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Via Electronic Mail

April 29, 2026

Ms. Lisa Danek Burke
EPA Project Manager
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)
Restoration Plan for Reach 5A, including Restoration Corrective Measures Coordination Plan

Dear Ms. Danek Burke:

In accordance with the Revised Final Permit for the Rest of River and the Final Revised Rest of River Statement of Work, GE is herewith submitting for EPA's review and approval the Restoration Plan for Reach 5A. This plan includes, as an appendix, a Restoration Corrective Measures Coordination Plan for Reach 5A.

The main text of this Restoration Plan and its appendices, excluding Drawings, are being provided by e-mail, and a link to a SharePoint site is being provided for the full Restoration Plan, including Design Drawings. A complete hard copy of the Restoration Plan will also be sent to you.

Appendix B to this Plan is a Rare Species Conservation and Management Plan under the Massachusetts Endangered Species Act. That plan contains information on the specific locations of state-listed species that is considered Confidential Business Information and is not for public distribution. Therefore, the version of Appendix B included with the enclosed Restoration Plan has been redacted to strike out that information. A separate version of Appendix B that shows the information on locations of state-listed species will be submitted to EPA as Confidential Business Information, with a copy to its consultants and the Massachusetts Division of Fisheries and Wildlife.

Please let me know if you have any questions about the enclosed Restoration Plan and its appendices.

Very truly yours,

Kevin G. Mooney
Senior Project Manager

Enclosure

SEMS Doc ID 700856

Cc: (via electronic mail except where noted and except for Drawings provided via SharePoint)

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AECOM

Housatonic River Reach 5A Restoration Plan

Prepared for General Electric Company

April 29, 2026

Delivering a better world

Housatonic River Reach 5A Restoration Plan

Prepared for:

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April 29, 2026

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Abbreviations

ARAR	Applicable or Relevant and Appropriate Requirement
BEHI	Bank Erosion Hazard Index
BMPs	Best Management Practices
BRA	Baseline Restoration Assessment
CD	Consent Decree
CMP	Rare Species Conservation and Management Plan
DBH	diameter at breast height (of trees)
EPA	U.S. Environmental Protection Agency
ESA	Federal Endangered Species Act
Final Revised SOW	*Final Revised Rest of River Statement of Work*
GE	General Electric Company
GPS	global positioning system
IPaC	Information for Planning and Consultation (USFWS)
IPANE	Invasive Plant Atlas of New England
LGS	Low-gradient stream
LiDAR	Light Detection and Ranging
LWD	Large Woody Debris
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
NCD	Natural Channel Design
NBS	Near-Bank Stress
NPT	Native Plant Trust
PCBs	polychlorinated biphenyls
PDI	pre-design investigation
RBP	EPA Rapid Bioassessment Protocol
RCMCP	Restoration Corrective Measures Coordination Plan
RCRA	Resource Conservation and Recovery Act
RD/RA	Remedial Design/Remedial Action
Revised Final Permit	Revised Final RCRA Permit Modification
ROR	Rest of River
RPOEC	Restoration and Performance Objectives Evaluation Criteria
RU	Remediation Unit
SAV	submerged aquatic vegetation
SIP	Supplemental Information Package
SDC	Supplemental Data Collection
SOP	Standard Operating Procedure
SOW	Statement of Work
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
VP	Vernal Pool
WMA	Wildlife Management Area
WWTP	Wastewater Treatment Plant

1. Introduction

1.1 Background

On December 16, 2020, pursuant to the 2000 Consent Decree (CD) for the GE-Pittsfield/Housatonic River Site, 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) located downstream of the confluence of the East and West Branches of the Housatonic River (the Confluence). The Revised Permit set forth a Remedial Action selected by EPA to address polychlorinated biphenyls (PCBs) in the ROR (**Figure 1-1**).

The Revised 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, after receipt of EPA's comments on an earlier version, GE submitted a *Final Revised Rest of River Statement of Work* (Final Revised SOW) on September 14, 2021 (Anchor QEA et al., 2021), and EPA approved it on September 16, 2021. The SOW directed, consistent with the Revised Permit, that GE will develop a Restoration Plan for each Remediation Unit (RU) to return all areas disturbed by the remediation activities to pre-remediation conditions to the extent practicable and consistent with the remediation requirements.

This Restoration Plan covers Reach 5A of the ROR, which is the first RU to be addressed since it is the most upstream reach in the ROR (**Figure 1-2**). Remediation in Reach 5A will include removal and capping of sediments in the riverbed and remediation of associated backwaters, certain other waterbodies, riverbank soils, and floodplain soils (including those at residential properties, non-residential floodplain areas, and vernal pools to the extent required by the applicable Performance Standards included in the Revised Final Permit (described below). This Restoration Plan for Reach 5A is being submitted in conjunction with the Reach 5A Final Remedial Design/Remedial Action Work Plan (Final RD/RA Work Plan; Anchor QEA et al., 2026a), which provides the final design for the remedial actions in Reach 5A.This Reach 5A Restoration Plan outlines the strategies and measures for restoring ecological habitats and functions in this reach of the ROR following (or in concert with) PCB remediation activities. The restoration efforts aim to re-establish pre-remediation ecological conditions, mitigate impacts from remedial actions, and ensure long-term habitat sustainability following the remedial activities designed to mitigate PCB contamination. In addition, to increase the likelihood of restoration success, this Restoration Plan describes measures that GE will implement prior to restoration to minimize or mitigate adverse habitat impacts from remediation and supporting activities.

The Final Revised Permit and Final Revised SOW also require submission of a Restoration Corrective Measures Coordination Plan (RCMCP). The RCMCP is a coordination document that describes how restoration will be implemented in coordination with the remedial actions in Reach 5A[1] to support phased disturbance and progressive recovery and to reduce the magnitude and duration of habitat disruption to the extent feasible and consistent with remediation requirements. The Final Revised SOW provides that the RCMCP for a given Remediation Unit may be submitted either as a stand-alone plan (concurrently with the Restoration Plan) or as part of the Restoration Plan for that Unit. For Reach 5A, GE has elected, with EPA concurrence, to include that plan in this Restoration Plan as **Appendix E**.[2]

In preparation of this Restoration Plan, GE has followed a systematic approach to document ecological conditions in the habitats of Reach 5A, all consistent with the Revised Permit and SOW, and conducted

[1] The Revised Final Permit generally uses the term "Corrective Measures" to refer to the remediation activities that comprise the ROR Remedial Action. The RCMCP and this Restoration Plan generally use the term remediation or remedial activities to refer to those required activities.

[2] To avoid undue repetition, the RCMCP addresses the requirements for that plan largely through a high-level overview of remediation-restoration coordination activities and cross-references to the Final RD/RA Work Plan and this Restoration Plan for discussion of the details.

under EPA review and approval. Field surveys and reports to document such baseline conditions date back to the spring of 2018. During this process, several work plans were prepared, approved by EPA, and served to define the full spectrum of field surveys to document existing ecological habitat conditions in Reach 5A. These investigations culminated in a Revised Reach 5A Baseline Restoration Assessment (BRA) Report submitted to EPA on February 19, 2024 (AECOM, 2024) and approved by EPA on March 5, 2024. That Revised BRA Report, along with supplemental data collection since that time, serves as the foundation for documenting ecological conditions which are addressed herein.

In addition, a Restoration and Performance Objectives Evaluation Criteria (RPOEC) Report was prepared (Arcadis and AECOM, 2024) and approved by EPA to provide site-wide standards and criteria for ecological restoration which are incorporated into this Restoration Plan. The BRA Report and the RPOEC Report are described further in this Restoration Plan and referenced extensively in describing the purpose and objectives of the restoration procedures, as well as the pre-restoration minimization and mitigation measures.

1.2 Purpose and Scope

The purpose of this Reach 5A Restoration Plan is to establish a framework for restoring disturbed habitats and ecological functions at the conclusion of remediation, ensuring that the riverine/floodplain ecosystem returns to conditions equivalent to pre-remediation baseline conditions relative to habitat functions, including protection of federally and state-listed rare species. It addresses potential impacts from remedial activities including dredging, capping, riverbank and floodplain excavations, as well as supporting activities (access and staging); and it describes measures to minimize or mitigate such impacts prior to, during, and after restoration. As discussed in the next section, and as required by the Revised Permit, the objective of the Restoration Plan is to return riverine, riverbank, backwater, and floodplain habitats 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.

The scope of this Restoration Plan encompasses all PCB-affected areas in Reach 5A, including the main river channel, backwaters, other aquatic areas designated Other Waterbodies (e.g., Sykes Brook, West Pond), riverbanks, floodplains (wetland and upland), and vernal pools.[3] All habitats to be affected by remedial activities are addressed, including access roads and staging areas. Pre-restoration and restoration activities will integrate data from the BRA and the Final RD/RA Work Plan for habitat-specific approaches (e.g., replanting transitional floodplain forests, stabilizing erodible banks using principles of Natural Channel Design [NCD]) and rare species mitigation (e.g., conservation plans for wood turtles [*Glyptemys insculpta*], rare plants, dragonflies, and other rare species identified).

As described in the Final RD/RA Plan, several aspects of the design require input from the remediation contractor based on its planned remediation methods, including sediment and soil removal and transport methods, sediment dewatering, water management, cap material handling and placement, riverbank excavations and stabilization, staging area size and locations, access routes, and work sequencing. These aspects also affect the details of the restoration efforts. Because a remediation contractor has not yet been selected, GE and EPA agreed that the Final RD/RA Work Plan would focus on the remediation design, including remediation depths and extents, engineered cap details, and performance requirements. That work plan includes general discussion of the types of sediment/soil removal and backfill/cap placement technologies that may be used by contractors, and it also addresses the items that were required by EPA's December 3, 2024 conditional approval of the prior Conceptual RD/RA Work Plan for Reach 5A (Anchor QEA et al, 2023) to be included in the Final RD/RA Work Plan. These considerations also require integration with final restoration details, as the manner in which the remediation work is carried out will affect the scope and details of the restoration efforts.

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[3] Restoration of vernal pools are addressed herein in a limited manner, as, with one exception, the remediation and restoration of vernal pools in Reach 5A will be evaluated through a separate pilot study of selected vernal pools to determine the most appropriate remediation, followed by a decision on the remediation approach for the remaining vernal pools that require remediation. The one exception is vernal pool 5A-VP-13, which will be remediated along with floodplain remediation because it is located on a floodplain residential property. Accordingly, the restoration of that vernal pool is described in this plan.

As discussed in the Final RD/RA Work Plan, the anticipated schedule for implementation of the remedial activities in Reach 5A is over a period of five years (see **Figure 1-2**). Accordingly, Reach 5A has been subdivided into five subreaches (each approximately one mile long) corresponding to each anticipated year of construction. This sequencing of work, with restoration similarly sequenced to follow the remedial work in each subreach, also affects the assessment of ecological impacts, efforts to minimize those impacts, and the restoration of habitats. Consistent with that approach, detailed remedial design involving NCD for instream and riverbank habitats is provided in the Final RD/RA Work Plan and this Restoration Plan for the portion of Reach 5A planned for Year 1 construction (Stations 0+00 to 48+00, or from the Confluence to the Pomeroy Bridge). This includes detailed layout of NCD features and assessment of the habitat restoration aspects of this design within this first subreach. Section 1.2 of the Final RD/RA Work Plan describes this progression of design and construction implementation in detail, and explains that the comparable detailed layouts for downstream reaches will be provided in a future revision of or addendum to that work plan.[4]

This Restoration Plan is not limited to describing the proposed restoration of habitats in only the first subreach, as that limitation applies only to the level of detail to which the NCD has been advanced and the associated assessment of habitat restoration. Remedial impacts and habitat restoration of the entirety of Reach 5A are addressed herein. However, for the reason given above, the details relating to the restoration of the river channel and the riverbanks based on NCD principles are limited to the first subreach, and the comparable details relating to the NCD-based river and riverbank restoration in remaining subreaches will be provided in a later addendum to this Restoration Plan.

In summary, this Restoration Plan includes: (1) a description of measures to be implemented before and during remediation to minimize and mitigate habitat impacts; (2) design details related to restoration of riverine, riverbank, backwater, Other Waterbody, floodplain, and vernal pool areas; and (3) proposed monitoring and assessment of post-restoration conditions.

1.3 Plan Organization

This Restoration Plan is organized into 13 sections, followed by tables, figures, references, and appendices. Section 1 (Introduction) provides background, purpose, scope, and organization of this plan. Section 2 describes Reach 5A restoration Performance Standards, objectives, and criteria, including Revised Permit Performance Standards, evaluation criteria, corrective measures coordination, and additional EPA conditions. Section 3 overviews the Reach 5A BRA and supplemental surveys, covering scope, community types, functions, rare species surveys, and invasive species. Sections 4 through 9 focus on habitat-specific impact minimization and restoration activities for, respectively, riverine habitat (Section 4), riverbank habitat (Section 5), backwater habitat (Section 6), habitat of the Other Waterbodies (Section 7), floodplain habitat (excluding vernal pools) (Section 8 with sub-sections on wetland and upland types), and vernal pool habitat (Section 9). Each of those sections includes, for each habitat type, a description of the habitat, potential remedial impacts, minimization/mitigation measures, and the restoration program. Section 10 describes the post-restoration monitoring/assessment to be conducted for each habitat type. Section 11 provides a summary of the assessment of federal and state-listed threatened, endangered, and special concern species (referred to generally as “rare species”), including identification of such species in Reach 5A, measures to avoid or minimize impacts on those species, "takes" of such species (as defined in the federal and state endangered species laws), mitigation measures for unavoidable takes of these species, and post-remediation monitoring of such measures – all of which are described in detail in a separate Rare Species Conservation and Management Plan (CMP). Section 12 summarizes invasive species in Reach 5A and the control plan for managing those species. Section 13 discusses reporting of restoration activities, and Section 14 lists references cited.

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[4] As also described in the Final RD/RA Work Plan, remediation contractor procurement activities for the initial subreach of Reach 5A will commence following submission of the Final RD/RA Work Plan. In addition, following receipt of EPA’s comments on the Final RD/RA Work Plan, GE will revise this work plan as needed to address those comments and to incorporate other design information where warranted. Further, following selection of a remediation contractor, GE will incorporate additional design details related to remedy implementation, based on input from the selected contractor, into that future work plan revision or as part of the Supplemental Information Packages (SIPs) to be submitted after contractor selection.

Supporting materials include tables (e.g., data summaries), figures (e.g., maps, designs), and appendices. The appendices provide: (A) a discussion of the geomorphic assessment conducted and the NCD techniques applied to the river channel and riverbanks; (B) the Rare Species CMP; (C) an Invasive Species Control Plan (ISCP); (D) Restoration Planting Drawings, and (E) the RCMCP.

2. Reach 5A Restoration Performance Standards/Objective/Criteria

This section describes the restoration Performance Standards, objectives, and evaluation criteria for Reach 5A of the Housatonic River, as required under the Revised Permit. Reach 5A, the initial Remediation Unit in the ROR, spans approximately 4.6 river miles beginning at the Confluence and extending downstream to the Pittsfield Wastewater Treatment Plant (WWTP) outfall for the river and to the Pittsfield-Lenox municipal boundary just south of the Pittsfield WWTP for the floodplain. Restoration efforts described herein focus on returning disturbed habitats that will be impacted by PCB remediation activities such as sediment removal, capping, and bank/floodplain excavation, to pre-remediation ecological conditions, while meeting PCB reduction goals and minimizing long-term impacts. These standards integrate data from the Revised Reach 5A BRA Report and supplemental baseline surveys, which document existing habitats, functions, rare species, and invasive species, and align with site-wide ROR requirements for Reaches 5 through 8.

2.1 Revised Permit Restoration Performance Standards

Section II.B.1.c of the Revised Permit sets forth Performance Standards and other requirements for Restoration of Areas Disturbed by Remediation. The latter term is defined in the Revised Permit as follows: “[F]or all areas disturbed by remediation activities under this Permit, the implementation of measures to return such areas 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.” The defined Performance Standards for Restoration of Areas Disturbed by Remediation are to:

(1) Implement a comprehensive program of restoration measures that addresses the impacts of the Corrective Measures (i.e., remediation activities)[5] on all affected ecological resources, species and habitats, including, but not limited to, riverbanks, riverbed, floodplain, wetland habitat, and the occurrence of threatened, endangered, or other state-listed species and their habitats; and

(2) Return such areas 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.

In addition, with specific reference to riverbanks, Section II.B.2.a.(1)(e) of the Revised Permit establishes the following Performance Standard:

> Excavated riverbanks shall be reconstructed to minimize erosion considering the principles of Natural Channel Design (NCD) and result in a channel that is in dynamic equilibrium, balances flow and sediment loads, and reduces erosive forces. This will allow the maximum use of bioengineering methods in restoring riverbanks. Riverbank reconstruction shall follow a hierarchy of approaches as follows, with i. being the most preferred.
>
> i. Reconstruct disturbed banks with solely bioengineering restoration techniques.
>
> ii. Reconstruct disturbed banks with an Engineered Cap extending into the riverbank placed under a bioengineering layer; or
>
> iii. Place rip-rap cap or hard armoring on residual surface of banks (e.g., where needed for protection of adjacent infrastructure).

Under Section II.B.1.c.(2), these Performance Standards are to be achieved through a program designed to address the potential impacts of remediation, which are to be specified in the following series of documents:

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[5] The Revised Permit generally uses the RCRA term “Corrective Measures” to refer to the remediation activities that comprise the ROR Remedial Action. This Restoration Plan generally uses the term remediation or remedial activities to refer to those required activities.

(1) BRA Work Plan;

(2) RPOEC Report to guide the design, remediation, restoration, construction, implementation of remedial activities, and evaluation of restoration success;

(3) RCMCP to be performed during the implementation of the remediation actions; and

(4) Restoration Plans specific to various remediation areas to return all areas disturbed by the remediation activities to pre-remediation conditions.

The BRA Work Plan and Report are cited in Section 1 and referenced throughout this report. The RPOEC Report is summarized below and also referenced throughout this report. The RCMCP is being submitted concurrently with this Restoration Plan as well as being summarized below. This document and associated plans and specifications constitute the Restoration Plan required by the last item listed above.

2.2 Restoration Performance Objectives and Evaluation Criteria

The Revised RPOEC Report was submitted to EPA on April 15, 2024. It responded to EPA's January 29, 2024 conditional approval letter and met requirements of the 2020 Revised Permit and Final Revised SOW. The site-wide document addressed restoration of eight habitats—riverine, riverbank, backwater, impoundment, floodplain wetland/upland, vernal pools, and rare species habitat—across Reaches 5–8 (Confluence to Rising Pond), building on completed baseline assessments of each RU (e.g., Reach 5A) to return disturbed areas to pre-remediation conditions to the extent feasible. That report was conditionally approved by EPA on January 29, 2024.

The RPOEC Report identified ten restoration objectives, focusing on minimizing ecological impacts, restoring natural channel morphology via NCD (e.g., maximizing bioengineering for riverbanks), preventing erosion, re-establishing native vegetation, preserving flood storage and wetland functions, and complying with Applicable or Relevant and Appropriate Requirements (ARARs) (including rare species net-benefit standards). These objectives are tied directly to habitat functions (hydrologic, geomorphic, physicochemical, biological) and services (flood control, water quality, recreation, wildlife habitat). The RPOEC Report defined measurable, structurally based evaluation criteria using tools such as EPA Rapid Bioassessment Protocols (RBP), habitat inventories, bank stability, vegetative cover, and sediment parameters, plus successional re-establishment of fish/benthic macroinvertebrate populations and rare-species mitigation. The RPOEC Report also described a preliminary seven-year post-construction monitoring program for the restoration measures (focusing on habitat structure, vegetation, functions) and maintenance/corrective actions for erosion, invasives, herbivory, or beaver (*Castor canadensis*) impacts.

2.3 Additional EPA Requirements

EPA's December 3, 2024 conditional approval letter for GE's Reach 5A Conceptual Work Plan contained a number of requirements to ensure that the Final RD/RA Plan addresses specific restoration aspects. These include the following conditions, which are addressed in this Restoration Plan:

- Condition 35: Discuss considerations given to seasonal construction limitations given species life history requirements;
- Condition 78: Address mitigative measures for potential impacts in-river from remediation, including dewatering impacts, water quality impacts, removal of woody debris and other structural habitat elements, substrate changes, and impacts to state-listed species;
- Condition 79: Propose riverine plantings of any aquatic state-listed species impacted by riverine remediation;
- Condition 80: Address the impact of large trees having to be removed as part of the riverbank restoration, including replacement plantings; and

- Condition 81: Address mitigative measures for impacts to riverbanks, including alteration of connectivity between the river and adjacent floodplain, removal of structural habitat features on the banks, alteration of bank suitability for providing burrows, nesting, and crevices/cavities for multiple wildlife species, potential impacts on state-listed species, and potential colonization of invasive species.

3. Reach 5A BRA and Ecological Characterization Overview

Reach 5A features a diverse array of ecological community types shaped by the river's meandering course, floodplain dynamics, and surrounding land uses, which include residential, protected open space, agricultural, and forested areas. The primary riverine habitat consists of a low-gradient, sinuous channel with widths ranging primarily from 70 to 100 feet and normal stage water depths of one to three feet, dominated by fine substrates like sand and silt deposits, interspersed with gravel and cobble riffles. This habitat supports aquatic communities including benthic macroinvertebrates (e.g., dragonflies, mayflies, caddisflies) and fish assemblages with species such as largemouth bass (*Micropterus salmoides*), yellow perch (*Perca flavescens*), and various minnows. Riverbank communities are transitional zones with overhanging trees interspersed with more open herbaceous and shrubby vegetation zones. Backwaters and remnant oxbows host emergent wetlands with cattails and sedges, providing unique hydrologic conditions closely tied to the riverine flooding and fostering diverse invertebrate and fish populations. The floodplain encompasses wetland types such as transitional floodplain forested wetlands (dominated by silver maple [*Acer saccharinum*], green ash [*Fraxinus pennsylvanica]*, and eastern cottonwood [*Populus deltoides*]), shrub swamps, shallow marshes, and wet meadows, alongside upland forests with oaks and hickories. Vernal pools are commonly dispersed throughout the floodplain, numbering 59 in Reach 5A, and represent ephemeral wetlands critical for breeding amphibians like wood frogs (*Lithobates sylvaticus*) and spotted salamanders (*Ambystoma maculatum*). These communities are interconnected, with urban/suburban influences near the upstream end transitioning to more natural forested settings moving downstream; these community cover types are shown, along with areas subject to remedial activities, on **Figure 3-1**.

While the various habitats (from the river through the floodplain) in Reach 5A are treated individually in the following sections, this Restoration Plan recognizes that these habitats are functionally interdependent and together comprise a large contiguous corridor. For example, aquatic riverine habitat cannot be considered separately from the banks and floodplain, including overbank flooding and flow dispersal in the floodplain, and the life cycles of many aquatic species have aerial/terrestrial periods or are dependent upon terrestrial processes (e.g., food inputs). Therefore, restoration of a specific resource such as in-stream habitat needs to consider the remedial activities and restoration of all other habitats.

3.1 Reach 5A BRA Scope

As previously noted, Section II.B.1.c.(2)(a) of the Revised Permit required GE to conduct a BRA of areas that will be affected by the ROR Remedial Action. GE submitted a Reach 5A BRA Report in August 2023 and subsequently submitted a Revised Reach 5A BRA Report in February 2024 (AECOM, 2024). The Revised Reach 5A BRA Report provides a description and assessment of the pre-remediation conditions, functions, and values of river bottom, riverbank, backwater, floodplain, impoundment, and vernal pool habitats as well as the identified habitats of federal or state-listed threatened or endangered species or other state-listed species and any invasive species in the areas affected by remediation within Reach 5A.

The BRA was based on data collection performed from July 2022 through June 2023 pursuant to the EPA-approved Revised Reach 5A BRA Work Plan (AECOM, 2022), which included BRA data collection and mapping within the 1 milligram per kilogram (mg/kg) PCB isopleth, which marks the lateral limit of the ROR floodplain in Reach 5A. The assessment also incorporated results from prior investigations, including ecological characterizations, rare species surveys, and vernal pool investigations conducted between 2018 and 2020, as well as updated mapping and information provided by the Massachusetts Natural Heritage and Endangered Species Program (MNHESP).

In addition to the original BRA field effort, supplemental BRA surveys were conducted in 2025 to further refine and update ecological baseline information within areas anticipated to be affected by remediation or associated support activities. These supplemental BRA surveys included additional surveys of riverine, backwater, riverbank, floodplain, vegetation, and wildlife habitat features, updated invasive plant mapping, tree surveys, and rare species investigations to enhance the characterization of existing conditions and to inform remedial design and restoration planning. These activities were described in GE's Supplemental Data Collection Summary Report for Reach 5A (Reach 5A SDC Report; Anchor QEA et al., 2026b).

3.2 Overview of Reach 5A Ecological Community Types and Functions

Reach 5A includes approximately 409 acres of habitat. This area contains the following habitat types: 39 acres of riverine habitat and 50,000 linear feet of riverbanks associated with the Housatonic River; four acres of backwater habitat; three acres of Other Waterbodies (e.g., Sykes Brook and Sackett Brook); 302 acres of floodplain wetland habitat (including vernal pools); and 55 acres of upland floodplain habitat, of which approximately 31 acres is managed/disturbed habitat (i.e., agriculture and cultural grasslands).

