; C=ACOE Invasive; D=MIPAG Likely Invasive

Table 6-1: Reach 6 Shoreline Support Facility Plant Species Summary Data

Layer	Common Name	Scientific Name	Status[1]
Tree Species	Red Maple	*Acer rubrum*	
	Sugar Maple	*Acer saccharum*	
	Downy Serviceberry	*Amelanchier arborea*	
	Yellow Birch	*Betula alleghaniensis*	
	Sweet Birch	*Betula lenta*	
	Paper Birch	*Betula papyrifera*	
	American Hornbeam	*Carpinus caroliniana*	
	Bitternut Hickory	*Carya cordiformis*	
	Shagbark Hickory	*Carya ovata*	
	Large-Fruit Hawthorn	*Crataegus macrosperma*	
	American Beech	*Fagus grandifolia*	
	White Ash	*Fraxinus americana*	
	Black Ash	*Fraxinus nigra*	
	Green Ash	*Fraxinus pennsylvanica*	
	Eastern White Pine	*Pinus strobus*	
	Northern Red Oak	*Quercus rubra*	
	American Basswood	*Tilia americana*	
	Eastern Hemlock	*Tsuga canadensis*	
	American Elm	*Ulmus americana*	
Shrub Species	Japanese Barberry	*Berberis thunbergii*	Invasive[A,B,C]
	Red Osier	*Cornus alba*	
	Alternate-Leaf Dogwood	*Cornus alternifolia*	
	Silky Dogwood	*Cornus amomum*	
	American Hazelnut	*Corylus americana*	
	Winged Euonymus	*Euonymus alatus*	Invasive[A,B,C]
	American Witch-Hazel	*Hamamelis virginiana*	
	Common Winterberry	*Ilex verticillata*	
	Morrow's Honeysuckle	*Lonicera morrowii*	Invasive[A,B]
	Common Buckthorn	*Rhamnus cathartica*	Invasive[A,B,C]
	Black Elder	*Sambucus nigra*	
	American Yew	*Taxus canadensis*	
	Highbush Blueberry	*Vaccinium corymbosum*	
	Maple-Leaf Viburnum	*Viburnum acerifolium*	
	Southern Arrow-Wood	*Viburnum dentatum*	
	Nanny-Berry	*Viburnum lentago*	
	Possumhaw	*Viburnum nudum*	

Table 6-1: Reach 6 Shoreline Support Facility Plant Species Summary Data (continued)

Layer	Common Name	Scientific Name	Status[1]
Woody Vine Species	Asian Bittersweet	*Celastrus orbiculatus*	Invasive[A,B,C]
	Virginia Creeper	*Parthenocissus quinquefolia*	
	River-Bank Grape	*Vitis riparia*	
Herb, Forb, Grass, Sedge and Rush Species	White Baneberry	*Actaea pachypoda*	
	Woodland Groovebur	*Agrimonia striata*	
	Garlic Mustard	*Alliaria petiolata*	Invasive[D]
	American Hog-Peanut	*Amphicarpaea bracteata*	
	Tall Thimbleweed	*Anemone virginiana*	
	Wild Sarsaparilla	*Aralia nudicaulis*	
	Northern Lady Fern	*Athyrium angustum*	
	Nodding Bur-Marigold	*Bidens cernua*	
	Devil's-Pitchfork	*Bidens frondosa*	
	Three-Lobe Beggarticks	*Bidens tripartita*	
	Small-Spike False Nettle	*Boehmeria cylindrica*	
	Narrow-Leaf Bittercress	*Cardamine impatiens*	Invasive[A,B]
	Quaker Bittercress	*Cardamine pensylvanica*	
	Fringed Sedge	*Carex crinita*	
	Hop Sedge	*Carex lupulina*	
	Retrorse Sedge	*Carex retrorsa*	
	Blunt Broom Sedge	*Carex tribuloides*	
	White Turtlehead	*Chelone glabra*	
	Chicory	*Cichorium intybus*	Non-native
	Bulblet-Bearing Water-Hemlock	*Cicuta bulbifera*	
	Shining Flat Sedge	*Cyperus bipartitus*	
	Straw-Color Flat Sedge	*Cyperus strigosus*	
	Queen Anne's-Lace	*Daucus carota*	Non-native
	Marginal Wood Fern	*Dryopteris marginalis*	
	Needle Spike-Rush	*Eleocharis acicularis*	
	Purple-Leaf Willowherb	*Epilobium coloratum*	
	Helleborine	*Epipactis helleborine*	Non-native
	Field Horsetail	*Equisetum arvense*	
	White Wood-Aster	*Eurybia divaricata*	
	Rough Bedstraw	*Galium asprellum*	
	Sweet-Scented Bedstraw	*Galium triflorum*	
	Eastern Teaberry	*Gaultheria procumbens*	
	Jewelweed	*Impatiens capensis*	
	Pale-Yellow Iris	*Iris pseudacorus*	Invasive[A,B]

Table 6-1: Reach 6 Shoreline Support Facility Plant Species Summary Data (continued)

Layer	Common Name	Scientific Name	Status[1]
Herb, Forb, Grass, Sedge and Rush Species	Lesser Poverty Rush	*Juncus tenuis*	
	Rice Cut Grass	*Leersia oryzoides*	
	Marsh Primrose-Willow	*Ludwigia palustris*	
	Northern Bugleweed	*Lycopus uniflorus*	
	Fringed Yellow-Loosestrife	*Lysimachia ciliata*	
	Creeping Jenny	*Lysimachia nummularia*	Invasive[A]
	Purple Loosestrife	*Lythrum salicaria*	Invasive[A,B,C]
	False Lily-of-the-Valley	*Maianthemum canadense*	
	Feathery False Solomon's-Seal	*Maianthemum racemosum*	
	Partridgeberry	*Mitchella repens*	
	Nimblewill	*Muhlenbergia schreberi*	
	True Forget-Me-Not	*Myosotis scorpioides*	Invasive[A,B]
	Sensitive Fern	*Onoclea sensibilis*	
	Royal Fern	*Osmunda spectabilis*	
	Arrow-Arum	*Peltandra virginica*	
	Swamp Smartweed	*Persicaria hydropiperoides*	
	Reed Canary Grass	*Phalaris arundinacea*	Invasive[A,B]
	American Lopseed	*Phryma leptostachya*	
	Canada Clearweed	*Pilea pumila*	
	Common Plantain	*Plantago major*	Non-native
	Christmas Fern	*Polystichum acrostichoides*	
	Pickerelweed	*Pontederia cordata*	
	Choke Cherry	*Prunus virginiana*	
	Northern Bracken Fern	*Pteridium aquilinum*	
	Shinleaf	*Pyrola elliptica*	
	Swamp Buttercup	*Ranunculus caricetorum*	
	Bloodroot	*Sanguinaria canadensis*	
	Mad-Dog Skullcap	*Scutellaria lateriflora*	
	Climbing Nightshade	*Solanum dulcamara*	Invasive[B]
	Wreath Goldenrod	*Solidago caesia*	
	Wrinkle-Leaf Goldenrod	*Solidago rugosa*	
	Broad-Fruit Bur-Reed	*Sparganium eurycarpum*	
	Heart-Leaved American-Aster	*Symphyotrichum cordifolium*	
	White Panicled American-Aster	*Symphyotrichum lanceolatum*	
	Fragile-Stem American-Aster	*Symphyotrichum racemosum*	
	Skunk Cabbage	*Symplocarpus foetidus*	

Table 6-1: Reach 6 Shoreline Support Facility Plant Species Summary Data (continued)

Layer	Common Name	Scientific Name	Status[1]
Herb, Forb, Grass, Sedge and Rush Species	Common Dandelion	*Taraxacum officinale*	Non-native
	Tall Meadow-rue	*Thalictrum pubescens*	
	Marsh Fern	*Thelypteris palustris*	
	Water-Chestnut	*Trapa natans*	Invasive[A,B]
	Colt's-Foot	*Tussilago farfara*	Invasive[A,B]
	Broad-Leaf Cattail	*Typha latifolia*	
	Cololmbian Watermeal	*Wolffia columbiana*	
	Golden Alexanders	*Zizia aurea*	

[1]Invasive Ratings: A= MIPAG Invasive; B=IPANE Invasive; C=ACOE Invasive; D=MIPAG Likely Invasive

Table 6-2: Plant Species Observed on the Woods Pond Rail Spur Site, October 15, 2024

Scientific Name	Common Name	Wetland Indicator Status
Acer platanoides	Norway Maple	UPL
Acer saccharum	Sugar Maple	FACU
Artemisia vulgaris	Common Wormwood	UPL
Asclepias syriaca	Common Milkweed	UPL
Celastrus orbiculatus	Asian Bittersweet	FACU
Cichorium intybus	Chicory	FACU
Daucus carota	Queen Anne's Lace	UPL
Galium triflorum	Sweet-scent Bedstraw	FACU
Juncus tenuis	Path Rush	FAC
Lonicera morrowii	Morrow's Honeysuckle	FACU
Parthenocissus quinquefolia	Virginia Creeper	FACU
Plantago major	Common Plantain	FACU
Rhus typhina	Staghorn Sumac	Not Listed
Salix alba	White Willow	FACW
Solidago canadensis	Canada Goldenrod	FACU
Taraxacum officinale	Common Dandelion	FACU
Verbascum thapsus	Great Mullein	UPL
Veronica officinalis	Common Gypsyweed	FACU
Vitis labrusca	Fox Grape	FACU

Table 7-1: Reach 6 State-Listed Species

Scientific Name	Common Name	State Status	Area in Reach 6 (acres)
Botaurus lentiginosus	American Bittern	Endangered	0.06
Haliaeetus leucocephalus	Bald Eagle	Special Concern	11
Quercus macrocarpa	Bur Oak	Special Concern	37
Gallinula galeata	Common Gallinule	Special Concern	88
Pieris oleracea	Mustard White	Threatened	84
Sagittaria cuneata	Wapato	Threatened	53
Myotis septentrionalis	Northern Long-Eared Bat	Endangered*	148
Perimyotis subflavus	Tricolored Bat	Endangered**	148

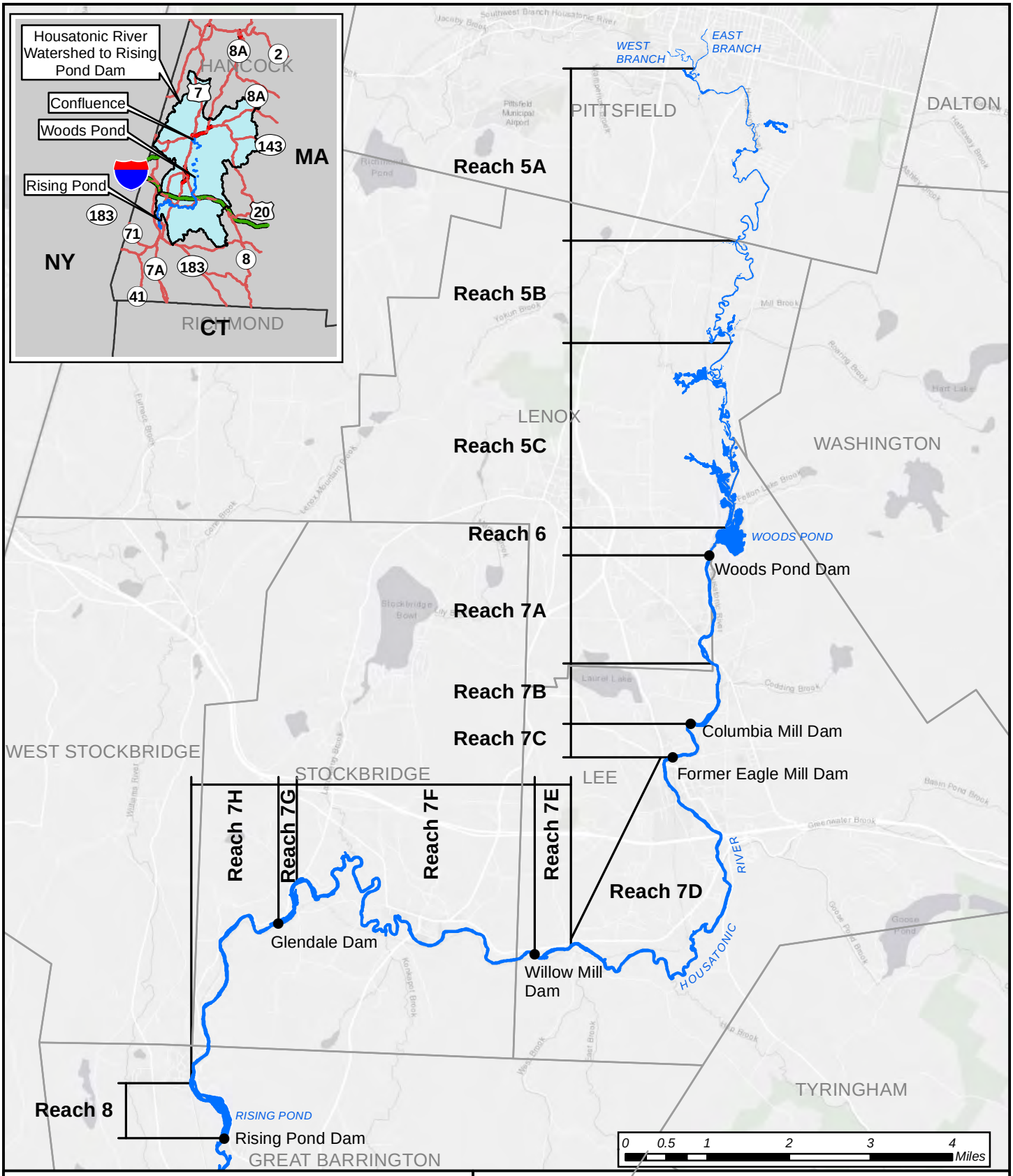
*Federally Listed Endangered
**Proposed Federally Endangered

Table 8-1. Invasive Plant Species Recorded in Reach 6

Layer	Common Name	Scientific Name	Status[1]
Herb, Forb, Sedge, Rush and Grass Species	Garlic mustard	*Alliaria petiolata*	D
	Narrow-leaved bitter-cress	*Cardamine impatiens*	A,B
	Japanese winged-knotweed	*Fallopia japonica*	A,B
	Yellow iris	*Iris pseudacorus*	A,B
	Moneywort	*Lysimachia nummularia*	A
	Purple loosestrife	*Lythrum salicaria*	A,B,C
	Water forget-me-not	*Myosotis scorpioides*	A,B
	European water-milfoil	*Myriophyllum spicatum*	A,B,C
	Reed canary grass	*Phalaris arundinacea*	A,B
	Common reed	*Phragmites australis*	B
	Curly pondweed	*Potamogeton crispus*	A,B
	Climbing nightshade	*Solanum dulcamara*	B
	Water-chestnut	*Trapa natans*	A,B
	Coltsfoot	*Tussilago farfara*	A,B
Shrub Species	Japanese barberry	*Berberis thunbergii*	A,B,C
	Burning bush	*Euonymus alatus*	A,B,C
	Glossy buckthorn	*Frangula alnus*	A,B,C
	Morrow's honeysuckle	*Lonicera morrowii*	A,B
	Common buckthorn	*Rhamnus cathartica*	A,B,C
	Multiflora rose	*Rosa multiflora*	A,B,C
Tree Species	Norway maple	*Acer platanoides*	A,B
Woody Vine Species	Asiatic bittersweet	*Celastrus orbiculatus*	A,B,C

1. Invasive Ratings: A= MIPAG Invasive; B=IPANE Invasive; C=ACOE Invasive; D=MIPAG Likely Invasive

Figures



Legend

- Dams
- Watershed to Rising Pond Dam
- Housatonic River

NOTE:
Basemap "Light Gray Canvas" from ESRI

Esri, HERE, Garmin, OpenStreetMap contributors, and the GIS user community

Rest of River Area Subject to Revised Permit
Reach 6 Baseline Restoration Assessment Report

SCALE	DATE	PROJECT NO.
1:104,000	10/25/2024	60736371

AECOM

Figure 1-1

56a
56
57
58
59
59a
60
60a
WOODS POND
Woodland Road
October Mountain Road
Willow Creek Road
Housatonic Street
Valley Road
Crystal Street
REACH 5C
REACH 6
REACH 6
REACH 7A
APPROXIMATE TRANSITION ZONE
APPROXIMATE TRANSITION ZONE
Potential Rail Spur with Loading/Unloading Zone
Shoreline Support Facility
Valley Mill Pond
Sediment Pipeline Route

Legend

- Potential Rail Spur
- Loading/Unloading Zone
- Sediment Pipeline Route
- Valley Mill Pond
- Shoreline Support Facility
- Reach Boundaries
- Potential Vernal Pool
- 1 mg/kg PCB Isopleth
- Exposure Subarea Boundary
- Exposure Area Boundary