The ecological functions in Reach 5A are integral to the overall health of the Housatonic River ecosystem, supporting biodiversity, water quality, and resilience to disturbances. The river channel facilitates sediment transport, nutrient cycling, and hydrologic connectivity, with riffle-pool sequences promoting oxygenation and habitat diversity for aquatic life. Vegetated riverbanks stabilize soils, reduce erosion, and filter runoff, while providing corridors for wildlife movement and nesting sites for birds and turtles. Backwaters act as nurseries for fish and amphibians, enhancing productivity through detrital decomposition and organic matter export to the main channel. The floodplain performs critical floodwater storage and attenuation, mitigating downstream flooding while recharging groundwater and supporting nutrient retention via wetland vegetation. Vernal pools offer predator-free breeding habitats, contributing to amphibian metapopulations and food web dynamics through seasonal pulses of biomass. Overall, these functions maintain species diversity, support trophic interactions (e.g., from invertebrates to piscivorous birds and mammals), and provide ecosystem services like water quality improvement and carbon sequestration.

Several investigations of the ROR over the past 25 years have noted the relationship between habitat diversity (as referenced above) and the instability of the system due to historic disturbances (e.g., Stantec, 2009; Weston, 2011, 2014). This instability is indicated by river channel geomorphic conditions such as tight meander bends with eroding outer banks and poor point bar development. Areas with high bank erosion are often out of phase with the planform of the river, resulting in areas of accelerated horizontal instability. These conditions may promote certain types of habitat diversity, but they are not sustainable and may promote erosion and transport of PCBs.

3.3 Reach 5A Rare Species Overview

Rare species considerations for Reach 5A were identified through federal and state screening reviews and then refined through field investigations. Federal species review relied on the U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) system to identify federally listed species with potential to occur in Reach 5A. State species review relied on information provided by the MNHESP, including Species Habitat, Priority Habitat, and Core Area mapping, to identify state-listed species and sensitive habitat areas within the reach.

As summarized in GE's BRA reports, the IPaC review identified the northern long-eared bat (*Myotis septentrionalis*) as a federally listed species with potential presence/habitat in Reach 5A and also identified the tricolored bat (*Perimyotis subflavus*) and the monarch butterfly (*Danaus plexippus*) as species proposed for federal listing with potential presence/habitat in Reach 5A. MNHESP mapping identified 20 state-listed plant and animal species with mapped Species Habitat in Reach 5A. The BRA also concluded that virtually all of Reach 5A falls within MNHESP-mapped Priority Habitat.

Following the BRA, targeted rare species surveys were conducted in 2025 under EPA-approved Standard Operating Procedures (SOPs) to refine the understanding of species presence, habitat use, and potential project-related impacts. The results of those investigations, the identification of rare species with potential presence or habitat in Reach 5A, and the assessment of anticipated impacts are summarized in Section 11, with details in the Rare Species CMP in **Appendix B**. Species-specific minimization, mitigation, and monitoring measures are also summarized in Section 11, with more details in the Rare Species CMP in **Appendix B**.

3.4 Reach 5A Invasive Species Overview

Invasive species in Reach 5A were evaluated in the Reach 5A BRA using established state, federal, and regional invasive species lists. Invasive plants were defined as those listed as "invasive" or "likely

invasive" by the Massachusetts Invasive Plant Advisory Group (MIPAG) and those identified by the U.S. Army Corp of Engineers (USACE) New England District and Invasive Plant Atlas of New England (IPANE). Potential "invasive aquatic animals" were identified using Massachusetts and U.S. Geological Survey guidance, with non-native fish not treated as invasive; zebra mussel (*Dreissena polymorpha*) and Asian clam (*Corbicula fluminea*) were identified as exotic aquatic invasive animals that could potentially occur in Reach 5A.

The BRA invasive species assessment integrated available information (including aerial photographic interpretation and site base mapping) with field verification conducted in conjunction with riverine, riverbank, backwater, floodplain and vernal pool habitat surveys. Invasive plant occurrence was ranked by relative foliage cover by stratum; discrete, contiguous infestations exceeding 50% cover were documented by global positioning system (GPS) where practicable, and extensive groundcover species (e.g., moneywort [*Lysimachia nummularia*] and garlic mustard [*Alliaria petiolata*]) were documented by presence where mapping was impracticable. Aquatic invasive species (plants and animals) were documented during river and backwater field surveys.

Invasive plant species were recorded across all habitat types during investigations dating back to 2018, with the most comprehensive dataset collected in 2022–2023. Overall, the BRA documented one invasive tree species (Norway maple [*Acer platanoides*]), eight invasive shrub species, one invasive woody vine, and 15 invasive herbaceous species. The invasive species recorded are described in Section 12.1. Invasive plant proliferation on the riverbanks and in the floodplains is recognized as a significant factor affecting the existing conditions of Reach 5A (as well as downstream reaches) and also represents an opportunity to improve habitat functions as part of the site restoration provided that control measures are successfully applied.

4. Riverine Habitat

4.1 Description of Riverine Habitats in Reach 5A

The Housatonic River in Reach 5A includes two primary flowing water habitat designations, as defined by MNHESP (Swain and Kearsley, 2000): medium-gradient stream (MGS) and low-gradient stream (LGS). Extending approximately 4.6 river miles, the total riverine habitat in Reach 5A is approximately 39 acres, of which approximately 25 acres are classified as MGS and approximately 14 acres as LGS.

Riverine habitat in Reach 5A is characterized by a free-flowing channel with numerous meanders, riffle/pool/run sequences, point bars, and accumulations of large woody debris (LWD). Overall river morphology proportions documented during BRA field surveys were pool-dominated, with runs and riffles comprising a smaller proportion of the reach. Reach 5A is 41% pool, 53% run/glide and 6% riffle. While riffle habitat does appear in the lower stretches of Reach 5A, this habitat is more prevalent in the upstream MGS-dominant area. Benthic habitat composition documented during BRA field investigations consisted primarily of sand (approximately 42%), gravel (21%), silt (20%), clay (approximately 8%), cobble (7%), and boulder (2%). Submerged aquatic vegetation (SAV) is sparse (less than approximately 5% cover), with periphyton algae representing the most common cover type and curly-leaf pondweed (*Potamogeton crispus*) the most common vascular aquatic plant.

Hydrologic and hydraulic characteristics strongly influence riverine habitat structure and function in Reach 5A. Channel morphology, sediment transport, flow variability, and floodplain connectivity collectively shape instream habitat features and substrate distribution. LWD and undercut banks contribute to habitat complexity, providing cover, refuge, and foraging habitat for fish, macroinvertebrates, reptiles, and other wildlife. **Appendix A** (Geomorphic Assessment and Natural Channel Design) provides additional information on riverine geomorphologic conditions in Reach 5A, including a description of different fluvial geomorphic characteristics within the five subreaches of Reach 5A established as part of the RD/RA process.

BRA field investigations included physical habitat surveys using EPA's RBP, benthic macroinvertebrate sampling, fisheries surveys and incidental wildlife observations. Benthic macroinvertebrate surveys documented relatively high species richness, reflecting diverse microhabitats and substrate conditions within the channel. Fisheries surveys identified white sucker (*Catostomus commersonii*) as the most abundant species, along with largemouth bass, rock bass (*Amblopites rupestris*), yellow perch, and multiple cyprinid (*Cyprinidae*) species. Additionally, rare-species habitat mapping (e.g., MNHESP Species Habitat/Core Areas) was compiled for the river corridor, and EPA-approved rare-species surveys were implemented in 2025 for riverine areas subject to remedial effects.

4.2 Potential Impacts of Remedial Activities

Remediation of the Reach 5A river channel will include dredging all river sediment (approximately 39 acres) and placement of an engineered cap over the entire riverbed. Because the Revised Permit requires removal and capping throughout Reach 5A, and because final channel and bank reconstruction must be completed in a manner consistent with NCD principles, the remedial action will directly modify the physical landscape that currently supports riverine habitat functions. In Reach 5A, that landscape includes a meandering channel with riffle/run/pool sequences, point bars and localized depositional features, variable bed materials, and structural elements such as boulders, exposed bars, and LWD. To the extent practicable, these features have been incorporated into the NCD of the restored river channel to maintain or enhance the conditions and functions of such river habitat features. In addition, final channel elevations and grades will necessarily vary from existing conditions in some locations, because post-remediation channel stability, cap performance, and construction tolerances will influence the final bed configuration. As a result, potential impacts include not only temporary construction disturbance, but also changes in channel form, bed composition, and habitat complexity that may persist until the reconstructed channel adjusts and biological communities re-establish. Again, the NCD approach addresses such changes and enhances current conditions, such as by adding riffle/run/pool sequences in settings which will be sustained by established flow regimes (see **Appendix A**).

The Final RD/RA Work Plan (in Section 8) describes the details of the sediment removal design and cap design for the main river channel. In general, for the first one mile of river downstream of the Confluence, this work involves removal of existing riverbed sediment followed by placement of approximately 22 inches of cap material. This cap will include approximately four inches of a surface habitat layer (on average) composed primarily of sands and gravels (similar to existing sediments). The surface habitat layer is anticipated to be distributed throughout the channel in accordance with the flow regime as established by the NCD features, as described further below. As noted above, the details of the NCD-based design for the remaining subreaches will be provided in a revision of or addendum to the Final RD/RA Work Plan.

An unavoidable effect of dredging river sediment will be the direct removal of benthic organisms and other sediment-associated biota from areas subject to disturbance. In portions of the river where dredging will occur under dewatered or partially isolated conditions, dewatering has the potential to affect eggs, seeds, larvae, and other resting or overwintering life stages present in exposed sediments or shallow-margin habitats. In areas that are not fully isolated, dredging, excavation, cap placement, and related construction activities may generate turbidity and downstream transport of suspended sediment, temporarily affecting water quality and reducing habitat suitability in and downstream of active work areas, although these effects will be controlled and monitored as described in the Final RD/RA Work Plan. These temporary effects may reduce foraging opportunity, cover, and passage quality for fish and other aquatic organisms through disturbed channel segments during construction. It is anticipated that virtually all the LWD in the river will be removed during the sediment dredging work.

Cap placement may also alter the bed substrate and associated mesohabitat structure. The existing channel supports habitat diversity through variation in depth, velocity, shear, substrate size, depositional features, and structural cover; remedial construction may simplify some of that variability, at least temporarily, where habitat-layer materials, erosion protection, and grading controls are driven by cap performance and channel stability requirements. Removal or burial of LWD, rocks, and other structural features may reduce localized shelter, basking, attachment, emergence, and flow-refuge habitat until such features are replaced to the extent practicable and consistent with cap integrity. In some situations, existing LWD contributes to bank erosion and channel instability by redirecting flows toward the banks and locally increasing shear stress along the banks. The restored NCD approach will provide such woody debris in a more controlled setting, such as with toe wood which both protects the channel/bank interface as well as provides habitat for species such as the wood turtle.

In addition, associated riverbank work may require pruning or removal of overhanging woody vegetation, which can reduce shading, increase solar exposure, and influence summer water temperature and nearshore habitat conditions locally. Channel and bank modifications also may alter local hydraulic patterns, including depth and velocity distributions, bed shear stress, and the frequency and character of overbank connection in specific locations, even though final design must satisfy applicable performance requirements for stability and flood storage. These effects are directly relevant to the riverine restoration criteria in the RPOEC Report, which focus on restoring channel morphology, substrate composition, habitat structures, and biological communities to conditions consistent with successional re-establishment of riverine habitat.

These impacts will also affect any riverine rare species present and their associated habitats. These will include state-listed dragonflies, wood turtles, and state-listed plants on the Reach 5A shoreline and on exposed sandy flats and point bars. The impacts on these rare species and the measures to be conducted to avoid, minimize, and/or mitigate such impacts are summarized in Section 11 and discussed in the Rare Species CMP in **Appendix B**.

Finally, disturbance of bed, bank, and shoreline areas during excavation, capping, access, and staging may create conditions favorable to invasive species establishment or recolonization, particularly in disturbed margins and other early successional areas before native cover and habitat structure are re-established; invasive species control efforts will be implemented to counter this issue.

4.3 Pre-Restoration Measures to Minimize Habitat Impacts

Potential impacts to Reach 5A riverine habitat will be minimized first through remedial design considerations (as has been implemented to date), construction sequencing, and work-area controls. As described in the Reach 5A Final RD/RA Work Plan, sediment removal and capping methods were evaluated in part based on their ability to reconstruct the channel and banks consistent with NCD principles, minimize downstream transport of suspended sediment and turbidity, and limit impacts to adjacent properties and sensitive habitats used for access, staging, and support activities. Accordingly, active in-river work will be confined to manageable segments, with sequencing and temporary isolation or diversion measures selected to reduce the length of channel subject to simultaneous disturbance and to support progressive restoration as work advances through the reach. Contractor-specific means and methods, operational controls, and best management practices (BMPs) will be finalized through the construction planning process and associated Supplemental Information Packages (SIPs) following the retention of a remediation contractor(s).

Prior to clearing and construction, habitat features to be avoided, protected, salvaged, or replaced where practicable will be identified based on the BRA information, final design, updated pre-construction surveys, and rare-species survey findings. This will include consideration of selected mature riparian trees along access routes, existing LWD, boulders, and other structural elements that contribute to cover, basking, refuge, emergence, or overwintering functions. The Reach 5A restoration framework specifically contemplates identifying habitat features to be avoided or preserved during site preparation, evaluating cut trees along the river's edge for possible reuse as habitat features, and identifying large in-stream woody debris or other features for possible use as toe wood after excavation. Additional pre-construction screening and species-protection measures also will be implemented where warranted for state-listed species. These measures are particularly important in Reach 5A because 2025 surveys confirmed use of riverine habitat by wood turtle, including use of large woody debris jams and other in-channel refuge features, and they also confirmed the presence of the state-listed riffle snaketail (*Ophiogomphus carolus*) in riverine habitat subject to remediation.

During active in-water work, operational controls and monitoring will be used to minimize turbidity generation, downstream transport of suspended sediment, and incidental disturbance outside the active work area (See Section 13.2.3 of the Final RD/RA Work Plan for discussion of this monitoring). Depending on final remediation contractor means and methods and local conditions, these controls may include work in dewatered cells or other isolated areas, temporary diversion structures, and erosion and sediment controls associated with access roads, staging areas, and bank tie-ins. Sediment remediation is expected to be performed in sequenced work areas, with contractor-specific isolation, dewatering (if used), sediment resuspension controls, and related construction methods to be finalized through the construction planning process and associated implementation documents. Water quality control requirements and associated construction monitoring will be implemented to support compliance during dredging, excavation, and capping activities. To the extent practicable, work areas will be managed to reduce direct mortality or stranding of aquatic organisms, and temporary loss of migration or movement corridor function will be limited by keeping the active disturbance footprint as short as practicable and restoring habitat continuity progressively as segments are completed.

Rare-species impact minimization measures are described in Section 11 and the Rare Species CMP in **Appendix B**. At a minimum, these will include pre-construction review of current rare-species data, work-area screening where warranted, and construction-phase procedures developed in consultation with EPA and MNHESP for species or habitat features present in affected areas. For wood turtle, pre-construction and construction measures will include attention to seasonal use patterns, review of telemetry and survey information where available, screening of affected areas before disturbance, and protection or replacement of habitat functions associated with woody debris jams, undercut banks, basking areas, and overwintering features where practicable. For state-listed dragonflies associated with riffle, run, and shoreline emergence habitats, impact minimization will include phased remediation and progressive restoration so that restored habitat becomes available for recolonization as construction advances. For the identified shoreline rare plant species (matted spike-sedge [*Eleocharis intermedia*] and Frank's lovegrass [*Eragrostis frankii*]), pre-construction seed collection and propagation efforts are proposed to be implemented, as described in Section 11 and **Appendix B**.

The risk of invasive species establishment or spread will also be addressed prior to and during construction periods. Control measures will include cleaning and inspection of equipment as appropriate, careful handling of infested or potentially infested materials, and stabilization and prompt restoration of disturbed margins. Additional details regarding invasive species are provided in Section 12 and the ISCP in **Appendix C**.

4.4 Restoration of Riverine Habitats

Restoration of riverine habitats in Reach 5A will be achieved through an integrated combination of sediment remediation, engineered capping, and grading to the final restoration surface, channel reconstruction using NCD principles, installation of structural habitat features where appropriate, and natural recolonization of biota as suitable physical habitat conditions are re-established. This section focuses on restoration of the main river channel, but it also includes reference to bank stabilization measures as these are integrated in design with the river channel consistent with the NCD approach. NCD components referred to in this section are more completely described in Section 5 (on riverbanks) and in **Appendix A**.[6]

River cap materials (including habitat materials) will be placed in accordance with the design drawings and specifications in the Final RD/RA Work Plan, having been designed with consideration of NCD addressing channel stability, hydraulic conditions, substrate composition, and habitat function. The restoration approach for Reach 5A specifically includes replacement of LWD (largely as toe wood and root wads), boulders, or other structural habitat features where doing so would not compromise cap integrity and is consistent with the restoration design; and it provides that final channel dimensions and geomorphic features will be consistent with NCD principles. The goal of riverine restoration is not to replicate every pre-remediation feature, but to reconstruct a stable channel that is consistent with NCD principles and capable of supporting the successional re-establishment of riverine habitat functions, including benthic macroinvertebrate, fish, and other aquatic and shoreline-associated biological communities. In the Reach 5A setting, it is recognized that a priority is placed on stabilization to reduce PCB transport while addressing NCD principles and ecological habitat goals to the extent practicable. This approach is consistent with the riverine restoration framework in the RPOEC Report, which emphasizes restoration in accordance with approved design requirements, restoration of channel morphology consistent with NCD, restoration or functional replacement of aquatic habitat structures, and recovery of benthic and fish communities indicative of successional re-establishment.

Additional details and restoration design plans associated with NCD are provided in **Appendix A**, and planting plans are provided in **Appendix D**.

4.4.1 Riverbed Remediation and Cap Materials

The principal remedial component contributing to restoration of riverbed habitat in Reach 5A is removal of contaminated sediment from the main river channel, followed by placement of engineered cap materials including a surface habitat layer to the final restoration surface. The existing overall stream alignment will remain mostly unaltered, with moderate shifts in a few locations to address high shear stress exerted on erodible banks. The profile is being modified to increase stable riffle habitat, maintain a relatively consistent channel width, and locate riffles and pools in sections of the alignment that are consistent with hydraulic and geomorphic processes associated with each feature. Riffles are designed in straight sections and pools are designed in bends to reduce cap erosion. Based on the current design for all of Reach 5A, riffle habitat proportion will increase from 6% to 29%, run/glide habitats will decrease from approximately 53% to 36%, and pool habitat proportion will decrease from 41% to 35%. Within the upper one-mile subreach, riffle habitat will increase from 17% to 32%, and pool habitat will also increase from 25% to 42%.[7]

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[6] As noted in **Appendix A**, the descriptions of the river channel and riverbank restoration based on NCD in that appendix are virtually the same as the descriptions in the Final RD/RA Work Plan, but are repeated to be applicable to this Restoration Plan.

[7] Note that estimates of riffle extent are subject to interpretation of where distinctions are drawn among riffles, runs, and glides.

As described in the Final RD/RA Work Plan and in **Appendix A** hereto, the final restoration surface will be governed by the NCD grading plan. For the portion of Reach 5A planned for Year 1 construction (Stations 0+00 to 48+00), that grading plan will establish the controlling geometry and elevations for the engineered cap and dredge prism. This work involves removal of existing riverbed sediment followed by placement of approximately 22 inches of cap material in various layers, as described in the Final RD/RA Work Plan. This cap will include an average of approximately four inches of a surface habitat layer composed primarily of sand and gravel with a particle size distribution similar to existing riffle sediments. The surface habitat layer is anticipated to be distributed throughout the channel in accordance with the flow regime as established by the NCD features, as described in detail in **Appendix A**. As previously noted, the cap and grading design for the remaining Reach 5A subreaches will be described in a revision of or addendum to the Final RD/RA Work Plan, and will be addressed in a later addendum to this Restoration Plan.

These riverbed remediation and capping elements are foundational to riverine habitat restoration because they establish the post-remediation bed composition and final restoration elevations on which subsequent channel form, hydraulic diversity, and biological recovery depend. The RPOEC Report specifically contemplates restoration of riverine habitat through approved design implementation, restoration of substrate and channel morphology, and installation or functional replacement of in-stream habitat features where included in the restoration design.

4.4.2 Natural Channel Design and Channel Reconstruction

Riverine restoration in Reach 5A is not limited to sediment removal and cap placement. The final restoration surface has been developed through an NCD-based channel reconstruction process that establishes the target channel dimension, pattern, and profile. As noted above, the NCD grading plan governs the final channel geometry and is used to define the engineered cap design surface and dredge prism. That grading plan includes channel adjustments such as establishment of riffle-pool sequences, modification of bed elevations, localized widening or narrowing of the active channel, shifts in the thalweg in some areas, and associated bank grading needed to achieve a more stable channel configuration.

The primary objective of this channel reconstruction is to provide a stable channel profile and reduce excess bank erosion without eliminating the river's natural sediment supply or degrading riverine habitat. In this regard, NCD is being used not simply as a bank-stabilization approach, but as the principal framework for reconstructing a river channel that is in dynamic equilibrium and that balances sediment transport, hydraulic function, and habitat complexity. Consistent with the RPOEC Report, the resulting post-remediation condition may differ in some respects from existing bathymetry and geomorphic features, but it is intended to restore and enhance the structural and physical parameters that give rise to riverine ecological function.

4.4.3 Structural Habitat Features

Structural habitat restoration in the main channel will be achieved through both use of natural materials where appropriate and installation of specific NCD-based features. The Reach 5A restoration framework includes LWD (e.g., root wads, toe wood, wood sills), boulders, and other structural habitat elements removed during remediation where utilizing these elements would not compromise cap integrity and is consistent with the final restoration design. As described in **Appendix A**, the NCD and riverbank stabilization design employed a toolbox which includes specific features such as coir matting, coir matting with rock toe, brush mattresses, root wads, lunkers, J-hooks, cross vanes, bendway weirs, and bioengineered bags, as appropriate to local channel geometry, hydraulics, bank condition, and stabilization needs.

Although many of these measures have been selected primarily to achieve channel and bank stability, they also perform important riverine habitat functions. Depending on feature type and location, they can provide overhead and submerged cover, flow deflection, velocity refuge, undercut-bank analogs, localized scour and depositional diversity, attachment and emergence surfaces, and increased coarse-wood complexity within the active channel margin. These features therefore contribute to restoration of epifaunal substrate and available cover, as well as to the habitat heterogeneity anticipated by the RPOEC Report for restored riverine reaches. The RPOEC Report expressly recognizes that the presence of

specific aquatic habitat structures and features installed as part of the restoration, including in-channel coarse wood, vanes, and weirs, is a relevant evaluation criterion for riverine restoration performance.

As noted above, NCD of the first one-mile subreach of Reach 5A has progressed to final design details. Specific NCD structures or features have been established through this detailed design for this first subreach and are shown on the design drawings included in an attachment to **Appendix A**.[8] Components of the NCD over this first subreach include nine riffle/run/pool sequences, 13 coir matting treatments, five areas of brush mattresses, two J-hooks, five bendway weirs, one cross vane, and three areas of toe wood. Rock riprap is used in only one location (at a 90-degree bend of the river with an existing highly erosional bank); the riprap will be planted in the rock voids with live stakes of shrub species to promote shrub cover in a few years following construction. These NCD components have been determined to best address the goals of achieving channel (and bank) stability while also maintaining or even enhancing habitat conditions (as described below). For example, riffle habitat in this upper reach will roughly double under the proposed conditions (17% to 32%). Again, as previously noted, the comparable details on NCD structures and features in the remaining subreaches of Reach 5A will be described in a revision of or addendum to the Final RD/RA Work Plan and will be addressed in a later addendum to this Restoration Plan.

4.4.4 Restoration of Habitat for Fish, Benthic Macroinvertebrates, Aquatic and Shoreline Plants, and Odonates

Restoration of habitat for fish and benthic macroinvertebrates will be achieved primarily through re-establishment of the physical and hydraulic conditions that support those communities. The combination of reconstructed and improved riffle/run/pool morphology, appropriate substrate sizing and distribution, installed structural habitat features, and reduced embeddedness is intended to restore or enhance the bed characteristics and mesohabitat variability needed to support successional re-establishment of benthic macroinvertebrate and fish populations. The RPOEC Report directly links riverine restoration success to restoration of channel morphology, substrate composition, aquatic habitat structures, and biological communities indicative of that successional recovery. For example, the establishment of nine riffle/run/pool sequences represents an improved benthic habitat in this upper subreach for many of the aquatic species of interest in this area compared to the current conditions where the occurrence of such habitat is less common and poorly developed due to the current state of instability. These in-river habitat complexes also provide suitable conditions for many of the fish species documented in Reach 5A. Similarly, the use of root wads and/or toe wood will provide enhanced riverbank stability on highly erosive banks while also providing hibernacula for the wood turtle, whereas currently the LWD in this area tends to be transitory and subject to movement by flood stage river current.