N

0 300 600 1,200 Feet

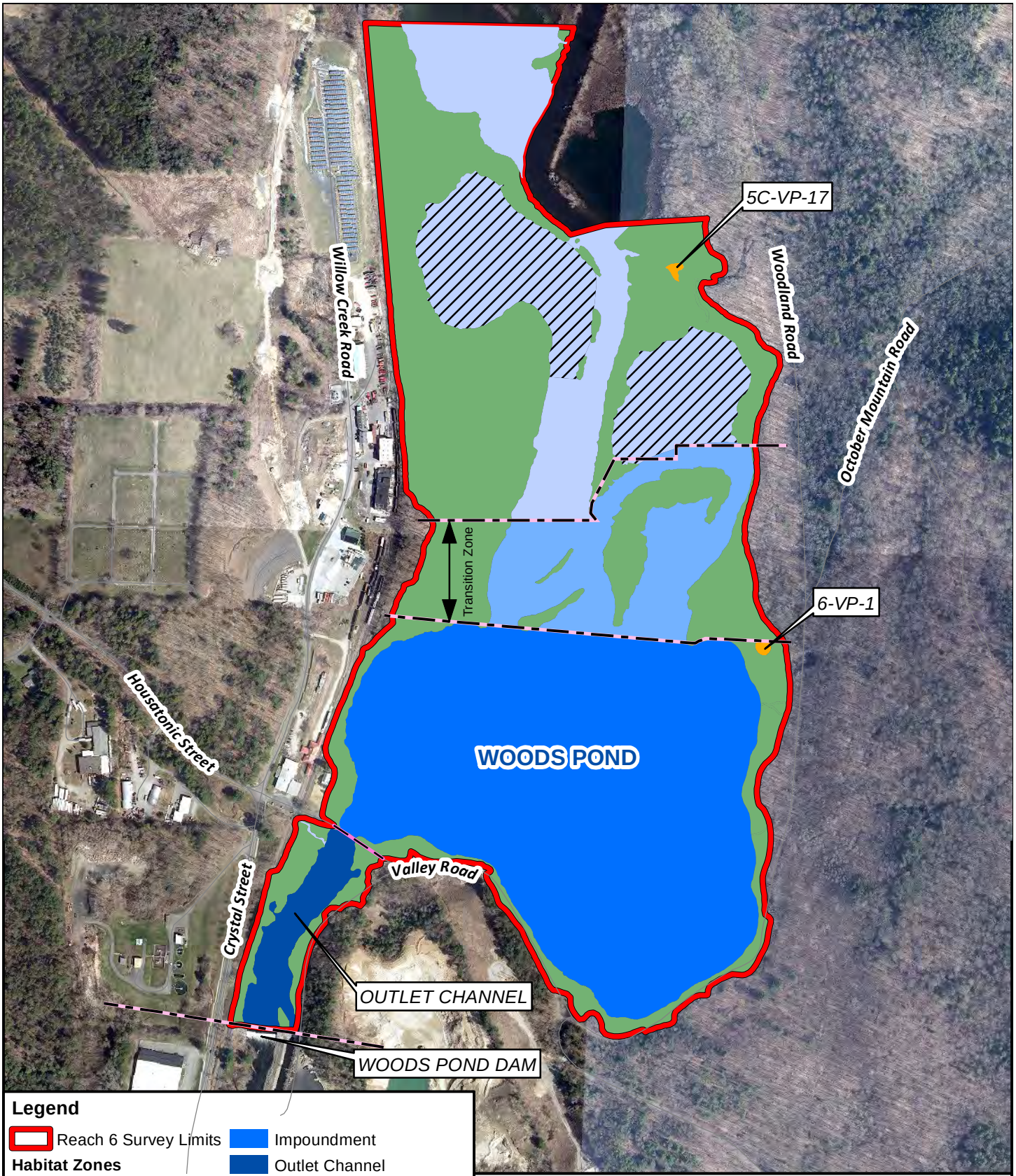
Reach 6 of the Rest of River

Reach 6 Baseline Restoration Assessment Report

SCALE	DATE	PROJECT NO.
1:7,200	10/25/2024	60736371

AECOM

Figure 1-2



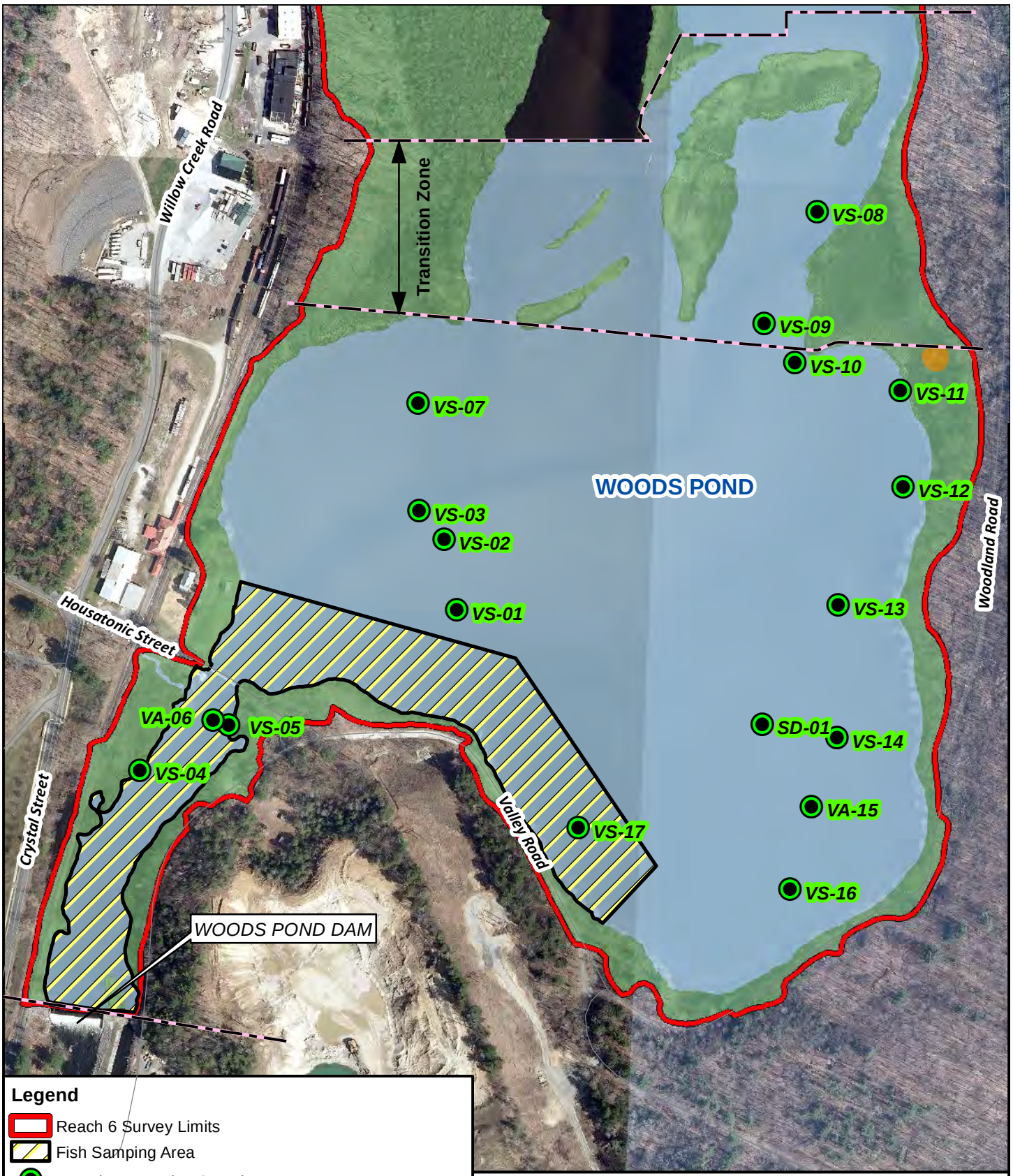
Reach 6 Habitat Zones

Reach 6 Baseline Restoration Assessment Report

SCALE	DATE	PROJECT NO.
1:7,200	10/25/2024	60736371

AECOM

Figure 1-3



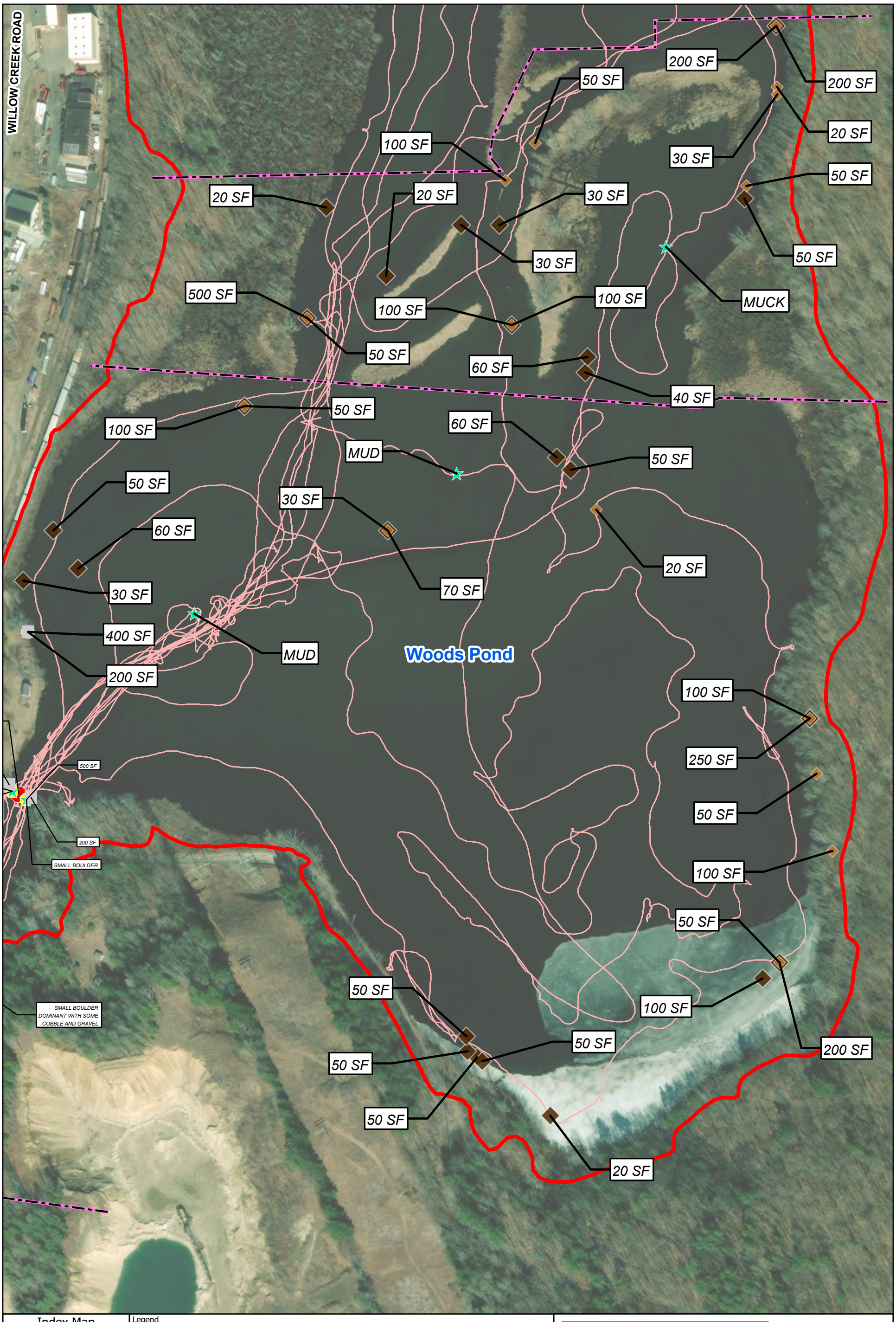
Reach 6 Aquatic Habitat Investigations

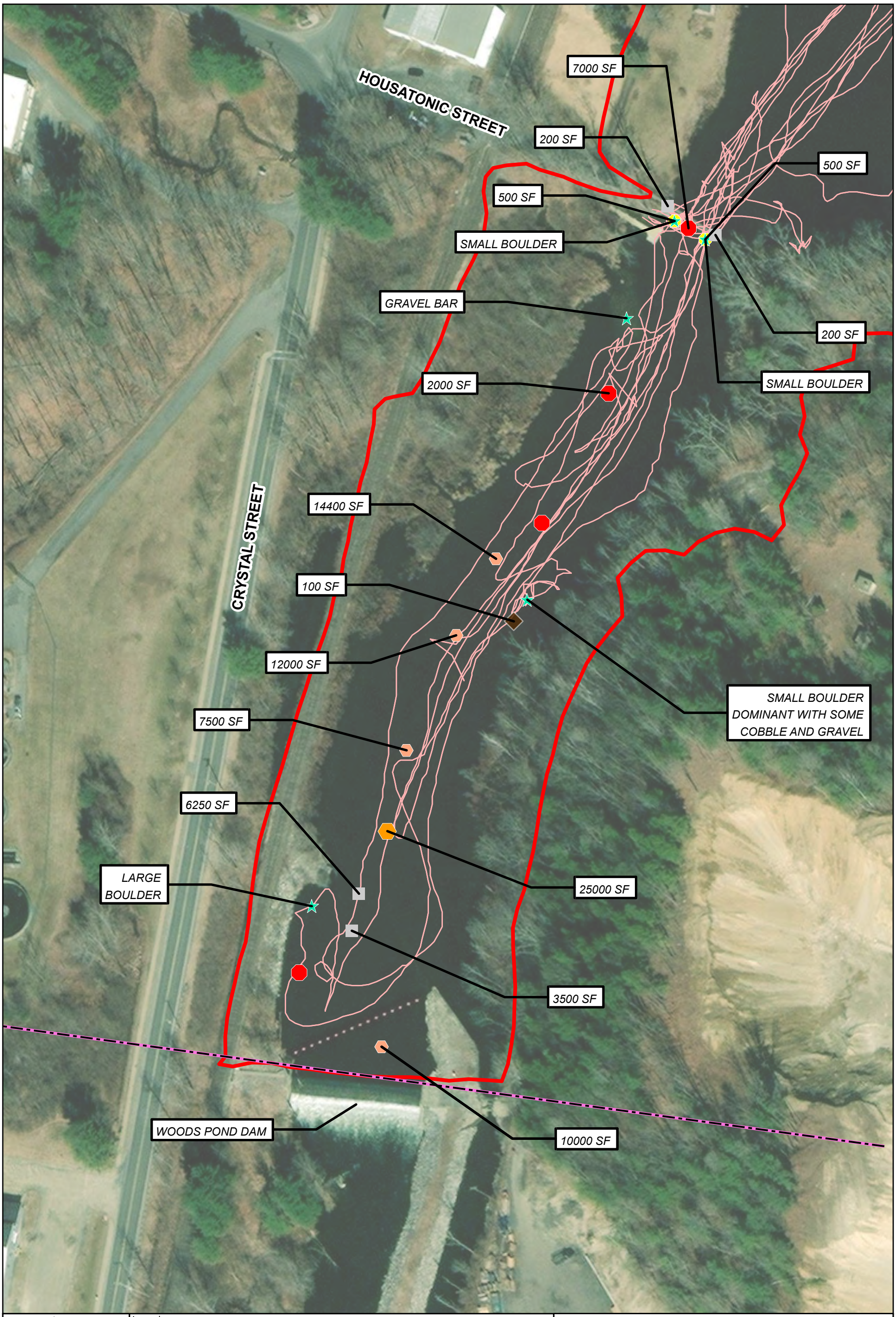
Reach 6 Baseline Restoration Assessment Report

SCALE	DATE	PROJECT NO.
1:4,200	10/25/2024	60736371

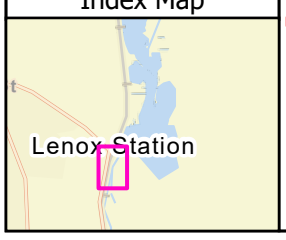
AECOM

Figure 3-1


WILLOW CREEK ROAD
200 SF
50 SF
200 SF
20 SF
100 SF
30 SF
50 SF
20 SF
20 SF
30 SF
30 SF
50 SF
MUCK
500 SF
100 SF
100 SF
50 SF
60 SF
40 SF
50 SF
100 SF
60 SF
MUD
50 SF
50 SF
30 SF
60 SF
70 SF
20 SF
30 SF
400 SF
MUD
Woods Pond
200 SF
100 SF
250 SF
50 SF
100 SF
50 SF
200 SF
500 SF
200 SF
SMALL BOULDER
SMALL BOULDER DOMINANT WITH SOME COBBLE AND GRAVEL
50 SF
100 SF
50 SF
50 SF
50 SF
20 SF
Index Map
Lenox Station
Legend
Reach 6 Survey Limits
Reach Boundaries
Large Boulder Dominant with Small Boulder
Ledge and Concrete
Small Boulder
Ground Truth
Fine Woody Debris (FWD)
Coarse Woody Debris (CWD)
Habitat Survey Track Line
N
0 137.5 275
Feet
Reach 6 / Woods Pond
Side Scan Sonar Habitat Survey
Reach 6 Baseline Restoration
Assessment Report
Housatonic River - Lee and Lenox, MA
SCALE
1:3,300
DATE
2/22/2024
PROJECT NO.
60719336
AECOM
Figure 3-2a
Map Sheet 1 of 2



Index Map



Legend

- Reach 6 Survey Limits
- Reach Boundaries
- Small Boulder Dominant with Large Boulder and Cobble
- Small Boulder Dominant with Cobble
- Large Boulder Dominant with Small Boulder
- Ledge and Concrete
- Small Boulder
- Ground Truth
- Coarse Woody Debris (CWD)
- Habitat Survey Track Line

N

0 62.5 125 Feet

Reach 6 / Woods Pond
Side Scan Sonar Habitat Survey
Reach 6 Baseline Restoration
Assessment Report
Housatonic River - Lee and Lenox, MA

SCALE	DATE	PROJECT NO.
1:1,500	2/22/2024	60719336

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Figure 3-2b

Map Sheet 2 of 2

Legend

- Reach 6 Survey Limits
- PCB Isopleth
- Shallow emergent marsh
- Housatonic River
- Raceway Channel
- Valley Mill Pond

N

0 100 200 400 Feet

Valley Mill Pond

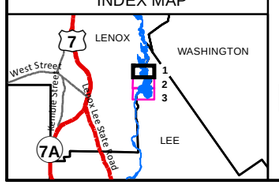
Reach 6 Baseline Restoration Assessment Report

SCALE	DATE	PROJECT NO.
1:2,400	10/25/2024	60736371

AECOM

Figure 3-3

INDEX MAP



- Reach Boundaries
- 1 mg/kg PCB Isopleth
- Potential Vernal Pool
- Reach 6 Survey Limits
- Reed Canary Grass
- Floodplain Habitat Plots

Plots with > 25% Invasive Cover

- Lonicera morrowii
- Lythrum salicaria
- Myosotis scorpioides
- Phalaris arundinacea

- 2 or More Inasive Plants with Cumulative Cover > 25%
- Low-gradient stream (LGS)
- High-gradient stream (HGS)
- Wet meadow (WM)
- Shallow emergent marsh (SEM)
- Shrub swamp (PSS)
- Red maple swamp (RMS)
- Red oak-sugar maple transition forest (RSTF)
- Northern hardwood-hemlock, white pine forest (NHHWP)
- Cultural grasslands (CGL)
- Developed / Disturbed (DVDS)

1 inch = 250 feet

0 125 250 500 Feet

Reach 6 Floodplain Natural Communities

Reach 6 Baseline Restoration Assessment Report

SCALE	DATE	PROJECT NO.
1:3,000	10/25/2024	60736371

AECOM

Figure 4-1a

Map Sheet 1 of 3

INDEX MAP

Reach Boundaries
1 mg/kg PCB Isopleth
Potential Vernal Pool
Reach 6 Survey Limits
Reed Canary Grass
Floodplain Habitat Plots

Plots with > 25% Invasive Cover

Lonicera morrowii
Lythrum salicaria
Myosotis scorpioides
Phalaris arundinacea

2 or More Inasive Plants with Cumulative Cover > 25%
Low-gradient stream (LGS)
High-gradient stream (HGS)
Wet meadow (WM)
Shallow emergent marsh (SEM)
Shrub swamp (PSS)

Red maple swamp (RMS)
Red oak-sugar maple transition forest (RSTF)
Northern hardwood-hemlock, white pine forest (NHHWP)
Cultural grasslands (CGL)
Developed / Disturbed (DVDS)

1 inch = 250 feet

0 125 250 500 Feet

Reach 6 Floodplain Natural Communities

Reach 6 Baseline Restoration Assessment Report

SCALE	DATE	PROJECT NO.
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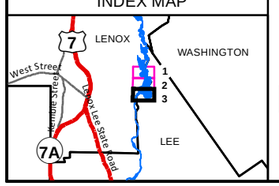
AECOM

Figure 4-1b

Map Sheet 2 of 3

Willow Creek Road
Housatonic Street
Crystal Street
Valley Road
Woodland Road
DVDS
DVDSSEM
SEM
RSTF
FP-44
FP-43
LGS
FP-45
FP-46
NHHWP
PSS
FP-42
FP-47
FP-48
FP-41
FP-40
FP-39
FP-38
FP-37
FP-36
FP-35
RMS
HGS
REACH 6
REACH 7

INDEX MAP



- Reach Boundaries
- 1 mg/kg PCB Isopleth
- Potential Vernal Pool
- Reach 6 Survey Limits
- Reed Canary Grass
- Floodplain Habitat Plots

Plots with > 25% Invasive Cover

- Lonicera morrowii
- Lythrum salicaria
- Myosotis scorpioides
- Phalaris arundinacea

- 2 or More Inasive Plants with Cumulative Cover > 25%
- Low-gradient stream (LGS)
- High-gradient stream (HGS)
- Wet meadow (WM)
- Shallow emergent marsh (SEM)
- Shrub swamp (PSS)

- Red maple swamp (RMS)
- Red oak-sugar maple transition forest (RSTF)
- Northern hardwood-hemlock, white pine forest (NHHWP)
- Cultural grasslands (CGL)
- Developed / Disturbed (DVDS)

1 inch = 250 feet

0 125 250 500 Feet

Reach 6 Floodplain Natural Communities

Reach 6 Baseline Restoration Assessment Report

SCALE	DATE	PROJECT NO.
1:3,000	10/25/2024	60736371

AECOM

Figure 4-1c

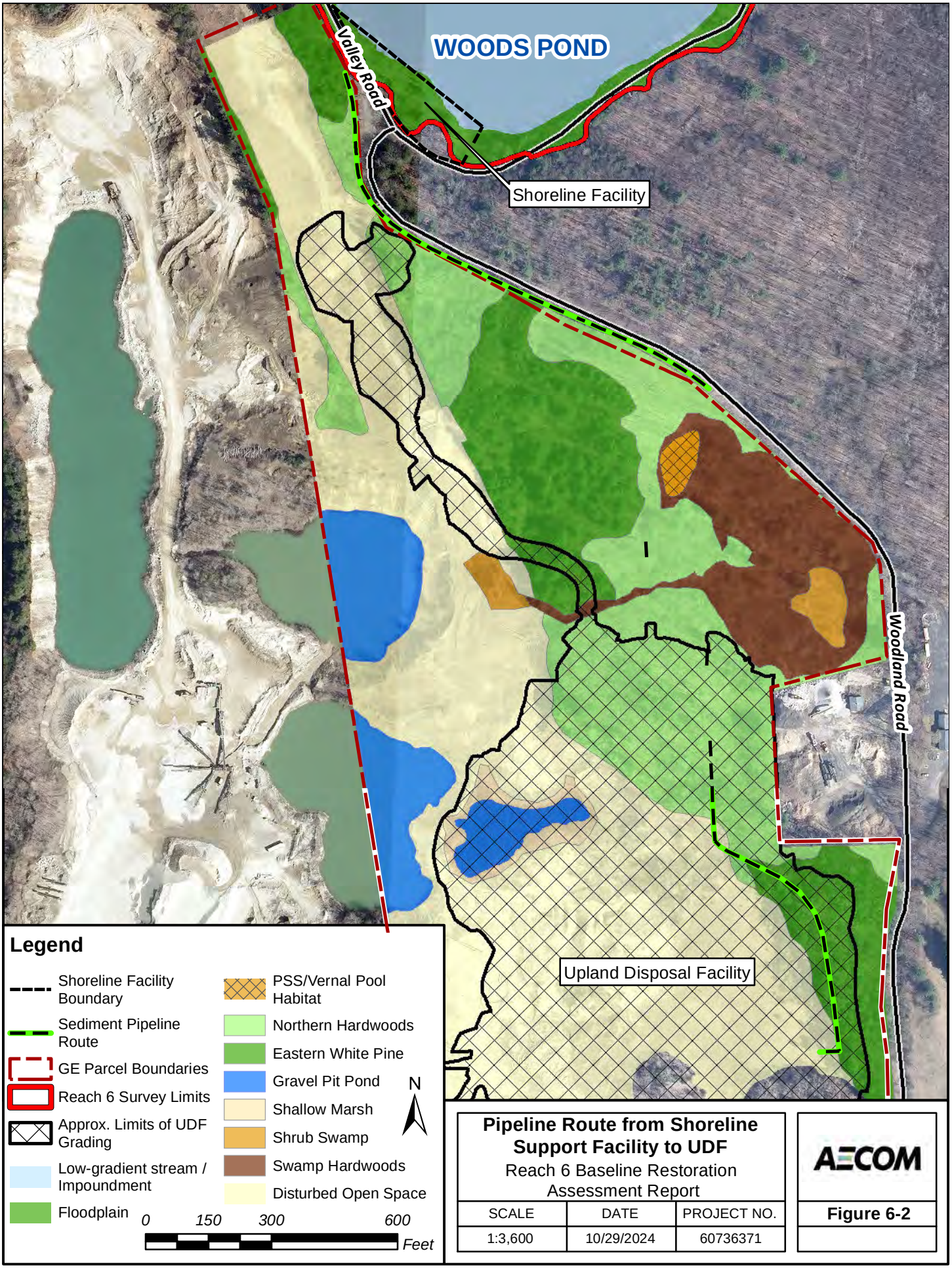
Map Sheet 3 of 3

Woods Pond
Shoreline Support Facility
Reach 6 Baseline Restoration Assessment Report

SCALE	DATE	PROJECT NO.
1:1,200	10/25/2024	60736371

AECOM

Figure 6-1



Pipeline Route from Shoreline Support Facility to UDF

Reach 6 Baseline Restoration Assessment Report

SCALE	DATE	PROJECT NO.
1:3,600	10/29/2024	60736371

AECOM

Figure 6-2

Legend

- Potential Rail Spur
- Loading/Unloading Zone
- Reach 6 Survey Limits

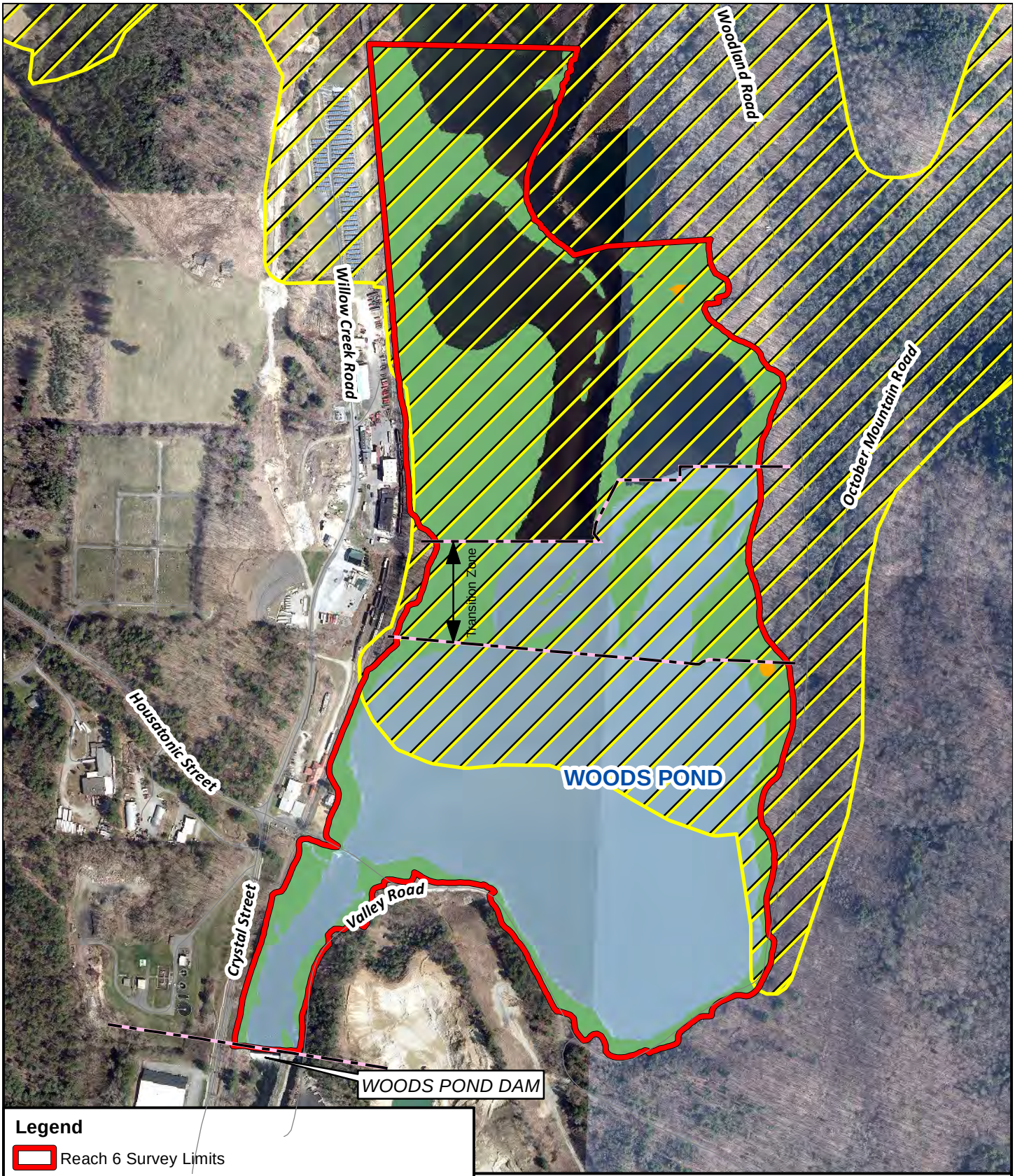
0 75 150 300 Feet

Woods Pond Rail Spur and Loading/Unloading Area
Reach 6 Baseline Restoration Assessment Report

SCALE	DATE	PROJECT NO.
1:1,800	10/25/2024	60736371

AECOM

Figure 6-3



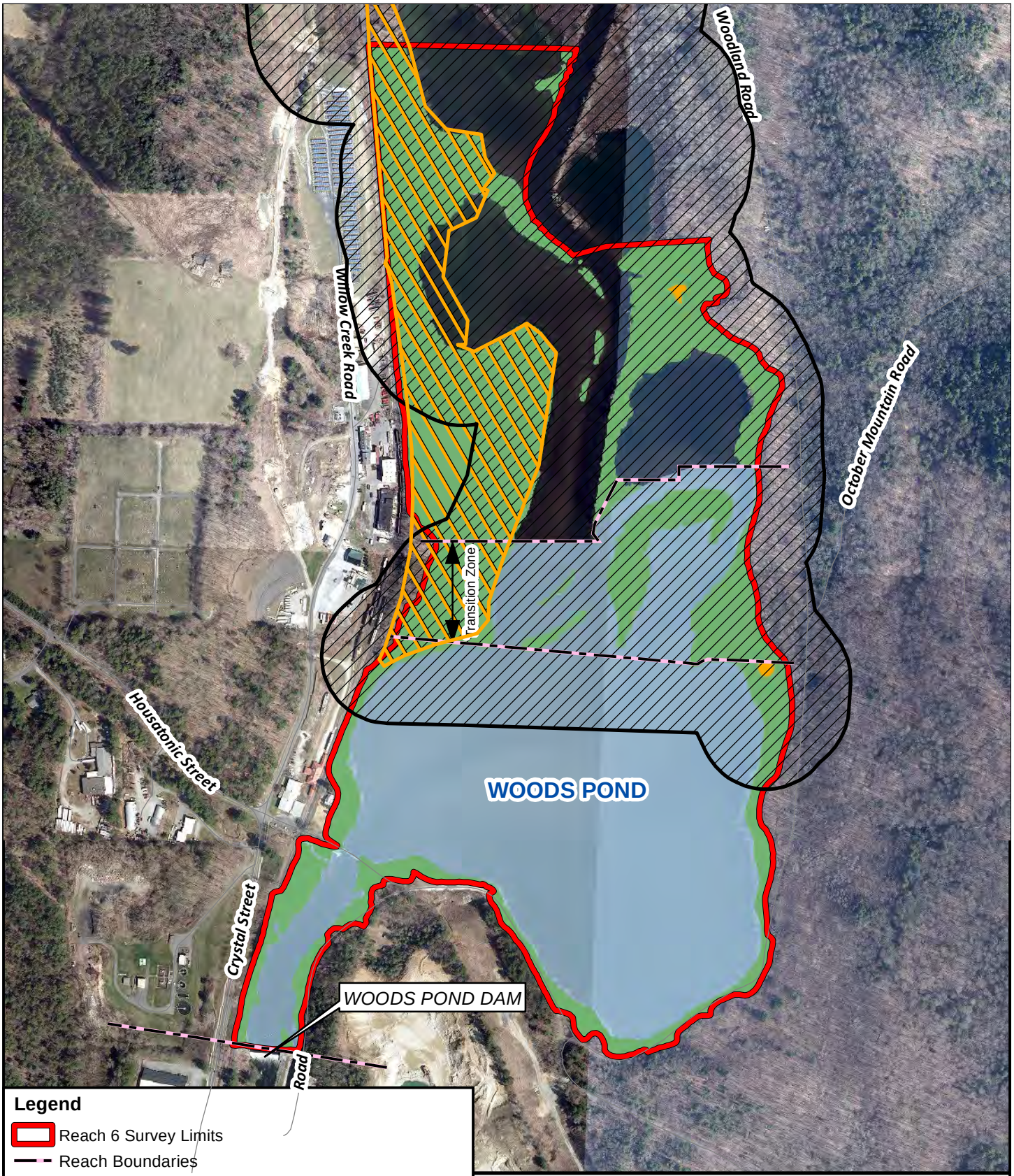
Reach 6 NHESP Priority Habitats

Reach 6 Baseline Restoration Assessment Report

SCALE	DATE	PROJECT NO.
1:7,200	10/25/2024	60736371

AECOM

Figure 7-1



Reach 6 NHESP Core Habitat Areas
Reach 6 Baseline Restoration Assessment Report

SCALE	DATE	PROJECT NO.
1:7,200	10/25/2024	60736371

AECOM

Figure 7-2

Appendix A
Aquatic Habitat/Impoundment Information

A.1 Impoundment Habitat Inventory Form

General Electric Housatonic Rest of River
Form IMP-1: Impoundment Habitat Inventory

I. General Information

Reach 6: Woods Pond
Impoundment Name

Impoundment on Housatonic River, Lee/Lenox, Massachusetts formed by Woods Pond Dam
Location/Physical Description

Detailed inventory on 8/28/24. Also various dates from August 2023 to October 2024
Date(s) of Site Visit(s) and Data Collection

100% overcast in morning, changing to mostly cloudy and breezy. Temperature in low 70s
Weather Conditions During Site Visit

T. Froonjian; T. White; S. Egan; J. Stearns; A. Lynn; S. Maxwell; D. Lowry; M. Lowry — Field Staff Performing Evaluation

9/11/24 – 1017/24 — Date this form was completed

II. Site Description

A. Impoundment Characterization (includes main pond, outlet channel, and transition zone)

Physical Dimensions (ft): Length ~2,300 Width ~1,800 Depth 0.5 to ~16 Area 70 acres

Sediment / Substrate composition: % Sand 10 % Silt 50 %Organic 40 Other _____

Bank stability / Observed erosional conditions: Eastern shoreline of Woods Pond has eroded/slumped banks (likely due to wind fetch). Erosion also observed along eastern boundary of outlet channel just north of the dam.