Aquatic plants are very sparse in Reach 5A. Therefore, the riverine restoration program in Reach 5A does not include active planting of native riverine aquatic plant species (with the exception of state-listed plants, discussed below). Rather, it is assumed that natural recolonization of plants from upstream would occur as suitable substrate conditions develop over time. However, there are two state-listed plant species that occur along the river margins and will be impacted by the river dredging and associated bank remediation and stabilization. These two species, matted spike-sedge and Frank's lovegrass, will be included in a plant propagation program which will involve seed collection and ultimately replanting in the appropriate restored conditions along the river margins. The NCD of the river channel includes creation or restoration of geomorphic settings such as sandy or gravelly point bars, quiescent shoreline margins, and other low-energy edge habitats that support these rare shoreline-associated plants. This process and associated habitat enhancement measures for rare plants are discussed in Section 11 and the Rare Species CMP in **Appendix B**.

For benthic macroinvertebrate biota (e.g., dragonflies and damselflies, including state-listed species) associated with Reach 5A riverine habitat, the restoration design will promote the restoration of hydraulic and substrate diversity rather than focus on a single discrete habitat feature. As described above, the NCD includes establishment of coarse substrates such as gravel and other rock, avoidance of excessive

[8] Again, the NCD-based design drawings of the river channel and riverbank restoration attached to **Appendix A** are the same as those included in the Final RD/RA Work Plan, but are repeated for applicability to this Restoration Plan.

embeddedness in fine substrates, riffle reconstruction, and incorporation of heterogeneity within riffles and runs, including low bars, boulder clusters, and subtle scour-fill features that create a mosaic of depths and velocities. Relative to existing overall Reach 5A conditions, where riffles comprise approximately 6% of riverine habitat, the NCD-based restoration design is expected to increase overall riffle habitat to approximately 29% of the restored riverine habitat, with an increase in riffle habitat in the first subreach from 17% currently to 32%. This increase in riffle habitat is expected to improve habitat suitability for riffle-associated odonates that depend on higher-energy habitats with appropriate gravel, cobble, sand, and hydraulic heterogeneity. In addition, the phased progression of in-river remediation and restoration through Reach 5A is intended to limit the extent of active disturbance at a given time and allow recolonization of restored habitats as construction advances.

Finally, the risk of invasive species establishment or spread will be addressed after restoration has been completed in each riverine subreach. Given that the Reach 5A restoration approach does not generally include active planting of native aquatic vegetation in the main channel and that natural recolonization from upstream will occur as suitable substrate conditions develop, post-restoration monitoring and adaptive management will be conducted to evaluate channel adjustment, habitat structure performance, benthic and fish recovery, and invasive species response. That monitoring is described in Section 10.1. If monitoring indicates underperformance, corrective measures such as erosion repairs, invasive species control, repair or replacement of restoration structures, and response to channel morphology changes will be implemented as needed to maintain progress toward the riverine restoration criteria specified in the RPOEC Report.

5. Riverbank Habitat

5.1 Description of Riverbank Habitats in Reach 5A

Riverbanks in Reach 5A generally range in height from three to seven feet (average of 6.2 feet among the surveyed stations), with areas of higher vertical banks ranging from eight to 12 feet.[9] Although the overall character of the Reach 5A riverbanks is primarily mature woodland, specific vegetative composition varies considerably based on factors such as location across the bank section (e.g., bank toe versus top of bank), hydrology, bank slope, and substrate. In general, the upper portions of the Reach 5A banks consist predominantly of trees, with interspersed sections being a shrub-dominated mix with some trees, vines, and herbaceous growths. LWD is also a common and important habitat feature along the banks. Field inventories documented localized special habitat features along banks (e.g., turtle hibernacula/nesting areas, bank swallow [*Riparia riparia*] and belted kingfisher [*Megaceryle alcyon*] nest sites in vertical sandy banks, otter slides, rock basking sites, beaver bank dens, burrows, and tree cavities). Point bars are present between the river and the banks and provide important habitat functions for a variety of species. Point bars are depositional features formed as secondary flow sweeps sand, gravel, and small stones laterally across the channel floor, depositing material on the inside of bends where river velocities are reduced. They typically have a gentle slope, are often submerged during flood events and periods of high water, and accumulate downed woody material and other debris that supports insect larval emergence and provides access between aquatic and terrestrial habitats for a variety of wildlife. Other bar formations occurring in the center of the channel and along the channel margins serve similar functions.

The field estimates of Reach 5A riverbank substrate indicate a relatively equal percentage of silts and sands with a range of physical attributes, including sloped and vegetated banks, vertical and exposed banks, erosional banks with slumping, and erosional but vegetated banks. Across surveyed stations, sand and silt comprised similar proportions of bank substrate (average of approximately 42% each), with subdominant gravel/cobble (average of approximately 13%). Vertical and exposed banks generally lack vegetative cover but provide important habitat functions. Undercut banks are an important habitat component of the riverbanks and are prevalent in Reach 5A, occurring at 97% of surveyed bank stations.[10] Mature trees overhanging the river and dense herbaceous and shrub communities are also prevalent on the banks in Reach 5A and provide shading to the river and foraging opportunities for wildlife.

The Reach 5A riverbanks support a mosaic of riparian and transitional communities characteristic of mid-order river systems in western Massachusetts. Based on the BRA and subsequent SDC activities, the primary riverbank biological communities include floodplain forest, shrub-dominated riparian thickets, herbaceous riparian fringes, and sparsely vegetated erosional banks. These communities collectively provide structural stability, organic matter inputs, wildlife habitat, and connectivity between aquatic and upland systems.

Floodplain forest communities occur along relatively stable banks and terraces and are dominated by mature canopy trees typical of alluvial settings, including silver maple, box elder (*Acer negundo*), green ash, and eastern cottonwood. The midstory and shrub layers commonly include silky dogwood (*Cornus amomum*), gray dogwood (*Cornus racemosa*), and common elderberry (*Sambucus canadensis*). The herbaceous layer is composed of native riparian forbs and graminoids interspersed with patches of invasive species. These forested banks provide shading, temperature moderation, LWD recruitment, and nesting and foraging habitat for riparian birds and small mammals.

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[9] This is based on field observational estimates at 34 riverbank stations in Reach 5A where habitat data were obtained; at these stations, the height was estimated from the toe of slope to the top of bank/edge of floodplain habitat.

[10] Because undercutting was recorded as a presence/absence condition at each station, the 97% value indicates that undercut banks were observed at most surveyed locations and is not intended to imply that 97% of total riverbank length is undercut.

Shrub-dominated riverbank communities are present on lower banks and recently stabilized areas. These areas are characterized by dense stands of willows (*Salix* spp.), red-osier dogwood (*Cornus sericea*), and other facultative wetland shrubs. These communities play a critical role in soil stabilization, sediment trapping, and rapid post-disturbance revegetation. Root mass density in these zones contributes significantly to bank cohesion and resistance to fluvial erosion.

Herbaceous riparian fringes occur along low benches and frequently inundated margins. Vegetation includes native sedges (*Carex* spp.), rushes (*Juncus* spp.), and wetland grasses, along with forbs adapted to seasonal flooding. These areas provide habitat for amphibians, invertebrates, and juvenile wildlife, and function as nutrient and sediment filters during overbank flows.

In select areas, sparsely vegetated or erosional banks are present where fluvial processes, steep slopes or prior disturbance have limited vegetative establishment. These areas offer limited habitat value but may provide basking or burrowing opportunities for certain fauna. Where sufficiently stable substrates exist, early successional colonization by herbaceous and shrub species is evident. Eroding riverbanks have been documented to contribute up to 45% of the overall mass of PCBs entering the Housatonic River (Weston, 2011), highlighting the issue between some habitat types and PCB fate and transport.

Collectively, the riverbank biological communities in Reach 5A support riparian habitat functions including bank stabilization, shading and thermal regulation, detrital input to the aquatic food web, wildlife habitat, and ecological connectivity. Restoration planning has prioritized re-establishment of native woody and herbaceous riparian vegetation consistent with existing community structure, control of invasive species, protection of existing mature canopy trees where feasible, and stabilization of erosional banks using bioengineering approaches that promote long-term vegetative cover and functional equivalency with pre-remediation conditions.

A key function of the Reach 5A riverbanks is the role they play in affecting floodwater dynamics between the river channel and the floodplain. The channel-forming flow, or bankfull discharge or flow, which transports the majority of the flow and sediment over time, forms and maintains the river channel. While the Reach 5A riverbank conditions indicate some instability (e.g., tight meander bends with eroding outer banks, poor point bar development), the bankfull flow parameters generally indicate only slight stream incision, such that overbank flooding into the floodplain appears to generally occur during flows generated by the 1.5- to two-year storm events (i.e., a normal flooding regime).

5.2 Potential Impacts of Remedial Activities on Riverbanks

Reach 5A covers approximately 50,000 linear feet of riverbank (including both left and right banks). Approximately 21,400 linear feet (or 43% of the total riverbank length), are anticipated to be subject to remediation and associated stabilization over all of Reach 5A (see **Figure 3-1**). These include a total of approximately 16,700 linear feet that were agreed upon with EPA during the conceptual design process (approximately 33% of the riverbanks in Reach 5A), plus any additional bank areas where grading is determined to be necessary to tie in to the remediated/stabilized banks. For the initial subreach of Reach 5A (between Stations 0+00 and 48+00), a total of approximately 5,790 linear feet of banks will be subject to removal and stabilization. This includes approximately 2,930 linear feet where remediation is required, plus an additional approximately 2,860 linear feet where remediation is not required but additional grading is proposed as part of NCD to transition or tie in to the remediated/stabilized banks. Within that upstream segment, approximately 2.7 acres of riverbank and adjacent floodplain areas will require this riverbank grading. Based on preliminary grading associated with the NCD conducted for the entirety of Reach 5A, a total of approximately 11.9 acres of riverbank and adjacent floodplain areas is estimated to require this riverbank grading.[11] These activities in Reach 5A will include removal of riverbank vegetation and woody debris, cutting back and reshaping of banks (typically to a 3:1 slope), and excavation of bank soils in designated locations. As a result, remedial activities will necessarily alter existing riverbank form and structure and will unavoidably remove existing habitat features that currently contribute to riverbank functions.

[11] Details of the NCD-based design for subreaches downstream of Station 48+00 are subject to change and will be provided in a revision of or addendum to the Final RD/RA Work Plan and in an addendum to this Restoration Plan.

Given the baseline conditions described above, riverbank remediation and stabilization are expected to affect habitat in several ways. Removal of bank soils and regrading of bank profiles will require vegetation cutting, may alter existing connectivity between the river and adjacent floodplain, and will modify bank geometry, substrate exposure, and bank hydraulic conditions. As noted above in Section 5.1, the riverbank geomorphology is a primary factor that affects overbank flooding into the adjacent floodplain. The proposed regrading of the riverbank, in concert with the NCD adjustments to the river channel (in both plan and profile), will not change the current bankfull level or overbank flooding to any appreciable degree. Further, since more than one-half of the riverbank in Reach 5A will not be altered by the proposed remediation and stabilization, the current overbank flooding characteristics and dynamics between the banks and the floodplain will be substantially maintained.

The process of implementing bank remediation may also create temporary secondary (or indirect) effects on habitat. Construction access, repeated equipment traffic, soil disturbance, and removal of obstructions such as trees and rocks will disturb existing vegetation and soils and may reduce habitat suitability for both aquatic and terrestrial species during construction. Disturbed riverbanks will also be susceptible to invasive-species establishment and expansion. This is of concern in Reach 5A because invasive plants are already common on riverbanks; the BRA documented 16 invasive plant species on riverbanks, with Asian bittersweet (*Celastrus orbiculatus*) recorded at 59% frequency and Japanese knotweed at 48% frequency. The riverbank remediation and stabilization work provides an opportunity to remove existing invasive species and to implement invasive species control measures for an extended time period to promote native plant communities in places currently dominated by invasive species. A summary of invasive species control measures is provided in Section 12 and more detail is provided in the ISCP in **Appendix C**.

5.3 Pre-Restoration Measures to Minimize Habitat Impacts

In preparation for and during remediation activities in Reach 5A, a suite of impact minimization measures will be implemented to reduce disturbance to riverbank habitats and maintain ecological function wherever possible. Vegetation removal will be strictly limited to the defined remediation footprint, with mature trees, shrubs, and existing woody debris retained in undisturbed areas to preserve habitat structure and continuity. Existing trees growing on or adjacent to bank remediation/stabilization areas will be evaluated to determine whether they need to be trimmed or cut, and if they need to be cut, whether the existing root systems can remain in place to maintain the stabilization that these roots provide. Construction access and staging will be carefully planned and controlled, utilizing temporary access mats and low-impact routes to minimize soil compaction and the loss of vegetative cover. Erosion and sediment control BMPs, such as silt fencing and straw wattles, will be deployed throughout the remediation process to prevent sedimentation of adjacent habitats and waterbodies. Prior to the commencement of work, pre-construction surveys will be reviewed (and supplemented if necessary) to identify active nests, known hibernacula, burrows, and dens; and where practicable, work will be scheduled to avoid direct disturbance to wildlife during sensitive periods, such as nesting and breeding seasons. For example, cutting of trees which provide roosting habitat for state-listed bat species will be conducted outside of the recognized active period for bats (currently from November through March). Where necessary, exclusion measures will be implemented to further protect wildlife from direct impacts during construction activities. Awareness of wood turtle seasonal patterns, such as emergence from or entrance into hibernacula, will be reviewed to ensure coordination with construction activities for minimizing impacts to this species.

Where feasible, undercut banks and vertical features will be identified and preserved on non-remediated/stabilized bank sections to benefit species such as wood turtles, bank swallows, and kingfishers. Similarly, woody debris on such non-remediated bank segments will be evaluated for retaining in place, and above-ground trees that need to be cut in nearby floodplain areas for remedial activities will be evaluated for reuse on-site to restore habitat complexity, provide cover, and support nesting or burrowing wildlife, where possible. However, it is recognized that such efforts must not conflict with the primary goals of closure and stabilization to limit PCB transport. For example, maintaining undercut banks on non-remediated bank segments may not be feasible to afford proper installation of the cap material along the edge of the riverbank. Contractor input in such circumstances will be required to determine feasibility.

Rare-species impact minimization measures will also be applied for riverbank work. These will include pre-construction review of current rare-species data, work-area screening where warranted, and construction-phase procedures developed in consultation with EPA and MNHESP for species or habitat features present in affected areas. For wood turtle, pre-construction and construction measures will include attention to seasonal use patterns, review of telemetry and survey information where available, screening of affected areas before disturbance, and protection or replacement of habitat functions associated with woody debris jams, undercut banks, basking areas, and overwintering features where practicable. For the identified shoreline/riverbank rare plant species (matted spike-sedge and Frank's lovegrass), pre-construction seed collection and propagation efforts be implemented. These pre-remediation impact minimization measures are summarized in Section 11 and described in detail in the Rare Species CMP in **Appendix B**.

5.4 Restoration of Riverbank Habitats

The bank restoration design has been guided by site-specific conditions established through pre-design investigations (PDIs), including mapping of bank geometry, substrate, erodibility (characterized using Bank Erosion Hazard Index [BEHI] and Near-Bank Stress [NBS] methods), and the presence of habitat features such as turtle hibernacula, bank swallow nest sites on vertical sandy banks, LWD, and undercut banks. The resulting restored banks are designed to address habitat conditions along with dynamic equilibrium, balancing flow and sediment loads and reducing erosive forces to the extent practicable while meeting the remedial design requirements.

The application of NCD principles means that the design and restoration of the riverbanks is closely linked to the design and restoration of the main river channel. The main goal of the riverbank grading is to reduce bank erosion and provide a stable bank following remedial activities. In general, riverbank grading has been specified at nearly a 3H:1V slope, with some exceptions in localized areas where that type of grading is not practicable. Following removal of riverbank soil in areas where bank excavation is required, the bank will be restored taking into consideration the principles of NCD. **Appendix A** provides details on the NCD process and methods that have been incorporated into the riverine/riverbank design, and reference is made to the Final RD/RA Work Plan for additional design details (especially for the first segment of Reach 5A upstream of Pomeroy Ave). As described previously, detailed design has been advanced for this upper segment, but the NCD process has been applied sufficiently for the remaining segments of Reach 5A to enable accurate representation of the general design through restoration.[12]

As noted above and described in **Appendix A**, the NCD and riverbank stabilization design employed a toolbox which includes specific bioengineering features such as coir matting, coir matting with rock toe, brush mattresses, root wads, lunkers, J-hooks, cross vanes, bendway weirs,, and bioengineered bags, as appropriate to local channel geometry, hydraulics, bank condition, and stabilization needs. These NCD components or features are each described in detail in **Appendix A**. As also previously noted, NCD of the first one-mile subreach of Reach 5A has progressed to final design details, with specific NCD structures determined through this detailed design for this first subreach; these are shown on the NCD-based design drawings included as an attachment to **Appendix A**. Components of the NCD over this first subreach (which encompass both riverbank and riverine areas) include nine riffle/run/pool sequences, 13 coir matting treatments, five areas of brush mattresses, two J-hooks, five bendway weirs, one cross vane, and three areas of toe wood. Rock riprap is used in only one location (at a 90-degree bend of the river with an existing highly erosional bank), and this area of riprap will be planted with live stakes of suitable shrub species, as described below. The riprap voids will be filled with a sand/silt/gravel matrix to support the live stake plantings. This "joint planting" refers to the insertion of plugs and/or live stakes between the rocks to encourage the growth of riparian vegetation. The planting of cuttings in riprap helps to provide longer-term stability once the vegetation is established. Finally, all areas of graded/reconstructed riverbanks not specifically subject to the NCD components described above will be covered in coir matting and vegetated as described below.

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[12] As noted above, design details for the NCD-based components have been developed to date only for the portion of Reach 5A planned for Year 1 construction (Stations 0+00 to 48+00) and will be presented for the remainder of Reach 5A in future submittals.

These NCD components have been determined to best address the goals of achieving channel (and bank) stability while also maintaining or enhancing habitat conditions in the upper stream segment of Reach 5A. These NCD components will also be used in the downstream subreaches of Reach 5A, and will be specified for those subreaches in a revision of or addendum to the Final RD/RA Work Plan and a later addendum to this Restoration Plan.

Restoration plantings in riverbank areas subject to remediation/stabilization will utilize a diverse mix of shrubs and herbaceous species/seed mixes, selected to match pre-existing community composition and structure, thereby quickly re-establishing vegetative cover, stabilizing soils, and providing food and shelter for wildlife. Native vegetation replanted on all remediated riverbanks in combination with coir matting will consist of applying a cover crop seed mix along with live stakes of native shrub species such as willows and dogwoods which grow rapidly and are adaptable to the varying hydrology of the riverbanks.

Proposed restoration species, including seed mixes, that will be applied to soil surfaces beneath the coir fiber matting are listed in **Table 5-1**, and live stakes and other trees and shrubs that will be planted, including several species of dogwood (*Cornus* sp.) and willow (*Salix* sp.), are listed in **Table 5-2**. These species will support the restored bank stabilization and enhance wildlife habitat function and cover. Based on the currently proposed limits of grading associated with remediation and NCD (subject to changes based on final design of the downstream subreaches), a total of approximately 11.9 acres of impacts will occur along the riverbanks and adjacent floodplain habitats. Areas within 12 feet of the river's edge graded as a result of the NCD (over half of the total) will be densely planted with live stakes, and graded areas outside of 12 feet will be planted to correspond with the existing natural community cover types present. All 11.9 acres will be stabilized with the coir fiber matting and seed mix presented in **Table 5-1**. Portions of riverbank requiring grading and restoration plantings are presented in **Appendix D** on **Figures D-1** through **D-21**.

At the specified seeding rate, a total of approximately 42 pounds of seed mix will be required. At the specified planting densities for live stakes, a total of approximately 73,000 live stakes will be needed to stabilize the riverbank areas within 12 feet of the river's edge. For areas affected by bank restoration in the adjacent floodplain habitats, a total of approximately 1,255 woody shrubs from 14 species and 1,735 trees from 15 species will be planted (**Table 5-2**).[13]

Invasive species management will be implemented as a critical component of riverbank restoration given the prevalence of Japanese knotweed (*Fallopia japonica*), purple loosestrife *(Lythrum salicaria*), reed canary grass (*Phalaris arundinaceae)*, and other invasive species along Reach 5A riverbanks, which pose a significant risk of rapid recolonization of disturbed areas. Invasive species controls will be implemented immediately after restoration and maintained throughout the monitoring period, consistent with the ISCP provided in **Appendix C**. It is acknowledged that full long-term recovery will depend in part on natural recolonization, ongoing bank stabilization and substrate development, and successful native plant establishment. The restoration approach is designed to maximize ecological function and resilience consistent with remediation requirements.

[13] Planting and seeding quantities presented in this Restoration Plan, including tables, are based upon the project layout and work activities anticipated at the time of preparation of this plan. Final quantities may vary from the amounts indicated herein based upon subsequent adjustment of project work limits, especially for areas downstream of the initial subreach.

6. Backwater Habitats

6.1 Description of Backwater Habitats in Reach 5A

Reach 5A contains six designated backwaters covering a total area of 3.9 acres, with individual backwaters ranging from approximately 0.04 to 2 acres (see **Figure 3-1**). These backwaters consist largely of deep marsh habitat, with some smaller areas of shallow marsh. All six backwater areas in Reach 5A will require remediation, as described in Section 8 of the Final RD/RA Work Plan. For three of the backwater areas, the remediation will involve sediment removal and capping (BW5A-2, BW5A-4, and BW5A-5); and two others will be subject to sediment removal and backfilling (BW5A-3 and BW5A-6). For BW5A-1 (located in Core Area 1 habitat), only a small portion will be subject to removal and capping, with the remaining area remediated by the application of an activated carbon-based amendment. Final grades in the backwaters are intended to be consistent with original grades.

The backwaters in Reach 5A (BW5A-1 through BW5A-6) were evaluated in the BRA to document pre-remediation conditions and the functions/values that could be affected by remedial activities. As shown by the backwater BRA activities, all six backwaters in Reach 5A share a similar hydrologic regime based on ephemeral surface-water connections to the river that allow back flooding during high-flow periods, followed by very shallow water or saturated soil/substrate conditions during summer low-flow periods. This hydrologic regime allows fish to access backwaters during high water; as waters recede, fish would be expected to return to the river, although some may be trapped within backwaters during low-flow drawdown. The six backwaters in Reach 5A consist generally of deep marsh habitat occurring on saturated, mucky mineral soils that are seasonally inundated and permanently saturated. The substrate is flooded by waters that are not subject to significant wave action, with water depths ranging from six inches to four feet. Water levels fluctuate seasonally, but the substrate is rarely dry, and there is usually some standing water throughout the year. The emergent vegetation in these deep marshes is variable, with a total of 55 plant species (including seven invasive and one other non-native plant) observed and documented within these six backwaters. Specific details of each backwater are described below.

BW5A-1 is situated along the eastern side of the Housatonic River between Stations 73+00 and 86+00, this backwater covers two acres within Canoe Meadows and connects to the Housatonic via a 50-foot-long and three-foot-wide swale. BW5A-1 is classified as a deep marsh with fringe areas of shallow marsh and with a small area mapped as transitional floodplain forest located in the northeastern part of the backwater. This backwater experiences drastic swings in water depths between spring flooding and summer low flow periods. It is bordered by steep upland forested slopes on the northern and eastern sides, and floodplain forest along the western and southern sides.

BW5A-2 is situated along the western side of the Housatonic River between Stations 117+00 and 120+00 in the northern portion of the Housatonic Valley Wildlife Management Area (WMA), this 0.38-acre backwater occupies a remnant oxbow channel approximately 460 feet long and 26-44 feet wide. It connects to the river through a low, broad channel at the south end and through a higher opening at the north end during high water. Primarily deep marsh, BW5A-2 remains flooded through most growing seasons and is bordered by floodplain forest to the north and south, with wet meadow floodplain along the central portion.

BW5A-3 and BW5A-4 are located along the western side of the river between Stations 126+00 and 128+00 in the northern Housatonic Valley WMA; they are small backwater pools ranging from 0.04 to 0.16 acre. Both connect to the river primarily at their southern ends, with additional high-water flow entering from the north across the floodplain. Their connecting channels are 60-80 feet long and 2-3 feet deep, generally retaining 1-2 feet of standing water even at low flow. These backwaters provide shallow marsh habitat (with BW5A-3 also containing some deep marsh). BW5A-3 is bordered by upland forest to the west and floodplain forest to the east, while BW5A-4 is bordered by floodplain forest and wet meadow.

BW5A-5 is positioned along the southern/western side of the river between Stations 143 and 150, and is a long, linear 1.6-acre backwater (1,020 feet long and 25-70 feet wide) lying at the base of a steep upland

slope to the east. It receives surface inflow from an extensive marsh on the western side. Hydrologic connection to the river occurs at the northern end through a broad marsh during high water, and through two narrow channels during lower flows. Classified primarily as deep marsh, portions of this system often remain flooded throughout the growing season with other areas remaining saturated to the surface and developing dense herbaceous cover of vegetation as the water levels draw down.

BW5A-6 is located at the downstream end of Reach 5A along the western riverbank and is a 0.33-acre deep-marsh backwater that receives Pittsfield WWTP discharge along its southwestern edge. It connects directly to the Housatonic through a 130-foot-wide opening in the riverbank on its eastern side, though only a 25-foot section remains open and flowing at low water to maintain effluent discharge.

The Reach 5A backwaters and associated deep emergent marshes are used by a range of bird, mammal, amphibian, and reptile species that rely on these areas for foraging, shelter, and breeding. These backwater and marsh habitats are important for nesting and foraging for a variety of bird species, including wood duck (*Aix sponsa*), mallard duck (*Anas platyrhynchos*), great blue heron (*Ardea herodias*), and green heron (*Butorides virescens*), among others. Wading birds preferentially use these backwater and emergent marsh areas of open water with minimal current for foraging, and species presence may vary among years depending on hydrologic conditions.