B. Bordering Habitat Types

Wetland

- ☐ Transitional floodplain forest
- ☐ High terrace floodplain forest
- ☒ Red maple swamp
- ☐ Vernal pool
- ☐ Black ash-red maple-tamarack calcareous seepage swamp
- ☒ Deep emergent marsh
- ☒ Shallow emergent marsh
- ☒ Shrub swamp
- ☒ Wet meadow
- ☐ Other _____

Upland

- ☐ Northern Hardwoods-Hemlock-White Pine Forest
- ☐ Rich mesic forest
- ☒ Red Oak-Sugar Maple Transition Forest
- ☐ Agricultural fields
- ☐ Cultural grassland
- ☒ Successional northern hardwoods
- ☐ Spruce-fir-northern hardwood forest
- ☒ Developed/disturbed cover types
- ☐ Other _____

Notes:

C. Hydrology

Stream gradient adjacent to Impoundment: ☒ Low Gradient ☐ Mid-Gradient ☐ High-Gradient

Impoundment Hydrology

☒ Dam Controlled (describe dam): Woods Pond dam at boundary between Reach 6 and Reach 7

Describe any other inlets, outlets, and other surface water inputs to Impoundment: High gradient stream flow from hillside occurs along east side. Discharge from Lenox WWTP along west side of outlet channel.

Water level fluctuation: Small fluctuations during frequent smaller storms due to dam control. 7 ft rise in 10-yr storm.

Field-Derived Evidence of Hydrologic Conditions

☒ Clear natural line impressed on bank	☒ Changes in character of soil
☒ Bed and banks	☐ Water staining
☒ Shelving	☒ Vegetation matted down, bent or absent
☒ Wrack lines (litter and debris)	☒ Changes in plant community
☒ Scour and/or Deposition	☐ Destruction of terrestrial vegetation
☐ Line of mud or silt on tree trunks/vegetation	☒ Debris stuck on overhanging tree limbs

☐ Other

D. Inventory of Aquatic Plant Community

% Cover:

90%	70% (15% submerged)	5%
Overall Aquatic Vegetation	Floating -Leaved Cover	Emergent Cover

Plant Lists (species that comprise 10% or more of the vegetative cover in each strata, or any amount of an invasive plant species; "*" designates a dominant plant species for the strata):

Strata	Plant Species	Strata	Plant Species
RV	*Trapa natans	FV	Lemna minor
RV	Myriophyllum spicatum	FV	Spirodela polyrhiza
RV	Elodea canadensis		
RV	*Ceratophyllum demursum		
RV	Valisneria americana		
FV	*Wolffia sp.		

Strata: AL=Algal, AM=Aquatic Moss, RV=Rooted Vascular, FV=Floating Vascular, PE=Persistent Emergent, NE=Non-persistent Emergent

III. Important Habitat Features

Wildlife Food

Important aquatic food plants (smartweeds, pondweeds, wild rice, bulrush, wild celery)

☒ Abundant ☐ Present ☐ Absent ☐ Not Applicable

Cover/Perches/Basking/Denning/Nesting Habitat

Trees (live) > 30" DBH adjacent to impoundment

☐ Abundant ☒ Present ☐ Absent ☐ Not Applicable

Tree cavities in trunks or limbs in or adjacent to impoundment

☐ Abundant ☒ Present ☐ Absent ☐ Not Applicable

Small mammal burrows on banks of impoundment

☐ Abundant ☒ Present ☐ Absent ☐ Not Applicable

Dense herbaceous cover on banks of impoundment (voles, small mammals, amphibians & reptiles)

☒ Abundant ☐ Present ☐ Absent ☐ Not Applicable

Large woody debris in contact with the water (fish & turtles)

☒ Abundant ☐ Present ☐ Absent ☐ Not Applicable

Rocks, crevices, logs, tree roots or hummocks under water's surface (fish, turtles, snakes, frogs)

☒ Abundant ☐ Present ☐ Absent ☐ Not Applicable

Rocks, crevices, fallen logs, overhanging branches or hummocks at, or within 1 m above the water's surface (fish, turtles, snakes, frogs, wading birds, wood duck, mink, raccoon)

☐ Abundant ☒ Present ☐ Absent ☐ Not Applicable

Live or dead tall standing vegetation overhanging water or offering good visibility of open water (e.g., bald eagle, osprey, kingfisher, flycatchers, cedar waxwings)

☒ Abundant ☐ Present ☐ Absent ☐ Not Applicable

Other Important Habitat Characteristics

Flat rocks and logs on banks or within exposed portions of the impoundment (cover and basking for herpetofauna)

☒ Abundant ☐ Present ☐ Absent ☐ Not Applicable

Underwater banks of fine silt and/or clay (beaver, muskrat, otter)

☐ Abundant ☒ Present ☐ Absent ☐ Not Applicable

Undercut or overhanging banks (fish, small mammals, mink, weasels, turtles)

☒ Abundant ☐ Present ☐ Absent ☐ Not Applicable

Mud flats

☐ Abundant ☐ Present ☒ Absent ☐ Not Applicable

Wildlife Dens/Nests (if observed)

Bank swallow colony(ies) (adjacent to impoundment)

☐ Abundant ☐ Present ☐ Absent ☒ Not Applicable (not in season)

Turtle nesting sites

☐ Abundant ☐ Present ☐ Absent ☒ Not Applicable

Nest(s) present of ☐ Bald Eagle ☐ Osprey ☐ Great Blue Heron

Den(s) present of ☐ Otter ☐ Mink ☐ Beaver

Other nests or dens (identify species): muskrat lodge in the northwestern part of the pond.

Emergent Wetlands within Impoundment (if Applicable)

Emergent wetland vegetation at least seasonally flooded during the growing season (American bittern, wood duck, green heron, black-crowned night heron, rails [sora, king, Virginia], moorhen, coot, etc.)

Flooded > 5 cm ☒ Present ☐ Absent

Flooded > 25 cm (pied-billed grebe) ☒ Present ☐ Absent

IV. Connectivity with Adjoining Natural Habitats

☐ No direct connections to adjacent areas of wildlife habitat (no connectivity function)

☐ Impoundment has a limited number of connectors to adjacent areas of habitat (somewhat important for connectivity function)

☒ Impoundment is embedded in a large area of natural habitat with unimpeded connection between Impoundment and other habitats (high connectivity function)

V. Rare Species and MNHESP Core Area Habitat Designation

☒ Core Area 1 ☒ Core Area 2 ☐ Core Area 3 ☒ Core Area 4

☒ Federally listed threatened or endangered species habitat (including species with known overlapping habitat):Northern long-eared bat. Tricolored bat (proposed federal listing)

☐ State-listed species habitat (including species with known overlapping Priority Habitat):

American bittern, bald eagle, bur oak, wapato, mustard white, common gallinule

Rare species direct observations during current field surveys (list): bald eagle; bur oak

VI. Incidental Direct Wildlife Observations

American crow	Bald eagle
Great Blue Heron	Osprey
Great Egret	Wood duck
Mallard	
American Goldfinch	
Blue Jay	
Spotted Sandpiper	

VII. Habitat Degradation (identify specific location within impoundment if applicable)

☐ Evidence of significant levels of dumping

☐ Evidence of significant erosion or sedimentation problems

☒ Presence of invasive plants* (e.g., purple loosestrife, *Phragmites*, Eurasian water-milfoil); identify and estimate approximate percent coverage of invasive plants; see BRA Report.

☒ Evidence of other human disturbance; describe: dam construction; foot trails

*Infestation of water chestnut (*Trapa natans*) has smothered most of the pond. Submerged invasive plants include curly pondweed (*Potamogeton crispus*) and Eurasian milfoil (*Myriophyllum spicatum*).

VIII. Restoration Opportunities

☒ Presence of potential restoration resources (e.g., boulders, large downed trees or woody debris, plant propagation source material). Identify specific items: Many logs and wind-thrown trees in adjacent habitats.

☐ Other restoration opportunities: Collect but oak acorns for propagation; collect LWD in areas to be dredged.

Notes:

A.2 Side-Scan Sonar Methods and Results

Appendix A-2: Fall 2023 R6 Side Scan Sonar Results

Side Scan Sonar Methods and Approach

Side scan sonar surveys of the habitat (substrate and woody debris) in the riverine and impoundment areas associated with the Housatonic River and Woods Pond was performed to quantify and map baseline habitat conditions. The objective is to identify an estimate the total two-dimensional area of habitat types in submerged environments (below the river bank). Surveys were conducted in Reach 6 from October 31 to November 2, 2023.

In areas where the water is too deep and murky to efficiently observe the underwater habitat components of the study area using traditional methods (e.g., direct observations through line of sight, diving, or taking grab samples) a shallow water side scan survey with a fixed transducer may be deployed.

Surveys were performed from a small jon boat during fall to avoid navigation and sonar conflicts with dense aquatic vegetation in the pond (i.e., water chestnut). Two modes of side scan survey were used to document habitat in these areas. The first (traditional) method requires the boat to move at a constant speed and direction as high frequency side-looking sonar transducers scan the bottom and produce an image from the return signals that represent the physical position and coarseness of the substrate. This technique is effective in areas with relatively straight transects and obstruction-free environments. Another side scan method uses a rotating transducer that allows the transducer to scan the substrate without requiring constant boat navigation to obtain images of the substrate. It also allows inspection of substrate from multiple angles. Both traditional and rotating transducer side-scan sonar methods were employed.

The advanced image processing and mapping capabilities in the sonar unit produce an image of the side scan output for inspection and documentation. Habitat points with associated areal coverage were recorded on field maps, then digitized into GIS for display. The following habitat types were differentiated and identified: rock (gravel, cobble, boulder, ledge), wood (large, fine), debris, and manmade structures (e.g., rip rap, concrete). Silt/mud was considered the default substrate/habitat, and sand was differentiated where possible. Each observed habitat type with side-scan sonar was verified at 3 locations in the field using an underwater camera, direct visual observation with a view tube or through the water with polarized glasses, and/or a metal pole that was used to contact the substrate.

AECOM

IMAGE LOG

Image No. 1

Description: This is an image of the channel upstream from the dam showing what appears to be some suspended booms. There is also some cobble and gravel bottom in the lower right center of the image. There are some hard returns as well as submerged aquatic vegetation (SAV) along the right shore.

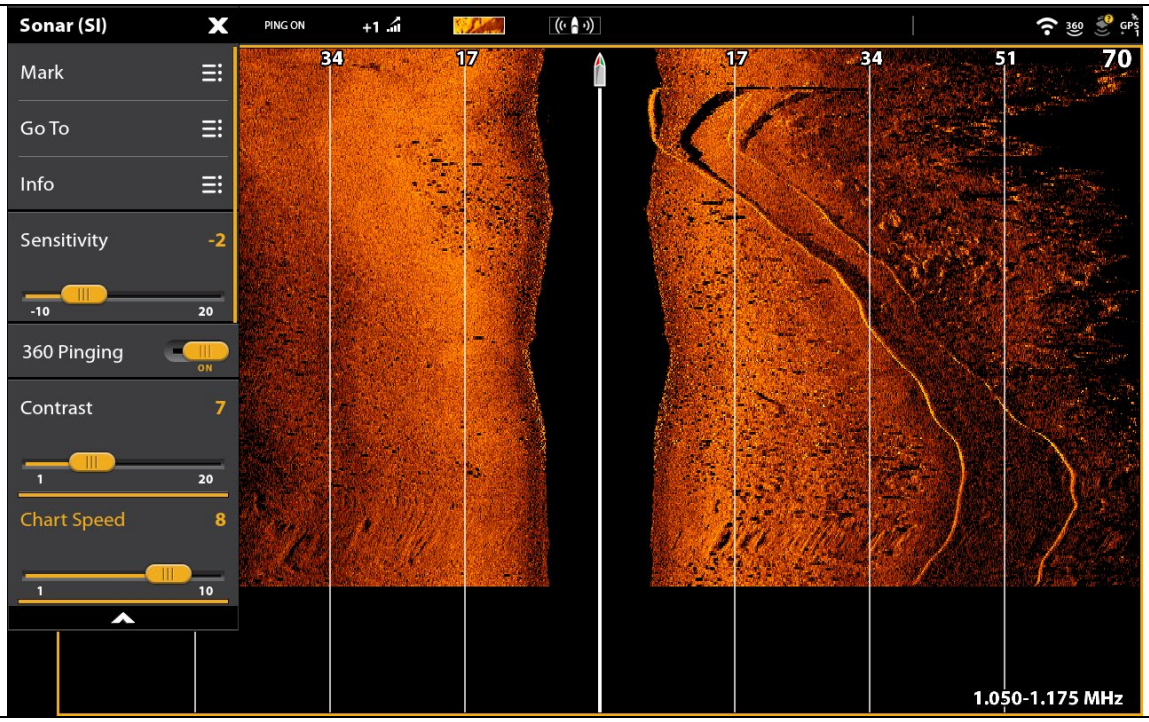
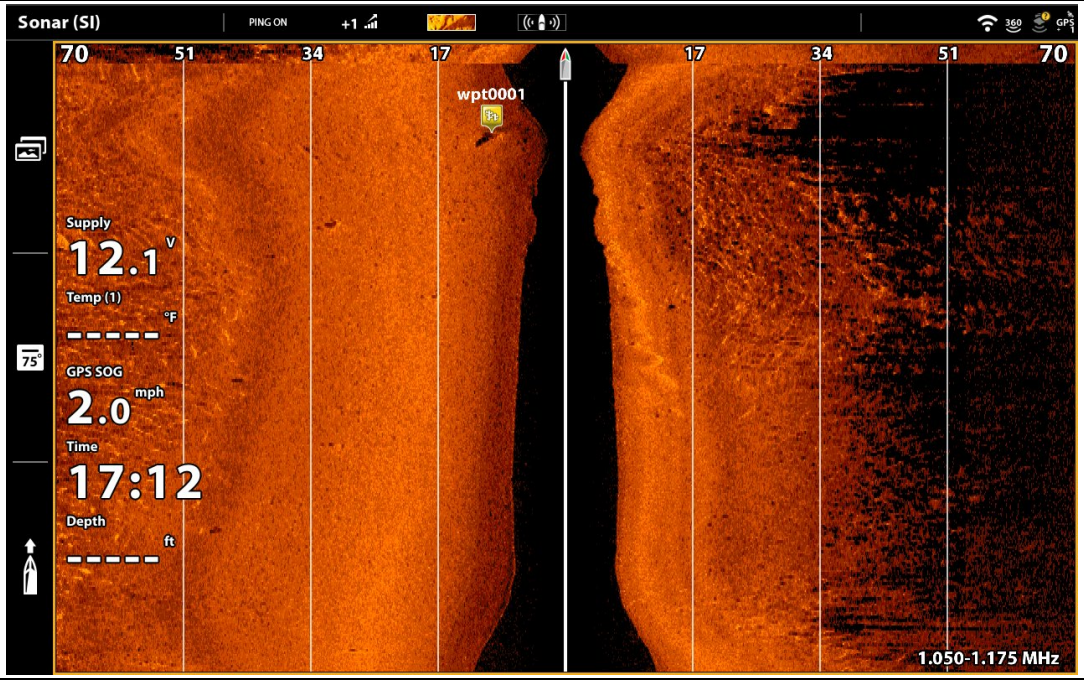


Image No. 2

Description: This is an image of low SAV in 3.4 feet of water that is in the process of senescence. Also, a point with woody debris is marked.



AECOM

IMAGE LOG

Image No. 3

Description: This is an image of SAV low to the bottom in 3.4 feet of water that is in the process of senescence.

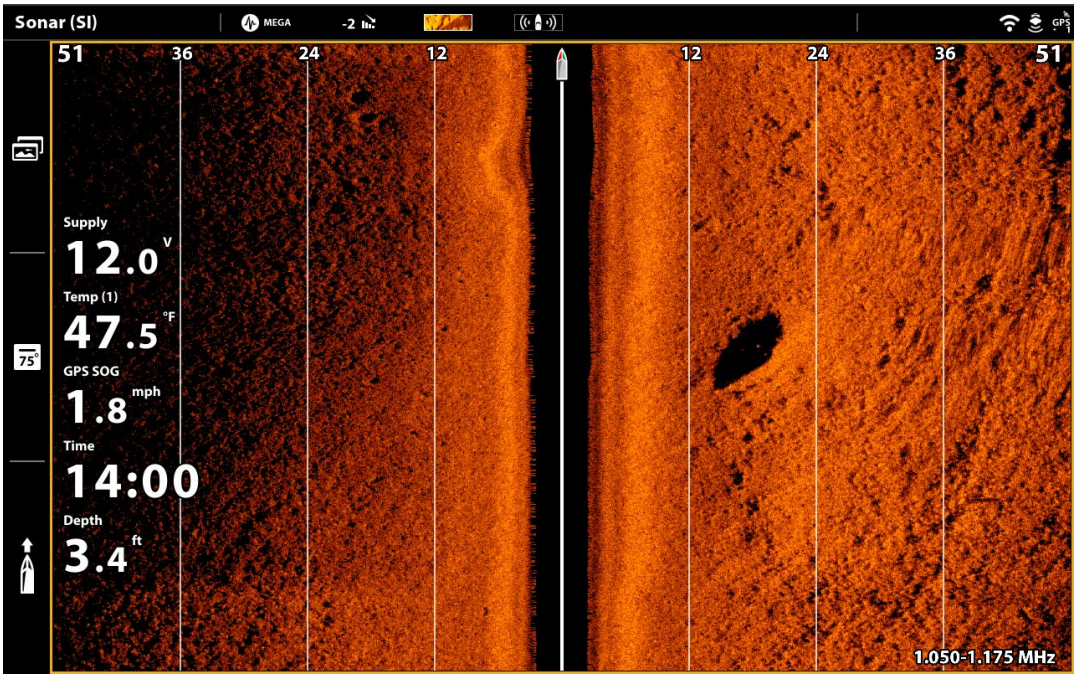
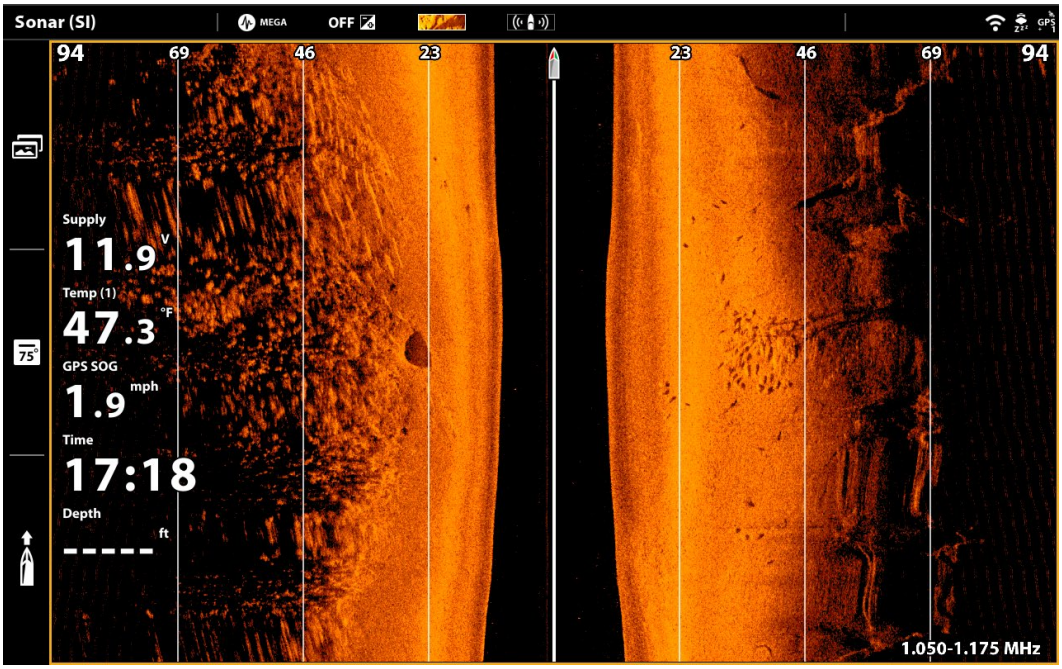


Image No. 4

Description: This image is likely a school of Carp about 2500 feet upstream of the bridge, in the channel alongside the dense weed bed. The vessel was proceeding south.



AECOM

AECOM

IMAGE LOG

Image No. 5

Description: This is an image of SAV habitats in the channel on the Northeast end of the pond around the islands.

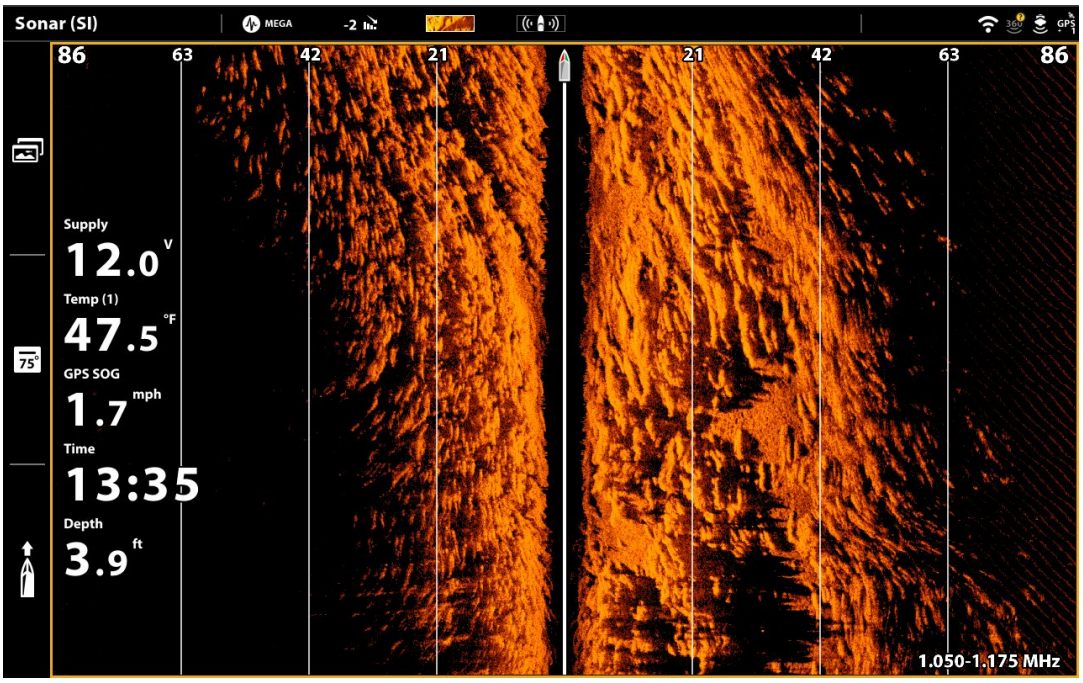
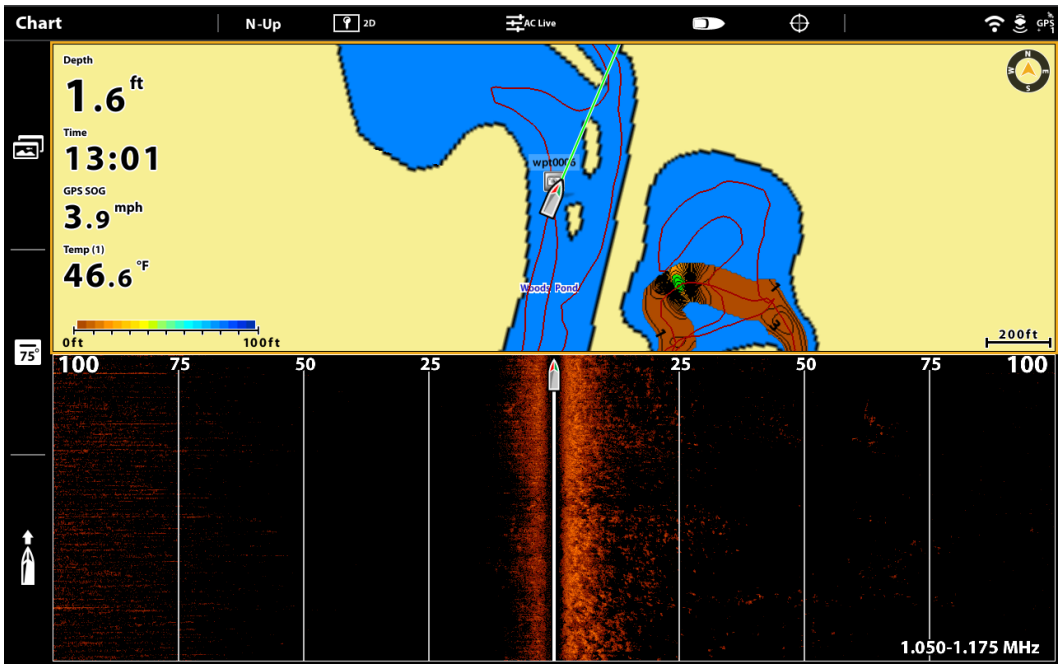


Image No. 6

Description: This image is the SAV habitats from Image No. 5 with its location shown in map view.



AECOM

IMAGE LOG

Image No. 7

Description: This image covers approximately 240 feet along the boat track line, starting at the safety rope for the dam (bottom of image) and moving upstream. An old dam is in the center of the photo. This is upstream of the current dam. There is ledge downstream of (below) the old dam and boulder and cobble piled upstream. The hard bright lines on either side of the old dam are vertical concrete walls. Image is slightly distorted due to small turns by the boat.

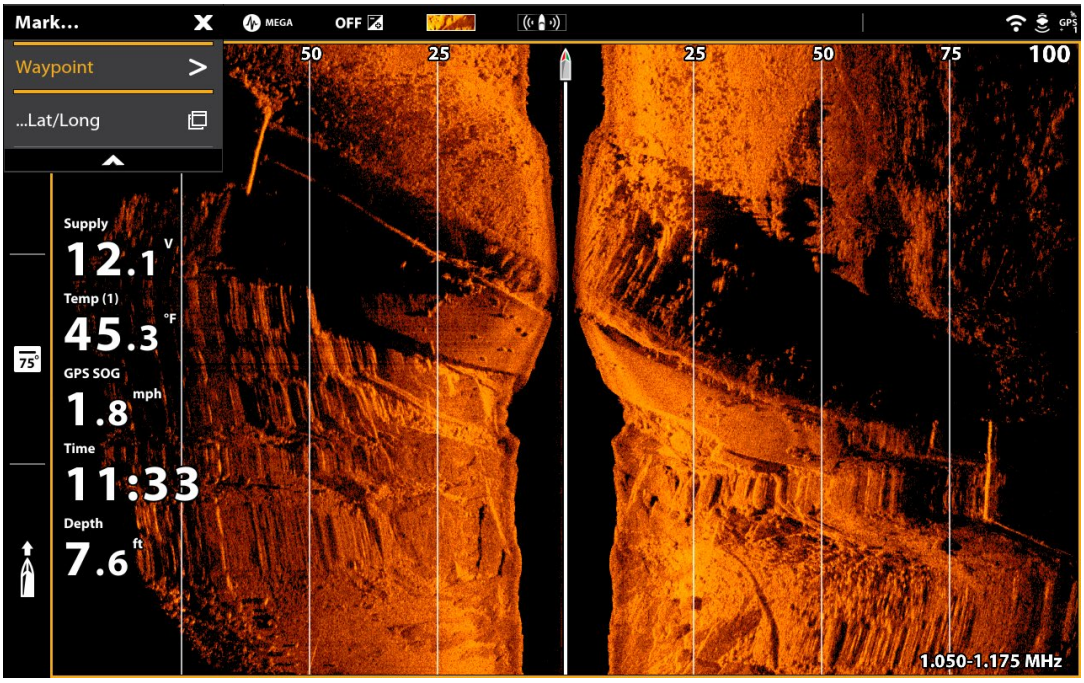
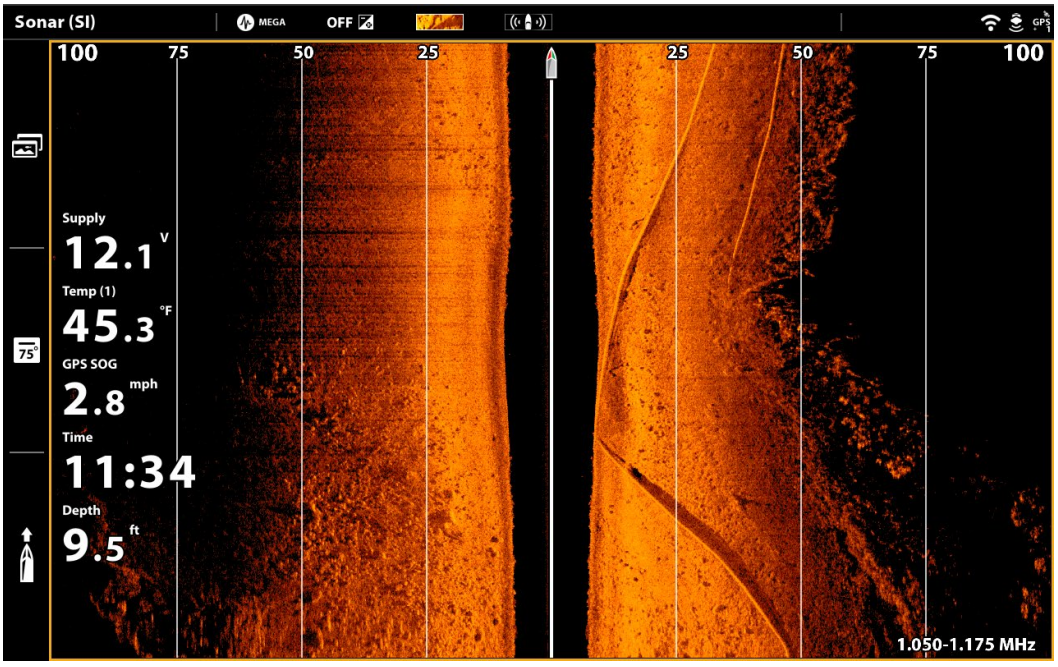


Image No. 8

Description: This image covers the next 240 feet upstream of Image No. 7. There are what appears to be submerged booms (assumption) with boulder and cobble in the middle.



AECOM

IMAGE LOG

Image No. 9

Description: This image covers the 240 feet upstream of Image No. 8. There continues to be submerged booms (assumption) with boulder and cobble in the middle.

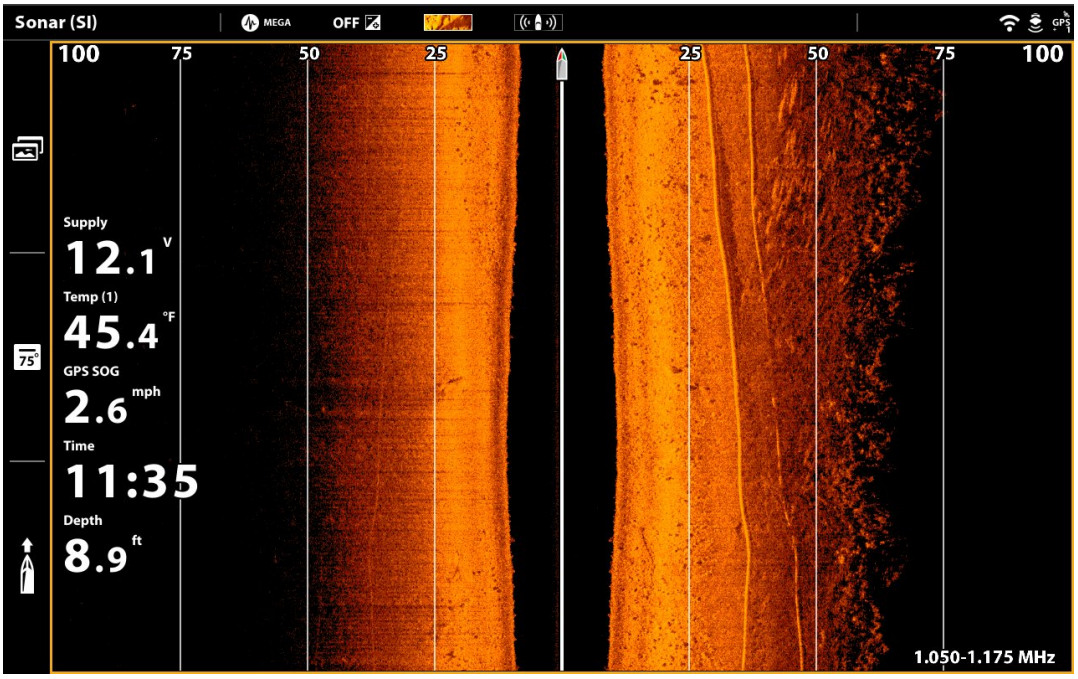
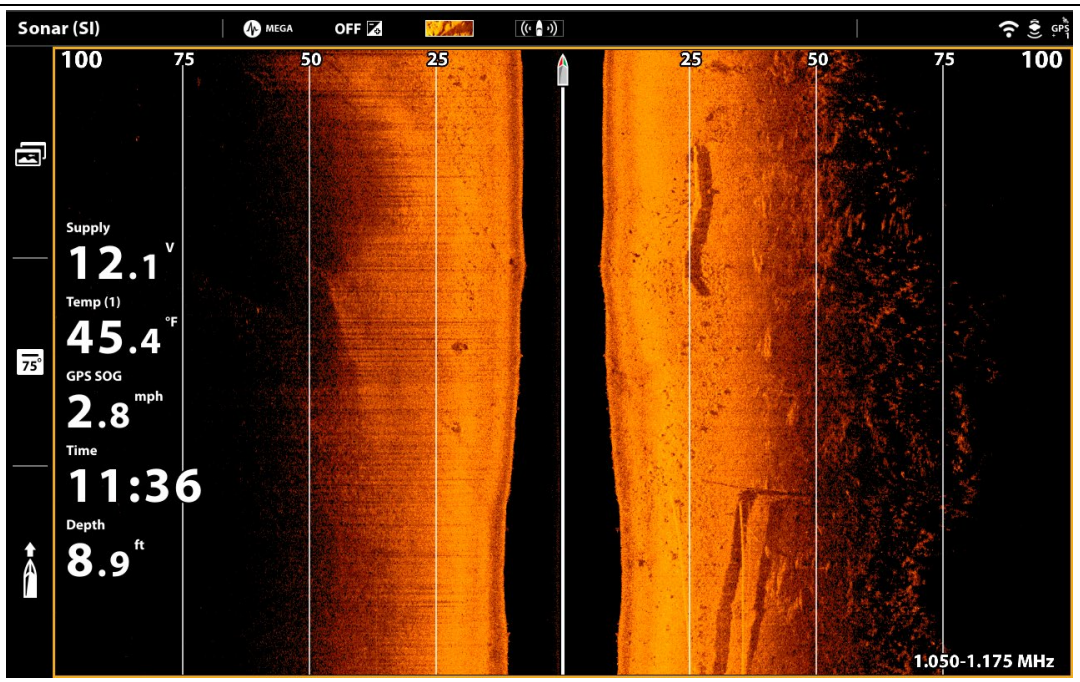


Image No. 10

Description: This image covers the 240 feet upstream of Image No. 9. There are what appears to be submerged booms (assumption) with boulder and cobble in the middle. Logs laying parallel to the channel can be seen on the right side.



AECOM

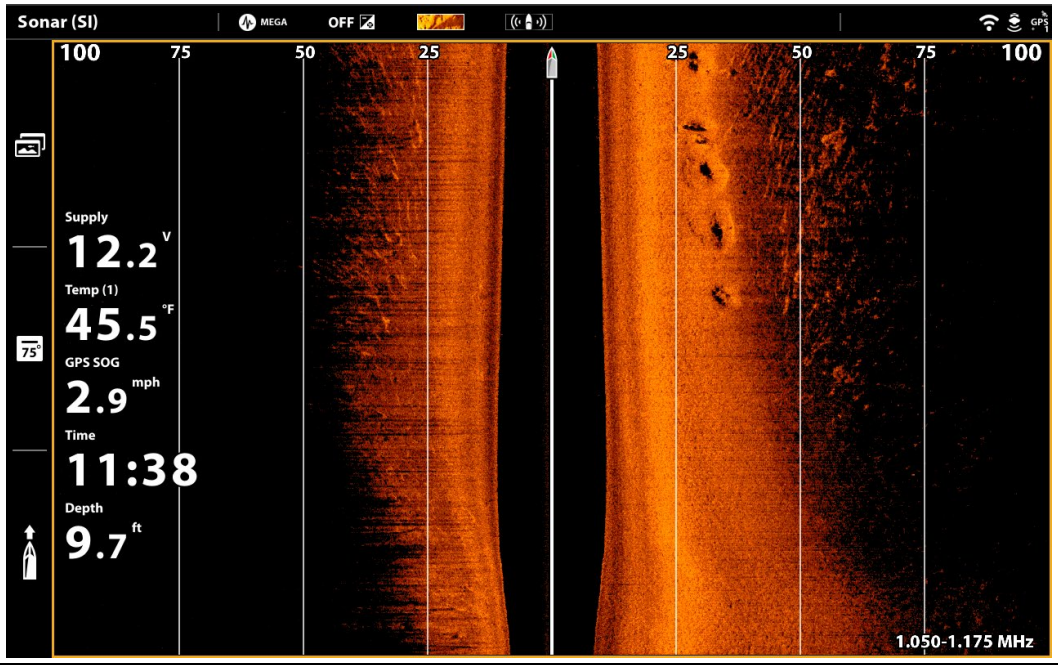
IMAGE LOG

Image No. 11

Description: This image covers the 240 feet upstream of Image No. 10 at the mouth of the outlet channel. There are structures associated with the foot bridge as well as riprap, boulder, and vertical concrete walls at the bottom of the image. There is a gravel patch (the brighter area) on the bottom left of the image next to the water column. There are SAV beds along both edges upstream of the bridge and the default habitat in the middle.

Image No. 12

Description: This image covers the 240 feet upstream of Image No. 11 in the channel upstream of the outlet channel. The dark spots with a crater appearance on the right side of the image are likely carp wallow holes or nests.



A.3 Aquatic Macrophyte Survey Results

Appendix A-3: Woods Pond Aquatic Macrophyte Survey Results

Date	Plot ID*	Layer	Species	% Cover (Invasives)
8/28/24	VS-01	H	*Trapa natans*	96-100
		H	*Spirodela polyrhiza*	
Depth: 1' 4" - No Secchi reading				
8/28/24	VS-02	H	*Trapa natans*	96-100
		H	*Spirodela polyrhiza*	
Depth 6" - No Secchi Reading				
8/28/24	VS-03	H	*Trapa natans*	76-95
		H	*Spirodela polyrhiza*	
		H	*Wolffia columbiana*	
		H	*Potamogeton epihydrus*	
		H	*Ceratophyllum demursum*	
Depth: 8' - Secchi Disk at 4' 7"				
8/28/24	VS-04	H	*Valisneria americana*	
		H	*Spirodela polyrhiza*	
		H	*Elodea canadensis*	
		H	*Ceratophyllum demursum*	
		H	*Potamogeton robbinsii*	
Depth 1' 6" - No Secchi reading				
8/28/24	VS-05	H	*Wolffia columbiana*	
		H	*Ceratophyllum demursum*	
		H	*Elodea canadensis*	
		H	*Valisneria americana*	
		H	*Myriophyllum spicatum*	26-75
		H	*Potamogeton natans*	
Depth 1' 6" - No Secchi reading				
Notes				

Date	Plot ID	Layer	Species	% Cover (Invasives)
8/28/24	VS-06	H	*Wolffia columbiana*	
Depth: 9' - Secchi Disk at 6' 7"				
8/28/24	VS-07	H	*Spirodela poluyrhiza*	
		H	*Trapa natans*	26-50
		H	*Valisneria americana*	
		H	*Myriophyllum spicatum*	26-50
		H	*Elodea canadensis*	
		H	*Potamogeton* sp.	
Depth 1' 6" - No Secchi reading				
8/28/24	VS-08	H	*Myriophyllum spicatum*	16-25
Depth 2' - No Secchi reading				
8/28/24	VS-09	H	*Trapa natans*	26-50
		H	*Wolffia columbiana*	
		H	*Ceratophyllum demursum*	16-25
Depth 6" - No Secchi reading				
8/28/24	VS-10	H	*Trapa natans*	76-95
		H	*Wolffia columbiana*	
Depth 1' 1" - No Secchi reading				
8/28/24	VS-11	H	*Trapa natans*	76-95
			Wolffia columbiana	
Depth 7" - Secchi Disk at 1" (turbid)				
8/28/24	VS-12	H	*Trapa natans*	76-95
			Wolffia columbiana	
Depth 1' 4" - No Secchi				
Notes				

*See Figure 3-1 for Plot Locations

Appendix A-3: Woods Pond Aquatic Macrophyte Survey Results (cont.)

Date	Plot ID*	Layer	Species	% Cover (Invasives)
8/28/24	VS-13	H	*Trapa natans*	51-75
		H	*Wolffia columbiana*	
		H	*Potamogeton crispus*	6-15
		H	*Ceratophyllum demursum*	
		H	*Elodea canadensis*	
Depth: 1' 2" - No Secchi reading				
8/28/24	VS-14	H	*Trapa natans*	76-95
		H	*Wolffia columbiana*	
Depth: 6' 8" - Secchi Disk at 6'				
8/28/24	VS-15	H	*Trapa natans*	76-95
		H	*Wolffia columbiana*	
		H	*Lemna minor*	
Depth: 4' 11" - Secchi Disk at 3' 6"				
8/28/24	VS-16	H	*Trapa natans*	76-95
		H	*Wolffia columbiana*	
Depth: 3' - No Secchi reading				
8/28/24	VS-17	H	*Trapa natans*	76-95
		H	*Wolffia columbiana*	
Depth: 3' 6" - No Secchi reading				
8/28/24	SD-1		*No vegetation*	
Depth: 16' - Secchi Disk at 4' 11"				

Date	Plot ID	Layer	Species	% Cover (Invasives)

Notes

Notes

*See Figure 3-1 for Plot Locations

A.4 Photographs of Aquatic Habitats in Reach 6

AECOM

PHOTOGRAPHIC LOG

Client Name: General Electric Company, Pittsfield, MA	**Site Location:** Housatonic River Reach 6 BRA	**Project No.** 60736371

Photo No. 1	**Date:** 6/29/2023	**Photo No. 2**	**Date:** 9/12/2024
Description: View north-northeast of Wood Pond from the footbridge.		**Description:** View south of outlet channel from the footbridge	

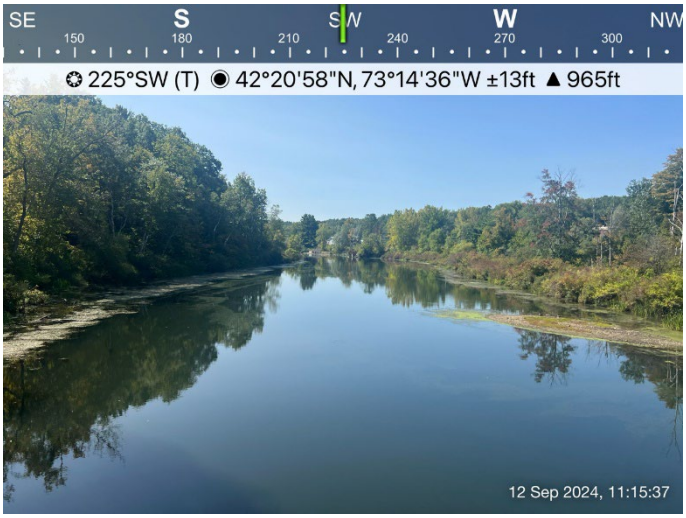
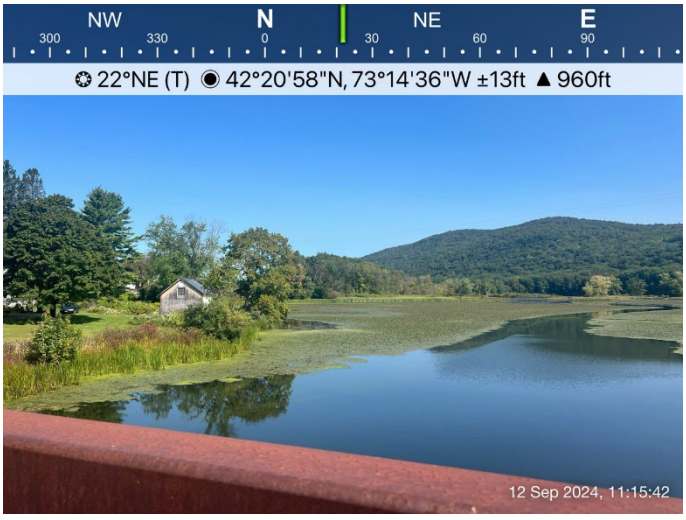
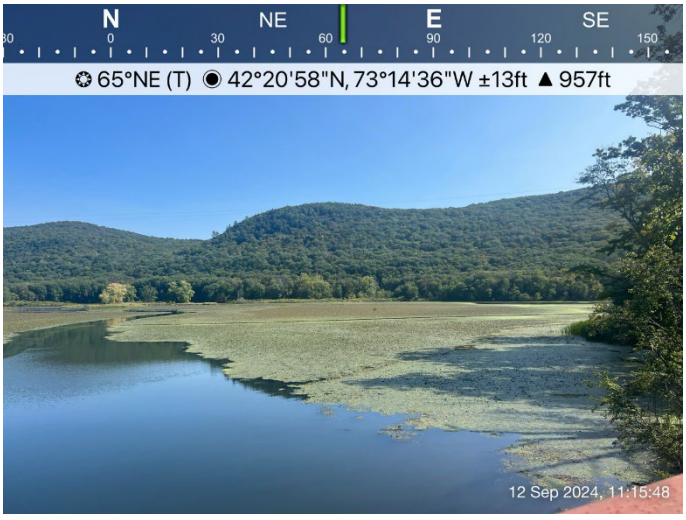


Photo No. 3	**Date:** 9/12/2024	**Photo No. 4**	**Date:** 9/12/2024
Description: View north of Woods Pond and Housatonic River channel (open water areas) from the footbridge.		**Description:** View northeast of Woods Pond and Housatonic River channel (open water areas) from the footbridge.	