6.2 Potential Impacts of Remedial Activities on Backwater Habitats

Remedial activities within the six designated backwater areas of Reach 5A will have unavoidable impacts on these aquatic and wetland habitats. The remediation strategy is tailored to the unique conditions of each backwater, with a combination of sediment removal followed by engineered capping (BW5A-2, BW5A-4, and BW5A-5) or backfilling with suitable substrate materials (BW5A-3, and BW5A-6). As currently anticipated, BW5A-2, 4, and 5 will each have the top one foot of soil dredged and will then be covered with a 12-inch sand cap that includes a sorptive carbon-based amendment, with final grades intended to be consistent with original grades. BW5A-3 and 6 will be dredged and backfilled to three feet and five feet, respectively, with a suitable sand and top-soil mixture. In the case of BW5A-1, approximately 0.15 acres of the most contaminated sediment will be excavated and capped, and the remaining 1.7 acres will receive a carbon-based amendment to reduce PCB bioavailability, thereby limiting physical disruption in this core habitat area. These approaches are designed to achieve Performance Standards for PCB concentrations while preserving as much of the existing habitat structure as feasible.

The physical habitat impacts of these remedial actions will include temporary alteration of hydrologic connectivity, changes to surface sediment characteristics, and removal of native vegetation and habitat structures such as LWD. Active nesting sites for marsh birds and waterfowl may be impacted if vegetation is removed or disturbed during the breeding season. Amphibians and reptiles, which often rely on shallow water and marsh edges for breeding and shelter, could be impacted if present when construction occurs, and may interrupt breeding or migration activity. The removal of LWD and alteration of microhabitats can further reduce shelter and basking sites for several species.

Engineered sand/gravel caps, amended with sorptive carbon-based material, are designed to support the re-establishment of native marsh vegetation, but may initially alter soil properties, hydrology, and seed banks. These changes can affect the recovery of plant communities that provide food and cover for wildlife. If invasive species colonize disturbed areas, they may outcompete native plants, further reducing habitat quality for specialist species.

Longer-term impacts depend on the effectiveness of restoration efforts, which have been created to address these risks by specifying criteria for re-establishing hydrologic connectivity, actively revegetating with native species, and restoring habitat complexity through placement of coarse woody debris and other structural features. Multi-year monitoring and adaptive management are planned to ensure that restoration goals are met, and that the long-term ecological integrity and habitat value of the Reach 5A backwaters are restored and maintained in accordance with habitat metrics outlined in the Revised BRA Report.

6.3 Pre-Restoration Measures to Minimize Habitat Impacts

Minimizing adverse impacts to backwater habitats entails maintaining the backwaters' hydrologic connectivity with the main stem of the Housatonic River, addressing rare species documented to occur in and near to each backwater, and protecting or restoring important habitat features to the extent practicable. Habitat features specific to each backwater have been documented as part of the BRA surveys, and this information along with the pre-construction surveys for state-listed plants and animals will be used to identify specific habitat features to address during remedial construction. Such features include documented rare species habitat and observation occurrences, large specimen trees, LWD, and specific hydrologic features which affect surface flow in and out of each backwater.

The baseline data described above will guide physical remediation efforts (which include removing sediment from and capping portions of each backwater). Construction will be confined to specifically delineated areas. Construction equipment will also be cleaned before entering backwater areas; and where feasible, its use will be minimized to limit soil, vegetation, and wildlife disturbances, including the spread of invasive species. Areas of habitat that require vegetation removal and ground disturbing activities (i.e., floodplain remediation areas, clearing for access and staging), and areas within 25 feet, will be pre-treated for invasive plant species prior to commencement of work, and monitored throughout the duration of work to support the development of native plant communities post-construction. As appropriate, surveys for state-listed species and training of general contractors, on-site professional project engineers, and construction field personnel will occur prior to habitat disturbance. Additional details on pre-restoration minimization measures to address rare species impacts are summarized in Section 11 and presented in the Rare Species CMP in **Appendix B**.

6.4 Restoration of Backwater Habitats

As noted above, all six backwater areas in Reach 5A will require remediation. Areas requiring sediment removal will be returned to original grades through backfilling with suitable soils or placement of an approximately 12-inch thick engineered sand/gravel cap that includes a sorptive carbon-based amendment and then planted with herbaceous vegetation appropriate for these habitats. Areas being treated with an activated carbon-based amendment will not be planted and are expected to revegetate naturally.

The primary goal for backwater restoration is to restore the surface water hydrology of deep marsh habitats by maintaining pre-remediation hydraulic connections to the river. In addition to occasional direct overbank flooding, this connection maintains the natural flooding and hydrologic regime which determines the content and characteristics of the biological communities. Beyond hydrology, restoration will focus on substrate and vegetation recovery; the proposed sand cap material and backfill substrates will serve as a robust growth medium for both shallow and deep emergent marsh species, supporting both natural recolonization and active planting efforts. Because these six areas flood at least annually, regular sediment deposition is expected to continually enhance substrate suitability and further supplement long-term revegetation needs.

Restoration planting plans developed for all backwater areas in Reach 5A are provided in **Appendix D** (see Figure D-7 for BW5A-1; Figures D-10 and D-11 for BW5A-2/3/4; Figure D-13 for BW5A-5; and Figure D-21 for BW5A-6). Plant selection was based on species observed during the BRA surveys, descriptions of natural communities available from MNHESP, and knowledge of habitat suitability and hardiness for additional plant species that were included to provide a more diverse plant community.

The planned restoration for each of the six backwaters is described in the following paragraphs, with proposed plant densities listed in **Tables 6-1** through **6-6**.[14]

[14] As previously noted, planting and seeding quantities presented in this Restoration Plan, including tables, are based upon the project layout and work activities anticipated at the time of this plan preparation and may change based upon subsequent adjustment of project work limits.

As noted above, BW5A-1 will have only about 0.15 acre of dredge and cap that will require replanting. Following plant densities outlined in **Table 6-1**, a total of 14 trees and shrubs and 138 herbaceous plant species suitable for deep emergent marsh habitats will be planted in this backwater. These include two species of trees and two species of shrubs typical of floodplain forest habitats, and two aquatic emergent, one aquatic submergent, and one floating-leaved aquatic species. In addition, approximately two pounds of a wetland seed mix will be evenly distributed along the margins of the deep emergent marsh areas and throughout the transitional floodplain forest habitats at specified rates to support site stabilization and provide additional diversity of native plants. The remaining 1.7 acres of this backwater consist primarily of deep and shallow emergent marsh habitats and are expected to revegetate naturally following application of the activated carbon-based amendment.

For BW5A-2, the cap will be planted following the schedule and densities outlined in **Table 6-2.** A total of 798 herbaceous plant species suitable for shallow and deep emergent marsh habitats will be planted in this backwater, including four aquatic emergent, one aquatic submergent, one floating-leaved aquatic, and one obligate wetland grass species. In addition, approximately five pounds of a wetland seed mix will be evenly distributed along the margins of the deep emergent marsh areas at specified rates to support site stabilization and provide additional diversity of native plants.

For BW5A-3, backfilled areas will be planted following the schedule and densities outlined in **Table 6-3.** A total of 520 herbaceous plant species suitable for shallow and deep emergent marsh habitats will be planted in this backwater, including four aquatic emergent, one aquatic submergent, one floating-leaved aquatic, and one obligate wetland grass species. In addition, approximately two pounds of a wetland seed mix will be evenly distributed along the margins of the deep emergent marsh areas at specified rates to support site stabilization and provide additional diversity of native plants.

For BW5A-4, the cap will be planted following the schedule and densities outlined in **Table 6-4.** A total of 157 herbaceous plant species suitable for shallow and deep emergent marsh habitats will be planted in this backwater, including three aquatic emergent, one aquatic submergent, and one obligate wetland grass species. In addition, approximately one pound of a wetland seed mix will be evenly distributed along the margins of the deep emergent marsh areas at specified rates to support site stabilization and provide additional diversity of native plants.

For BW5A-5, the cap will be planted following the schedule and densities outlined in **Table 6-5.** A total of 1,661 herbaceous plant species suitable for growing in shallow emergent marsh habitats and 576 herbaceous species suitable for growing in deep emergent marsh habitats will be planted in this backwater, including six aquatic emergent, one aquatic submergent, one floating-leaved aquatic, and one obligate wetland grass species. In addition, approximately four pounds of a wetland seed mix will be evenly distributed along the margins of the deep emergent marsh areas at specified rates to support site stabilization and provide additional diversity of native plants.

For BW5A-6, backfilled areas will be planted following the schedule and densities outlined in **Table 6-6.** A total of 91 herbaceous plant species suitable for growing in shallow emergent marsh habitats and 340 herbaceous species suitable for growing in deep emergent marsh habitats will be planted in this backwater, including five aquatic emergent, two aquatic submergent, one floating-leaved aquatic, and one obligate wetland grass species. In addition, approximately one pound of a wetland seed mix will be evenly distributed along the margins of the deep emergent marsh areas at specified rates to support site stabilization and provide additional diversity of native plants.

The restoration approach is designed to maximize ecological function and resilience consistent with remediation requirements. Monitoring and invasive species management will be implemented as part of the backwater restoration. Invasive species controls will be implemented immediately after restoration and maintained throughout the monitoring period, consistent with the ISCP in **Appendix C**. It is acknowledged that full long-term recovery will depend in part on natural recolonization, ongoing substrate development, and successful native plant establishment.

7. Other Waterbody Habitats

In Reach 5A, five features were identified as Other Waterbodies: the outlet from Morewood Lake (known as Wampenum Brook [W-OWB1]), the Intermittent Side Channel (E-OWB1), West Pond (OWB-WP), Sackett Brook (E-OWB2), and the Lower Sykes Brook confluence (E-OWB3). These Other Waterbodies are shown in **Figure 3-1**. As described in the Final RD/RA Work Plan, no remediation is required in Wampenum Brook and Sackett Brook; therefore, these areas are not addressed further in this section. The other three areas will be subject to remediation. Although these three areas differ in form and function, each is currently hydraulically connected to the main stem of the Housatonic River. West Pond and the Lower Sykes Brook confluence are subject to sediment remediation. The Intermittent Side Channel is being disconnected from the main river channel and filled; this area will be restored with native floodplain vegetation, forming a floodplain forest/shrub wetland habitat.

7.1 Description of Other Waterbody Habitats in Reach 5A Subject to Remedial Activities

The evaluation of Reach 5A Other Waterbodies combined GIS/desktop review with targeted field habitat assessments using procedures established in the Revised Reach 5A BRA Work Plan. Assessments were conducted on October 24, 2025, and were populated with plant community observations collected during the summer and fall of 2025. Field methods were designed to identify habitat type and existing conditions: the Intermittent Side Channel was assessed using riverbank-form surveys because the intermittent flow regime is not suitable for the application of riverine methods; West Pond was evaluated using the backwater/pond habitat form and the Lower Sykes Brook confluence was evaluated using RBP-style riverine habitat characterization.

The Other Waterbodies in Reach 5A form a complementary matrix of connected pond/backwater, intermittent overflow, and tributary-confluence habitats that increase floodplain habitat diversity. Their functions and values are driven primarily by connectivity, hydraulics, and habitat structure.

The Intermittent Side Channel is an episodically connected overflow/side-channel feature that does not sustain surface flow beyond significant high flow events and did not maintain flowing or standing water during 2025 observations. Functionally, it appears to operate mainly as a high-flow conveyance/overflow channel, with ecological value constrained by limited persistent aquatic habitat and invasive-dominated structure. Banks are relatively high and moderately steep, substrates are fine and silt-dominant with organic material, and vegetation is heavily influenced by Japanese knotweed. Habitat feature richness is generally low, and the ecological value of the feature appears limited by the lack of persistent aquatic conditions and the invasive dominated structure.

West Pond is a shallow floodplain pond with permanent hydrologic connectivity to the Housatonic River via Sackett Brook to the south and an additional flow path over or near beaver dam infrastructure and into a secondary outlet channel to the west. Water levels appear to be strongly influenced by beaver activity. The pond margins provide high habitat complexity, including woody debris, logs, roots, hummocks, rocks, crevices, and tall emergent vegetation. As a result, West Pond provides a broad range of aquatic and semi-aquatic wildlife habitat functions.

The Lower Sykes Brook confluence is a low-gradient, pool-dominated depositional area influenced by tributary confluence and backwater hydraulics, with fine sediments and organic muck. Instream habitat complexity is limited, with minimal coarse substrate and cover, although some woody debris is present. Functionally, this area serves as a low-energy depositional environment that retains fine sediment and organic matter and provides seasonal or flow-dependent aquatic habitat.

7.2 Potential Impacts of Remedial Activities

The impacts of remediation on the Intermittent Side Channel, West Pond, and Lower Sykes Brook confluence differ because each area has different characteristics and the remediation will be different.

West Pond and the Lower Sykes Brook confluence will undergo sediment remediation, while the Intermittent Side Channel will be filled and restored as floodplain shrub/transitional forest wetland habitat. As presented in the Final RD/RA Work Plan, these remedial activities will affect approximately 2.06 acres in West Pond and 0.06 acre in the Lower Sykes Brook confluence. The Intermittent Side Channel will be altered through filling, grading, and revegetation into transitional forest wetland habitat with a dense shrub understory to provide additional soil stabilization.

In West Pond, surface and subsurface sediments will be removed, followed by backfill placement. Because West Pond functions as a ponded aquatic habitat, the likely habitat impacts are similar to those expected in backwaters, as discussed in Section 6.2. These include changes in surface sediment content and characteristics, removal of the existing seed bank and sediment-dwelling organisms, loss of structural habitat features such as LWD and rocks, potential impacts to habitats used by state-listed species, and the risk of colonization by invasive species following disturbance. In addition, post-restoration hydrologic conditions in West Pond will need to account for the influence of beaver activity, particularly near the western outlet area. See Figure 8-5b of the Final RD/RA Work Plan for the limits of the removal and backfill extent for West Pond.

At the Lower Sykes Brook confluence, the top 1.5 feet of sediment will be removed followed by the placement of an engineered cap. Because this area functions as a tributary confluence with riverine characteristics, the likely habitat impacts are more similar to those associated with in-channel and near-channel work in the main stem as described in Section 4.2. See Figure 8-5d for the limits of the removal and cap area for the Lower Sykes Brook.

As outlined in the Final RD/RA Work Plan, the Intermittent Side Channel will be disconnected from the main channel at three points (near River Stations 1+00, 10+00, and 15+00; see Figure 8-6 of the Final RD/RA Work Plan) through re-building and stabilizing the riverbanks of the Housatonic River and then backfilling the channel with 1,800 cy of clean material to support a floodplain transitional forest/shrub wetland habitat and mitigate potential erosion. This backfill will include a three-inch compacted silty layer that will be placed to meet the elevations required to cut off the channel from the river and will be topped with a nine-inch layer of uncompacted topsoil to support the native tree and shrub growth. This process is anticipated to benefit the floodplain habitats to the east of the channel, since overbank flooding will be allowed to be dispersed across the floodplain rather than be channelized back into the Housatonic River as it does currently. The wooded/shrub floodplain habitat established will provide a suitable habitat for a suite of herpetofauna, birds, and small mammals, whereas the current defined channel provides minimal habitat functions in addition to short-circuiting overbank flowage.

7.3 Pre-Restoration Measures to Minimize Habitat Impacts

Prior to and during construction, minimization measures will be implemented to reduce habitat disturbance in the affected Other Waterbodies. These measures will include designation of restoration, compliance, and biological oversight responsibilities, daily coordination and environmental inspection during active work, and clear communication procedures for addressing unanticipated field conditions or sensitive resource encounters. In addition, where feasible and consistent with design requirements, cut woody debris and other natural materials will be evaluated for reuse as habitat features in restored areas. Collectively, these measures are intended to reduce unnecessary habitat loss, protect adjacent resources during construction, and improve the likelihood of successful restoration following completion of remedial work.

Construction controls will be used to limit direct and indirect disturbance to the greatest extent practicable. These measures include installation of silt fencing and wildlife exclusion barriers where appropriate, restriction and marking of access and staging areas, and identification, delineation, and flagging of sensitive habitat features before ground disturbance begins. In West Pond and the Lower Sykes Brook confluence, the limits of work, adjacent vegetated areas, and habitat features to be preserved will be identified in advance so that disturbance remains confined to the approved work areas. In the Intermittent Side Channel, the limits of clearing, bank reconstruction, fill placement, and restoration planting will likewise be established before work begins.

Impact minimization measures for rare species are summarized in Section 11 and described in the Rare Species CMP in **Appendix B**.

7.4 Restoration of Other Waterbody Habitats

Restoration of the remediated Other Waterbodies in Reach 5A will be coordinated with remediation phasing as described in the Final RD/RA Work Plan. Because the Intermittent Side Channel, West Pond, and Lower Sykes Brook confluence differ in habitat type and restoration goals, restoration will be tailored to existing conditions, remedial design, and the intended post-construction function of each area. Restoration planting plans have been developed for all remediation areas in Reach 5A and are provided in **Appendix D** (see Figure D-1 for the Intermittent Side Channel; Figure D-5 for West Pond; and Figure D-8 for the Lower Sykes Brook area). Plant selection was based on species observed during the BRA surveys, descriptions of natural communities available from MNHESP, and knowledge of habitat suitability and hardiness for additional plant species that were included to provide a more diverse plant community. Planting tables for the Intermittent Side Channel and West Pond, are specified in **Table 7-1** and **Table 7-2**, respectively. Lower Sykes Brook will be restored as subaqueous riverine habitat and will not be planted.

Intermittent Side Channel. For the Intermittent Side Channel, restoration will focus on converting the existing overflow channel feature into stable floodplain habitat, as noted above. Following disconnection from the main river channel and placement of clean backfill the entire length, the area will be graded to the approved design elevations and restored with appropriate floodplain vegetation to be consistent with the adjacent transitional floodplain forest habitats with a dense shrub thicket understory. The three locations where this intermittent side channel currently connects through the riverbank out to the Housatonic River will be stabilized and re-built to eliminate the connection to the river. This restoration approach is intended to establish a stable floodplain surface, reduce future erosion risk, and support the intended hydrologic function of the adjacent floodplain. As specified in the design, subsurface preparation and grading will be used to limit infiltration losses and support the intended movement or retention of shallow surface water. Disturbed areas will be stabilized and planted.

For the Intermittent Side Channel, following planting densities outlined in **Table 7-1**, a total of 1,114 herbaceous perennials, ferns, shrubs and trees of 18 different species will be planted in portions of the former channel that flow through transitional floodplain forest, and a total of 51 herbaceous perennials, ferns and shrubs composed of eight different species will be planted in the wet meadow habitats located within an unmaintained powerline corridor. It is expected that this selection of species will enable this restored floodplain habitat to integrate with the adjacent plant communities. Selected species also include four herbaceous perennials and one fern that may also function as host plants for state-listed moths and butterflies. In addition, approximately nine pounds of seed mix containing species suitable for these two habitats will be broadcast throughout the restoration area at specified rates to support site stabilization and provide additional diversity of native plants into each restoration area.

Some species of herbaceous plugs listed in **Table 7-1** may be planted as a seed mixture if available, provided that plant species intended to provide host plants for the state-listed butterfly are included. However, fern species that function as host plants for the state-listed moth (i.e., ostrich fern) are typically propagated and sold as six-inch pots, plugs, or rhizomes.

West Pond. For West Pond, restoration will focus on re-establishing the ponded habitat and its hydraulic connection to the river following dredging and backfill placement. The primary objective will be to restore appropriate water depths, hydrologic connectivity, and substrate conditions so that aquatic and marsh vegetation can recolonize naturally where feasible. **Table 7-2** outlines the planting densities and species for respective cover types within shrub swamp, shallow emergent marsh, and deep emergent marsh habitat. The backfill material specified is expected to serve as a suitable medium for planting and natural recolonization of deep marsh plant species.

A total of approximately 560 herbaceous plant species suitable for growing in shallow emergent marsh habitats and approximately 628 herbaceous species suitable for growing in deep emergent marsh

habitats will be planted around the periphery of West Pond and within the channel that drains in a southerly direction towards Sackett Brook. These include four aquatic emergent, two aquatic submergent, one floating-leaved aquatic, and one obligate wetland grass species. In addition, approximately four pounds of a wetland seed mix will be evenly distributed along the margins of West Pond, which will support site stabilization and provide additional plant diversity into the local wetland system. Open water areas of West Pond will not be planted.

Additionally, West Pond outlet flows and water stage will require addressing beaver dam activity, particularly on the western side, where maintaining discharges from the pond through beaver impoundments has been an ongoing effort by MassAudubon. GE anticipates working cooperatively with MassAudubon to restore the “beaver deceiver” outlet structures as desired by MassAudubon as part of the restoration activities.

Lower Sykes Brook. Following dredging and cap placement at the Lower Sykes Brook confluence, restoration will focus on re-establishing stable riverine habitat conditions by applying NCD principles and design as detailed in Section 7.5.1 of the Final RD/RA Work Plan. During capping and grading, specified materials will be placed in accordance with design plans, and structural habitat elements such as LWD, boulders, or other structural features may be incorporated where feasible and consistent with cap integrity and restoration design. As noted in **Appendix A**, a large center bar has formed at the confluence of Sykes Brook and the main stem river, where the channel is quite wide (130 to 140 feet). This center bar will be dredged as part of the riverine remediation; as the NCD process moves into detailed phases for this third segment, consideration will be given to establishing a LWD complex (e.g., a lunker) in this area as an enhanced wood turtle habitat feature. This will be addressed in the addendum to this Restoration Plan that addresses the downstream subreaches.

With the exception of two state-listed species that have been documented in the vicinity of Sykes Brook outlet (matted spike-sedge and Frank’s lovegrass), active planting of native aquatic vegetation is not anticipated, with natural recolonization expected as suitable substrate conditions develop. To the extent that matted spike-sedge and/or Frank’s lovegrass are removed by the remediation, they will be replanted.

8. Floodplain Habitats (excluding Vernal Pools)

8.1 Description of Floodplain Habitats in Reach 5A

Floodplain habitats in Reach 5A were characterized in the Reach 5A BRA and follow-on supplemental BRA surveys conducted in 2025 to establish baseline (pre-remediation) conditions and document functions and values that could be affected by remediation and support activities. The Revised BRA Report provides the primary description of floodplain habitat extent, cover types, and functions, while the supplemental 2025 surveys refined conditions within remediation and support areas, including tree inventories, wildlife habitat features, invasive plant concentrations, and rare species survey information. A summary of the BRA findings relevant to floodplain habitat is provided below. For additional details, see the Revised Reach 5A BRA Report and the Reach 5A SDC Report.

Reach 5A includes approximately 370 acres of floodplain habitat, defined by the area between the riverbanks and the 1 mg/kg PCB isopleth, which approximates the 10-year floodplain. Most of this area (approximately 85%) consists of wetland community types. Floodplain wetlands in Reach 5A are composed of seven plant community cover types. Forested wetland habitats comprise the largest component of the floodplain, totaling approximately 167 acres, with transitional floodplain forest the dominant wetland cover type at approximately 147 acres followed by high terrace floodplain forest (11 acres) and red maple swamp (nine acres). An additional 147 acres of other floodplain wetland communities include shrub swamp (64 acres), wet meadow (24) acres, and shallow and deep emergent marshes (46 and 13 acres, respectively). Shallow and deep emergent marsh habitats within the floodplain are restricted to vernal pools and backwaters, and are thus not covered in this section. Vernal pool habitat within the floodplain is covered in Section 9.

Floodplain upland community types account for approximately 45 acres and occur primarily along the outer margins of the floodplain. These upland habitats include approximately 26 acres of cultural grassland, 4.4 acres of agricultural fields, 14 acres of upland forest cover types, and approximately 0.6 acre of developed/disturbed cover. The floodplain also includes approximately 11.6 acres of open water associated with small ponds and beaver impounded areas of Sykes and Sackett Brooks in Canoe Meadows.

Assessment of floodplain wetland and upland functions indicates that these habitats provide numerous ecological functions, including flood storage and floodflow alteration, groundwater recharge/discharge, water quality improvement, wildlife habitat, and rare species habitat. Floodplain inventories documented flood frequency and water-regime conditions, soils, vegetation, wildlife habitat features, invasive plant concentrations, rare-species habitat context, and restoration opportunities. The distribution of specific wetland and upland cover types across the floodplain reflects differences in hydrologic regime, soils, and local microtopography. The 2025 supplemental surveys further refined information within remediation and support areas by documenting tree composition, mapping wildlife habitat features, delineating concentrated invasive plant populations, and updating rare species information relevant to restoration planning.

8.2 Potential Impacts of Remedial Activities on Floodplain Habitats

Impacts from direct floodplain remediation within Reach 5A (excluding vernal pools as well as support areas) total approximately 12.9 acres, including 9.2 acres of floodplain forest, 0.1 acre of upland forest, 3.1 acres of non-forested floodplain wetlands and 0.5 acre of cultural grasslands and other developed or disturbed areas. In addition, temporary access roads and staging areas within the floodplain/isopleth (excluding those associated with vernal pool remediation) are estimated to impact approximately 13.3 acres, distributed among the following cover types: 7.0 acres of floodplain forest habitat; 0.10 acre of upland forest; 2.2 acres of non-forested floodplain wetlands; and 4.0 acres of upland fields or other disturbed/developed conditions. Another 27.8 acres of habitat consisting of upland fields or other disturbed/developed conditions are anticipated to be affected outside of the floodplain/ PCB isopleth in association with these temporary access roads and staging areas.

There will likely be several types of impacts to the floodplain wetland and upland habitats from remediation and staging/access activities. One is loss of vegetative cover, which will be most prominent in forested areas. In that habitat, the cutting and removal of mature trees will have direct and collateral impacts. Further, the grubbing of the root systems, where necessary, will extend laterally (perhaps outside of the direct footprint of the activity) and to the subsurface soils. This impact may be limited in some cases with the use of timber matting, low-ground-pressure equipment, or other measures where grubbing may be limited or not be needed (e.g., gravel bedding). Non-forested portions of the floodplain may be less impacted, especially from access roads and staging areas, because the grubbing activity may not be warranted and would be more confined to the areas directly impacted by remediation.

In addition, although floodplain areas subject to remedial excavation and other activities will be returned to grades consistent with pre-remediation conditions (to the extent practicable) by backfilling and grading, changes in structural characteristics and physical-chemical properties of existing floodplain soils are to be expected despite the use of BMPs. Further, changes in the floodplain microtopography are likely to occur with both remedial excavation as well as access and staging construction and operation. These impacts will be minimized to the extent practicable by detailed specifications and adherence to the BMPs.

Floodplain habitats have developed based on complex patterns of surface water flow during flooding conditions and by shallow groundwater and interstitial water dynamics. These surface and subsurface hydrological conditions can be altered by excavation and re-grading and by compaction from heavy equipment operations.

Finally, as with other habitats, remedial and support activities in the floodplain can impair state-listed species habitat, where applicable, and can lead to increased colonization by invasive species.

8.3 Pre-Restoration Measures to Minimize Habitat Impacts

Measures to minimize adverse impacts to floodplain habitats will include limiting disturbance to the minimum area necessary to complete remediation and associated support activities. The temporary access roads and staging areas identified in the Final RD/RA Work Plan have been located, where practicable, in previously disturbed or degraded areas, utility corridors, open fields, invasive-species-dominated areas, existing paths, or other comparatively lower-value habitat areas, to reduce impacts to higher-value floodplain habitats and rare species habitat. Notably, of the seven staging areas required for completing remediation activities in Reach 5A, only one is located within forested floodplain habitat north of Pomeroy Avenue; all others have been located outside the floodplain in open field habitats.

Prior to construction, the limits of work will be reviewed with the remediation contractor, clearly demarcated on plans or in the field if necessary (such as for rare plants), and exclusion/protection areas will be established around habitat features designated for preservation. These features may include selected large native trees, snags, coarse woody debris, root wads, localized microtopographic features, and other wildlife habitat elements that can be retained without interfering with remediation. Surveys for trees greater than 10 inches in diameter at breast height (DBH) and standing dead tree snags within floodplain and riverbank remediation areas and staging areas have already been conducted and were described in the Supplemental Data Collection Summary Report for Reach 5A. Clearing of vegetation will be limited to that necessary for remediation, access, staging, and safe equipment operation. When possible, access road alignment will be adjusted in the field to avoid large trees or other important habitat features. In floodplain areas, low-ground-pressure equipment, timber matting, or other low-impact access methods will be used where practicable to reduce rutting, soil mixing, and unnecessary grubbing. In areas where tree removal cannot be avoided, salvage of suitable logs, root wads, boulders, and other natural materials will be evaluated for reuse as habitat features in restored floodplain areas.

There are numerous mature trees within and adjacent to floodplain excavation areas that serve to provide erosion control as well as habitat. As noted in the Final RD/RA Work Plan, for mature trees that are adjacent to floodplain soil excavations limited to the top foot of soil, an effort will be made to leave those trees in place to the extent consistent with the remediation, and excavations in the vicinity of these trees will be performed by hand by the remediation contractor under GE and EPA oversight. However, trees

located within or adjacent to excavations greater than one foot will typically need to be removed due to potential tree health and stability concerns associated with deeper excavations, unless otherwise proposed by GE and approved by EPA in the field. Methods for preserving root systems of larger trees are outlined in technical specifications provided in Appendix B of the RD/RA Work Plan.

Invasive species control will also be integrated into impact minimization. Where invasive woody or herbaceous species dominate work areas, pre-treatment or early treatment will be conducted, if practicable, to reduce reinfestation of restored habitats and to improve restoration success. Additionally, invasive tree species such as Norway maple will not be flagged to remain. Further details on invasive species control are provided in the ISCP (**Appendix C**).

Finally, construction-phase environmental oversight will be provided by qualified personnel. This oversight will include pre-construction review of work areas, verification of erosion and sediment controls, and coordination of species-protection measures before and during work.

Measures to minimize or mitigate impacts to rare species are summarized in Section 11 and described in the Rare Species CMP (**Appendix B)**.

8.4 Restoration of Non-Residential Floodplain Habitats

Floodplain restoration in the non-residential Exposure Areas will be directed toward re-establishing floodplain conditions comparable to those present prior to remedial disturbance, including appropriate elevation, soil moisture regime, overbank flooding influence, and localized microtopography. Restoration will seek to maintain or recreate hydrologic gradients and floodplain features that support natural community development rather than creating uniformly graded surfaces. Following completion of grading and placement of suitable surface soils, the restored surface will be stabilized using an initial seed mix or temporary cover appropriate for floodplain conditions. The purpose of this first phase will be to stabilize the soil surface, reduce erosion potential, and suppress invasive recolonization while the site transitions toward final planting.

After this initial establishment period, final plantings will be installed. These plantings will include a mix of tree, shrub, and herbaceous species appropriate to the target floodplain community and hydrologic setting. Woody plantings will be distributed in a manner that reflects natural floodplain heterogeneity rather than rigid uniform spacing, except where spacing is needed to meet performance requirements or facilitate monitoring.

Natural recruitment of native species from adjacent intact floodplain habitats will also be allowed to contribute to restoration success where consistent with the design objectives and invasive species management needs. Where feasible, as previously noted, mature native trees or discrete areas of native herbaceous or shrub vegetation will be preserved at the margins of work areas and standing dead tree snags will be salvaged for incorporation into restored floodplain forest areas as LWD that will accelerate development of structural habitat complexity.

Restoration planting plans for all affected floodplain areas in Reach 5A are provided in **Appendix D** (see **Figures D-1 through D-21**). Plant selection was based on species observed during the BRA surveys, descriptions of natural communities available from MNHESP, and knowledge of habitat suitability and hardiness for additional plant species that were included to provide a more diverse plant community. Proposed plantings for each natural community cover type impacted by floodplain remediation and placement of access roads and staging areas are discussed below and specified in **Tables 8-1** through **8-4**.

8.4.1 Transitional Floodplain Forest Restoration

Transitional floodplain forest restoration will be directed toward re-establishing native floodplain forest conditions comparable to those present prior to remedial disturbance. In such areas, the restoration will seek to restore appropriate grading, soil conditions, and localized microtopography needed to support redevelopment of transitional floodplain forest and shallow hydrologic gradients rather than creating

uniformly graded surfaces. Following completion of grading and placement of suitable surface soils, the restored surface will be stabilized using an initial seed mix or temporary cover appropriate for transitional floodplain forest conditions. The purpose of this first phase will be to stabilize the soil surface, reduce erosion potential, and suppress recolonization by invasive plants while the site transitions toward final planting.

After this initial establishment period, final plantings will be installed. These plantings will include a mix of tree, shrub, and herbaceous species appropriate to the target transitional floodplain forest community and hydrologic conditions. Woody plantings will be distributed in a manner that reflects natural floodplain forest heterogeneity rather than rigid uniform spacing, except where spacing is needed to meet performance requirements or facilitate monitoring.

A total of approximately 15.8 acres of transitional floodplain forest areas will be impacted by floodplain remediation and installation of temporary access roads and staging areas. Following the planting schedule and densities outlined in **Table 8-1**, a total of 32,294 herbaceous plugs, 4,758 woody shrubs and 6,853 trees will be needed for restoration.[15] This planting list includes a total of 22 species (seven herbs, seven woody shrubs and eight trees). In addition, approximately 284 pounds of seed mixture specific to transitional floodplain forest habitats will be needed. Other commercially available seed mixtures may be acceptable if deemed appropriate for these habitats. Seed mix will be evenly distributed throughout each restoration area at specified rates to support site stabilization and provide additional diversity of native plants into each restoration area.

Planting specifications for this plant community type include a higher density of trees than in other open plant community types (e.g., shrub swamp, wet meadow) and a corresponding lower density of woody shrubs. The total number of trees required may also be reduced depending on how many existing mature trees can be preserved during the remediation efforts.

Also included in **Table 8-1** are herbaceous plants and ferns that function as host plants for state-listed moths and butterflies. Some species of herbaceous plugs listed in **Table 8-1** may be planted as a seed mixture if available, provided that plant species intended to provide host plants for the state-listed butterfly are included. However, the fern species that function as host plants for the state-listed moth (i.e., ostrich fern) are typically propagated and sold as six-inch pots, plugs, or rhizomes.

8.4.2 High-Terrace Floodplain Forest Restoration

High-terrace floodplain forest restoration will be directed toward re-establishing native floodplain forest conditions comparable to those present prior to remedial disturbance, while recognizing the somewhat drier and less frequently inundated setting of these upper floodplain surfaces relative to adjacent forested wetlands and their unique vegetation community. In these areas, the restoration will seek to restore appropriate grading, soil conditions, and localized microtopography needed to support redevelopment of high-terrace floodplain forest habitat rather than creating uniformly graded surfaces. Following completion of grading and placement of suitable surface soils, the restored surface will be stabilized using an initial seed mix or temporary cover appropriate for upper floodplain forest conditions. Again, the purpose of this first phase will be to stabilize the soil surface, reduce erosion potential, and suppress invasive recolonization while the site transitions toward final planting.

After this initial establishment period, final plantings will be installed. These plantings will include a mix of tree, shrub, and herbaceous species appropriate to the target high terrace floodplain forest community and site conditions. Woody plantings will be distributed in a manner that reflects natural floodplain forest heterogeneity rather than rigid uniform spacing, except where spacing is needed to meet performance requirements or facilitate monitoring.

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[15] As previously noted, planting and seeding quantities presented in this Restoration Plan, including tables, are based upon the project layout and work activities anticipated at the time of this plan preparation and are subject to change based upon subsequent adjustment of project work limits, especially for areas downstream of the initial subreach.

A total of approximately 0.51 acres of high terrace floodplain forest areas will be impacted by floodplain remediation and installation of temporary access roads and staging areas. Following the planting schedule and densities outlined in **Table 8-2**, a total of 1,050 herbaceous plugs, 97 woody shrubs and 87 trees will be needed for restoration. This planting list includes a total of 17 species (eight herbs, four woody shrubs and five trees). In addition, approximately nine pounds of seed mixture specific to high-terrace floodplain forest habitats will be needed. Other commercially available seed mixtures may be acceptable if deemed appropriate for these habitats. Seed mix will be evenly distributed throughout each restoration area at specified rates to support site stabilization and provide additional diversity of native plants into each restoration area.

As with transitional floodplain forest areas, planting specifications for this plant community type include a higher density of trees than in other open plant community types (e.g., shrub swamp, wet meadow) and a corresponding lower density of woody shrubs. The total number of trees required may also be reduced depending on how many existing mature trees can be preserved during the remediation efforts.

Also included in **Table 8-2** is a species of fern (i.e., ostrich fern) that functions as host plants for a state-listed moth. Some species of herbaceous plugs listed in **Table 8-2** may be planted as a seed mixture if available, However, the fern species that function as host plants for the state-listed moth (i.e., ostrich fern) are typically propagated and sold as six-inch pots, plugs, or rhizomes.

As in traditional floodplain forest areas, natural recruitment of native species from adjacent intact floodplain habitats will be allowed to contribute to restoration success where consistent with the design objectives and invasive species management needs. Again, where feasible, mature native trees or discrete areas of native herbaceous or shrub vegetation will be preserved at the margins of work areas and salvaged coarse woody debris will be incorporated into restored high-terrace floodplain forest areas to accelerate development of structural habitat complexity.

8.4.3 Shrub Wetland Restoration

Shrub wetland restoration will focus on restoring the shallow saturation and seasonal inundation patterns necessary to support scrub-shrub wetland communities and associated habitat structure. Design grades will preserve or recreate the subtle relief and wetness gradients that typically produce a mosaic of shrub-dominated patches interspersed with herbaceous openings. Following final grading and topsoil placement, the restored area will be stabilized with an initial wetland seed mix and temporary cover appropriate to the site. This initial stabilization phase will reduce erosion, promote early cover, and help suppress invasive regrowth while hydrologic conditions are confirmed.

Once site stabilization and initial hydrologic performance have been assessed, final shrub wetland plantings will be installed. These will include clustered plantings of native shrub species, supplemented as needed by herbaceous wetland species in the interspaces, so that the restored area develops as a heterogeneous floodplain shrub wetland rather than a uniform monoculture.

A total of approximately 1.1 acres of shrub swamp habitats will be impacted by floodplain remediation and installation of temporary access roads and staging areas. Following the planting schedule and densities outlined in **Table 8-3**, a total of 509 herbaceous plugs, 721 woody shrubs and 28 trees will be needed for restoration. This planting list includes a total of 20 species (seven herbs, 11 woody shrubs, and two trees). Planting densities of woody shrubs will be greater than those specified for forested habitats. Although shrub swamps are typically open areas with dense shrub cover, sporadic trees growing on drier hummocks or earthen mounds are not uncommon. Therefore, a limited number of trees have been included in this planting schedule to accommodate topographic variability where present, or trees may also be planted around the periphery of shrub swamp habitats. Also included in this table are herbaceous plants and ferns that function as host plants for state-listed moths and butterflies.

In addition to plantings, approximately 19 pounds of a wetland seed mixture will be evenly distributed throughout each restoration area at specified rates to support site stabilization and provide additional diversity of native plants. Other commercially available seed mixtures may be acceptable if deemed appropriate for these habitats.

Some species of herbaceous plugs listed in **Table 8-3** may be planted as a seed mixture if available, provided that plant species intended to provide host plants for the state-listed butterfly are included. However, fern species that function as host plants for the state-listed moth (i.e., ostrich fern) are typically propagated and sold as six-inch pots, plugs, or rhizomes. Milkweed plugs have also been included in restoration planting plans to promote the growth of milkweeds, which are host plants for monarch butterflies a species that is not state-listed but has been proposed for federal listing.

Because shrub wetlands are vulnerable to reinvasion by woody invasive species, follow-up invasive species control will be a core part of establishment. Monitoring during the first growing seasons will be used to identify sprouting or colonizing invasives so they can be treated before they dominate the restored shrub layer.

8.4.4 Wet Meadow Restoration

Restoration of wet meadow habitats will be based on re-establishing the elevation, seasonal water regime, and soil conditions needed to support wet-meadow communities in the Reach 5A floodplain. Because year-to-year hydrology may shift the relative expression of wet meadow vegetation, the restoration objective will be to restore the physical template for these habitats rather than impose rigid boundaries between them. Grading will therefore emphasize restoration of low-relief surfaces, shallow depressions, and gentle transitions to adjacent shrub and forested wetland habitats.

Following grading and surface-soil placement, these areas will be seeded promptly with an appropriate native wetland herbaceous mix and temporary cover as needed for stabilization. In areas where rapid establishment of structure is important or where design conditions warrant more directed establishment, selected plugs or other herbaceous wetland plant materials may also be installed.

A total of approximately four acres of wet meadow habitats will be impacted by floodplain remediation and installation of temporary access roads and staging areas. Following the planting schedule and densities outlined in **Table 8-4**, a total of 1,907 herbaceous plugs, and 107 woody shrubs will be needed for restoration. This planting list includes a total of 11 species (six herbs and five woody shrubs). Although wet meadows are typically open areas dominated by herbaceous sedges, rushes, grasses and forbs, sporadic woody shrubs growing on drier hummocks or earthen mounds are not uncommon. Therefore, a limited number of woody shrubs have been included in this planting schedule to accommodate topographic variability where present, or shrubs may also be planted around the periphery of wet meadow habitats. Also included in this table are herbaceous plants and ferns that function as host plants for state-listed moths and butterflies.

In addition to plantings, approximately 71 pounds of a wetland seed mixture will be evenly distributed throughout each restoration area at specified rates to support site stabilization and provide additional diversity of native plants. Other commercially available seed mixtures may be acceptable if deemed appropriate for these habitats.

Some species of herbaceous plugs listed in **Table 8-4** may be planted as a seed mixture if available, provided that plant species intended to provide host plants for the state-listed butterfly are included. However, fern species that function as host plants for the state-listed moth (i.e., ostrich fern) are typically propagated and sold as six-inch pots, plugs, or rhizomes. Again, milkweed plugs have been included in the restoration planting program to promote the growth of these host plants and thus restore or improve the habitat for monarch butterflies.

Consistent with the overall floodplain restoration approach, these habitats may rely in part on natural recolonization from adjacent wetlands and seed sources, but active planting and seeding will be used as needed to achieve the target plant community composition, stabilize disturbed surfaces, and reduce the likelihood that invasive species dominate the restored emergent zone.

8.4.5 Restoration of Forested Upland Floodplain Habitats

Floodplain upland habitats affected by remedial excavation or temporary support activities will be restored to pre-remediation topographic and habitat conditions to the extent practicable. These areas include the limited portions of upland floodplain directly excavated for remediation (0.23 acres), together with floodplain upland portions of access roads and staging areas that are ultimately used during construction. The final extent of floodplain upland disturbance associated with support activities will be confirmed in the final design.

Restoration of floodplain uplands will include removal of temporary construction materials; decompaction where needed; replacement or re-spreading of suitable topsoil; and re-establishment of the pre-existing contour and surface-drainage relationship to adjacent wetlands, channels, and floodplain surfaces. A temporary stabilization seed mix or cover crop will be applied following grading, after which final planting or seeding will be implemented based on the target upland floodplain community type.

Approximately 0.7 acre of upland forest areas will be impacted by floodplain remediation and installation of temporary access roads and staging areas. Following the planting schedule and densities outlined in **Table 8-5**, a total of 236 herbaceous plugs, 197 woody shrubs and 284 trees will be needed for restoration. This planting list includes a total of 13 species (three herbs, four woody shrubs and six trees). In addition, approximately five pounds of seed mixture specific to upland forest habitats will be needed. Other commercially available seed mixtures may be acceptable if deemed appropriate for these habitats. Seed mix will be evenly distributed throughout each restoration area at specified rates to support site stabilization and provide additional diversity of native plants into each restoration area.

Planting specifications for this community type include a higher density of trees than in other open plant community types (e.g., shrub swamp, wet meadow) and a corresponding lower density of woody shrubs and herbs. The total number of trees required may be reduced depending on how many existing mature trees can be preserved during the remediation efforts.

8.5 Restoration of Other Upland Habitats

Other upland habitats outside of the 1 mg/kg PCB isopleth that are disturbed by temporary access, staging, or related support activities will be restored to reflect the specific baseline condition of the affected areas and their final intended post-construction use. These areas are expected to include primarily previously disturbed, open, or developed upland settings.

At a minimum, restoration of these upland areas will include removal of temporary construction materials and surfacing, grading to pre-construction contours or approved final contours, decompaction where necessary, and placement or re-spreading of topsoil suitable for revegetation. Areas that were previously open field, herbaceous, or otherwise disturbed conditions will be restored primarily through stabilization seeding, invasive-species control, and natural recolonization, supplemented by active planting where needed to re-establish the desired cover type. Areas that supported woody vegetation prior to disturbance will be restored through a combination of initial stabilization seeding and subsequent installation of native trees and shrubs appropriate to the pre-existing upland habitat.

A total of approximately 27.6 acres of other upland habitats located outside the 1 mg/kg PCB isopleth will be impacted through construction of temporary access roads and staging areas. This includes 0.6 acre of forested uplands and 27 acres of cultural grasslands and other areas of developed/disturbed open space. Plantings for forested uplands will follow species selection and densities outlined above in **Table 8-5** and cultural grasslands will be replanted with a native seed mix or annual grass cover at the property owners' choice.

8.6 Restoration of Residential Properties

As described in Section 10.1.1 of the Final RD/RA Work Plan, there are 13 residential properties in Reach 5A that require soil removal. Restoration of those properties will return disturbed areas to pre-remediation conditions (or as otherwise agreed by GE and the property owners) using property-specific approaches to

backfilling, surface stabilization, landscaping, hardscape repair, stormwater drainage protection, and safeguarding existing structures and utilities. Excavated areas will be backfilled with clean, suitable material to original or near-original grades; topsoil will be replaced as needed; and lawns, gardens, walkways, fencing, and other site features will be restored, all as discussed with the property owner and with any modifications agreed to by GE and the property owner. Pre-existing drainage patterns will be re-established and disturbed surfaces stabilized through seeding, sodding, or other appropriate measures, again as discussed with the property owner.

Where the residential property area remediated consists of a maintained cover (e.g., mowed lawn, hedgerow, etc.), it is anticipated that that maintained cover will be restored following remediation, subject to discussion and agreement with the property owner. Where the work at a residential property occurs in an unmaintained floodplain area with habitat conditions consistent with the natural community cover type mapping described in Section 8.4 for floodplain habitats, it is anticipated that the restoration of habitat will follow the procedures for each respective habitat type described in Section 8.4 (e.g., transitional floodplain forest habitat will be restored as this habitat type). However, variations to this approach may be made based on discussions with the property owner and with EPA approval.

9. Vernal Pool Habitat

9.1 Description of Affected Vernal Pool Habitats in Reach 5A

Reach 5A contains 59 seasonally wet depressions that meet the MNHESP criteria for certification as certified vernal pools. As described in the Final RD/RA Work Plan, 48 of those 59 pools have spatially weighted average PCB concentrations above the vernal pool Performance Standard of 3.3 mg/kg and therefore will require remediation This section focuses on those 48 pools requiring remediation. Under the Revised Permit, the remediation of those pools will involve either removal and replacement of soil or reduction in the bioavailability of PCBs in the pool through placement of amendments. The final remedial approach for the majority of those pools has not yet been selected, because the remaining pool-specific remediation approach will be informed by the results of the vernal pool pilot study, as described in the Final Revised Vernal Pool Pilot Study Work Plan (Final Pilot Work Plan; Anchor QEA and AECOM, 2025). However, remediation of one non-pilot-study vernal pool (5A-VP-13) via soil removal and replacement has been included in the Final RD/RA Work Plan because it intersects with the remediation required for residential Parcel I6-3-13.

The affected vernal pools in Reach 5A consist of depressions that are capable of holding standing water through at least a portion of the amphibian breeding season and function as breeding habitat for obligate vernal pool species, such as wood frog, spotted salamander, and fairy shrimp (*Eubranchipus vernalis*). They also provide breeding, foraging, and rehydration/thermoregulation habitat for other amphibians and reptiles, including northern spring peeper (*Pseudacris crucifer*), northern leopard frog (*Lithobates pipiens*), green frog (*Lithobates clamitans*), snapping turtle (*Chelydra serpentina*), painted turtle (*Chrysemys picta*), garter snake (*Thamnophis sirtalis*), American toad (*Anaxyrus americanus*), and bullfrog (*Lithobates catesbeianus*). In addition, ribbon snakes (*Thamnophis sauritus*), wood turtles, and spotted turtles (*Clemmys guttata*) may forage and estivate in or near these riparian vernal pools. The most consistently documented obligate vernal pool indicator species in Reach 5A are wood frog, fairy shrimp, and spotted salamander.

Baseline characterization of vernal pools in Reach 5A was completed through prior investigations, including prior field screening and confirmation of certified vernal pools, documentation of pool physical setting and hydrology, vegetation and invasive species observations, landscape-context analysis, selected soil and water chemistry sampling, and relative-value screening. The pilot study baseline program further refined understanding of vernal pool conditions through additional amphibian breeding surveys, fairy shrimp surveys, vegetation surveys, topographic data collection, hydroperiod and flooding-depth monitoring, soil profile descriptions, and water-quality sampling in the pilot study pools.

9.2 Potential Impacts of Remedial Activities

As noted above, remediation of the 48 Reach 5A vernal pools will ultimately consist of either removal-based remediation with backfilling and restoration or amendment-based remediation intended to reduce PCB bioavailability. Ten pools have been selected for the pilot study to evaluate these two approaches, and the remediation approach for the remaining pools (other than 5A-VP-13) will be determined after EPA review of the pilot study results.

Because the final approach for the remaining vernal pools has not yet been selected, the discussion below is necessarily general. For amendment-based remediation, potential impacts include temporary disturbance to existing surface conditions during amendment placement; cutting or disturbance of herbaceous and shrub vegetation to facilitate access or amendment application; temporary removal or displacement of woody debris or small woody vegetation where needed for equipment access or amendment mixing; and potential short-term changes in vernal pool vegetation, hydrology, hydroperiod, and other ecological conditions that will need to be assessed through monitoring. For removal-based remediation, potential impacts include direct removal of existing topsoil or sediment in selected portions of the pool; temporary disturbance of existing pool morphology and microrelief; temporary removal or disturbance of woody debris and vegetation; and short-term disruption of existing biological communities

until backfilling, restoration, and revegetation are completed. Related support activities, including temporary access and staging, may also disturb adjacent vernal pool envelope habitat, compact soils, alter shallow surface-water flow patterns, and remove or damage vegetation if not carefully controlled.