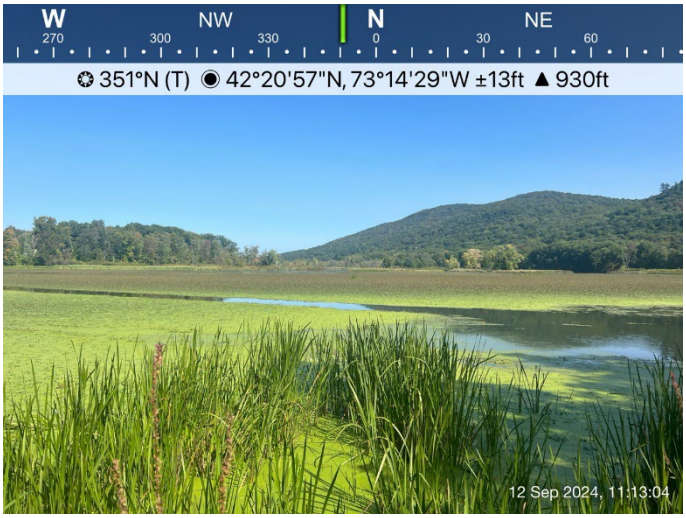


AECOM

PHOTOGRAPHIC LOG

Client Name: General Electric Company, Pittsfield, MA	**Site Location:** Housatonic River Reach 6 BRA	**Project No.** 60736371

Photo No. 5	**Date:** 9/12/2024	**Photo No. 6**	**Date:** 9/12/2024
Description: View north of Woods Pond from the southern shoreline (near the powerlines).		**Description:** View east, of Woods Pond from shoreline just north of the Shoreline Support Facility	



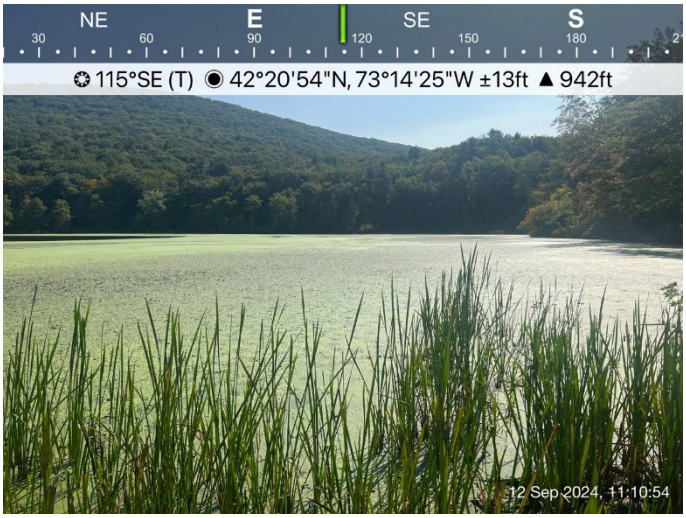
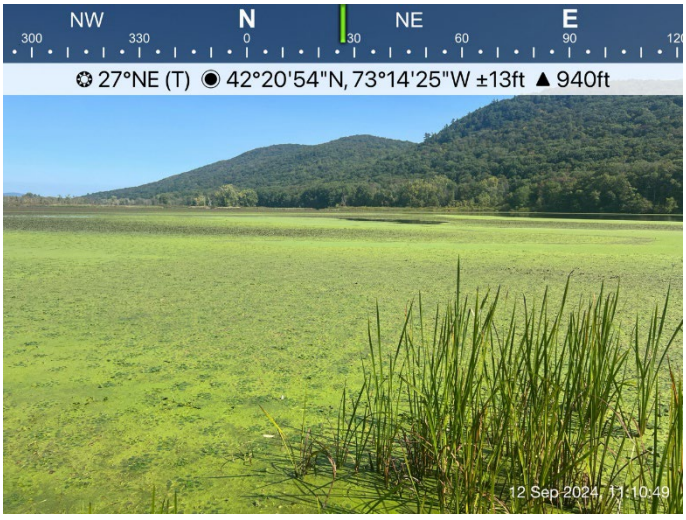


Photo No. 7	**Date:** 9/12/2024	**Photo No. 8**	**Date:** 4/20/2023
Description: View north of Woods Pond from shoreline just north of the Shoreline Support Facility		**Description:** View north from same location as Photos 6 and 7.	



AECOM

PHOTOGRAPHIC LOG

Client Name: General Electric Company, Pittsfield, MA	**Site Location:** Housatonic River Reach 6 BRA	**Project No.** 60736371

Photo No. 9	**Date:** 9/12/2024	**Photo No. 10**	**Date:** 4/20/2023
Description: View north-northwest of Woods Pond from southeastern corner of the pond.		**Description:** 1000's of water chestnuts along the shoreline.	

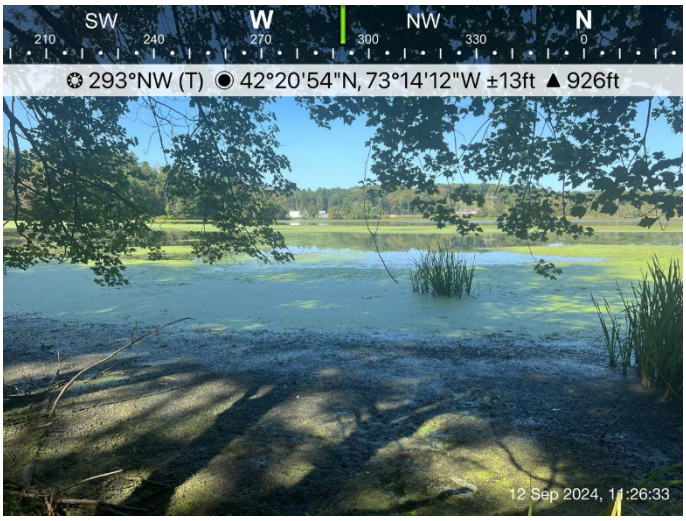
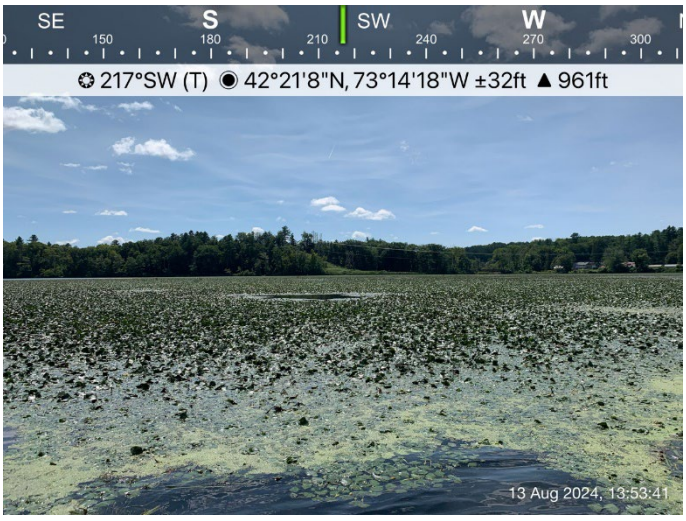


Photo No. 11	**Date:** 8/13/2024	**Photo No. 12**	**Date:** 4/20/2023
Description: View looking southwest towards the footbridge, northeast corner of Woods Pond		**Description:** View west of northern island in the transition zone.	



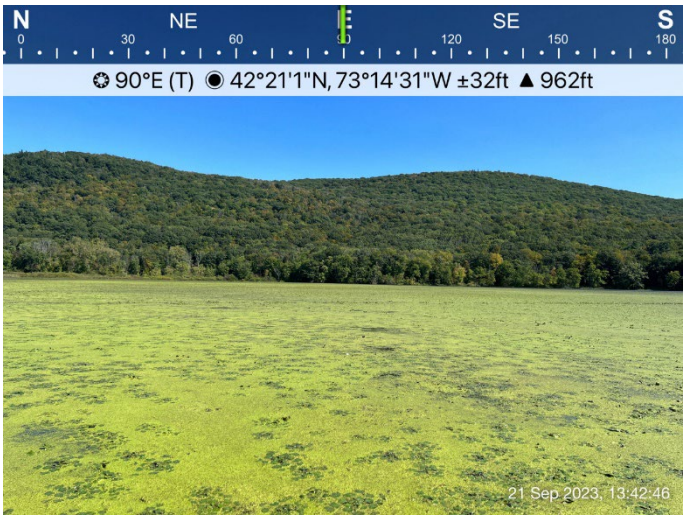
AECOM

PHOTOGRAPHIC LOG

Client Name: General Electric Company, Pittsfield, MA	**Site Location:** Housatonic River Reach 6 BRA	**Project No.** 60736371

Photo No. 13	**Date:** 4/27/2023	**Photo No. 14**	**Date:** 4/27/2023
Description: View south looking at the Housatonic River through the transition zone.		View north looking at the Housatonic River through the transition zone along the western river shoreline.	

Photo No. 15	**Date:** 4/27/2023	**Photo No. 16**	**Date:** 49/21/2023
Description: View looking east across Woods Pond at the transition line between Woods Pond proper and the Transition Zone		**Description:** View east of Woods Pond with dense cover of water chestnut and duckweed.	



PHOTOGRAPHIC LOG

Client Name: General Electric Company, Pittsfield, MA	**Site Location:** Housatonic River Reach 6 BRA	**Project No.** 60736371

Photo No. 17	**Date:** 9/21/2023	**Photo No. 18**	**Date:** 9/21/2023
Description: View north across Woods Pond (covered in water chestnut) and Housatonic River channel (open water areas). Looking towards FP-33		**Description:** View south across Woods Pond and powerline easement	

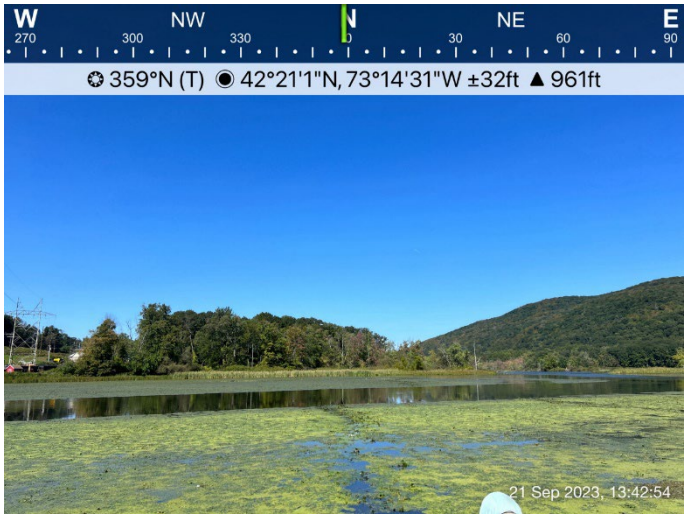


Photo No. 19	**Date:** 11/1/2023	**Photo No. 20**	**Date:** 11/1/2023
Description: View South of outlet channel / Housatonic River from boat dock.		**Description:** Side scan sonar boat set-up	

AECOM

PHOTOGRAPHIC LOG

Client Name: General Electric Company, Pittsfield, MA	**Site Location:** Housatonic River Reach 6 BRA	**Project No.** 60736371

Photo No. 17	**Date:** 11/2/2023	**Photo No. 18**	**Date:** 9/21/2023
Description: Sandy/gravelly substrates in outlet channel		**Description:** Mucky bottom substrates with floating-leaved aquatics (yellow pond-lily).	

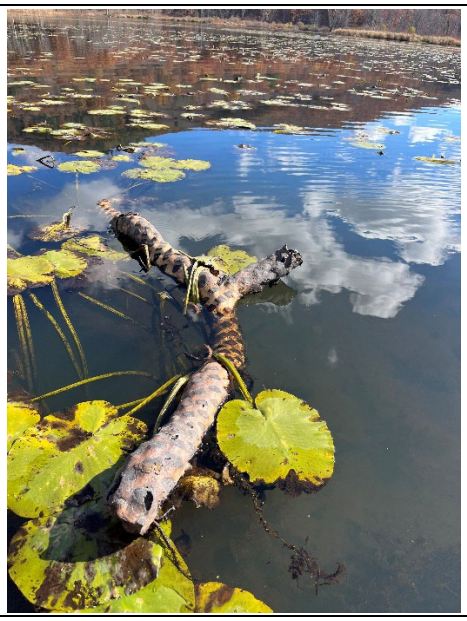
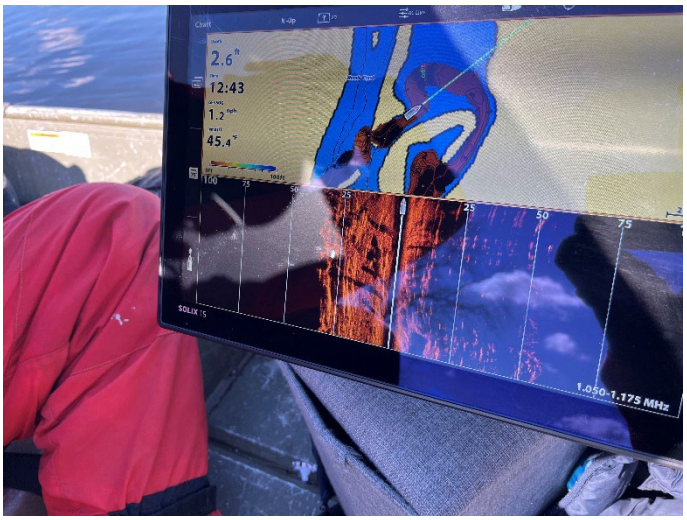


Photo No. 19	**Date:** 11/2/2023	**Photo No. 20**	**Date:** 11/2/2023
Description: Mucky bottom substrates with submerged aquatics including coontail, Robbins' pondweed and water chestnut		**Description:** Side scan sonar operation	



Appendix B
Floodplain Habitat Information

1. Representative photographs of floodplain habitats
2. Form FP-1 (Blank)

B.1 Photographs of Floodplain Habitats in Reach 6

AECOM

PHOTOGRAPHIC LOG

Client Name: General Electric Company, Pittsfield, MA	**Site Location:** Housatonic River Reach 6 BRA	**Project No.** 60736371

Photo No. 1	**Date:** 9/20/2023	**Photo No. 2**	**Date:** 9/20/2023
Description: View west, red maple swamp at FP-3.		**Description:** View east, shallow emergent marsh dominated by broad-leaved cattail.	

Photo No. 3	**Date:** 9/20/2023	**Photo No. 4**	**Date:** 5/4/2023
Description: View north, wet meadow habitats dominated by reed canary grass		**Description:** View west, shrub swamp at FP-9.	

AECOM

PHOTOGRAPHIC LOG

Client Name: General Electric Company, Pittsfield, MA	**Site Location:** Housatonic River Reach 6 BRA	**Project No.** 60736371

Photo No. 5	**Date:** 9/20/2023	**Photo No. 6**	**Date:** 9/21/2023
Description: View east, shrub swamp at FP-19.		**Description:** View south, red maple swamp at FP-16	

Photo No. 7	**Date:** 9/21/2023	**Photo No. 8**	**Date:** 9/20/2023
Description: View south, red oak-sugar maple-transition forest at FP-16.		**Description:** View east, shrub swamp dominated by silky dogwood at FP-20.	

AECOM

PHOTOGRAPHIC LOG

Client Name: General Electric Company, Pittsfield, MA	**Site Location:** Housatonic River Reach 6 BRA	**Project No.** 60736371

Photo No. 9	**Date:** 9/14/2023	**Photo No. 10**	**Date:** 9/21/2023
Description: View west, red oak-sugar maple-transition forest at FP-12.		**Description:** View west, red oak-sugar maple-transition forest at FP-24.	

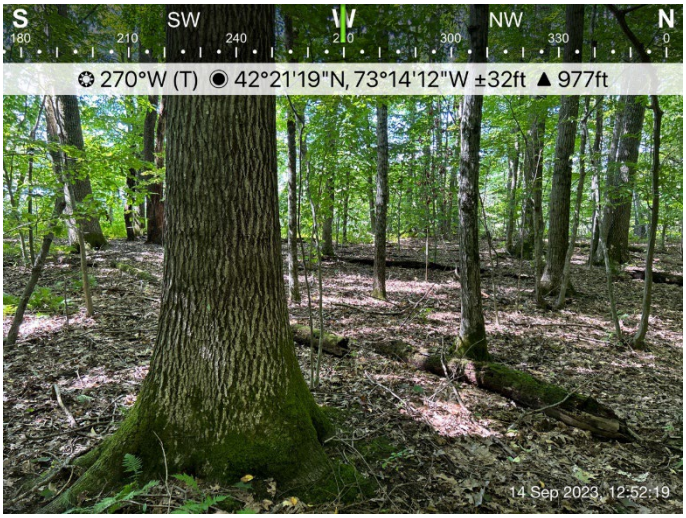


Photo No. 11	**Date:** 9/21/2023	**Photo No. 12**	**Date:** 5/4/2023
Description: View east, wet meadow and shrub swamp habitats at FP-23.		**Description:** View west, high gradient stream near 5C-VP-17.	

AECOM

PHOTOGRAPHIC LOG

Client Name: General Electric Company, Pittsfield, MA	**Site Location:** Housatonic River Reach 6 BRA	**Project No.** 60736371

Photo No. 13	**Date:** 9/14/2023	**Photo No. 14**	**Date:** 9/21/2023
Description: View north, shrub swamp and shallow emergent marsh habitats looking towards FP-31.		**Description:** View north of Woods Pond and adjacent residential property from foot bridge.	

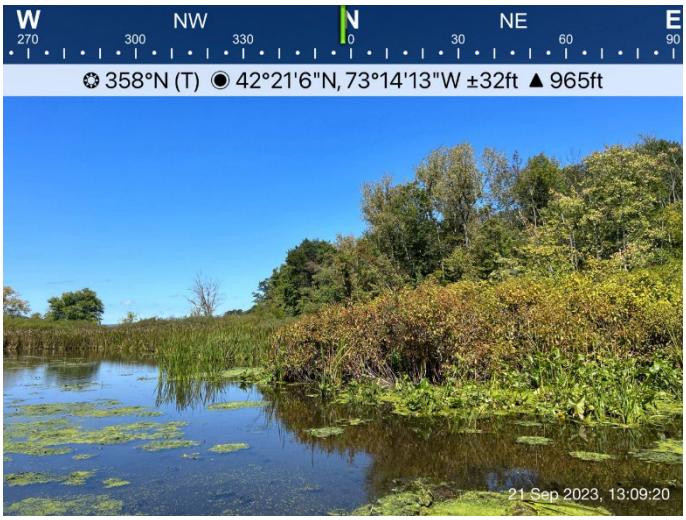
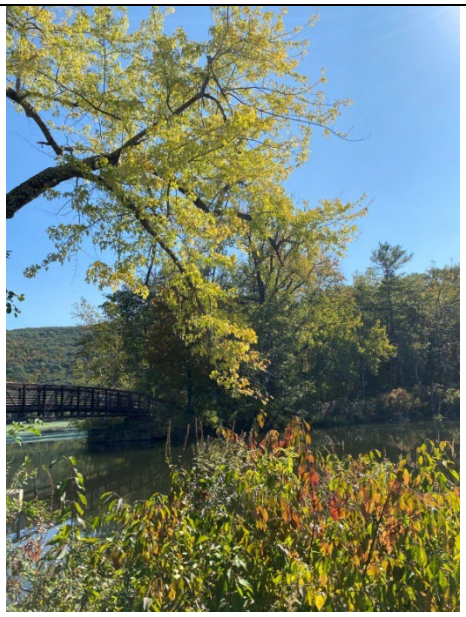


Photo No. 15	**Date:** 9/21/2023	**Photo No. 16**	**Date:** 9/27/2023
Description: View southwest from foot bridge of boat dock and shrub swamp habitats at FP-43.		**Description:** View northeast of foot bridge from FP-43	



AECOM

PHOTOGRAPHIC LOG

Client Name: General Electric Company, Pittsfield, MA	**Site Location:** Housatonic River Reach 6 BRA	**Project No.** 60736371

Photo No. 17	**Date:** 9/22/2023	**Photo No. 18**	**Date:** 9/21/2023
Description: View east, shrub swamps along the river at FP-47.		**Description:** View east of Woods Pond with dense cover of water chestnut	

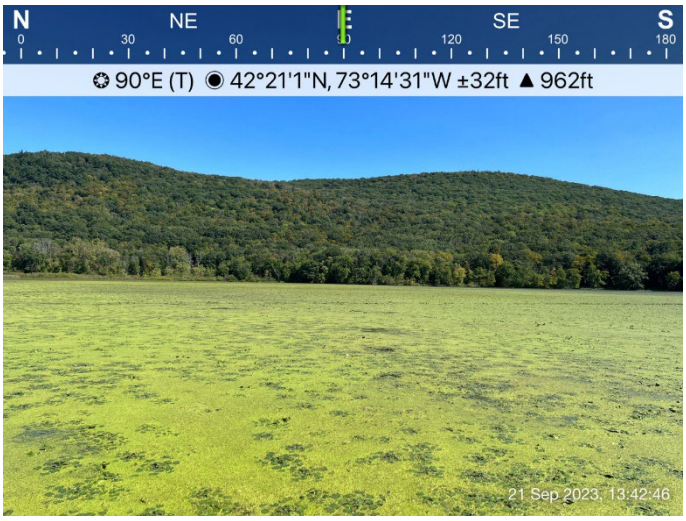
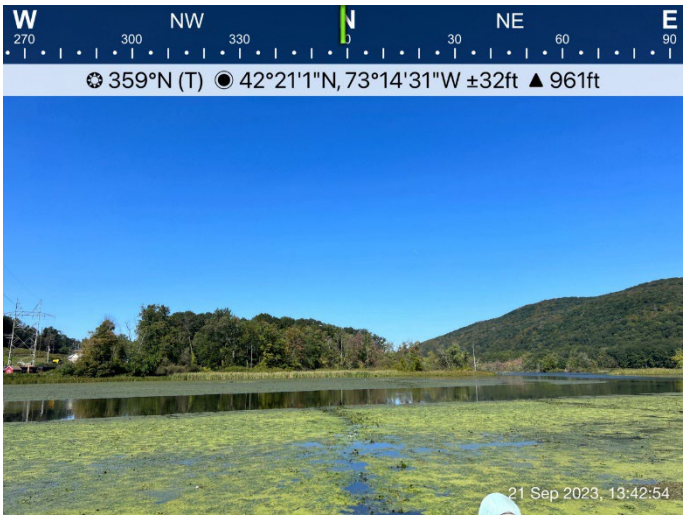


Photo No. 19	**Date:** 9/21/2023	**Photo No. 20**	**Date:** 9/21/2023
Description: View north across Woods Pond (covered in water chestnut) and Housatonic River channel (open water areas). Looking towards FP-33		**Description:** View south across Woods Pond and powerline easement	



AECOM

PHOTOGRAPHIC LOG

Client Name: General Electric Company, Pittsfield, MA	**Site Location:** Housatonic River Reach 6 BRA	**Project No.** 60736371

Photo No. 21	**Date:** 8/7/2024	**Photo No. 22**	**Date:** 9/21/2023
Description: View east, beaver lodge on bank of the Housatonic River		**Description:** View east of eagle perched on snag tree	

Photo No. 23	**Date:** 9/20/2023	**Photo No. 24**	**Date:** 9/21/2023
Description: Great egret perched on snag tree		**Description:** Green frog (adult female)	

AECOM

PHOTOGRAPHIC LOG

Client Name: General Electric Company, Pittsfield, MA	**Site Location:** Housatonic River Reach 6 BRA	**Project No.** 60736371

Photo No. 25	**Date:** 9/15/2024	**Photo No. 26**	**Date:** 4/10/2024
Description: Pickerel frog		**Description:** Bur oak leaf and bark	

Photo No. 27	**Date:** 4/10/2024	**Photo No. 28**	**Date:** 9/19/2023
Description: Bur oak acorn cap		**Description:** Hatchling snapping turtles	

B.2 Form FP-1 (Blank)

General Electric Housatonic Rest of River
Form FP-1: Floodplain Habitat Inventory Form

I. General Information

Site Name and Evaluation Area (including whether wetland or upland)

Location/Physical Description

Date(s) of Site Visit(s) and Data Collection

Weather Conditions During Site Visit

Field Staff Performing Evaluation | Date this form was completed

II. Site Description

A. Hydrology/Water Regime

- ☐ Permanently flooded
- ☐ Intermittently exposed
- ☐ Semi-permanently flooded
- ☐ Seasonally flooded
- ☐ Upland
- ☐ Saturated
- ☐ Temporarily flooded
- ☐ Intermittently flooded
- ☐ Artificially flooded

Estimated Flooding Regime: __Flooded Annually __2-Year Flood __10-Year __100-Year Flood
Notes:

B. Community Cover Type(s)

Wetland

- ☐ Transitional floodplain forest
- ☐ High terrace floodplain forest
- ☐ Red maple swamp
- ☐ Vernal pool
- ☐ Black ash-red maple-tamarack calcareous seepage swamp
- ☐ Deep emergent marsh
- ☐ Shallow emergent marsh
- ☐ Shrub swamp
- ☐ Wet meadow
- ☐ Other _____

Upland

- ☐ Northern Hardwoods-Hemlock-White Pine Forest
- ☐ Rich mesic forest
- ☐ Red Oak-Sugar Maple Transition Forest
- ☐ Agricultural fields
- ☐ Cultural grassland
- ☐ Successional northern hardwoods
- ☐ Spruce-fir-northern hardwood forest
- ☐ Developed/disturbed cover types
- ☐ Other _____

Notes:

Bordering Riverine/Aquatic Habitat

- ☐ High-gradient stream
- ☐ Low-gradient stream
- ☐ Medium-gradient stream
- ☐ Moderately alkaline lake/pond
- ☐ Backwater
- ☐

C. Inventory (Plant community: tree and vine data obtained in a 30' radius plot; shrubs in a 15' radius plot; and herbaceous plant data in a 5' radius plot.)