A more detailed evaluation of remediation effects, restoration implementation, and post-restoration ecological response will be made based on the pilot study and will be documented in the Vernal Pool Pilot Study Construction Completion Report and the Vernal Pool Pilot Study Summary Report. The latter report will provide recommendations regarding the appropriate remediation approach for the remaining Reach 5A vernal pools.

9.3 Pre-Restoration Measures to Minimize Habitat Impacts

Measures to minimize impacts to vernal pool habitats during the pilot study will be implemented through the pilot study design, site preparation procedures, temporary access road and staging/support area design, erosion and sedimentation control measures, and restoration requirements. Access to the pilot pools will be established through the pilot study access and staging arrangements shown in the pilot study design and further refined in the SIP for that study and will rely, where practicable, on existing unimproved paths, sewer easements, private roads, gravel paths, and other previously disturbed or degraded areas. Clearing of vegetation will be limited to what is necessary to access the vernal pools and to construct temporary access and staging areas. Mature trees greater than six inches in DBH will be left in place to the extent practicable under oversight by a project wetland scientist. Following contractor selection and after determining the final locations and extents of access roads and temporary staging areas, GE will conduct an inventory of trees, shrubs and other significant vegetation anticipated to be removed, and an Adjacent Area Site Restoration Plan will be developed and presented in the SIP (per the Final Pilot Work Plan). During this process, any habitat features identified for preservation, such as trees, downed woody debris, or standing dead trees, will be identified and protected before clearing or excavation begins.

The Final Pilot Work Plan for this study includes pre-remediation measures to address rare species. It provides that pre-construction screening for wood turtles will be conducted in all access, staging, and vernal pool remediation areas by a qualified biologist, including radio telemetry scanning, and that any wood turtles encountered will be relocated to suitable habitat outside active work areas and handled in accordance with approved wood turtle procedures. It also provides that rare plant surveys and other rare species surveys conducted in 2025-2026 will be used to refine the assessment of potential presence of rare species in vernal pool work areas and support areas. It notes that a Rare Species Mitigation Plan will be included in the SIP for the pilot study.

Comparable pre-restoration measures will also be implemented for vernal pool 5A-VP-13 to the extent applicable. Because 5A-VP-13 overlaps the remediation required for residential Parcel I6-3-13, that pool will be remediated concurrently with the residential soil removal. Prior to initiating removal, the horizontal limits of excavation will be surveyed and staked in the field, and field measurements will be used during construction to verify that the target removal depths and elevations have been achieved. Soil removal in 5A-VP-13 is planned to occur during the pool's dry season (July-September), after which the excavated area will be backfilled with suitable soils and graded to match the pre-excavation microtopography of the pool. To further minimize impacts, low-ground-pressure equipment and/or construction mats will be used where practicable. Where mature trees occur adjacent to shallow excavation areas, they will be left in place where practicable and consistent with the remediation, and excavation in their vicinity will be performed by hand under GE and EPA oversight. The outlet channel that connects 5A-VP-13 with the Housatonic River at the eastern end of the vernal pool will be left undisturbed during construction to minimize any changes in vernal pool hydrology associated with the inflow-outflow conditions through this channel. In addition, a wood sill will be installed along the bank of the Housatonic River where this channel discharges to the river. This sill will ensure that the prevailing elevation of the channel at this critical control point is maintained during and after the remediation/restoration process. Finally, pre-construction measures to minimize impacts to rare species will be consistent with those summarized in Section 11 and described in the Rare Species CMP in **Appendix B**.

Measures to minimize impacts for the remaining Reach 5A vernal pools that will require remediation after completion of the pilot study will be evaluated in light of pilot study construction experience and monitoring results. Those later measures will be presented in the Vernal Pool Pilot Study Summary Report and the subsequent addendum to the Final RD/RA Work Plan for Reach 5A that addresses those remaining vernal pools.

9.4 Restoration of Vernal Pool Habitats

Restoration of the vernal pools involved in the pilot study was described in Section 5.5.8 of GE's Final Pilot Work Plan and the associated design specifications and drawings. It is summarized in the following paragraphs.

- For amendment-based pilot pools, following amendment placement, a one- to two-inch layer of leaf litter composed primarily of locally sourced floodplain-forest leaves will be applied over the treated pool surface, with oak leaves limited to less than 30%. Woody debris on the vernal pool surface will be left in place to the extent feasible or temporarily removed and then replaced in generally the same location and density after amendment placement; woody debris which is buried within existing soils will not be disturbed unless approved by EPA. Small above-ground woody vegetation cut to facilitate amendment placement will be staged and then replaced along pool edges to function as temporary egg-attachment sites and cover for larvae.

- For removal-based pilot pools, following excavation, clean topsoil/backfill will be placed to re-establish pre-removal grades, with average post-placement elevations at or below original grade to avoid loss of pool depth or floodplain storage. Woody debris will be incorporated into the surface and near-surface topsoil to recreate microtopographic variability and habitat structure consistent with pre-test conditions. Woody debris removed before construction will be returned following backfilling (provided that it was not in contact with the soil) in a manner generally consistent with pre-construction size, density, and location; woody debris which is buried within existing soils will not be reused unless an acceptable washing procedure is approved by EPA. Cut shrubs or branches will be placed along pool edges to function as temporary egg-attachment sites and cover for developing larvae. The pilot study design also provides for vegetation restoration to match pre-excavation conditions through planting and seeding, followed by application of a one- to two-inch leaf-litter layer. Site-specific planting plans for each of the removal-based pilot pools are included in the Final Pilot Work Plan.

- Restoration of areas outside the pool footprints but disturbed by implementation, such as secondary access roads, temporary staging areas, and other adjacent disturbed areas, will be addressed through an Adjacent Area Site Restoration Plan to be included in the SIP for the pilot study. That plan will include a planting plan for impacted areas outside the test pools and will identify required topsoil replacement, grading restoration, and tree/shrub installation, as appropriate.

As noted above, remediation of one non-pilot-study vernal pool (5A-VP-13) has been included in the Final RD/RA Work Plan because it overlaps with the remediation required on a residential parcel. Approximately 0.22 acre of vernal pool 5A-VP-13 will be remediated through excavation and backfilling with suitable soils for wetland plant community development. Prior to soil excavation, the vegetation and organic material in and surrounding the vernal pool will be documented to replicate habitat conditions following the excavation. Soil will be removed during the pool's dry season, and excavated areas will then be backfilled with moisture-holding soils and graded to match the micro-topography of the vernal pool prior to excavation. The area will be replanted with native vegetation, which will include trees or taller vegetation that previously provided shade and unique ecological functions to the vernal pool ecosystem. Specifically, following planting densities outlined in **Table 9-1**, a total of 62 trees and shrubs from six different species and 152 herbaceous plant species suitable for shallow and deep emergent marsh habitats will be planted in this pool. These include three aquatic emergent species for planting around the pool margins and one submergent species to be included in deeper areas of the pool. In addition, approximately one pound of a wetland seed mix will be evenly distributed along the margins of the vernal pool at specified rates to support site stabilization and provide additional diversity of native plants. A planting plan for 5A-VP-13 is included in **Appendix D** on **Figure D-22**.

For the remaining non-pilot vernal pools, restoration details will be refined based on an evaluation of the restoration performed in the pilot pools, which will be presented in the Vernal Pool Pilot Study Summary Report. The restoration plan for those remaining pools will then be presented in the subsequent addendum to the Final RD/RA Work Plan for Reach 5A that addresses those vernal pools.

10. Monitoring and Assessment of Post-Restoration Conditions

Post-restoration monitoring and assessment for the restored Reach 5A habitat discussed in prior sections will be implemented in accordance with the applicable monitoring framework established in the RPOEC Report. In general, monitoring will begin with post-construction verification to confirm that restoration measures were installed in accordance with the approved plans and specifications. Thereafter, monitoring will be conducted on a phased basis as restoration areas are completed and will be used to evaluate whether restored habitats are progressing toward the applicable restoration evaluation criteria specified in the RPOEC Report, whether corrective actions are needed, and whether adaptive management measures should be implemented. In accordance with the Final Revised ROR SOW, the monitoring described in this section will be included in the future Inspection, Monitoring, and Maintenance (IMM) Plan discussed in Section 20 of the Final RD/RA Work Plan.

For most restored habitats in Reach 5A, post-restoration monitoring will extend for seven years following completion of restoration in each of the five subreaches in Reach 5A, unless otherwise specified for a particular habitat type or treatment approach. The specific assessments to be conducted in each of those years were specified in Table 16 of the RPOEC Report. Monitoring areas will be defined by the final restored footprints documented through as-built drawings and related closeout documentation. Annual reporting will be used to summarize monitoring methods, observations, quantitative data, comparison to applicable evaluation criteria, maintenance items, corrective actions, and recommendations for subsequent monitoring years.

Maintenance and corrective action will be implemented where monitoring indicates that restoration measures are not progressing toward the applicable evaluation criteria or where site conditions threaten restoration objectives. In each habitat type, adaptive management will distinguish between expected natural adjustment and conditions that warrant intervention. Depending on the habitat and observed condition, corrective actions may include erosion repair, invasive-species control, reseeding or replanting, maintenance or replacement of herbivory controls, repair or replacement of installed habitat features, supplemental stabilization, hydrologic corrections, or other measures identified through monitoring and adaptive-management review.

10.1 Riverine Habitats

Post-restoration monitoring of riverine habitats will be implemented on a phased basis as work areas are completed and will extend for seven years following completion of restoration in each of the five riverine subreaches in Reach 5A. Monitoring will begin with post-construction verification to confirm that riverine restoration elements were installed in accordance with the approved plans and specifications. Thereafter, annual spring qualitative site visits will be conducted to assess overall habitat condition, including erosion, scour, channel adjustment, the stability and condition of installed habitat structures, and other observable conditions that could adversely affect riverine function. Post-storm inspections will also be performed following storm events equal to or greater than a 10-year flow event, after flows return to typical seasonal conditions, to identify damage or channel changes affecting restored riverine habitat.

Quantitative riverine habitat assessment will be conducted in Years 3, 5, and 7 using the RBP Riverine Habitat Assessment and Physicochemical Characterization field forms identified in the RPOEC Report. These assessments are intended to evaluate structural and physical parameters tied to the applicable riverine restoration criteria and to generate RBP scores for assessed riverine segments. Sampling locations will generally be comparable to those used in the BRA. Benthic macroinvertebrate monitoring will be conducted in Years 3, 5, and 7 and fish community monitoring will be conducted in Years 5 and 7 to document post-restoration successional recovery of aquatic communities. Incidental wildlife observations will be recorded during site visits, while rare-species monitoring will be addressed separately through species-specific protocols, as applicable.

If monitoring indicates that riverine restoration measures are not progressing toward the applicable criteria in the RPOEC Report, the initial response will involve review of the available monitoring data followed by additional field assessment, as needed, to define the cause, spatial extent, and significance of the observed condition. Erosion, scour, or channel adjustment that could adversely affect restored riverine habitat, installed habitat features, or overall restoration performance will be evaluated and addressed through targeted corrective measures, as warranted. A distinction will be maintained between natural channel adjustment and conditions that threaten the riverine restoration objectives. Repair or replacement of installed habitat structures will be considered on a case-by-case basis where structures are absent, damaged, displaced, or no longer functioning as intended. Where physical habitat conditions appear not to support the expected recovery of fish and benthic macroinvertebrate communities, additional assessment will be conducted and adaptive measures implemented as appropriate. Conditions affecting engineered cap areas will be addressed through the applicable cap inspection, monitoring, and maintenance program rather than through this section.

10.2 Riverbank Habitats

Post-restoration monitoring of riverbank habitats will extend for seven years following completion of restoration in each of the five subreaches in Reach 5A, with monitoring areas defined by the final restored riverbank footprint as documented on as-built drawings and closeout records. An initial post-construction site visit will be conducted to verify that riverbank restoration components were installed in accordance with the approved restoration plans and contract specifications, including confirmation that the restoration was implemented consistent with NCD principles, maximized the use of bioengineering methods, and followed the hierarchy specified in the Revised Permit.

Annual spring site visits will be conducted throughout the monitoring period. Field teams will traverse all restored riverbank areas by land or water, as appropriate, to assess the consistency of restored conditions with design and specifications, identify erosion that may negatively affect bank stability and vegetation establishment, evaluate the stability of installed habitat structures and features, assess successional development of restored plant communities, and document the presence and extent of invasive plant species. Areas of concern will be photo documented and recorded by sub-meter GPS, and incidental wildlife observations will be recorded during site visits.

Riverbank Habitat Inventory Forms will be completed in Years 3, 5, and 7. Field data collection will document physical metrics, soil and substrate composition, bank stability, hydrologic indicators, floodplain connectivity, bordering habitats, corridor connectivity, and habitat degradation, including invasive-species occurrence. RBP field measurements for bank stability, vegetative protection, and riparian zone width will be incorporated into the inventory data collection and used to generate an RBP score for each assessed riverbank segment. Quantitative vegetation monitoring will also be conducted during summer site visits in Years 1 through 5 and Year 7. Permanent transects will be established through restored vegetated riverbanks to collect data on total vegetative cover, herbaceous, shrub, and tree cover, species composition, invasive-species occurrence, vegetation height, stress and herbivory observations, and soil texture and moisture.

Where monitoring indicates that riverbank restoration measures are not progressing toward the applicable criteria in the RPOEC Report, corrective action will be implemented through an adaptive-management framework. Erosion on restored riverbanks will be evaluated during all site visits, and subsequent responses may include increased monitoring frequency, additional data collection such as surveyed cross-sections or LiDAR topographic surveys, and site-specific repairs where needed. Erosion repairs will be implemented where observed conditions are directly affecting vegetation establishment, the functioning of a restored riverbank, or floodplain hydrology necessary to support design plant communities. Invasive-species control will be implemented as necessary throughout the monitoring period. Where native vegetation cover or tree and shrub survival are not meeting the applicable criteria, areas will be identified for reseeding or replacement planting in the subsequent spring or fall. Herbivory controls, including deer fencing, tree cages, guards, or collars, will be maintained until no longer necessary or until program closeout. Installed restoration structures, including coarse woody debris

features, vanes, weirs, and other bank and habitat elements, will be monitored throughout the seven-year period, and repair or replacement will be evaluated on a case-by-case basis where needed.

10.3 Backwater Habitats

Post-restoration monitoring of backwater habitats will be conducted to assess compliance with the applicable restoration performance standards and will generally extend for seven years following completion of restoration in the backwaters in each subreach of Reach 5A. Monitoring will begin with an initial post-construction site visit to verify that backwater restoration was completed in accordance with the site-specific plans and is aligned with the intended restoration objectives. Thereafter, qualitative backwater habitat surveys will be performed each spring to document restored habitat status.

These assessments will document and track, as applicable, hydrologic connectivity to the river, seasonal water depths, erosion affecting bank stability and vegetation establishment, the stability of habitat structures installed during restoration, and the prevalence of native and invasive species. Backwater Habitat Inventory Forms will be completed in Years 3, 5, and 7. Consistent with the RPOEC Report, post-restoration monitoring will evaluate whether backwaters maintain hydrologic connection to the river in comparable form and function to pre-remediation conditions or conditions specified in the design drawings and specifications; maintain seasonal water depths consistent with pre-remediation conditions or design expectations under normal climatic conditions; retain installed habitat structures in a manner that supports backwater hydrology, floodplain connectivity, habitat, and planted vegetation, if any; and maintain restored sediment characteristics and composition in accordance with the contract specifications.

Because each Reach 5A backwater is expected to include plantings as part of restoration, post-restoration monitoring and assessment will also evaluate vegetation establishment. This will include determining whether mean percent cover of native target species is at least 80% in each design plant community type, whether mean percent cover of invasive or likely invasive plant species is no more than 10% (or no greater than documented reference-site conditions where applicable), and whether restored planted communities achieve stem densities reflecting a minimum of 80% surviving, established, or naturally recruited native species per acre.

If monitoring indicates that restoration is failing to meet the applicable criteria, maintenance and corrective action will be implemented through the adaptive-management framework. Given the primary habitat components of backwaters, corrective actions may include erosion repairs to stabilize banks and maintain hydrologic connectivity, invasive-species control using mechanical, chemical, or biological methods, and replanting or reseeding where native vegetation has not established successfully. Maintenance of herbivory controls and repair or replacement of habitat structures such as coarse woody debris or other installed features may also be necessary. Corrective actions will be tailored to the specific backwater and the observed condition and adjusted as needed based on monitoring results.

10.4 Other Waterbody Habitats

Post-restoration monitoring of Other Waterbody habitats will be conducted in accordance with the approved plans and the monitoring framework established in the RPOEC Report. Monitoring will begin shortly after completion of restoration in disturbed areas and will generally continue for approximately seven years after completion of restoration in each Other Waterbody, inclusive of a full growing season within the first year, except where a different schedule is warranted by habitat type or treatment approach. Because the Other Waterbody habitats addressed in Reach 5A include features with differing restoration characteristics, the applicable monitoring approach will reflect the habitat type being restored.

For the Intermittent Side Channel, which is treated as a floodplain wetland habitat for monitoring purposes, post-construction verification will be conducted to confirm that restoration was completed in accordance with the approved design. Annual spring site visits will evaluate hydrology, vegetation, and habitat structure, with incidental wildlife observations recorded. Floodplain Habitat Inventory Forms will be

completed in Years 3, 5, and 7 to document hydrology, vegetation, soils, invasive species, and rare species, and quantitative vegetation sampling will be conducted in Years 1 through 5 and Year 7.

For West Pond, which will be monitored as a backwater habitat, post-construction verification will be conducted to confirm that restoration actions were implemented in accordance with the approved plans. Annual spring site visits will assess hydrologic connectivity, water depth, erosion, habitat structure, and vegetation, with incidental wildlife observations recorded. Backwater Habitat Inventory Forms will be completed in Years 3, 5, and 7, and quantitative vegetation sampling will be conducted where planting or seeding has occurred.

For the Lower Sykes Brook confluence, which will be monitored as a riverine habitat, post-construction verification will be conducted to confirm restoration per design. Annual spring site visits will assess habitat condition, erosion, and vegetation, with incidental wildlife observations recorded each year. In Years 3, 5, and 7, RBP assessments, benthic macroinvertebrate sampling, and fish community surveys will be performed.

If monitoring identifies deficiencies in restoration performance or site stability in Other Waterbody habitats, maintenance and corrective actions will be implemented in accordance with the adaptive-management framework. For the Intermittent Side Channel, corrective actions may include repair of localized erosion or settlement within the filled area, stabilization of former channel connection points, supplemental shrub or herbaceous planting, invasive-species treatment, and protection from herbivory or other disturbance where needed. For West Pond, corrective actions may include reseeding or replanting if revegetation targets are not met, treatment of invasive species, and measures to address hydrologic or outlet-function issues that interfere with the intended restored condition. For the Lower Sykes Brook confluence, corrective actions may include erosion repair along disturbed margins, maintenance or replacement of installed habitat features, reseeding or planting of disturbed banks, and invasive-species control. In each case, monitoring will be used to distinguish expected natural processes from site conditions that threaten restoration objectives.

10.5 Floodplain Habitats

Post-restoration monitoring of restored Reach 5A non-residential floodplain habitats, including both those in remediation areas and those in support areas, will be conducted in accordance with the RPOEC Report. Such monitoring will extend for seven years following completion of floodplain restoration in each of the five subreaches in Reach 5A. Monitoring of the floodplain habitats will focus on the extent to which restored floodplain wetland and floodplain upland areas are developing toward the approved design conditions and meeting the applicable restoration evaluation criteria.

An initial post-construction review will be conducted to verify that grading, soils, habitat structures, and plant installations were completed in accordance with the approved plans and specifications. Thereafter, qualitative field reviews of restored floodplain habitats will be conducted during annual spring monitoring visits through the applicable monitoring period. These visits will assess whether conditions are present that could adversely affect restoration performance, including erosion, instability, poor plant establishment, excessive mortality, invasive-species establishment, or failure of installed habitat structures. Areas of concern will be photo documented and mapped with GPS so that trends and needed corrective actions can be tracked over time.

For floodplain habitats excluding vernal pools, more detailed floodplain habitat assessments will be conducted using protocols consistent with the BRA and RPOEC framework, including completion of Floodplain Habitat Inventory Forms during later monitoring years. Wetland and upland floodplain habitats will be assessed separately. These assessments will evaluate, as applicable, wetland hydrology, soil development, plant community composition, invasive-species cover, habitat structure, signs of erosion or degradation, and general habitat function. Quantitative vegetation monitoring will also be conducted during summer monitoring visits using permanent or repeatable transects and/or plots established in restored floodplain habitats. Parameters to be evaluated will include total vegetative cover, species composition, percent cover by target native species, percent cover by invasive species, woody stem

density, evidence of stress or herbivory, and other measures needed to assess progress toward the applicable restoration criteria.

The principal evaluation criteria for floodplain wetland habitats will include, as applicable, restoration of wetland acreage and function with no net loss of wetland area or functions, restored topsoil conditions consistent with specifications, absence of significant erosion affecting vegetation establishment or floodplain hydrology, mean percent cover of native target species of at least 80%, mean percent cover of invasive species of no more than 10% or no more than reference-site conditions where applicable, successful establishment or natural recruitment of woody plants, and the presence of indicators of floodplain wetland hydrology and hydric soil development. For floodplain uplands, monitoring will similarly assess restored acreage, topsoil condition, restored hydrologic relationship to adjacent floodplain habitats, absence of significant erosion, vegetation establishment, invasive cover, and woody stem establishment where such plantings are part of the design.

Maintenance and corrective action for floodplain habitats will follow the adaptive management approach set forth in the RPOEC Report. Certain actions, particularly invasive-species management, may begin during the first growing season and will not necessarily wait for later monitoring results. Where monitoring indicates that restoration criteria are not being met, the first step will be to evaluate whether additional information is needed to define the problem. Once sufficient information is available, corrective measures will be implemented. Potential corrective actions include erosion repairs, invasive-species control using mechanical, chemical, biological, or other approved methods, maintenance or replacement of herbivory controls, reseeding of areas with inadequate native herbaceous establishment, replacement planting of trees and shrubs where stem-density or survival criteria are not being achieved, and repair or replacement of installed habitat structures. In areas where hydrology is not functioning as intended, corrective actions may also include drainage corrections or other measures identified through adaptive-management review. In beaver-influenced portions of the floodplain, beaver-related effects on hydrology and woody plant establishment will also be evaluated, and appropriate management responses considered where such effects threaten restoration performance or nearby infrastructure.

For each of the restored residential properties, post-restoration monitoring will likewise be conducted for seven years following completion of floodplain restoration in the subreach containing that property. Where the restored area consists of a maintained cover (e.g., mowed lawn, hedgerow, etc.), the monitoring will focus on maintaining the condition of the cover and addressing any problems identified with the condition of the cover. Specifically, the focus for such areas will be on successful growth of planted/seeded areas over the course of the monitoring period as well as ensuring sustained stable conditions (e.g., lack of erosion). For unmaintained floodplain areas at residential properties, the monitoring will be the same as described above for non-residential floodplain areas to the extent applicable, but will include addressing issues identified by the property owner to extent that they are related to the restoration work conducted by GE.

10.6 Vernal Pool Habitats

Post-restoration monitoring and assessment for the pilot-study vernal pools were described in Sections 8.2.2 and 8.3.2 of the Final Pilot Work Plan. This monitoring will be conducted annually for a minimum of three years and will include porewater PCB sampling, activated carbon monitoring, ecological monitoring, and surface-water monitoring. Ecological monitoring will include surveys of amphibian egg masses and fairy shrimp, hydrology and topography, amphibian larval development and recruitment, macroinvertebrate community structure, and soils and vegetation, including invasive species colonization. Water depth and hydroperiod will also be monitored through the breeding season to assess whether amendment placement affects breeding-habitat suitability. In addition, in the removal-based pools, soil profile descriptions will be collected to assess development of hydric soil conditions.

To support interpretation of results, the pilot study also includes monitoring of control pools during each of the three monitoring years. Results from amendment-based, removal-based, and control pools will be compared with baseline conditions, with one another as appropriate, and with the applicable chemical and ecological performance criteria. The Final Pilot Work Plan also provides for annual reporting of first-

and second-year monitoring results to EPA, followed by a Vernal Pool Pilot Study Summary Report after completion of the three-year monitoring period. If monitoring indicates that pilot-study methods are not working as intended or may not achieve performance criteria, corrective actions or adjustments to the monitoring program may be developed within an adaptive-management framework.

For vernal pool 5A-VP-13 which is being remediated and restored as part of the first Reach 5A subreach remediation, post-restoration monitoring and assessment will be conducted consistent with the vernal pool monitoring program presented in the RPOEC Report. That program will include assessment of restored vernal pool physical parameters (e.g., size/dimensions, microrelief, wood debris), soil characteristics, hydrology, stability (e.g., lack of erosion), and plant species composition and coverage.