% Cover: _____ Trees (> 20') _____ Shrubs (< 20') _____ Woody vines _____ Mosses _____ Herbaceous

Plant Lists (species that comprise 10% or more of the vegetative cover in each strata or any amount of an invasive plant species; "*" designates a dominant plant species for the strata):

Strata	Plant Species	Strata	Plant Species

Strata: T=Tree, S=Shrub, L=Liana (vine), H=Herb (Includes grasses, herbs, pterophytes [ferns], lichens, woody seedlings, and mosses)

Notes:

D. Inventory (Soils)

_____ Soil Survey Unit _____ Drainage Class

_____ Texture (upper part) _____ Depth

Representative Soil Pit Log

Soil Horizon	Depth (inches)	Color	Soil Texture	Mottling

Notes:

III. Important Habitat Features

Wildlife Food

Important wetland food plants (smartweeds, pondweeds, wild rice, bulrush, wild celery)

☐ Abundant ☐ Present ☐ Absent ☐ Not Applicable

Important upland food plants (hard mast and fruit/berry producers)

☐ Abundant ☐ Present ☐ Absent ☐ Not Applicable

Shrub thickets with suitable earthworm habitat (American woodcock)

☐ Abundant ☐ Present ☐ Absent ☐ Not Applicable

Cover/Perches/Basking/Denning/Nesting Habitat

Shrub and/or herbaceous vegetation (suitable for birds such as veery nesting)

☐ Abundant ☐ Present ☐ Absent ☐ Not Applicable

Trees (live or dead) > 30” DBH

☐ Abundant ☐ Present ☐ Absent ☐ Not Applicable

Standing dead trees (potential for cavities and perches)

☐ Abundant ☐ Present ☐ Absent ☐ Not Applicable

Tree cavities in trunks or limbs

☐ Abundant ☐ Present ☐ Absent ☐ Not Applicable

Small mammal burrows:

☐ Abundant ☐ Present ☐ Absent ☐ Not Applicable

Dense herbaceous cover (voles, small mammals, amphibians & reptiles)

☐ Abundant ☐ Present ☐ Absent ☐ Not Applicable

Large woody debris on the ground (small mammals, mink, amphibians & reptiles)

☐ Abundant ☐ Present ☐ Absent ☐ Not Applicable

Rocks, crevices, logs, hollow logs, tree roots or hummocks (for multiple wildlife habitat purposes)

☐ Abundant ☐ Present ☐ Absent ☐ Not Applicable

Live or dead standing vegetation overhanging water or offering good visibility of open water (e.g., osprey, kingfisher, flycatchers, cedar waxwings)

☐ Abundant ☐ Present ☐ Absent ☐ Not Applicable

Depressions that may serve as seasonal (vernal/autumnal) pools

☐ Abundant ☐ Present ☐ Absent ☐ Not Applicable

Standing water present at least part of the growing season, suitable for use by

☐ Breeding amphibians ☐ Non-breeding amphibians (foraging, re-hydration)

☐ Turtles ☐ Foraging waterfowl

Sphagnum hummocks or mats, moss-covered logs or saturated logs, overhanging or directly adjacent to pools of standing water in spring (four-toed salamander)

☐ Abundant ☐ Present ☐ Absent ☐ Not Applicable

Exposed areas of well-drained, sandy soil suitable for turtle nesting

☐ Abundant ☐ Present ☐ Absent ☐ Not Applicable

Wildlife Dens/Nests (if observed)

Turtle nesting sites

☐ Abundant ☐ Present ☐ Absent ☐ Not Applicable

Nest(s) present of ☐ Bald Eagle ☐ Osprey ☐ Great Blue Heron

Den(s) present of ☐ Otter ☐ Mink ☐ Beaver

Other nests or dens (identify species): _____

Emergent Wetlands (if Applicable)

Persistent emergent wetland vegetation at least seasonally flooded during the growing season (American bittern, wood duck, green heron, black-crowned night heron, rails [sora, king, Virginia], moorhen, coot, etc.)

Flooded > 5 cm ☐ Present ☐ Absent

Flooded > 25 cm (pied-billed grebe) ☐ Present ☐ Absent

Fine-leafed emergent vegetation (grasses and sedges) at least seasonally flooded during the growing season (common snipe, spotted sandpiper, sedge wren)

Flooded > 5 cm ☐ Present ☐ Absent

Flooded > 25 cm (least bittern, common moorhen) ☐ Present ☐ Absent

Notes:

IV. Connectivity with Adjoining Natural Habitats

☐ No direct connections to adjacent areas of wildlife habitat (no connectivity function)

☐ Limited number of connectors to adjacent areas of habitat (somewhat important for connectivity function)

☐ Area is embedded in a large area of natural habitat with unimpeded connection to other habitats (high connectivity function)

V. Rare Species and MNHESP Core Area Habitat Designation

☐ Core Area 1 ☐ Core Area 2 ☐ Core Area 3 ☐ Core Area 4

☐ Federally listed threatened or endangered species habitat (including species with known overlapping habitat):

☐ State-listed species habitat (including species with known overlapping Priority Habitat):

Rare species direct observations during current field surveys (list):

VI. Incidental Direct Wildlife Observations

VII. Habitat Degradation (identify specific location within area if applicable)

☐ Evidence of significant levels of dumping

☐ Evidence of significant erosion or sedimentation problems

☐ Presence of invasive plants (e.g., purple loosestrife, *Phragmites*, glossy buckthorn); identify plants and estimate approximate percent coverage: _____

☐ Disturbance from roads or highways ☐ Evidence of fire

☐ Evidence of other human disturbance; describe: _____

VIII. Restoration Opportunities

☐ Potential suitability of area for access road or staging area

☐ Presence of potential restoration resources (e.g., boulders, large trees or woody debris, plant propagation source material). Identify specific items: _____

_____

☐ Other restoration opportunities: _____

_____

_____

_____

Appendix C
Wetland Function and Value Assessment

Wetland Function-Value Evaluation Form

Total area of wetland 20-acres Human made? No Is wetland part of a wildlife corridor? Yes or a "habitat island"? No

Adjacent land use Open land, Commercial, Industrial Distance to nearest roadway or other development 500-feet

Dominant wetland systems present PSS and SEM Contiguous undeveloped buffer zone present Yes

Is the wetland a separate hydraulic system? No If not, where does the wetland lie in the drainage basin? Upper to Mid

How many tributaries contribute to the wetland? 1 Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D. Reach 6 Wetland

Latitude 42.353103 Longitude -73.241570

Prepared by: Julia Stearns Date 10/10/2024

Wetland Impact:
Type PSS, SEM, RMS Area 16-acres

Evaluation based on:
Office _____ Field _____

Corps manual wetland delineation completed? Y____ N____

Function/Value	Suitability Y / N	Rationale (Reference #)*	Principal Function(s)/Value(s)	Comments
Groundwater Recharge/Discharge	Y	2,4,7,9		Wetland associated with a perennial watercourse and lacks defined outlet.
Floodflow Alteration	Y	1,2,3,5,7,9,10,13,14,16,18	Y	Wetland contains hydric soils able to absorb water, may retain water from rainfall.
Fish and Shellfish Habitat	Y	1,2,3,4,5,6,7,8,10,12,14,15,16,17	Y	Abundance of cover, able to support fish/shellfish, part of a larger contiguous watercourse.
Sediment/Toxicant Retention	Y	1,2,3,4,5,6,7,8,9,10,16,14,15,16	Y	Opportunity for sediment trapping by deepwater habitat, associated with perennial stream
Nutrient Removal	Y	2,3,5,6,8,9,10,11,12	Y	Deep water habitat,potential for sediment trapping exists, saturated most of the season
Production Export	Y	1,2,4,5,6,7,8, 9,12,14	Y	Wildlife food sources, wildlife use, vegetation density present.
Sediment/Shoreline Stabilization	Y	2,3,4,5,7,9,10,11,12,13,15	Y	No distinct shoreline or bank between waterbody and wetland, boating present.
Wildlife Habitat	Y	1,3,4,5,6,7,8,9,11,12,13,14,15,16,17,18,19,20,21,3	Y	Not fragmented by development, wildlife over land access,food source present.
Recreation	Y	1,2,4,5,6,8,9,10,12	Y	Recreation is available in the area, access is available for hiking and walking.
Educational/Scientific Value	Y	1,2,3,4,5,6,7,8,9,11,12,14	Y	No parking or handicap accessibility available, though parking is available near potential educational site.
Uniqueness/Heritage	Y	3,4,5,6,7,15,22,24	Y	Overall view of wetland is difficult to access, critical habitat present.
Visual Quality/Aesthetics	Y	1,2,3,4,5,7,8,9,10,11	Y	No viewing locations present though undeveloped land use surrounds wetland.
ES Endangered Species Habitat	Y	1,2	Y	Wetland is known to contain threatened or endangered species.
Other				

Notes:

* Refer to backup list of numbered considerations.

Appendix D
Vernal Pool Photo Log

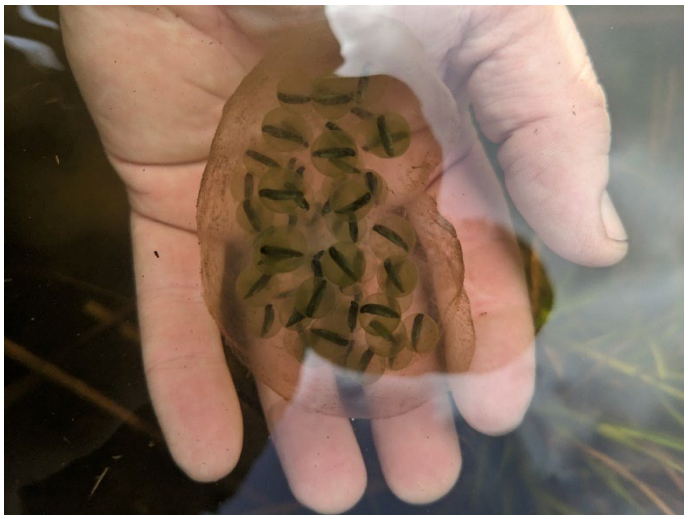
AECOM

PHOTOGRAPHIC LOG

Client Name: General Electric Company, Pittsfield, MA	**Site Location:** Housatonic River Reach 6 BRA	**Project No.** 60736371

Photo No. 1	**Date:** 5/4/2023	**Photo No. 2**	**Date:** 9/22/2023
Description: View northwest, 5C-VP-17		**Description:** View north, 5C-VP-17, pool dry	

Photo No. 3	**Date:** 5/4/2023	**Photo No. 4**	**Date:** 5/4/2023
Description: 5C-VP-17, Spotted salamander egg mass		**Description:** 5C-VP-17, red-spotted newt (red eft developmental stage)	



AECOM

PHOTOGRAPHIC LOG

Client Name: General Electric Company, Pittsfield, MA	**Site Location:** Housatonic River Reach 6 BRA	**Project No.** 60736371

Photo No. 5	**Date:** 5/4/2023	**Photo No. 6**	**Date:** 4/20/2023
Description: 5C-VP-17, wood frog tadpole. One of many observed.		**Description:** View west, 6-VP-1	

Photo No. 7	**Date:** 5/4/2023	**Photo No. 8**	**Date:** 4/20/2023
Description: 6-VP-1, Spotted salamander egg masses		**Description:** 6-VP-1, dead fish (genus: *Lepomis*)	

Appendix E
Rare Species Information for Reach 6

Appendix E: Rare Species Information for Reach 6

To identify federally listed threatened or endangered species in Reach 6, the U.S. Fish and Wildlife Service (USFWS) on-line Information, Planning, and Consultation System (IpaC) was consulted in August 2023. That review identified only one federally listed rare species as potentially occurring within the limits of Reach 6 – the northern long-eared bat *(Myotis septentrionalis)*, which is endangered. It also identified one species proposed for listing – the tricolored bat (*Perimyotis subflavus)* – and one candidate species (under consideration for federal listing) – the monarch butterfly (*Danaus plexippus*) – as potentially occurring within the Reach 6 area.

State-listed species and their habitats in Reach 6 were determined based upon information provided by MNHESP. In October 2022 MNHESP provided GE with digital information presenting its delineation of state-listed species habitats in Reaches 5 through 8 of the ROR. These individual species maps are referred to as Species Habitat Maps. They are prepared by MNHESP using the "best scientific evidence available," examining individual occurrence records in the context of species listing status and applying certain criteria, as described in Section 6 of the main Baseline Restoration Assessment Report for Reach 6.

Table E-1 presents a summary of the state-listed species information generated from the digital data provided by MNHESP. In addition to the Species Habitat mapping provided by MNHESP for six state-listed species in Reach 6, two additional state-listed species (the northern long-eared bat and tricolored bat) are also included in the table that were not included in the MNHESP data. MNHESP has advised GE that it will not allow presentation of the Species Habitat Maps by individual species, although GE may report the overall area (i.e., acreage) in Reach 6 mapped for each state-listed species and present a general description of that area. Therefore, Table E-1 also provides the acreage of the Species Habitat map within Reach 6 for each of the six species for which digital map information was provided. For the northern long-eared bat and tricolored bat, the full area of the Reach 6 limits was included in the acreage tabulation based upon the mapping of these species from the USFWS IPaC consultation.

Following Table E-1, a summary is provided for each of the federally or state-listed species, describing the life-cycle and general habitat requirements of each species, along with a discussion of the extent (i.e., acreage) of the mapped Species Habitat for each state-listed species in Reach 6 and a general description of that area and of the observed suitability of Reach 6 to meet the species' habitat requirements based upon the field surveys conducted to date. Most of the life-cycle and habitat information for each state-listed species has been generated from the species fact sheets provided by MNHESP as available on its website. These fact sheets are referenced in the species summaries and also included in the references listed after those summaries along with some additional references for certain species as appropriate. The extent of mapped Species Habitat for each species is taken from the Species Habitat maps provided by MNHESP.

Table E-1: State-Listed Species with Species Habitat Mapping* Overlapping Reach 6 as shown on MNHESP Data Provided in October 2022

Scientific Name	Common Name	State Status	Area in Reach 6 (Acres)	Taxonomic Group
Botaurus lentiginosus	American Bittern	E	0.06	Bird
Haliaeetus leucocephalus	Bald Eagle	SC	11	Bird
Quercus macrocarpa	Bur Oak	SC	37	Plant
Gallinula galeata	Common Gallinule	SC	88	Bird
Pieris oleracea	Mustard White	T	84	Invertebrate
Myotis septentrionalis	Northern Long-Eared Bat	E	148*	Mammal
Perimyotis subflavus	Tricolored Bat	E	148*	Mammal
Sagittaria cuneata	Wapato	T	53	Plant

*The acreages of the Northern Long-Eared Bat and Tricolored Bat are derived from the IPaC data, since no Species Habitat maps for those species were provided by MNHESP. Those acreages correspond to the total area of Reach 6.

GENERAL INFORMATION ON LISTED RARE SPECIES

American Bittern (*Botaurus lentiginosus*)

Summary of Species Life Cycle and Habitat Requirements

The American bittern (*Botaurus lentiginosus*) is a wading bird that inhabits freshwater wetlands, spending most of its time secretly dwelling in marshland emergent vegetation. The American bittern is an endangered species under the Massachusetts Endangered Species Act (MESA) (MNHESP 2020). It is a brown, streaked, medium sized (23-34 inches long) heron that hides among emergent vegetation including sedges, rushes, and grasses. It has pale yellow or yellowish-green bill, legs, and feet, and a buff-colored stripe over its yellow eyes. Its wingspan is 32 to 50 inches with black wingtips easily identified in flight. In Massachusetts, the American bittern inhabits freshwater meadows, marshes, fens, and bogs dominated by cattails, bulrushes, sedges, and grasses, and may also be found in brackish wetlands. It prefers expansive areas of contiguous wetlands but will occasionally utilize upland grasslands for foraging and nesting. Its slow and stealthy walk and characteristic motionless stance with bill pointed upwards when startled, enhance its resemblance to marsh vegetation or debris, a camouflage which the American bittern relies on to escape notice by predators, or with slowly aimed bill, strike and seize unsuspecting prey. Preferred foods include frogs, small snakes and eels, salamanders, crayfish, fish, and occasionally mice and grasshoppers caught on visits to wet meadows and grasslands.

The American bittern migrates from its winter habitat in the southern United States and arrives in Massachusetts marshes in April. Courtship behavior includes aerial and ground chases with males stalking females, displaying their white plumes and calling in loud, guttural "pumps." Courtship calls stop by the end of May, and the female builds a nest of dead reeds, cattails, grasses and sedges about one foot (30 cm) in diameter on the ground in dense vegetation. American bitterns prefer marshes for nesting sites and are known to also construct nesting platforms of vegetation a foot above water. They will occasionally nest in uplands adjacent to wetlands. American bitterns have shown relatively high site fidelity (Azure 1998). Males appear territorial during the breeding season and stay close to the nest site. They may be polygonous. Females care for the young. A clutch will typically have four to five eggs that will hatch within 24 to 29 days. The chicks become fledglings after 14 days and by the end of the summer, juvenile American bitterns begin to wander away from the nest. There is only one clutch per year with the female continuing to tend to her young for an undetermined length of time after they leave the nest. American bitterns may winter as far north as the east coast of Massachusetts. Migration to habitats in the southern U.S. occurs during October and November, and by December, most American bitterns have left Massachusetts. The American bittern has been reported from many towns of Berkshire County, including Pittsfield and Lenox, as well as across Massachusetts (MNHESP 2015a).

American Bittern Habitat in Reach 6

According to the 2022 MNHESP maps, Species Habitat for the American bittern in Reach 6 covers only a small area of floodplain in the northern portion of the Reach. Suitable bittern marsh habitat occurs in this area along the Housatonic River, including in that portion of Reach 6.

Bald Eagle (*Haliaeetus leucocephalus*)

Summary of Species Life Cycle and Habitat Requirements

The bald eagle *(Haliaeetus leucocephalus)* is the largest raptor (bird of prey) found in Massachusetts and the only member of the *Haliaeetus* (fish or sea eagle genus) that occurs regularly in North America. The bald eagle is classified as an endangered species under MESA (MNHESP 2020). This species usually inhabits coastal areas, estuaries, and larger inland waters. It requires a high amount of water-to-land edge incorporating stands of forest for nesting and trees projecting above the forest canopy for perching, an adequate supply of moderate-sized to large fish, an unimpeded view, and little human disturbance. When available, fish (both marine and freshwater) are the bald eagle's preferred food. Birds, especially waterfowl, small mammals, and carrion, particularly dead fish, are also in the bald eagle's diet.

The bald eagle has the ability for long-distance flight. The hunting area or home range patrolled by a bald eagle varies from 1,700 to 10,000 acres and is generally dependent on the availability of food (Rutlidge, 2010). In winter, eagles of all ages gather in areas with open water where fish or other food sources are abundant. Wintering eagles require, and may travel substantial distances to reach, suitable thermally protected roost trees for communal night roosting and food sources in waters that are not frozen.

The breeding and nesting season for bald eagles in Massachusetts begins in March (MNHESP 2019a). Courtship occurs in mid- to late winter, with pairs then mating for life. Sexual maturity is reached at four to six years of age. After courtship, the mated pair builds a large nest made with sticks and lined with sprigs of pine, grasses, and other soft materials. The male eagle collects the nest material and delivers it to his mate, who is responsible for most of the actual nest construction. Once the nesting site is chosen, the mated pair will generally return every year to the same site and add to the existing structure. The nests are located in hardwoods or conifers from 30 to 120 feet above the ground and may measure up to 12 feet high and 8.5 feet wide, with a weight of hundreds of pounds. Trees selected (for nesting, and also for roosting and sometimes perching) are typically older trees, taller than their surroundings.

The female bald eagle lays one to three (two average) dull white eggs several days apart, usually by in late March or early April. The eggs are incubated for approximately 35 days until hatching. Ten weeks after hatching, chicks begin making short flights and by late fall the adults no longer care for their young. Most bald eagles appear to nest within 200 miles of where they hatched.

Bald Eagle Habitat in Reach 6

According to the 2022 MNHESP maps, Species Habitat for the bald eagle in Reach 6 covers only a small area of floodplain in the northern portion of the reach (approximately 10.9 acres). Suitable bald eagle habitat occurs throughout this area along the Housatonic River, including Reach 6. The areal extent of this habitat includes the main stem of the Housatonic River, Woods Pond, backwater areas, emergent marsh, wet meadow, shrub swamp, floodplain forest, and northern hardwoods hemlock/white pine forest. Preferred hunting habitats for the bald eagle found within or near Reach 6 include the main stem of the Housatonic River, Woods Pond, and the large backwater areas. The surrounding floodplain forests provide nesting and perching habitat near these waterbodies.

Previous field surveys conducted in 1998-2000 within the Primary Study Area (PSA) that consists of Reaches 5 and 6 observed instances of bald eagles flying, feeding, or perching in the spring and fall in the vicinity of Woods Pond and backwaters north of the pond (Woodlot 2002). MNHESP has stated (May 2009) that it has documentation of at least one bald eagle nesting site within the PSA. Bald eagles were occasionally observed in Reach 6 during the 2023-2024 habitat field surveys; however, no evidence of nesting activity was observed.

Bur Oak (*Quercus macrocarpa*)

Summary of Species Life Cycle and Habitat Requirements

Bur oak, or mossy-cup oak (*Quercus macrocarpa*), is a tree that is a member of the beech family (Fagaceae). It is a species of special concern under MESA (MNHESP 2020). Mature trees reach heights of up to 160 feet (50 meters). The acorn of the bur oak is large (1 to 1.5 inches long) with a deep, saucer-shaped cup with a fringe-like edge. Bur oak trees start to bear fruit at about 35 years of age and produce heavy seed crops every two to three years. Bur oak occurs in several habitats including forested fens, forested swamps, floodplain forests influenced by calcareous (alkaline or basic) seepage water, and in mesic to wet sites in shady areas subject to seasonal flooding. Current records for bur oak specimens in Massachusetts are confined to Berkshire County (MNHESP 2015b).

Mapped Species Habitat in Reach 6

MNHESP 2022 Species Habitat mapping for the bur oak extends throughout the floodplain of Reach 6 (covering 37 acres of Reach 6), including the larger marshy island in the eastern side of the headwaters transition zone and also along the eastern side of Woods Pond. Suitable habitat for this species occurs in these areas, and numerous bur oak trees were documented in this mapped area during the 2023-2024 habitat investigations.

Common Gallinule (*Gallinula galeata*)

Summary of Species Life Cycle and Habitat Requirements

The common gallinule (*Gallinula galeata*), formerly known as the common moorhen, is a duck-like swimming bird that inhabits large freshwater or brackish marshes and water bodies with cattails and other emergent vegetation. The common gallinule is a species of special concern under MESA (MNHESP 2020). It is described as having a length of 13 inches with a wingspan of 21 inches, large yellow unwebbed feet, a black head and neck, and a yellow-tipped red bill that runs up its forehead to form a red shield. Its back is brown, underside is slate-grey, and its short, upturned tail has white outer and black inner undertail feathers. Preferred habitat is shallow bodies of water with dense stands of emergent vegetation interspersed with areas of open water. In Massachusetts, preferred habitats of the common gallinule are waterbodies that are at least one foot deep with dense cattail beds, and occasionally shrub marsh adjacent to open water with aquatic bed vegetation. Although common gallinules prefer emergent wetlands as foraging, breeding, nesting, and protective cover habitat, they also utilize margins of lakes, ponds, and slow-flowing rivers and streams as feeding areas. Using the cover of the dense vegetation at the edges of open water, the wading or dabbling common gallinule feeds on grass, sedge seeds, berries, foliage, underwater plants, and duckweed, along with insects, snails, worms, and other invertebrates.

The common gallinule migrates from wintering ranges in the southern U.S. to Massachusetts in late April or May. Nesting begins in May to early June. The nest is well-made of dead cattails, rushes, and stems of other aquatic plants. It is built in supportive dense vegetation typically less than one foot over water but up to two feet where it is well hidden within the surrounding plants, often with a ramp leading from the water. Unfinished nest-like platforms may be found in the vicinity of the nest for roosting and brooding, and may be used by the young that have left the original nest to spend the night as they wander the marsh. Incubation of the 6-17 eggs (typically 10-12) beginning in late May involves both parents for three weeks. As the chicks hatch, they are cared for by the male while the female incubates the remaining eggs, completing hatching by mid-July. The young are precocial and ready to leave the nest within a day of hatching, feed independently after three weeks, and fly in six to seven weeks; however, they remain with their parents for some time thereafter. The common gallinule may have one or two broods per year. Although a rare breeder in Massachusetts, this species has been found breeding across the state. There have been 23 verified sites for this species in Massachusetts over the past 25 years with most supporting only a single breeding pair (MNHESP 2019b). MNHESP's field surveys find the presence of invasive plants, particularly common reed, to be the largest limiting factor to current common gallinule occupied sites. The flight pattern of the common gallinule tends to consist of short, local flights, except during migration when they are found to exhibit a strong site fidelity, returning to familiar grounds (Bannor and Kiviat 2002). Home range sizes for this species are relatively small averaging approximately three acres (range of 0.5-8 acres) for nesting adults, and home ranges of 15 acres for non-nesting adults (Bannor and Kiviat 2002). Migration to their wintering range occurs in October. Reported occurrences of the common gallinule in Berkshire County are in the towns of Pittsfield, Lenox, Lee, Richmond, Washington, Stockbridge, Egremont, and Sheffield; other reports are from eastern Massachusetts (MNHESP 2019b).

Common Gallinule Habitat in Reach 6

MNHESP 2022 Species Habitat mapping of the gallinule extends throughout most of Reach 6, with the exception of the southern half of Woods Pond and its outlet channel. The Species Habitat mapping covers 88 acres of Reach 6, and suitable habitat occurs throughout this mapped area.

Monarch Butterfly (*Danaus plexippus*)

Summary of Species Life Cycle and Habitat Requirements

The monarch butterfly migrates each year from as far as Canada and across the United States to a few forested overwintering sites in the mountains of central Mexico and coastal California (USFWS 2022). Adult monarchs are pollinators, feeding on a variety of native wildflowers. Milkweed (*Asclepias syriaca*) is the only host plant used during the larval stage (caterpillars) for this species. The adults lay their eggs on the underside of the leaf and the larva feeds on the leaves as it grows before entering the pupa stage and eventually emerging as an adult butterfly. Over the last two decades, numbers have declined, and therefore this species is a candidate for listing by the USFWS. Primary threats to this species appear to be conversion of grasslands to agriculture, urban development, widespread use of herbicides, logging/thinning at overwintering sites in Mexico, unsuitable management of overwintering groves in California, drought, continued exposure to insecticides, and effects of climate change (USFWS 2022). The monarch butterfly is not currently a state-listed species in Massachusetts.

Monarch Butterfly Habitat in Reach 6

Open meadows (both wetland and upland) and even some marsh areas in Reach 6 provide potentially suitable habitat for monarch butterflies. These habitats support several milkweed species which serve as the larval host plants for monarch butterflies. These habitats are widely dispersed in Reach 6 but overall are not very common.

Mustard White (*Pieris oleracea*)

Summary of Species Life Cycle and Habitat Requirements

The mustard white (*Pieris oleraceae*) is a medium-sized, white (pierid) butterfly member of the Pieridae family that is thought to belong to the Pieris napi complex (an Old World species). It is a threatened species under MESA (MNHESP 2020). The wings of the spring brood of the mustard white are white with a small yellow spot on the underside of the hind wing at the humeral angle, and distinct gray to black scales outlining the wing veins that are only faintly seen in later broods. The only markings above are some gray to black shading along the costa and at the apex of the forewing. Its wingspan is 32-50 millimeters. Typically, there are three broods and three flight periods of the mustard white. In Massachusetts, the spring brood flies from mid to late April through May, the second brood from July to early August, and a third brood flies in late August to early September. In some years, a fourth late season brood is possible (Nelson 2010). The flight of the mustard white butterfly is considered weak or docile when compared to other butterfly species (Leahy et al. 2006).

The mustard white is typically found in moist, rich, (mesic) openings in woodlands and riparian floodplains, edges of fens, marshes and streams, and open wet meadows, fields, and pastures. The home range and travel patterns of the mustard white appear to depend primarily on the availability and distribution of the host plants at the time of each brood. Two herbaceous woodland plants are essential larval hosts – the native two-leaved toothwort (*Cardamine diphylla*) found in deciduous forests and floodplains, and the introduced cuckoo-flower from Eurasia (*Cardamine pratensis*) growing in forests and floodplains, meadows, lawns, and roadsides. Other larval hosts include rape (*Brassica rapa*), which is found in hayfields and on roadsides; watercress (*Nasturtium*), which is found only in wet areas with running water; and other mustard family plants (Brassicaceae). However, these are typically only available for second and third broods, making nearby forests with the early flowering toothwort and/or early flowering cuckoo-flower a critical habitat requirement (Stichter 2015). Females are also attracted to common winter cress (*Barbarea vulgaris*) and field pennycress (*Thlaspi arvense*) as potential host plants, but these plants do not support larval growth (Leahy et al. 2006).

In Massachusetts, the largest known populations of mustard white are found in open, damp meadows where larvae feed mainly on the introduced cuckoo-flower as it is an early growth larval host plant available for the spring brood as well as later broods, and it beneficially promotes a fast growth rate and high survivorship (Stichter 2015). With the spread of invasive garlic mustard, growth of host plants were inhibited, and female mustard white butterflies began to lay their eggs on garlic mustard despite its effect of slow larval growth and poor survivorship (Courant et al. 1994). Observations in Lee, MA in 1990, however, provided initial evidence that the mustard white may be successfully adapting to the effective use of the garlic mustard as a larval host with increasing

survivorship; and other, similar evidence has accumulated since then (Keeler & Chew 2008), inciting speculation that since garlic mustard is a prominent suitable host for the related P. napi species in Europe, it is possible that the North American mustard white is in the process of adapting to it (Stichter 2015). Adult butterflies feed on the nectar of the larval host plants and other flowers (MNHESP 2015c). Adult males will patrol open areas in search of receptive females during warm daylight hours. Females deposit single eggs on the underside of the leaves of host plants. The mustard white overwinters in a chrysalis attached to a plant stem close to the ground.

Massachusetts is the southern range of the mustard white, and it is currently only known in seven towns in central Berkshire County, including Pittsfield, Lenox, and Lee (MNHESP 2015d). The mustard white has been in decline in Massachusetts since about 1850. The focus of limitations for this species is primarily the loss of forest and meadow habitats and the host plants they support, with greatest emphasis on the host plants, toothwort and cuckoo-flower, that are critical to the success of the spring brood (Stichter 2015). Parasitism by the introduced braconid wasp, *Cotesia glomerat*a, a parasite of the introduced cabbage white butterfly, inhibited the mustard white population as its caterpillars were found preferable over those of the cabbage white; however, in recent years there has been a dramatic decline in the braconid wasp population in Massachusetts (Van Driesche et al. 2003). The invasive garlic mustard has spread, inhibiting host plant growth, and is used instead by female mustard white butterflies as host plants to lay eggs on. However, slow larval growth and poor survivorship on garlic mustard contributed to its decline. As noted above, more recent evidence in Massachusetts indicates that larval growth rates and survivorship have improved, suggesting that the mustard white can adapt to effectively use garlic mustard as a host. The adaptability of the mustard white has also been shown by populations in Massachusetts using the introduced cuckoo-flower as a host, which has proven to promote fast larval growth and high survivorship for all broods. Another limitation for the population of the mustard white is hydrologic alteration in riparian floodplain habitat where periodic flooding maintains host plants.

Mustard White Habitat in Reach 6

The mapped Species Habitat of the mustard white butterfly in Reach 6 extends south contiguously throughout Reach 6 except in the southern part of Woods Pond and its outlet channel, and it covers 84 acres. Although the mustard white's primary habitat is moist deciduous woodlands, this species utilizes a diversity of habitats and could be found within or at the edges of all these communities. Literature reviews for this species indicate that the species uses a fairly diverse group of habitats, and most of the mapped Species Habitat would be acceptable habitat for the mustard white during some stage of its life cycle (except for the purely aquatic habitats).

Northern Long-Eared Bat (*Myotis septentrionalis*)

Summary of Species Life Cycle and Habitat Requirements

The northern long-eared bat (*Myotis septentrionalis*) or northern myotis is a small, brown bat with unique large, long ears that distinguish it from other species in Massachusetts. The northern long-eared bat is an endangered species under MESA (MNHESP 2020). Its long ears distinctively extend at least four millimeters (mm) past its nose when pushed forward. Its light brown fur, wing membranes, and dark base to light tip hairs on its back give it an overall brown color. It averages 50-95 mm in total length with a tail of 34-42 mm, and 5-8 grams in weight.

The northern long-eared bat is found in forested habitats in the warm months of the year where it roosts in trees and forages. Although found in other tree roosts, it prefers roosts in large, tall cavities of large, live or dead trees in clustered hardwood stands. They may also be found in human-made structures. Northern long-eared bats forage under canopies through complex strata of forest habitats, often feeding on insects above small ponds, vernal pools, and streams, or along gravel paths, roads, and forest edges. After their daytime roosts, northern long-eared bats emerge at dusk to begin feeding flights where they fly slowly, snatching up insects on the fly or resting insects on foliage while navigating through their complex forest environment with the aid of their specially adapted long tails and large wing membranes. They use passive listening and emit high frequency echolocation calls to locate resting insects. The northern long-eared bat's body weight increases up to 45% between August and October, preparing a winter fat reserve for hibernation. Typical winter hibernacula are in natural caves and abandoned mines meeting their preference for sites with high humidity where water droplets may accumulate on their fur. They swarm the entrances of caves in late summer, possibly testing the air for suitable winter hibernacula, and mate at this time with sperm stored within females until spring. Northern long-eared bats enter their winter hibernacula sites by early November after migrating up to 56 km from their foraging habitat. They share caves with other species and typically hibernate singly or in small groups in deep cracks or crevices of the caves. Once the northern long-eared bat is settled in its winter hibernacula, its metabolism slows and it enters torpor, although able to stir occasionally to drink water throughout the winter. They return year after year to the same winter hibernacula, but do not necessarily hibernate in the same location. Females bear their single young and rear them from mid-May through July. The longevity record of the northern long-eared bat is 18 years.

Northern long-eared bat populations, once common in the northern United States, have been devastated by the spread of the white-nose syndrome fungus. Infected hibernacula in caves in the Northeast have caused catastrophic population losses of 90-100%. During hibernation, the fungus grows and spreads over the bats causing them to rouse frequently from dormancy and use valuable stored fat needed to survive the winter, resulting in death. The movements of breeding male bats are believed to be primarily responsible for passing the fungus from cave to cave, but transport by humans is also thought to infect some hibernacula. Northern long-eared bats are widespread in Massachusetts and have been found in 11 of 14 counties. Winter hibernacula have been reported in Berkshire, Franklin, Hampden, Middlesex, and Worcester Counties (MNHESP 2019c).

Northern Long-Eared Bat Habitat in Reach 6

MNHESP did not provide Species Habitat mapping of the northern long-eared bat. However, the USFWS IPaC consultation indicates that potential habitat for this bat species occurs throughout all of Reach 6. The full 148 acres of Reach 6 appear to contain suitable habitat, including forested and forest edge areas for roosts as well as foraging habitat alongside and over Woods Pond.

Tricolored Bat (*Perimyotis subflavus*)

Summary of Species Life Cycle and Habitat Requirements

The tricolored bat (formerly called the eastern pipistrelle) is a small bat with tricolored fur on its back. In September 2022. the USFWS proposed the tricolored bat for listing as endangered; this proposal is still under review. The habitat requirements of the tricolored bat, as well as its range in

Massachusetts, are similar to those of the northern long-eared bat, and the impacts from the white-nosed syndrome are also similar and constitute the primary reason for the proposed listing (MNHESP 2015d).

Tricolored Bat Habitat in Reach 6

MNHESP did not provide Species Habitat mapping of the tricolored bat. However, the USFWS IPaC consultation indicates that potential habitat for this bat occurs throughout all of Reach 6. The full 148 acres of Reach 6 appear to contain suitable habitat, including forested and forest edge areas for roosts as well as foraging habitat alongside and over Woods Pond.

Wapato (*Sagittaria cuneata*)

Summary of Species Life Cycle and Habitat Requirements

The aquatic wapato (*Sagittaria cuneata*) is an herbaceous perennial of the water-plantain or arrowhead family (Alismataceae) found in nearly neutral to slightly basic, open-water habitats. The wapato is a threatened species under MESA (MNHESP 2020). In Massachusetts, wapato is found in very slow-moving or stagnant waters of riverine floodplain habitats in alkaline backwaters, oxbow ponds, small shallow depressions with muddy substrate, and a few occurrences on pond shores. Wapato displays high variability in its growth form as an emergent and emersed plant, a floating plant, or entirely submerged plant depending on its growth conditions. Wapato typically has basal rosettes of leaves with expanded blades with sagittate or arrow-head shaped leaves growing from stoloniferous corms; however, wapato leaves display great variance (or phenotypic plasticity) having three different leaf morphologies depending on the hydrology and prevailing water level of its habitat. Emersed plants have leaf blades that are linear to sagittate with a central lobe that is broad-lanceolate to triangular-ovate, on top of recurved petioles. Floating plants in moderate to deep water have heart-shaped or sagittate leaf blades with long triangular petioles. Entirely submerged plants in deep water have long narrow, ribbon-like, bladeless, expanded leaf-like petioles (phyllodia). The long-stalked flowering raceme has two to10 whorls of three-lobed white flowers that produce achenes, or one-seeded fruit, that are flattened and encased in dense spheres. Wapato flowers beginning July to mid-September, and fruits mid-July through September. Distinct to the identification of wapato is a tiny erect beak on its achene, as well as the phenotypic plasticity of its leaf morphology. The average height of wapato is about 1.5 feet, but it may reach over 3.5 feet. In Massachusetts, wapato is reported in Berkshire County in the towns of Pittsfield, Lenox, Lanesboro, Great Barrington, and Sheffield, and in Hampden County in the town of Holyoke (MNHESP 2015e).

Wapato Habitat in Reach 6

Mapped Species Habitat of wapato in Reach 6 extends along the wetter floodplain borders with aquatic habitats and over most of the headwaters transition area into the northern edge of Woods Pond proper, comprising 53 acres in Reach 6. Principal natural communities identified within the mapped Species Habitat include muddy substrates along the shallow edges of the main stem of the river, Woods Pond, backwater habitats, and a variety of floodplain habitats, including emergent marsh, floodplain forest, and shrub swamps bordering the river. This species requires total to partial submersion in water during most of its life cycle. Thus, seasonally exposed muddy substrates along

the river, Woods Pond, backwater areas, emergent marshes, and seasonal pools in the floodplain forest constitute the primary habitat for this species.

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Appendix F
Invasive Plant Species in Reach 6

1. Identification of Invasive Plant Species in Reach 6
2. General Information on Primary Invasive Species Identified
3. Water Chestnut Assessment and Management Information

Appendix F-1: Identification of Invasive Plant Species in Reach 6

For the assessment of invasive species in Reach 6, the definition of invasive plant species was based on the plant species listed by recognized organizations – notably, the Massachusetts Invasive Plant Advisory Group (MIPAG) (considering both "invasive" or "likely invasive" species), the USACE New England District, and the Invasive Plant Atlas of New England (IPANE).

MIPAG defines invasive plants as "non-native species that have spread into native or minimally managed plant systems in Massachusetts. These plants cause economic or environmental harm by developing self-sustaining populations and becoming dominant and/or disruptive to those systems" (MIPAG 2005). Its list includes species determined to be "invasive," "likely invasive," and "potentially invasive." For a species to be included on the MIPAG list, it must be substantiated by scientific investigation (including herbarium specimens, peer-reviewed papers, published records and other data available for public review) to meet specific criteria. The process of reviewing individual plant species for their invasiveness in Massachusetts is ongoing and may result in a change in status based on new data and further review. As noted above, for the purposes of assessing invasive species in Reach 6, the species rated by MIPAG as "invasive" or "likely invasive" were included.

IPANE similarly defines invasive species as "any species that is non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health. These invasive species aggressively compete with and displace the associated flora and fauna communities" (IPANE 2007). Originally based at the University of Connecticut and specific to New England invasive plant species, IPANE now collaborates with the broader Invasive Plant Atlas of the United States at: Invasive Plant Atlas of the United States - Database of Plants Invading Natural Areas: Invasive Plant Atlas of the United States. For the purposes of assessing invasive species in Reach 6, the list of invasive species published by IPANE at www.ipane.org has been used.

The USACE New England District address invasive plant species in its wetland mitigation standard operating procedures document, available at: NEW ENGLAND DISTRICT REGULATORY DIVISION COMPENSATORY (army.mil) (USACE 2020). This document provides a focused list of 13 invasive species which the Corps considers invasive at wetland mitigation sites and "must be controlled" at mitigation sites. This list of species has been used in this current assessment as "ACOE Invasive" (see **Table F-1**). This list of invasive species does not include any species that are not listed as invasive or likely invasive by MIPAG or IPANE. Note that the Corps also provides a more extensive list of "unacceptable" species in Appendix K of its mitigation document; these are species which the Corps finds unacceptable to include in wetland planting plans as part of the Section 404 CWA permit program, but these "unacceptable" species are not included as invasive plants for this current assessment.

The methods used in the identification of invasive species in Reach 6 are described in Section 8.1 of the main Baseline Restoration Assessment (BRA) Report for Reach 6, and the results are discussed in Section 8.2 of that report.

In addition, **Table F-1** provides a listing of all invasive plant species identified in Reach 6 during the 2023-2024 field investigations. It also clarifies the status of each species relative to whether it is listed as MIPAG invasive (or likely invasive), IPANE invasive, or ACOE invasive (as described above).

Appendix F-2 provides general information on the primary invasive species identified in Reach 6, and **Appendix F-3** provides an assessment of management considerations for water chestnut in connection with remedial activities in Woods Pond.

Table F-1. Invasive Plant Species Recorded in Reach 6

Layer	Common Name	Scientific Name	Status[1]
Herb, Forb, Sedge, Rush and Grass Species	Garlic mustard	*Alliaria petiolata*	D
	Narrow-leaved bitter-cress	*Cardamine impatiens*	A,B
	Japanese winged-knotweed	*Fallopia japonica*	A,B
	Yellow iris	*Iris pseudacorus*	A,B
	Moneywort	*Lysimachia nummularia*	A
	Purple loosestrife	*Lythrum salicaria*	A,B,C
	Water forget-me-not	*Myosotis scorpioides*	A,B
	European water-milfoil	*Myriophyllum spicatum*	A,B,C
	Reed canary grass	*Phalaris arundinacea*	A,B
	Common reed	*Phragmites australis*	B
	Curly pondweed	*Potamogeton crispus*	A,B
	Climbing nightshade	*Solanum dulcamara*	B
	Water chestnut	*Trapa natans*	A,B
	Coltsfoot	*Tussilago farfara*	A,B
Shrub Species	Japanese barberry	*Berberis thunbergii*	A,B,C
	Burning bush	*Euonymus alatus*	A,B,C
	Glossy buckthorn	*Frangula alnus*	A,B,C
	Morrow's honeysuckle	*Lonicera morrowii*	A,B
	Common buckthorn	*Rhamnus cathartica*	A,B,C
	Multiflora rose	*Rosa multiflora*	A,B,C
Tree Species	Norway maple	*Acer platanoides*	A,B
Woody Vine Species	Asiatic bittersweet	*Celastrus orbiculatus*	A,B,C

1. Invasive Ratings: A= MIPAG Invasive; B=IPANE Invasive; C=ACOE Invasive; D=MIPAG Likely Invasive

Appendix F-2: General Information on Primary Invasive Species Identified in Reach 6

Common (or European) Buckthorn (*Rhamnus cathartica*)

While buckthorn was apparently introduced to the United States in Massachusetts in late 1800s. Its occurrence as an invasive species affecting habitat quality has been noted more prominently in the upper Midwest, leading to extensive research and control efforts in those states versus the Northeast. However, the information and experience gained from the upper Midwest are directly applicable to the Northeast given the ecological similarities between these regions. In New England, buckthorn is found most often on disturbed, open, moist sites and successfully invades abundant habitats including "abandoned fields and pastures, open woods, early successional forests, edges, planted forests, floodplain and riparian forests, wet meadows, ravines, open disturbed areas, roadsides, fencerows, vacant lots, and yards or gardens" (IPANE 2007). Buckthorn outcompetes native understory species for light, nutrients, and moisture, potentially forming monotypic stands that suppress plant and animal diversity. In addition, the leaves and fruits may also have an allelopathic effect, which functions to inhibit seed germination and growth of other plants. Old field areas most often show buckthorn abundance and preference on sites that had a history of plowing compared to former pastures or continuously forested woodlots (McDonald et al. 2008). As buckthorn continues to persist and establish, further invading a forested area to become increasingly dominant, it creates shadier areas throughout the growing season than forested areas not invaded by buckthorn, thus progressively shading out the native seedlings and saplings of herbaceous, shrub and tree layers and outcompeting most plants that try to grow beneath it. The most effective method for the control of common buckthorn is cutting the plant near the soil surface and treating the stump with an herbicide to prevent resprouting. Triclopyr in particular has shown effectiveness for controlling buckthorn, as this herbicide allows application early enough in the summer to kill trees before drupe/seed production. Buckthorn seeds remain viable in the soils for at least several years, so ongoing management after the initial treatment may be necessary (Minnesota DNR 2022).

Morrow's Honeysuckle *(Lonicera morrowii)*

Morrow's honeysuckle is a deciduous shrub that was imported from Japan and South Korea in the 1800s for use as an ornamental, wildlife food and cover, and soils erosion control. After wide planting through the 20th century, its progressive destructive impact on native species in natural areas, and parks and gardens prompted its recognition as a highly invasive species. It is shade tolerant but prefers full sun where it produces more flowers and fruit, and invades forest edges and interiors, floodplains, pastures, old fields, roadsides and other disturbed areas through the help of rapid seed dispersal by birds and mammals. It also spreads vegetatively promoting its ability to form dense thickets by outcompeting native trees, shrubs, and herbaceous plants, thereby displacing them. The branching structure of Morrow's honeysuckle promotes nest predation of birds. Its fruit provides some nutrition for birds and mice in winter, but is overall insufficient for the nutrition

needed to sustain birds, particularly migrating birds, naturally provided by the nutrition-rich fruit of native species. Its prevention and control are similar to those for buckthorn, consisting of pulling seedlings, cutting larger stems, and applying herbicides containing glyphosate or triclopyr to foliage or cut stems.

Multiflora Rose (*Rosa multiflora*)

Multiflora rose is an invasive shrub introduced to the United States in 1866 from East Asia as rootstock for its aesthetic ornamental roses, and use as a fence, as well as for erosion control and wildlife food and cover. It is found in abandoned fields, hedgerows, forest edges and roadsides with its preference for full sun to moderate shade environments, but can also endure the shade of mature forests. It flourishes on sites having general poor growth conditions involving light, moisture, salinity, or pH, but does not tolerate extreme cold below -28 degrees F. Multiflora rose spreads by seed, root sprouting and layering, a process where a stem, or cane, comes in contact with the soil as it grows, and produces roots to become a functionally independent plant. The fruit, or hips, persist on branches through winter providing a continuous food source as they are commonly found among the next year's flowers. Birds facilitate seed dispersal and seeds can remain viable in the soil for up to 20 years. After an initial slow growth period the first 1-2 years, the plant reproduces aggressively by seeds and sprouts, and expands through layering to form dense thickets, establishing monocultures that deteriorate natural environments and inhibit plant and wildlife diversity. Native invertebrates rarely consume its leaves, resulting in a change in the chemical composition of the decomposing leaf litter that enhances the shrub's growth and dominance of the site, particularly in riparian areas. Treatment for control of multiflora rose includes cutting of stems and application of herbicides.

Asiatic Bittersweet (*Celastrus orbiculatus*)

Asiatic (or Asian) bittersweet is an invasive deciduous, woody, twining vine native to China, Japan, and Korea, which was introduced into the United States around 1860 as an ornamental plant. Although hybridization with native American bittersweet has been observed in the laboratory, it is unclear how commonly it may occur naturally. It is most productive in full sun, but it also easily germinates in shade and its seedlings are extremely shade-tolerant. It is found in grasslands, open woods, woodland edges, closed-canopy forest, roadsides and fence rows. Its growth by climbing any available support significantly threatens plant communities. It grows rapidly and shades out the vegetation supporting it, while encircling and girdling trees and shrubs, cutting off water and nutrients. Having a deep, extensive root system, it grows to 30 meter (98.5 feet) in length and 18 centimeters (seven inches) in diameter. It reproduces by seed and vegetatively by spreading underground roots that form new stems, as well as sprouting from the root crown and small root fragments, thereby forming abundant clones from one or few seedlings. Flowers are produced by male (for pollen) and female plants by two years of age, and prolific fruit is produced by mature female plants with highest fruit production in full sun. Fruits are eaten and dispersed by birds and mammals, where the seed has been observed to remain in the gut of birds for extended time (14-42 days) promoting long distance dispersal of the species. Humans also

contribute significantly to its dispersal through planting, and the use of its fruiting clustered scarlet berries with yellow-orange outer covering in fall decoration, facilitating its spread. Asian bittersweet vines and leaves may become a massive weight burdening and weakening trees, causing them to become vulnerable to wind and ice storms. Trees attached by these vines may also be pulled down when one tree falls or is cut down. The destructive impacts of invasive Asian bittersweet on trees and shrubs requires its prevention and control using mechanical (cutting and pulling) and chemical (herbicide treatment) methods .

Purple Loosestrife (*Lythrum salicara*)

Purple loosestrife, a native plant of Eurasia, was first reported in North America in 1814. Its means of introduction is unclear and may have involved multiple introductions. These include being introduced accidentally through ship ballasts or seeds that were transported in imported raw wool or on sheep, or deliberately brought over as an ornamental plant, a source of nectar for beekeeping or for medicinal reasons. The recognized presence of purple loosestrife populations established in estuaries between Massachusetts and New Jersey before 1900 is thought to indicate the area of its original introduction. More inland populations were reported by the 1900s with continual spread through garden plantings and waterways. Purple loosestrife is a striking herbaceous perennial wetland plant, standing three to 10 feet tall but five feet tall on average, with beautiful purple flowers adorning the 4-16 inch spikes at the tips. Its beauty is deceptive, however, as its rapid, spreading growth forms a monotypic stand that no bird, mammal, or fish depends on. A purple loosestrife plant produces 2.5 to 2.7 million seeds annually that are viable for years, remaining dormant until germination conditions are suitable, and are easily dispersed and transported by water, wind, birds, mammals, and humans. Purple loosestrife also spreads by resprouting from broken stems, underground roots, and plant fragments. It has no natural predators, disease or insect, on this continent, which only strengthens its prevailing ability to out-compete native vegetation and form monotypic stands. It prefers moist organic soils, fluctuating water levels and full sunlight, conditions under which many native plants are stressed. Purple loosestrife tolerates a wide range of environmental conditions such as temperature, sunlight, pH and nutrient levels, and has the ability to grow and establish on a wide range of substrates including gravel, sand, clay, and organic soil. Its favored habitats are freshwater marshes, open stream margins, and alluvial floodplains; however, it successfully invades wet meadows, pasture wetlands, cattail marshes, stream and riverbanks, lake shores, irrigation ditches, drainage ditches and stormwater retention basins, and disturbed areas such as construction sites. Purple loosestrife displaces and replaces native flora and fauna, causing habitat devastation and resulting in elimination of food, nesting, and shelter for wildlife and diminished habitat availability. It threatens wetlands and waterways, as well as fish spawning and waterfowl habitat. It fills in wetlands and reduces the water flow and flood retention. Although no control method will completely eliminate purple loosestrife, the use of physical, biological, and chemical controls helps to stabilize populations within ecologically acceptable limits. Loosestrife-feeding beetles (*Galerucella* spp.) from Europe have been introduced to North America in the 1990s as a potential biological control. There has been considerable success in using these beetles to control purple

loosestrife levels in marshes throughout the Northeast, including in Massachusetts (e.g., at the Unkamet Brook Area of the GE-Pittsfield/Housatonic River Site; see, e.g., GE 2023).