For the remaining Reach 5A vernal pools subject to remediation, post-restoration monitoring and assessment will be proposed after evaluation of the pilot study and will be presented in the subsequent addendum to the Reach 5A Final RD/RA Work Plan that addresses those vernal pools. Consistent with the RPOEC Report, the final monitoring program for conventional removal-and-restoration pools will address, as applicable, restoration of vernal pool acreage and density, topsoil properties, pool size and depth, microrelief, woody debris, hydroperiod, erosion, absence of reproducing fish, native vegetation establishment, invasive species cover, and restoration of rare-species habitat to pre-remediation conditions to the extent practicable. The RPOEC Report also notes that vernal pools treated by amendment application may warrant a reduced or otherwise modified set of evaluation criteria and monitoring requirements depending on application method, pool characteristics, and pilot-study findings.

11. Rare Species Assessment

This section provides a brief summary of GE's assessment of federally and state-listed rare species in Reach 5A, including identification of those species, determination of which ones are subject to a "take," a description of measures to be implemented to minimize the impacts on these species, description of the extent of unavoidable takes, a discussion of the measures proposed by GE as mitigation for the unavoidable takes, and a description of the post-restoration monitoring and assessment of rare species. All of these matters are presented and discussed in detail in the Rare Species CMP in **Appendix B** (referred to simply as the CMP in this section).

11.1 Identification of Rare Species

Rare species considerations for Reach 5A were identified through federal and state screening reviews and then refined through targeted field investigations conducted in 2025. The review addressed bats, marsh birds, butterflies and moths, dragonflies, plants, and wood turtle. As discussed in Section 3.3, federal screening relied on the USFWS IPaC system, and state screening relied primarily on information provided by the MNHESP, particularly Species Habitat mapping, together with the results of the 2025 survey program.

Based on these reviews and surveys, the federally and state-listed rare species potentially present in Reach 5A are listed in Table 2-3 and discussed in Section 2.2 of the CMP, along with their federal and state status, As noted, there are 30 such federally or state-listed species

11.2 Determination of Takes of Rare Species

Under the Massachusetts Endangered Species Act (MESA), a "take" includes actions that harass, harm, capture, or otherwise disrupt nesting, breeding, feeding, or migratory activity, including through modification, degradation, or destruction of habitat. The federal Endangered Species Act (ESA) defines "take" as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." As described in the CMP, based on MNHESP mapping, the current survey results, the Reach 5A remedial design, an assessment of each species' habitat requirements and sensitivity to habitat impacts, and measures to be taken to avoid impacts to the species, GE has evaluated which of the identified rare species would be subject to a take due to the Reach 5A remediation and supporting activities. The resulting species subject to a take are the wood turtle, several state-listed plants (bristly buttercup [*Ranunculus pensylvanicus*], wapato [*Sagittaria cuneata*], hairy wild rye [*Elymus villosus*], Frank's lovegrass, matted spike-sedge, great blue lobelia [*Lobelia siphilitica*], and possibly Tuckerman's sedge [*Carex tuckermanii*]), two state-listed butterflies/moths associated with host plants present in work areas (i.e., mustard white butterfly [*Pieris oleracea*] and ostrich fern borer moth [*Papaipema sp. 2*]), and five state-listed dragonflies associated with riverine habitat disturbance (riffle snaketail, brook snaketail [*Ophiogomphus aspersus*], rapids clubtail [*Phanogomphus quadricolor*], spine-crowned clubtail [*Hylogomphus abbreviatus*], and ocellated darner [*Boyeria grafiana*]).[16]

As also discussed in the CMP, it has been determined that a take would not occur for the following: (a) other state-listed plant species because remedial activities are not proposed in proximity to identified locations of such plants; (b) the state-listed marsh birds because they have not been observed and are highly unlikely to be present in Reach 5A; and (c) the federally and state-listed bats due to seasonal restrictions on tree cutting and/or site-specific surveys of trees to be cut outside the seasonal restrictions.

[16] Because the monarch butterfly (which was also identified in Reach 5A) is not a state-listed species and has only been proposed for federal listing, it was excluded from the species take analysis. However, impacts to host plants for the monarch butterfly (milkweeds) are addressed in this Restoration Plan and the CMP through protection and/or relocation of milkweeds and inclusion of milkweed plugs in floodplain restoration planting plans. See Sections 8.4.3 and 8.4.4 above.

The species-specific bases for these determinations are presented in the CMP, which. explains how survey results, mapped habitat, habitat suitability, and other factors were used to distinguish species currently treated as subject to a take from those determined not to be subject to a take.

11.3 Pre-Restoration Measures to Minimize Rare Species Impacts

Pre-restoration measures to minimize rare-species impacts have been incorporated into the Reach 5A restoration and construction framework and are described in detail in the CMP. In general, these measures include limiting disturbance to the minimum practicable area, sequencing work to reduce the extent of concurrent habitat disruption, progressively restoring completed areas, reviewing updated rare-species information during pre-construction planning, and implementing species-specific field controls where warranted. They also include taxon-specific minimization measures for wood turtle, rare plants, rare lepidopterans, and rare dragonflies, including pre-construction screening, protection of documented occurrences or habitat features where practicable, and construction-phase procedures for sensitive habitats and species encounters.

11.4 Extent of Unavoidable Takes

The extent of unavoidable takes has been evaluated through a species-specific analysis that combines MNHESP Species Habitat mapping, 2025 survey results, and the current remediation and support-area footprint. This analysis does not rely solely on mapped habitat overlap, but also considers habitat suitability, confirmed observations, and species-specific factors relevant to the affected work areas as well as the design and anticipated means and methods of implementing remedial activities (including access and staging areas).

The resulting affected habitat acreage for each species currently treated as subject to a take is presented in the CMP. The methods used to derive those acreages, including species-specific adjustments to mapped habitat overlap, are also described in the CMP.

However, as discussed further in the CMP, it is important to recognize that, in determining the extent of impacts for each species, several additional factors need to be taken into account. These include the mitigation ratios provided in the MESA regulations. They also include the potential for additional, downstream impacts from the Reach 5A remediation. At the same time, the extent of impacts will be reduced by a number of factors specific to the ROR project that are important to take into account but cannot practicably be quantified. These include: (a) the pre-restoration measures to minimize impacts to the subject species and thus lessen the extent of the takes; (b) the phasing of the work so that the take of any species that is distributed throughout the reach will apply to only a limited portion of the available reach habitat at a given time; and (c) the restoration of disturbed areas as remediation progresses so that habitat functions are returned to pre-remediation conditions relatively quickly for most species. While these influences cannot practicably be quantified, they are taken into account qualitatively in determining the extent of takes that will require mitigation and the adequacy of the proposed mitigation.

11.5 Mitigation for Unavoidable Takes of Rare Species

For species determined to be subject to an unavoidable take, GE's mitigation framework consists of two principal components: (a) species-specific actions that can be implemented as part of the designed restoration and will provide enhancement of the habitat for the subject species or other net benefits to that species (including, where relevant, selected invasive species management actions); and (b) protection or preservation of a number of existing GE-owned properties along the ROR in Reach 5A that contain suitable habitat for the subject species through placement of conservation restrictions on the properties or transfer of the properties to the Massachusetts Division of Fisheries and Wildlife (MassDFW) within the Department of Fish and Game for preservation/conservation. The intent is to provide long-term habitat benefit for the affected species in a manner coordinated with the overall restoration program.

The CMP provides a full discussion of these proposed mitigation measures for wood turtle, state-listed plants, rare lepidopterans, and state-listed dragonflies, including both the role of preservation or protection of GE-owned properties and species-specific habitat enhancement measures. The identified GE-owned properties are described in detail in the CMP, including the extent of MNHESP-mapped habitat

for each species on each of the identified GE-owned properties. The most appropriate mechanism for the placement of conservation restrictions on these GE-owned properties or their transfer to MassDFW for preservation/conservation will need to be worked out in discussions with EPA and MassDFW (and, as necessary, other state agencies).

Given both the quantitative impacts and qualitative factors discussed in Section 11.4, GE submits that these proposed mitigation measures will provide a long-term net benefit to the conservation of the state-listed species that will be subject to a take in Reach 5A. In addition, GE plans to discuss with EPA the extent to which the proposed mitigation measures can also be used as mitigation for rare species takes in downstream reaches of the ROR that will require later remediation.

11.6 Monitoring and Assessment of Post-Restoration Conditions

Post-restoration rare-species monitoring and assessment will be implemented in coordination with the broader Reach 5A monitoring program to evaluate whether restored habitats are functioning as intended for the rare species addressed in this section and whether adaptive management is needed. In general, this monitoring will focus on the condition and use of restored habitats, the establishment of replanted or reintroduced species or host plants where applicable, and the performance of species-specific mitigation measures.

The detailed rare-species monitoring framework is presented in Section 8 of the CMP. That framework includes taxon-specific monitoring and assessment plans for wood turtle, state-listed plants, lepidopteran host plants, and rare dragonflies. It also includes the use of adaptive management to address future monitoring, assessment, and (where necessary) corrective action.

12. Invasive Species Treatment Measures

12.1 Summary of Existing Invasive Species in Reach 5A

Invasive species occurrence in Reach 5A was documented during BRA investigations conducted from 2018 through 2023 (with emphasis on 2022–2023) across all habitat types (riverine, riverbanks, backwaters, Other Waterbodies, floodplain wetlands and uplands, and vernal pools). The invasive species definition, assessment approach, and habitat-specific results are summarized in Section 4.4. A full list of invasive species found in Reach 5A during the BRA surveys is provided in Table 12-1.

The BRA documented one invasive tree species (Norway maple), eight invasive shrub species, one invasive woody vine, and 15 invasive herbaceous species within Reach 5A. Invasive plants were recorded in each habitat type, with the greatest mapped dominance occurring in discrete floodplain stands of Japanese knotweed, reed canary grass, and common reed/phragmites (*Phragmites australis*). Aquatic invasive plants were present in small patches in riverine and backwater settings, and Asian clams were suspected based on shell observations, although identification could not be verified; no invasive fish and no other potential invasive aquatic animal species were detected in Reach 5A. To assess existing plant communities with the survey area, vegetation data were collected at 201 plot locations on the floodplain. The following summarizes the primary findings on invasive species for each of the habitat surveys.

Riverine Invasive Species

- Eurasian watermilfoil (*Myriophyllum spicatum*) and curly-leaf pondweed were detected in small patches throughout Reach 5A, with limited amounts of yellow iris (*Iris pseudacorus*) observed along river margins and other areas.
- Asian clams are suspected to be present in Reach 5A based on observation of small clam shells, but identification could not be verified.
- No invasive fish or any other potential invasive animal species such as zebra mussels were detected.

Riverbank Invasive Species

- Sixteen different invasive species were recorded (no invasive tree species, four invasive shrub species, one invasive vine species, and 11 invasive herbaceous species).
- Asian bittersweet was the most common invasive vine, detected with 59% frequency.
- The most prevalent invasive species on the riverbanks were Asian bittersweet (59% frequency), Japanese knotweed (48%), common buckthorn (*Rhamnus cathartica*) (29%), Morrow's honeysuckle (*Lonicera morrowii*) (22%), water forget-me-not (*Myosotis scorpiodes*) (18%), purple loosestrife (12%), and bishop's goutweed (*Aegopodium podagraria*) (10%).[17]

Backwater Invasive Species

- A total of seven invasive plant species were observed in the six Reach 5A backwater habitats.
- No invasive shrubs, trees, or vines were observed in the backwaters. Invasive herbaceous plant species in the backwaters included yellow iris, moneywort, purple loosestrife, water forget-me-knot, reed canary grass. Two aquatic species were also observed: Eurasian watermilfoil and water chestnut (*Trapa natans*).

[17] The percentages in parenthesis following the species names in this bullet and some of the following bullets correlate to the number of times that a specific invasive species was recorded within the 201 plots.

- The backwater observed to have the most species of invasive plants was BW5A-2 with five invasive plant species, followed by BW-3 with four invasive plant species, and then BW-1, BW-4, BW-5 and BW-6, each with two invasive plant species.

Other Waterbody Invasive Species

- Invasive plant occurrence in the Other Waterbodies was most evident in the Intermittent Side Channel and in and around West Pond; there was not a comparable invasive-dominance pattern at the Lower Sykes Brook confluence.
- The Intermittent Side Channel was observed to be dominated by Japanese knotweed, and it also contained Norway maple, Morrow's honeysuckle, and common buckthorn within the riverbank/riparian area.
- West Pond supported the most diverse invasive assemblage among the Other Waterbodies, with the following species documented in and around the pond: one invasive tree species (Norway maple), five invasive shrub species (Japanese barberry [*Berberis thunbergii*], glossy buckthorn [*Frangula alnus*], Morrow's honeysuckle, common buckthorn, multiflora rose [*Rosa multiflora*]), one invasive woody vine (Asian bittersweet), and five invasive or likely invasive herbaceous species (moneywort, purple loosestrife, water forget-me-not, reed canary grass, and climbing nightshade [*Solanum dulcamara*]).

Floodplain Invasive Species (including Vernal Pools)

- Invasive plant species were observed at 179 of 201 floodplain plots (89%).
- A total of 21 species listed as invasive or likely invasive were observed growing in floodplain habitats (11 herbs, eight shrubs, one tree, 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 common buckthorn (26.2%), Morrow's honeysuckle (25.2%), and multiflora rose (7.4%).
- The most prevalent invasive herbaceous species encountered were purple loosestrife (28.7%) and moneywort (23.7%), followed by reed canary grass (7.9%), bishop's goutweed (6.9%), garlic mustard (4%), and Japanese knotweed (3.5%).
- Monoculture stands of invasive herbaceous species mapped through GPS survey and interpretation of aerial photography included 11.3 acres of Japanese knotweed and 10.8 acres of phragmites.
- Specific to vernal pool habitat with the floodplain, a total of 14 species listed as invasive or likely invasive were documented (six herbs, seven shrubs, and one woody vine). These were included in the list of most frequently encountered floodplain species for the herb, shrub and vine layers.

In addition to the overall data summary provided above on invasive species in Reach 5A, three species of invasive plants have developed discrete areas of dominance in the floodplain that are large enough in area to map (i.e., >0.5 acre). These three species are Japanese knotweed, reed canary grass, and phragmites (or common reed). The limits of the discrete areas of dominance by these species were mapped, as shown on Revised BRA Report Figures 10-1a through 10-1e, and were incorporated into the assessment of degraded or disturbed areas that was considered in the layout of access roads and staging areas. Other areas of invasive species do not present such discrete areas of dominance that afford an ability to map specific zones.

12.2 Summary of Invasive Species Control Plan

The ISCP for Reach 5A is contained in **Appendix C**. It provides a comprehensive framework for preventing the introduction and spread of invasives during remediation, controlling existing populations,

and facilitating native vegetation establishment in restored habitats. Key elements of the ISCP are as follows:

- **Identification of Invasive Species in Reach 5A:** The ISCP lists the 25 invasive plants that have been identified in Reach 5A and specifies that 15 of them have been identified for specific control measures.
- **Management of Invasive Species:** The ISCP includes a set of maps depicting known locations of the invasive plants, which will be used to guide invasive plant treatment actions. It also explains that pre-remediation surveys will be conducted to locate and map all areas of Japanese knotweed and common reed (phragmites) in Reach 5A so that they can be targeted for eradication.
- **Description and Control Measures:** The ISCP describes each of the 15 invasive plat species identified for control and describes potential and preferred treatment methods for each, including mechanical, physical, and biological methods.
- **Measures to Prevent the Spread of Invasive Species:** The ISCP describes best management practices (BMPs) that will be implemented throughout the project to minimize the spread of existing invasive species and to prevent introduction of invasive plant species and seeds into restored areas and associated buffers.
- **Monitoring and Adaptive Management**: The ISCP explains that annual post-restoration monitoring will be conducted for seven years following completion of restoration in each of the five subreaches in Reach 5A to track invasive species cover. It also describes the adaptive responses to be taken based on the monitoring results, including corrective actions (e.g., spot treatments) if the specified threshold criterion of 10% invasive species cover (or no more than reference-site conditions where applicable) is exceeded.

13. Reporting

During the performance of the Reach 5A Remedial Action, GE will prepare annual restoration reports on the pre-restoration avoidance, minimization, and protection measures implemented and the restoration activities conducted during the prior year in the subject subreach. Each of these reports will include the following:

- Description of the pre-construction and during-construction measures implemented to avoid and minimize adverse habitat impacts, including impacts to rare species;
- Specific summary of wood turtle protection measures and documentation of wood turtle monitoring activities and any corrective actions;
- Description of the restoration activities conducted in the river, riverbanks, backwaters, Other Waterbodies, and/or floodplain (including 5A-VP-13 if applicable), including documentation of installed NCD structures and summary of plantings and seedings conducted in each restored area;
- Results of monitoring performed during restoration activities;
- Representative project photographs; and
- Documentation of any observed rare species and measures implemented for their protection.

These restoration reports will be included in or submitted concurrently with the annual interim construction completion reports described in Section 18.6 of the Final RD/RA Work Plan and will likewise be combined and integrated in the overall Interim Remedial Action Completion Report for Reach 5A required by the Final Revised ROR SOW and also discussed in Section 18.6 of the Final RD/RA Work Plan.

In addition, during the performance of post-restoration monitoring in a given subreach, GE will prepare and submit an annual report summarizing the post-construction restoration monitoring conducted during the prior year, as noted in Section 10 above and described in GE's Revised RPOEC Report as approved by EPA. That annual monitoring report will provide suitable information to evaluate the existing condition of the restored areas and achievement of or progress towards achieving the restoration evaluation criteria in the RPOEC Report and functioning of the restored habitats. This reporting will be included in the future IMM Plan discussed in Section 20 of the Final RD/RA Work Plan.

14. References

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Weston (Weston Solutions, Inc), 2014. Comparative Analysis of Remedial Alternatives for the General Electric (GE)-Pittsfield/Housatonic River Project, Rest of River. SDMS 557091. May 2014.

Tables

Table 5-1. Preliminary Bank Restoration Seed Mix.[1]

Scientific Name	Common Name	Percent in Mix
Lolium multiflorum	Annual Ryegrass	20%
Schizachyrium scoparium	Little Bluestem	20%
Elymus canadensis	Canada Wild Rye	16%
Panicum virgatum	Switchgrass	10%
Agrostis perennans	Autumn Bentgrass	8%
Tridens flavus	Purple Top	8%
Coreopsis lanceolata	Lanced Leaved Coreopsis	5%
Agrostis scabra	Ticklegass (Rough Bentgrass)	4%
Elymus virginicus	Virginia Wild Rye	4%
Penstemon digitalis	Tall White Beard Tongue	3%
Monarda fistulosa	Wild Bergamot	2%

Notes: ERNMX-181 Seeding Rate: 30 pounds per acre, or 1 pound per 1,000 SF or comparable
Total area of riverbank remediation and grading associated with NCD is approximately 11.6 acres, requiring 41.6 pounds of seed.

Table 5-2. Bank Restoration Planting List.

	Scientific Name	Common Name	Size	Quantity #/acre	Total Num Live Stakes
		Lower Riverbank (6.5 acres)			
Live Stakes	*Cornus racemosa*	Gray Dogwood	2-3 foot	2200	14,740
	Cornus stolonifera	Red-osier Dogwood	2-3 foot	3200	21,440
	Salix discolor	Pussy Willow	2-3 foot	3000	20,100
	Salix sericea	Silky Willow	2-3 foot	500	3,350
	Salix interior	Sandbar Willow	2-3 foot	1200	8,040
	Salix purpurea	Purpleosier Willow	2-3 foot	800	5,360
		Transitional Floodplain Forest (3.6 acres)			
Shrubs	*Amelanchier canadensis*	Shadbush	18 to 24”	52	186
	Cornus amomum	Silky dogwood	18 to 24”	80	286
	Sambucus canadensis	Elderberry	18 to 24”	52	186
	Vaccinium corymbosum	Highbush blueberry	18 to 24”	40	143
	Viburnum dentatum	Arrowwood	18 to 24”	38	136
	Spiraea alba	White Meadowsweet	18 to 24”	20	72
	Ilex verticillata	Common Winterberry	18 to 24”	20	72
Trees	*Acer negundo*	Boxelder maple	3-4’	100	358
	Acer saccharinum	Silver maple	3-4’	50	179
	Tilia americana	American linden	3-4’	50	179
	Quercus bicolor	Swamp white oak	3-4’	25	89
	Populus deltoides	Eastern cottonwood	3-4’	100	358
	Ulmus americana	American elm	3-4’	40	143

[1] Planting and seeding quantities presented in these tables, are based upon the project layout and work activities as anticipated at the time of this plan preparation. Final quantities may vary from the amounts indicated herein based upon subsequent changes in project work limits. This is especially true for areas downstream of Pomeroy Avenue (i.e., downstream of the first subreach work area).

	Scientific Name	Common Name	Size	Quantity #/acre	Total Num Live Stakes
	Carpinus caroliniana	American hornbeam	3-4’	40	143
	Platanus occidentalis	American sycamore	3-4’	30	107
	High Terrace Floodplain Forest (0.49 acres)				
Shrubs	*Carpinus caroliniana*	Ironwood	18 to 24”	60	29
	Viburnum dentatum	Arrowwood	18 to 24”	40	20
Shrubs	*Viburnum lentago*	Nannyberry	18 to 24”	65	32
	Hamamelis virginiana	Witch-hazel	18 to 24”	25	12
Trees	*Acer saccharum*	Sugar maple	3-4’	40	20
	Betula alleghaniensis	Yellow birch	3-4’	20	10
	Quercus bicolor	Swamp white oak	3-4’	20	10
	Platanus occidentalis	American sycamore	3-4’	30	15
	Tilia americana	American linden	3-4’	60	29
	Wet Meadow (0.56 acres)				
Shrubs	*Cornus amomum*	Silky dogwood	18 to 24”	10	6
	Rosa palustris	Swamp rose	18 to 24”	2	1
	Sambucus canadensis	Elderberry	18 to 24”	5	3
	Spiraea latifolia	Meadowsweet	18 to 24”	5	3
	Ilex verticillata	Winterberry	18 to 24”	5	3
				Total Pounds Needed	
Seed Mix	*NEWP WetMix*			10	
	Forested Uplands (0.22 acres)				
Shrubs	*Amelanchier canadensis*	Shadbush	18 to 24”	50	11
	Corylus americana	American hazelnut	18 to 24”	82	18
	Hamamelis virginiana	American witch hazel	18 to 24”	70	15
	Viburnum acerfolium	Maple Leaf Viburnum	18 to 24”	100	22
Trees	*Prunus serotina*	Black cherry	3-4’	80	18
	Pinus strobus	Eastern white pine	3-4’	100	22
	Ostrya virginiana	Hop-hornbeam	3-4’	60	13
	Quercus rubra	Northern red oak	3-4’	100	22
	Acer saccharum	Sugar maple	3-4’	40	9
	Betula populifolia	Gray Birch	3-4’	56	12

1. Live stakes to be planted at a density of 2-foot on center (10,890 stakes per acre)
2. Transitional floodplain forest: Shrubs 12x12 spacing for a total of 302 shrubs / acre. Trees planted on 10X10-foot grid (436 trees / acre).
3. High terrace floodplain forest: Shrubs 16x16 spacing for a total of 170 shrubs / acre. Trees planted on 10X10-foot grid (436 trees / acre).
4. Wet meadow: Shrubs planted on 40X40-foot grid (27 shrubs / acre). Seeding rate of 18 pounds / acre.
5. Forested uplands: Shrubs 12x12 spacing for a total of 302 shrubs / acre. Trees planted on 10X10-foot grid (436 trees / acre)

Table 6-1. Planting table for portions of BW5A-1 subject to dredge and cap activities.

Cover type	Scientific Name	Common Name	Size	Total Num Plantings
Transitional Floodplain Forest (0.01 acres)				
Shrubs[1]	*Ilex verticillata*	Common Winterberry	18 to 24”	4
	Sambucus nigra	Black Elder	18 to 24”	6
Trees[2]	*Acer negundo*	Boxelder maple	18 to 24”	3
	Acer saccharinum	Silver maple	18 to 24”	1
			Total Pounds Needed	
Seed Mix[3]	*NEWP WetMix*		1	
Deep Emergent Marsh (0.13 acres)				
Herbaceous[4]	*Nuphar variegata*	Spatterdock	2” plug	33
	Schoenoplectus tabernaemontani	Softstem Bulrush	2” plug	20
	Ludwigia palustris	Marsh Purslane	2” plug	53
	Pickerelweed	Pontederia cordata	2” plug	33

1. Shrubs 8' on-center (OC) spacing for a total of 681 shrubs / acre.
2. Trees planted 12'OC (303 trees per acre).
3. Seeding rate of 18 pounds / acre.
4. Two-inch plugs planted 6' OC (total 1050 plants / acre).

Table 6-2. Planting table for portions of BW5A-2 subject to dredge and cap activities.

Cover type	Scientific Name	Common Name	Size	Total Num Plantings
Shallow and Deep Emergent Marsh (0.29 acres)				
Herbaceous[1]	*Sagittaria latifolia*	Broad-Leaf Arrowhead	2” plug	147
	Sparganium americanum	American Bur-Reed	2” plug	176
	Leersia oryzoides	Rice Cut Grass	2” plug	73
	Alisma subcordatum	American Water-Plantain	2” plug	117
	Schoenoplectus tabernaemontani	Softstem Bulrush	2” plug	73
	Ludwigia palustris	Marsh Purslane	2” plug	88
	Nuphar variegata	Spatterdock	2” plug	123
			Total Pounds Needed	
Seed Mix[2]	*NEWP WetMix*		5	

1. Two-inch plugs planted 4' OC (total 2720 plants / acre).
2. Seed mix distributed evenly along shallow margins of the backwater. Seeding rate of 18 pounds / acre.