Reed Canary-Grass (*Phalaris arundinaceae*)

Reed canary-grass is native to Europe, Asia, and North America; however, the European cultivar was introduced to the United States in the early 1800s for forage grasses and revegetation of eroded stream banks. The growth of the European reed canary-grass is more aggressive and is believed to have been cross-bred for this trait, resulting in the invasive reed canary-grass cultivars. Reed canary-grass is a perennial sod-forming grass that grows two to nine feet tall. It inhabits areas typical of wet soils, preferably wetlands and floodplains adjacent to rivers and streams that are found in cool-season regions. It is also found thriving along lakesides, and in marshes and ditches. Although it favors wet soils, it can also grow in dry soils in wooded areas that are shaded and along roadways. Reed canary-grass invades and spreads rapidly through rhizomes and runners and its dense growth eliminates other native vegetation, including tree growth in floodplain forests. It forms dense monotypic colonies that may grow to cover acres, severely diminishing available wildlife or waterfowl habitat. It is difficult to eradicate established colonies and various mechanical and chemical methods are required for control.

Water Chestnut (*Trapa natans*)

Water chestnut (*Trapa natans*) is an aggressively invasive, non-native, rooted, floating aquatic plant. It has been declared a noxious weed in Massachusetts and placed on the Massachusetts Prohibited Plant List since January 1, 2006. As an invasive species, water chestnut is able to quickly adapt to a new environment, and with no natural predators, it thrives to form massive populations that devastate a community habitat. Water chestnut is a very hardy annual species that invades preferably quiet, nutrient-rich shallow to deep (growth in up to 16 feet depth) freshwater habitats. It may also be found growing in slow-moving water. It endures a pH range of 6.7 to 8.2 and may over-winter in the frozen lakes of northern climates (MA DCR 2024). Water chestnut infests areas by intrusively covering the water surface with mats up to three layers deep (Concord 2024). It is a prolific reproducer, producing at least one flower annually that forms a nut-like fruit that produces 10-15 floating rosettes by mid-July with each rosette having a four-horned, sharpy barbed nut-like structure (water caltrop) attached to the underside. Each water caltrop produces up to 20 seeds, which ripen and drop by mid-August. Seeds may embed within the sediments below or be carried a distance by water or by clinging to wildlife, boats, and other equipment used for water recreation. Each seed is viable for up to 12 years within sediments (CT River Conservancy 2024, MA DCR 2024, Concord 2024). To envision the prolificacy of the water chestnut, in “one single season, one acre of Water Chestnut can produce enough seeds to cover 100 acres the following year” (MA DCR 2024).

Appendix F-3 provides additional information on water chestnut, including an assessment of management considerations associated with the remedial activities in Woods Pond.

References for Appendix F-2

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Minnesota DNR (Department of Natural Resources), 2022. Buckthorn Management. Available at: https://www.dnr.state.mn.us/invasives/terrestrialplants/woody/buckthorn/index.html. Also see: https://www.dnr.state.mn.us/invasives/terrestrialplants/woody/buckthorn/control.html.

MIPAG (Massachusetts Invasive Plant Advisory Group), 2005. The Evaluation of Non-Native Plant Species for Invasiveness in Massachusetts (with annotated list). Massachusetts Invasive Plant Advisory Group. April 1, 2005. Updates on-line at: MIPAG - Massachusetts Invasive Plant Advisory Group (massnrc.org).

USACE, 2020. New England District Compensatory Mitigation Standard Operating Procedures. December 29, 2020. NEW ENGLAND DISTRICT REGULATORY DIVISION COMPENSATORY (army.mil).

The following websites have also provided information in assembling the invasive species summaries:

https://www.invasive.org/weedcd/pdfs/ipane/Phalarisarundinacea.pdf

https://www.invasive.org/alien/pubs/midatlantic/phau.htm

https://www.invasive.org/alien/pubs/midatlantic/lomo.htm

https://www.invasive.org/weedcd/pdfs/ipane/Lythrumsalicaria.pdf

www.des.nh.gov

www.mass.gov/doc/purple-loosestrife-0/download

https://www.invasive.org/weedcd/pdfs/ipane/Phalarisarundinacea.pdf

https://naturalresources.extension.iastate.edu/encyclopedia/reed-canary-grass-invasive-species-profile

https://dnr.wisconsin.gov/sites/default/files/topic/invasives/ReedCanaryGrass.pdf

IPANE - Catalog of Species Search Results (invasive.org)

(https://extension.psu.edu/multiflora-rose).

https://www.michigan.gov/invasives/id-report/plants/vines/oriental-bittersweet

https://www.lmpa.org/wp-content/uploads/The-Practical-Guide-to-Lake-Management-in-Massachusetts.pdf

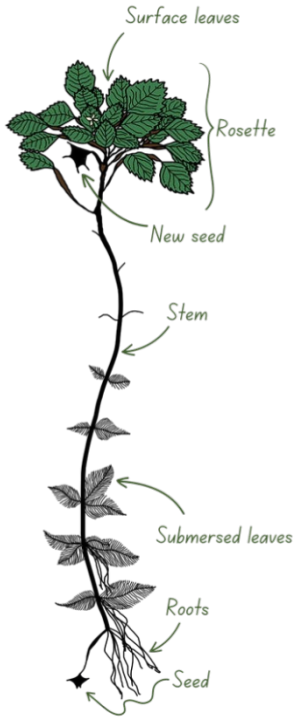
Appendix F-3: Assessment of Water Chestnut Management Considerations Associated with Remedial Activities in Woods Pond.

Introduction and Background

A dominant feature of the biota in the main part of Woods Pond is the aquatic macrophyte community. While both native and invasive floating-leaved and submerged aquatic plants are prevalent here, much of the pond is overwhelmed with the growth of the invasive water chestnut (*Trapa natans*), with Eurasian watermilfoil (*Myriophyllum spicatum*) also common. Woods Pond is densely choked with these species, particularly from the mid-summer to early fall time period. While there is some habitat value to any submerged or floating-leaved plant growth, the excessive density of the water chestnut results in adverse impacts to habitat functions and water quality by depleting dissolved oxygen levels, blocking incident sunlight, and displacing other native submerged aquatic macrophytes with greater habitat value (Humel and Kiviat 2004). The density of aquatic plant growth is reduced in the deeper portions of the southeastern basin and in the areas of submerged channel flow, including throughout much of the headwaters zone and also in the outlet channel upstream of the dam. Due to the dominance of water chestnut in the Woods Pond aquatic habitat, and the need to consider the control and management of this species in connection with remedial activities, this appendix provides additional focused information on the water chestnut, including summaries of other management efforts in southern New England. No definitive plan for water chestnut has been developed at this time. However, it is anticipated that management of this species will need to be part of the dredging program in Woods Pond, and the information presented in this appendix will be considered in the development and evaluation of management options.

Water Chestnut: Background and Biology

Water chestnut is an aggressively invasive, non-native, rooted, floating aquatic plant (see inset figure). It has been declared a noxious weed in Massachusetts and placed on the Massachusetts Prohibited Plant list since January 1, 2006 (MA DCR 2024). It is native to Europe and Asia and believed to have been first observed in 1859 in Concord, MA. Water chestnut was reportedly planted intentionally in Fresh Pond, Cambridge, MA (and a few other ponds) in 1897 by a gardener and rapidly spread into nearby rivers and ponds. It became well established in the Concord and Charles River systems and reached western portions of the state by 1920 (MA DCR 2024). The CT River Conservancy reports water chestnut was introduced to the Cambridge Botanical Garden at Harvard University in 1877 and planted in Collins Lake as well as other ponds in Massachusetts. The water chestnut escaped and was found growing in the Charles River by 1879 and further established in the Hudson and Connecticut Rivers, spreading as far south as Virginia and Kentucky and north to Quebec and continues its spread (CT River Conservancy 2024).



As an invasive species, water chestnut is able to quickly adapt to a new environment, and with no natural predators, it thrives to form massive populations that devastate a community habitat. Water chestnut is a very hardy annual species that invades preferably quiet, nutrient-rich

shallow to deep (growth in up to 16 feet depth) freshwater habitats. It may also be found growing in slow moving water. It endures a pH range of 6.7 to 8.2 and may over-winter in the frozen lakes of northern climates (MA DCR 2024). Water chestnut infests areas by intrusively covering the water surface with mats up to three layers deep (Concord MA 2024). It is a prolific reproducer, producing at least one flower annually that forms a nut-like fruit that produces 10-15 floating rosettes by mid-July with each rosette having a four-horned, sharpy barbed nut-like structure (water caltrop) attached to the underside. Each water caltrop produces up to 20 seeds, which ripen and drop by mid-August. Seeds may embed within the sediments below or be carried a distance by water or by clinging to wildlife, boats, and other equipment used for water recreation. Each seed is viable for up to 12 years within sediments (CT River Conservancy 2024, MA DCR 2024, Concord MA 2024). To envision the prolificacy of the water chestnut, in "one single season, one acre of Water Chestnut can produce enough seeds to cover 100 acres the following year" (MA DCR 2024).

Description of Water Chestnut

Water chestnuts are rooted aquatic plants that have 2-4 centimeter (cm) wide leaves that form floating rosettes on the water's surface. The triangular leaves are waxy and shiny on the upper side with fine hairs covering the underside, toothed on two sides with wavy leaf margins, and attached to the main stem by a flexible, submerged inflated petiole. At the base of the floating rosette is an air bladder. The submerged feathery leaves are whorled around the stem that grows in shallow to deep freshwater habitats, reaching lengths of up to 15-16 feet to facilitate its invasion and colonization. Tiny white, four petaled flowers that typically bloom in July, but potentially develop until the first frost, produce a three cm seed or nut with four characteristic horns that have very sharp ½-inch barbs. A single rosette or plant floating on the water indicates a newly invaded or lightly infested area, but left untreated, water chestnut will grow and spread to form dense floating mats that cover waterbody surfaces (MA DCR 2024, CT River Conservancy 2024).

Ecological Impacts of Water Chestnut

Water chestnut creates imminent threats to any water habitat it invades. Water chestnut forms dense mats that have little nutritional or habitat value to fish and waterfowl. Its impact as a highly competitive plant with its rapid growth and spread is devastating to native species, forcing their displacement and reducing the biodiversity of the water habitat as it drains the available nutrients from the water and soil, depriving native plant species of essential nutrients for survival. The dense, impenetrable floating mat cover prevents light availability for aquatic organisms and photosynthesis by other submerged plants, which kills and excludes species creating 'dead zones' of reduced carbon dioxide and consumption and oxygen production, which in turn displace native aquatic plants and organisms (Humel and Kiviat 2004). As increased water chestnut and loss of submerged plants decompose, the water's dissolved oxygen availability decreases and the abundance of decaying plants warms the water, progressively impairing the survival of fish and aquatic life. These adverse impacts subsequently yield displacement of essential native plant life, fish, and aquatic organisms, followed by the consequential displacement and habitat loss of waterfowl and wildlife, ultimately affecting the function of the entire aquatic ecosystem. The thick mats of water chestnut can trap and collect organic matter creating water pollution hazards (Humel and Kiviat 2004) and prolific breeding grounds for mosquitos, and may also trap silt leading to sediment accumulation of plant material and silt detrimental to fish and aquatic life (MADCR 2024). Water chestnut spreads and clogs the water surface to greatly impede or totally limit recreational

activities such as boating, fishing, swimming, and water skiing, and create a hazard for walking and for swimmers and beach goers along the shoreline as the sharp ½-inch barbs of the four-pronged nut are able to penetrate leather soles of shoes. The presence and effects of water chestnut also ultimately impact real estate values (MA DCR 2024).

Options and Considerations in the Management of Water Chestnut

The removal of invasive water chestnut promotes the repopulation of native aquatic plants and solidification of sediment in the water habitat. The key to keeping water chestnut from invading new areas is to remove plants before they have a chance to go to seed (CT River Conservancy 2024). Although biological control is effective in its original native areas, there is no known biological control of water chestnut in the U.S. Due to its seed viability of 12 years, any method of control used requires attentive monitoring and harvesting for years for successful removal. Any method of removal must be done during the summer months of June to August before the seeds fall. Current water chestnut removal methods may include mechanical removal, drawdowns, or herbicides. These options are briefly discussed below, as summarized by the Massachusetts environmental agencies (MA EOEEA et al. 2004), along with initial considerations in the application of each option at Woods Pond as part of the dredging operation.

The Massachusetts environmental agencies have collaborated on the issuance of a Generic Environmental Impact Report (GEIR) on Eutrophication and Aquatic Plant Management in Massachusetts (MA EOEEA et al. 2004), and this information was substantially updated in 2020 as a result of lake management consultation meeting involving the City of Pittsfield, Massachusetts, the Lake Onota Preservation Association (LOPA), the Friends of Pontoosuc (FOP), and Dr. Ken Wagner on January 13, 2020 (Wagner 2020, considered an informal update to the GEIR). The GEIR is intended to provide guidance to lake and pond managers, conservation commissions, and citizens concerned with lake management issues. The GEIR describes technical approaches and management options for control of aquatic vegetation and for the protection and enhancement of lakes and ponds in Massachusetts.

Mechanical Harvesting

Mechanical harvesting is most often associated with large machines on pontoons that cut and collect vegetation, but encompasses a range of techniques from simply cutting the vegetation in place to cutting, collecting, and grinding the plants, to collection and disposal outside the waterbody. In its simplest form, cutting, a blade of some kind is applied to plants, severing the active apical meristem (location of growth) and possibly much more of the plant from the remaining rooted portion. Regrowth is expected, and in some species that regrowth is so rapid that it negates the benefits of the cutting in only a few weeks. If the plant can be cut close enough to the bottom, or repeatedly, it will sometimes die, but this is more the exception than the rule. Cutting is defined here as an operation that does not involve collecting the plants once they are cut, so impacts to dissolved oxygen and nutrient release are possible in large-scale cutting operations.

Advanced technology cutting techniques involve the use of mechanized barges including harvesters or hydro-rakes normally associated with harvesting operations, in which plants are collected for out-of-waterbody disposal. Hydroraking involves the equivalent of a floating backhoe, usually outfitted with a york rake that looks like a farm implement for tilling or moving silage. The tines of the rake attachment are moved through the sediment, ripping out thick root masses and associated sediment and debris. A

hydrorake can be a very effective tool for removing submerged stumps, water lily root masses, or floating islands. Use of a hydrorake is not a delicate operation, however, and will create substantial turbidity and plant fragments. Hydroraking in combination with a harvester can remove most forms of vegetation encountered in lakes. Hydroraking is also often used to remove subsurface obstructions such as stumps or logs.

Harvesting may involve collection in nets or small boats towed by the person cutting the weeds, or can employ smaller boat-mounted cutting tools that haul the cut biomass into the boat for eventual disposal on land. It can also be accomplished with larger, commercial machines with numerous blades, a conveyor system, and a substantial storage area for cut plants. Off-loading harvested plants can be difficult, requiring large equipment due to the weight of plants and also requiring sizeable area for staging, processing, and transporting plant material removed from the water. Cutting rates for commercial harvesters tend to range from about 0.2 to 0.6 acre per hour, depending on machine size and operator ability, but the range of possible rates is larger and is often dependent upon distance to the offloading location when out-of-waterbody disposal is planned.

The use of a mechanical harvester in deeper, more open water (as it cannot be used in shallow water) or a hydrorake in shallow water and along shorelines are suitable methods for water chestnut removal when completed before mid-August when the water caltrops ripen, begin their release, and drop into the water. Harvesting before seed-producing species such as water chestnut can generate and disperse seeds can reduce the abundance of those species once the existing seed bed has been depleted.

Mechanical harvesting of water chestnut appears to be a viable option to consider at Woods Pond as part of the dredging operation. This could involve harvesting in sections of the pond in advance of hydraulic dredging in order to remove the water chestnut biomass and aid in clearing the pond bottom for the initial dredging operation. As noted above, options for off-loading and disposal of the plant biomass would need to be considered, as would the timing and sequencing of plant harvesting in conjunction with the dredging. For subsequent (future) sediment removal/capping operations in Woods Pond after upstream remediation has occurred, the applicability of mechanical harvesting would need to be evaluated based upon the status of water chestnut recolonization. It seems likely that the initial deepening of the pond and removal of the major water chestnut seed bank in the dredged sediments would result in minimal recolonization and negate the need for future mechanical harvesting; however, spot herbicide treatments may be considered (see discussion below).

Drawdowns

Drawdowns are used to reduce the water level of a pond or lake to kill invasive plants by providing access to cut them down, exposing their roots to freezing temperature (fall/winter), and restricting available water, while providing ease of removal from the shoreline. Drawdowns are usually done in October, after the water chestnut has already dropped its seeds and is dying or dead, and therefore not a candidate for removal treatment at that time. Drawdowns during the summer may be effective in water chestnut removal if done for a time and at a depth sufficient to prevent seeds from re-growing, and multiple times during the growing season to catch late seeds, which is realistically thought to be unreasonable. Drawdown of a waterbody, especially in summer, can negatively impact fish, reptiles, amphibians, aquatic organisms and downstream habitats. The water level must be lowered slowly with care to not lower it too much to allow for aquatic life and wildlife to adjust to the new water level and

pressure changes in the habitat, and also to prevent flooding, sediment relocation, decrease in oxygen concentrations, and other negative effects on downstream habitats.

The application of drawdowns at Woods Pond would appear to be limited due to the above constraints as well as those associated with controlling the flow of water from the Housatonic River. While unlikely, consideration could be given to partial drawdown for certain shallow portions of the pond.

Herbicides

The use of approved herbicides to manage the excessive growth of aquatic plants is a long-standing (>50 years) accepted practice in the Northeast U.S., including Massachusetts. The acceptability of this practice is recognized in the regulations to the Massachusetts Wetlands Protection Act, where "the removal of aquatic nuisance vegetation to retard pond and lake eutrophication" is included as an Ecological Restoration Project under limited project provisions (310 CMR 10.53(4)(e)5.). This is particularly applicable in cases such as Woods Pond where excessive growth of invasive aquatic macrophytes predominates in the pond; removing invasive species is by definition not detrimental to aquatic habitat functions. Use of an herbicide that is included in the GEIR implicitly indicates compliance with requirements for applying herbicides to aquatic habitats in the Commonwealth. The technical guidance in the GEIR includes information on the herbicides that are approved for use in lakes and ponds to control aquatic vegetation (Appendix III of GEIR). In order to have new active ingredients and products added to the GEIR, a critical technical review is conducted by staff of MA DEP and the Massachusetts Department of Agricultural Resources (MA DAR). The review is conducted with an emphasis on non-target aquatic toxicity.

Herbicide treatments are effective in the removal of invasive aquatic plant infestations, including water chestnut. "Very few techniques can get a plant infestation under control quickly and at a reasonable cost the way herbicides can, when properly chosen and applied" (Wagner 2015). Contact herbicides may be effective for small areas of invasive plants but may not kill the roots and therefore are best for removing annuals and not reliable for removal of perennials. In addition, seeds may not be affected by contact herbicides. This requires attention to the timing and possibly multiple herbicidal treatments to eliminate annual regrowth. Systemic herbicide application is taken up by the plant roots and stems, killing the entire plant as the herbicide is translocated throughout it, ensuring elimination of regrowth. It is most effective against large invasive plant infestations, such as that of water chestnut at Woods Pond. Systemic herbicide treatment is effective for removal of perennial plants (such as water chestnut) since it works to kill the entire plant, provided that care is taken to prevent seed regrowth with yearly treatments to seed bank growths (MA EOEEA et al. 2004).

The choice of herbicide to manage an undesirable plant population depends on the properties of the herbicide, the relative sensitivity of the target and non-target plants and other organisms that will be exposed, and water use restrictions after herbicide use (MAEOEEA et al. 2004). Effectiveness in controlling the target plant species is normally the primary consideration. Other factors determine possible choice between two or more potentially effective herbicides, dose, and whether a treatment is actually feasible. Herbicide effectiveness may be influenced by such factors as timing, rate and method of application, species present and weather conditions. Detailed information, especially for newer herbicides, can be obtained online through the MA DAR (https://www.mass.gov/herbicides-for-aquatic-vegetation-management), which must approve herbicides before they can be used in Massachusetts and prepares thorough documentation on each herbicide proposed for use in the state. The GEIR

updated information (Wagner 2020) indicates that a "high level of control" of water chestnut is possible with several approved herbicides, including imazamox (with a trade name of Clearcast), imazapyr, 2,4-D (2,4-dichlorophenoxyacetic acid), and florpyrauxifen-benzyl. Recent experience in Massachusetts has shown that the selection of Clearcast for treating water chestnut has resulted in very effective control (see case study discussed below for the Sudbury River and associated waterbodies). MA DAR and MA DEP issued a technical review on imazamox in 2014, which serves as the basis for the update to the GEIR for the use of this herbicide (MA DAR and MA DEP 2014). AECOM (2009) provided a comprehensive review of imazamox as part of a Supplemental Final Environmental Impact Statement submitted to the New York State Department of Environmental Conservation; it notes that "Imazamox is practically non-toxic to fish and aquatic invertebrates [citing USEPA, 2008]. At the highest concentration tested, there were no observed adverse effects to fish or aquatic invertebrates."

Based on the information considered to date, the use of herbicides to manage and control water chestnut biomass in connection with the Woods Pond dredging operations appears to be a viable and even preferred option. Foliar applications directly to water chestnut by imazamox or imazapyr (for example) could relatively quickly reduce the biomass in advance of hydraulic dredging, and these herbicides degrade quickly in the aquatic environment. Caution may be applied to treatment of too large of an area at one time, since with the heavy biomass present in Woods Pond in late summer concern is warranted for creating excessive dead and dying macrophyte biomass following applications that could impact dissolved oxygen levels in the pond for a temporary period. Herbicide control measures may also be considered during the interim period between the initial dredging and follow-up removal/capping if water chestnut re-colonization is noted during that period.

Case Studies of Water Chestnut Control Efforts in Sudbury, MA

A collaborative effort among the U.S. Fish and Wildlife Service,, the Town of Sudbury, MA, and the Hop Brook Protection Association has worked to manage water chestnut growth in the Sudbury River and associated waterbodies including Grist Mill, Carding Mill, and Stearns Mill Ponds over a multi-year period starting in 2020 (Water Chestnut Management in Sudbury » Conservation Commission). The subject area includes a portion of the Great Meadows national wildlife refuge in Sudbury and Wayland, MA along the Sudbury River, which is tributary to the Concord River. The invasive water chestnut was first observed in Concord, MA and established in the Concord and Charles River systems in the 1800s, which facilitated its prolific spread and establishment across the state. After many years of unsuccessful mechanical and manual attempts to harvest the aggressive, invasive water chestnut from these waterbodies, these agencies chose to use an herbicidal treatment, Clearcast (imazamox), approved under an Order of Conditions issued by Sudbury Conservation Commission and a MA DEP permit. Clearcast was applied with knowledge that it would be a multiple-year application process due to the potential seed viability of the water chestnut in seed banks of up to 12 years.

The liquid herbicide, Clearcast (imazamox), was paired with a non-ionic surfactant. The surfactant helps the herbicide stick to the target water chestnut plants and also increases penetration through the plant. A calibrated spray utilized to spread the product by the foliar application method. This methodology ensures that the herbicide is evenly spread in treatment areas and applied on the surface of the leaves. Clearcast applications by a licensed applicator (Water & Wetland, Inc.) in early summer (by the first week of July) resulted in noticeably dead and dying water chestnut within two weeks of application, with some plants having fallen from the water column within that time period (Water Chestnut

Management in Sudbury » Conservation Commission). A second application in later July was directed at remaining live water chestnut plants. The applicator noted that earlier applications in June were recommended prior to any seed setting, and also to address the dense water chestnut growth, where it grows on top of itself, leaving some plants less susceptible to herbicide coverage. Overall, the applicator found that by late summer the water chestnut had significantly decreased in densities following the series of treatments performed earlier in the summer. The applicator concluded that with these as the only locations of invasive water chestnut known in Sudbury, covering about 100 acres of the ponds and the Sudbury River, effective management through herbicide treatments will continue to reduce populations with time and minimize its spread downstream until the goal of its eradication from these waterbodies is achieved (Water & Wetlands 2022a and 2022b).

The recent experience of treating water chestnut in the Sudbury River and associated waterbodies using imazamox (or Clearcast) provides useful information of how this species may be managed in Woods Pond in connection with the remedial dredging program, as well as potentially as part of the post-dredging restoration program in Reach 6.

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