Table 6-3. Planting table for portions of BW5A-3 subject to dredge and backfill activities.

Cover type	Scientific Name	Common Name	Size	Total Num Plantings
Shallow and Deep Emergent Marsh (0.18 acres)				
Herbaceous[1]	*Sagittaria latifolia*	Broad-Leaf Arrowhead	2” plug	109
	Sparganium americanum	American Bur-Reed	2” plug	90
	Leersia oryzoides	Rice Cut Grass	2” plug	90
	Alisma subcordatum	American Water-Plantain	2” plug	54
	Schoenoplectus tabernaemontani	Softstem Bulrush	2” plug	45
	Ludwigia palustris	Marsh Purslane	2” plug	58
	Nuphar variegata	Spatterdock	2” plug	73
			Total Pounds Needed	
Seed Mix[2]	*NEWP WetMix*		2	

1. Two-inch plugs planted 4' OC (total 2720 plants / acre).
2. Seed mix distributed evenly along shallow margins of the backwater. Seeding rate of 18 pounds / acre.

Table 6-4. Planting table for portions of BW5A-4 subject to dredge and cap activities.

Cover type	Scientific Name	Common Name	Size	Total Num Plantings
Shallow and Deep Emergent Marsh (0.06 acres)				
Herbaceous[1]	*Sagittaria latifolia*	Broad-Leaf Arrowhead	2” plug	40
	Sparganium americanum	American Bur-Reed	2” plug	35
	Leersia oryzoides	Rice Cut Grass	2” plug	29
	Alisma subcordatum	American Water-Plantain	2” plug	17
	Schoenoplectus tabernaemontani	Softstem Bulrush	2” plug	14
	Ludwigia palustris	Marsh Purslane	2” plug	21
			Total Pounds Needed	
Seed Mix[2]	*NEWP WetMix*		1	

1. Two-inch plugs planted 4' OC (total 2720 plants / acre).
2. Seed mix distributed evenly along shallow margins of the backwater. Seeding rate of 18 pounds / acre.

Table 6-5. Planting table for portions of BW5A-5 subject to dredge and cap activities.

Cover type	Scientific Name	Common Name	Size	Total Num Plantings
Shallow Emergent Marsh (0.47 acres)				
Herbaceous[1]	*Sagittaria latifolia*	Broad-Leaf Arrowhead	2” plug	427
	Sparganium americanum	American Bur-Reed	2” plug	332
	Leersia oryzoides	Rice Cut Grass	2” plug	261
	Alisma subcordatum	American Water-Plantain	2” plug	190
	Eleocharis palustris	Spike Rush	2” plug	261
	Pickerelweed	Pontederia cordata	2” plug	190
			Total Pounds Needed	
Seed Mix[2]	*NEWP WetMix*		4	
Deep Emergent Marsh (0.55 acres)				
Herbaceous[3]	*Nuphar variegata*	Spatterdock	2” plug	274
	Schoenoplectus tabernaemontani	Softstem Bulrush	2” plug	164
	Ludwigia palustris	Marsh Purslane	2” plug	137

1. SEM Plugs planted ~3' OC (total 3500 plants per acre).
2. Seed mix distributed evenly along shallow margins of the backwater. Seeding rate of 18 pounds / acre.
3. DEM Plugs planted ~6' OC (total 1050 plants per acre).

Table 6-6. Planting table for portions of BW5A-6 subject to dredge and backfill activities.

Cover type	Scientific Name	Common Name	Size	Total Num Plantings
Shallow Emergent Marsh (0.03 acres)				
Herbaceous[1]	*Sagittaria latifolia*	Broad-Leaf Arrowhead	2” plug	23
	Peltandra virginica	Arrow Arum	2” plug	18
	Leersia oryzoides	Rice Cut Grass	2” plug	20
	Eleocharis palustris	Spike Rush	2” plug	16
	Alisma subcordatum	American Water-Plantain	2” plug	14
			Total Pounds Needed	
Seed Mix[2]	*NEWP WetMix*		1	
Deep Emergent Marsh (0.32 acres)				
Herbaceous[3]	*Nuphar variegata*	Spatterdock	2” plug	113
	Schoenoplectus tabernaemontani	Softstem Bulrush	2” plug	65
	Potamogeton pectinatus	Sago Pondweed	tubers	97
	Ludwigia palustris	Marsh Purslane	2” plug	65

1. SEM Plugs planted ~3' OC (total 3500 plants per acre).
2. Seed mix distributed evenly along shallow margins of the backwater. Seeding rate of 18 pounds / acre.
3. DEM Plugs planted ~6' OC (total 1050 plants per acre).

Table 7-1. Planting table for Intermittent Side Channel restoration.

Cover type	Scientific Name	Common Name	Size	Total Num Plantings
Transitional Floodplain Forest (0.4 acres)[1]				
Herbaceous	*Matteuccia struthiopteris*	Ostrich fern	6" Pot / 2" plug	60
	Onoclea sensibilis	Sensitive fern	6" Pot / 2" plug	25
	Parathelypteris noveboracensis	New York fern	6" Pot / 2" plug	60
	Cardamine concatenata	Cut-leaved toothwort	2" plug	401
	Cardamine diphylla	Two-leaved toothwort	2" plug	273
Shrubs	*Amelanchier canadensis*	Shadbush	18 to 24"	25
	Cornus amomum	Silky dogwood	18 to 24"	48
	Sambucus canadensis	Elderberry	18 to 24"	21
	Viburnum dentatum	Arrowwood	18 to 24"	19
	Spiraea alba	White Meadowsweet	18 to 24"	8
Trees	*Acer negundo*	Boxelder maple	3-4'	40
	Acer saccharinum	Silver maple	3-4'	20
	Tilia americana	American linden	3-4'	20
	Quercus bicolor	Swamp white oak	3-4'	10
	Populus deltoides	Eastern cottonwood	3-4'	40
	Ulmus americana	American elm	3-4'	16
	Carpinus caroliniana	American hornbeam	3-4'	16
	Platanus occidentalis	American sycamore	3-4'	12
			Total Pounds Needed	
Seed Mix	*Habitat Specific mix*		7	
Wet Meadow (0.1 acres)[2]				
Herbaceous	*Onoclea sensibilis*	Sensitive fern	6" Pot / 2" plug	24
	Thelypteris palustris	Marsh fern	6" Pot / 2" plug	12
	Cardamine pensylvanica	Pennsylvania Bittercress	2" plug	4
	Asclepias incarnata	Swamp Milkweed	2" plug	6
	Verbena hastata	Blue Vervain	2" plug	2
Shrubs	*Cornus amomum*	Silky dogwood	18 to 24"	2
	Sambucus canadensis	Elderberry	18 to 24"	1
	Ilex verticillata	Winterberry	18 to 24"	1
			Total Pounds Needed	
Seed Mix	*NEWP WetMix*		2	

1. Transitional floodplain forest

Six-inch pots (#1 container) or 2" plugs (if available) planted 3' OC, in three 0.025-acre patches per acre (total 362 plants / acre).
Plugs planted 18" OC, in three 0.025-acre patches per acre (total 1688 plants / acre).
Shrubs 12x12 spacing for a total of 302 shrubs / acre.
Trees planted on 10X10-foot grid (436 trees / acre).
Seeding rate of 18 pounds / acre.

2. Wet meadow

Six-inch pots (#1 container) or 2" plugs (if available) planted 3' OC, in three 0.025-acre patches per acre (total 362 plants / acre).
Plugs planted 6' OC, in three 0.025-acre patches per acre (total 120 plants / acre).
Shrubs planted on 40X40-foot grid (27 shrubs / acre).
Seeding rate of 18 pounds / acre.

Table 7-2. Planting table for West Pond (OWB-WP) restoration area.

Cover type	Scientific Name	Common Name	Size	Total Num Plantings
Shrub Swamp (0.23 acres)				
Shrubs[1]	*Ilex verticillata*	Common Winterberry	18 to 24”	23
	Cornus amomum	Silky Dogwood	18 to 24”	45
	Alnus incana	Speckled Alder	18 to 24”	36
	Sambucus nigra	Black Elder	18 to 24”	23
	Salix discolor	Pussy Willow	18 to 24”	27
Trees[2]	*Ulmus americana*	American Elm	18 to 24”	3
	Acer rubrum	Red Maple	18 to 24”	3
				Total Pounds Needed
Seed Mix[3]	*NEWP WetMix*			4
Shallow Emergent Marsh (0.16 acres)				
Herbaceous[4]	*Sagittaria latifolia*	Broad-Leaf Arrowhead	2” plug	136
	Sparganium eurycarpum	Broad-Fruit Bur-Reed	2” plug	192
	Leersia oryzoides	Rice Cut Grass	2” plug	152
	Alisma subcordatum	American Water-Plantain	2” plug	80
Deep Emergent Marsh (0.60 acres)				
Herbaceous[5]	*Nuphar variegata*	Spatterdock	2” plug	150
	Schoenoplectus tabernaemontani	Softstem Bulrush	2” plug	120
	Potamogeton pectinatus	Sago Pondweed	tubers	179
	Ludwigia palustris	Marsh Purslane	2” plug	179

1. Shrubs 8x8 spacing for a total of 681 shrubs / acre.
2. Trees planted on 40X40-foot grid (27 trees / acre).
3. Seeding rate of 18 pounds / acre.
4. SEM Plugs planted ~3' OC (total 3500 plants / acre).
5. DEM Plugs planted ~6' OC (total 1050 plants / acre).

Table 8-1. Planting tables for floodplain remediation areas (including access and staging) located within Transitional Floodplain Forests

Cover type	Scientific Name	Common Name	Size	Total Num Plantings
Transitional Floodplain Forest (15.8 acres)				
Herbaceous[1,2]	*Matteuccia struthiopteris*	Ostrich fern	6" Pot / 2" plug	2,363
	Onoclea sensibilis	Sensitive fern	6" Pot / 2" plug	977
	Parathelypteris noveboracensis	New York fern	6" Pot / 2" plug	2,363
	Cardamine concatenata	Cut-leaved toothwort	2" plug	9,452
	Cardamine diphylla	Two-leaved toothwort	2" plug	7,089
	Lepidium virginicum	Poorman's-Pepper	2" plug	4,537
	Turritus glabra	Tower Mustard	2" plug	5,514
Shrubs[3]	*Amelanchier canadensis*	Shadbush	18 to 24"	819
	Cornus amomum	Silky dogwood	18 to 24"	1,260
	Sambucus canadensis	Elderberry	18 to 24"	819
	Vaccinium corymbosum	Highbush blueberry	18 to 24"	630
	Viburnum dentatum	Arrowwood	18 to 24"	599
	Spiraea alba	White Meadowsweet	18 to 24"	315
	Ilex verticillata	Common Winterberry	18 to 24"	315
Trees[4]	*Acer negundo*	Boxelder maple	3-4'	1,575
	Acer saccharinum	Silver maple	3-4'	788
	Tilia americana	American linden	3-4'	788
	Quercus bicolor	Swamp white oak	3-4'	394
	Populus deltoides	Eastern cottonwood	3-4'	1,575
	Ulmus americana	American elm	3-4'	630
	Carpinus caroliniana	American hornbeam	3-4'	630
	Platanus occidentalis	American sycamore	3-4'	473
			Total Pounds Needed	
Seed Mix[5]	*Habitat specific mix*		284	

1. Six-inch pots (#1 container) or 2" plugs (if available) planted 3' OC, in three 0.025-acre patches per acre (total 362 plants / acre).
2. Plugs planted 18" OC, in three 0.025-acre patches per acre (total 1688 plants / acre).
3. Shrubs 12x12 spacing for a total of 302 shrubs / acre.
4. Trees planted on 10X10-foot grid (436 trees / acre).
5. Seeding rate of 18 pounds / acre.

Table 8-2. Planting tables for floodplain remediation areas (including access and staging) located within High-Terrace Floodplain Forests

Cover type	Scientific Name	Common Name	Size	Total Num Plantings
High-Terrace Floodplain Forest (0.51 acres)				
Herbaceous[1,2]	*Adiantum pedatum*	Northern maidenhair fern	6" Pot / 2" plug	31
	Matteuccia struthiopteris	Ostrich fern	6" Pot / 2" plug	62
	Onoclea sensibilis	Sensitive fern	6" Pot / 2" plug	51
	Polystichum acrostichoides	Christmas fern	6" Pot / 2" plug	41
	Caulophyllum thalictroides	Blue cohosh	2" plug	180
	Erythronium americanum	Trout-lily	2" plug	231
	Solidago flexicaulis	Zigzag goldenrod	2" plug	148
	Carex pensylvanica	Pennsylvania Sedge	2" plug	308
Shrubs[3]	*Carpinus caroliniana*	Ironwood	18 to 24"	31
	Viburnum dentatum	Arrowwood	18 to 24"	21
	Viburnum lentago	Nannyberry	18 to 24"	33
	Hamamelis virginiana	Witch-hazel	18 to 24"	13
Trees[4]	*Acer saccharum*	Sugar maple	3-4'	21
	Betula alleghaniensis	Yellow birch	3-4'	10
	Quercus bicolor	Swamp white oak	3-4'	10
	Platanus occidentalis	American sycamore	3-4'	15
	Tilia americana	American linden	3-4'	31
			Total Pounds Needed	
Seed Mix[5]	*Habitat specific mix*		9	

1. Six-inch pots (#1 container) or 2" plugs (if available) planted 3' OC, in three 0.025-acre patches per acre (total 362 plants / acre).
2. Plugs planted 18" OC, in three 0.025-acre patches per acre (total 1688 plants / acre).
3. Shrubs 16x16 spacing for a total of 170 shrubs / acre.
4. Trees planted on 10X10-foot grid (436 trees / acre).
5. Seeding rate of 18 pounds / acre.

Table 8-3. Planting tables for floodplain remediation areas (including access and staging) located within Shrub Swamp habitats

Cover type	Scientific Name	Common Name	Size	Total Num Plantings
Shrub Swamp (1.1 acres)				
Herbaceous[1,2]	*Matteuccia struthiopteris*	Ostrich fern	6" Pot / 2" plug	159
	Onoclea sensibilis	Sensitive fern	6" Pot / 2" plug	95
	Osmundastrum cinnamomeum	Cinnamon fern	6" Pot / 2" plug	64
	Thelypteris palustris	Marsh fern	6" Pot / 2" plug	64
	Cardamine pensylvanica	Pennsylvania Bittercress	2" plug	42
	Asclepias incarnata	Swamp Milkweed	2" plug	64
	Eupatorium perfoliatum	Boneset	2" plug	21
Shrubs[3]	*Amelanchier canadensis*	Shadbush	18 to 24"	42
	Cephalanthus occidentalis	Buttonbush	18 to 24"	42
	Cornus amomum	Silky dogwood	18 to 24"	212
	Rosa palustris	Swamp rose	18 to 24"	53
	Salix discolor	Pussy willow	18 to 24"	85
	Sambucus canadensis	Elderberry	18 to 24"	53
	Spiraea latifolia	Meadowsweet	18 to 24"	53
	Vaccinium corymbosum	Highbush blueberry	18 to 24"	42
	Viburnum dentatum	Arrowwood	18 to 24"	42
	Rhododendron viscosum	Swamp azalea	18 to 24"	32
	Ilex verticillata	Winterberry	18 to 24"	64
Trees[4]	*Acer rubrum*	Red maple	3-4'	15
	Salix nigra	Black willow	3-4'	13
			Total Pounds Needed	
Seed Mix[5]	*NEWP WetMix (or similar approved)*		19	

1. Six-inch pots (#1 container) or 2" plugs (if available) planted 3' OC, in three 0.025-acre patches per acre (total 362 plants / acre).
2. Plugs planted 6' OC, in three 0.025-acre patches per acre (total 120 plants / acre).
3. Shrubs 8x8 spacing for a total of 681 shrubs / acre.
4. Trees planted on 40X40-foot grid (27 trees / acre).
5. Seeding rate of 18 pounds / acre.

Table 8-4. Planting tables for floodplain remediation areas (including access and staging) located within Wet Meadow habitats

Cover type	Scientific Name	Common Name	Size	Total Num Plantings
Wet Meadow (4.0 acres)				
Herbaceous[1,2]	*Matteuccia struthiopteris*	Ostrich fern	6" Pot / 2” plug	483
	Onoclea sensibilis	Sensitive fern	6" Pot / 2” plug	554
	Thelypteris palustris	Marsh fern	6" Pot / 2” plug	396
	Cardamine pensylvanica	Pennsylvania Bittercress	2” plug	158
	Asclepias incarnata	Swamp Milkweed	2” plug	237
	Verbena hastata	Blue Vervain	2” plug	79
Shrubs[3]	*Cornus amomum*	Silky dogwood	18 to 24”	40
	Rosa palustris	Swamp rose	18 to 24”	8
	Sambucus canadensis	Elderberry	18 to 24”	20
	Spiraea latifolia	Meadowsweet	18 to 24”	20
	Ilex verticillata	Winterberry	18 to 24”	20
			Total Pounds Needed	
Seed Mix[4]	*NEWP WetMix (or similar approved)*		79	

1. Six-inch pots (#1 container) or 2” plugs (if available) planted 3' OC, in three 0.025-acre patches per acre (total 362 plants).
2. Plugs planted 6' OC, in three 0.025-acre patches per acre (total 120 plants).
3. Shrubs planted on 40X40-foot grid (27 shrubs / acre).
4. Seeding rate of 18 pounds / acre.

Table 8-5. Planting tables for floodplain remediation areas (including access and staging) located within Forested Upland habitats.

Cover type	Scientific Name	Common Name	Size	Total Num Plantings
Forested Uplands (0.65 acres)				
Herbaceous[1]	*Onoclea sensibilis*	Sensitive fern	6" Pot / 2" plug	39
	Parathelypteris noveboracensis	New York fern	6" Pot / 2" plug	78
	Dennstaedtia punctilobula	Hay-Scented Fern	6" Pot / 2" plug	119
Shrubs[2]	*Amelanchier canadensis*	Shadbush	18 to 24"	33
	Corylus americana	American hazelnut	18 to 24"	53
	Hamamelis virginiana	American witch hazel	18 to 24"	46
	Viburnum acerfolium	Maple Leaf Viburnum	18 to 24"	65
Trees[3]	*Prunus serotina*	Black cherry	3-4'	52
	Pinus strobus	Eastern white pine	3-4'	65
	Ostrya virginiana	Hop-hornbeam	3-4'	39
	Quercus rubra	Northern red oak	3-4'	65
	Acer saccharum	Sugar maple	3-4'	26
	Betula populifolia	Gray Birch	3-4'	37
			Total Pounds Needed	
Seed Mix[4]	*Habitat Specific mix*		5	

1. Six-inch pots (#1 container) or 2" plugs (if available) planted 3' OC, in three 0.025-acre patches per acre (total 362 plants / acre).
2. Shrubs 12x12 spacing for a total of 302 shrubs / acre.
3. Trees planted on 10X10-foot grid (436 trees / acre).
4. Seeding rate of 18 pounds / acre.

Table 9-1. Planting table for 5A-VP-13.

Cover type	Scientific Name	Common Name	Size	Total Num Plantings[1]
Trees and Shrubs (0.08 acres)				
Shrubs[2]	*Ilex verticillata*	Common Winterberry	18 to 24”	9
	Cornus amomum	Silky Dogwood	18 to 24”	13
	Sambucus nigra	Black Elder	18 to 24”	5
Trees[3]	*Ulmus americana*	American Elm	18 to 24”	3
	Acer negundo	Boxelder maple	18 to 24”	5
	Acer saccharinum	Silver maple	18 to 24”	7
			Total Pounds Needed	
Seed Mix[4]	*NEWP WetMix*		1	
Shallow and Deep Emergent Marsh (0.22 acres)				
Herbaceous[5]	*Sagittaria latifolia*	Broad-Leaf Arrowhead	2” plug	45
	Sparganium americanum	American Bur-Reed	2” plug	56
	Alisma subcordatum	American Water-Plantain	2” plug	34
	Ludwigia palustris	Marsh Purslane	2” plug	18

1. Placement of aquatic emergent plugs, woody shrub, and trees will be directed by the supervising wetland scientist or otherwise specified in the SIP.
2. Shrubs planted around pool edges at ~8' OC for a total of 681 shrubs / acre.
3. Trees planted around pool edges at ~12' OC for a total of 303 trees / acre.
4. Seed mix distributed evenly along shallow margins of the pool. Seeding rate of 18 pounds / acre.
5. Plugs planted 8' OC (total 680 plants per acre).

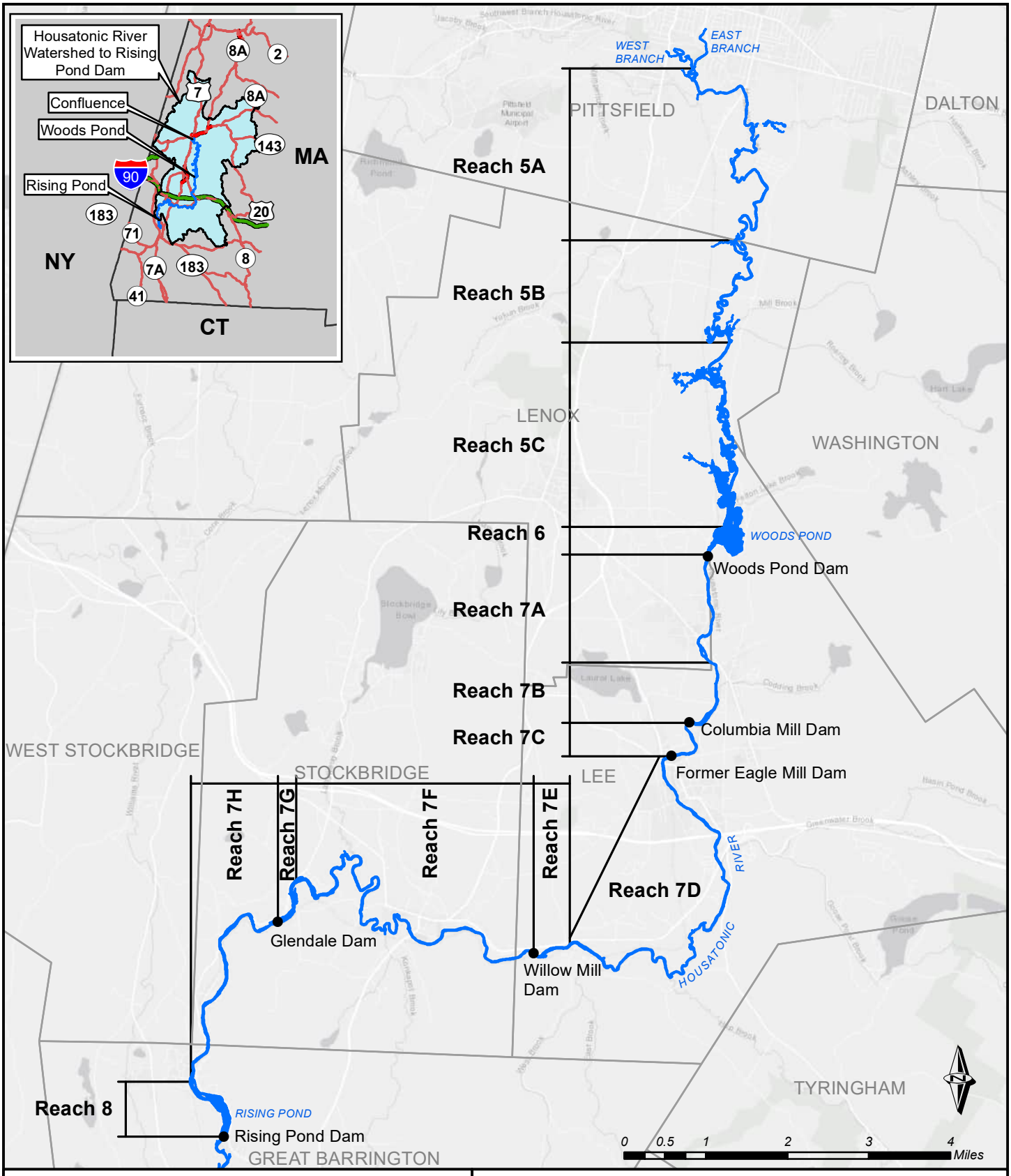
Table 12-1. Invasive Plant Species Observed in R5A

Layer	Common Name	*Scientific Name*	Status[1]	Occurrence*
Tree	Norway maple	*Acer platanoides*	AB	FP
Shrub	Japanese barberry	*Berberis thunbergii*	ABC	FP; VP
	Autumn olive	*Elaeagnus umbellata*	ABC	FP
	Burning bush	*Euonymus alatus*	ABC	FP; B; VP
	Glossy buckthorn	*Frangula alnus*	ABC	FP; VP
	Border privet	*Ligustrum obtusifolium*	D	FP; B; VP
	Morrow's honeysuckle	*Lonicera morrowii*	AB	FP; B; VP
	European buckthorn	*Rhamnus cathartica*	ABC	FP; B; VP
	Multiflora rose	*Rosa multiflora*	ABC	FP; VP
Woody Vine	Asian bittersweet	*Celastrus orbiculatus*	ABC	FP; B: VP
Herb	Bishop's goutweed	*Aegopodium podagraria*	AB	FP; B
	Garlic mustard	*Alliara petiolata*	AB	FP; B
	Japanese knotweed	*Fallopia japonica*	ABC	FP; B
	Gill-over-the-ground	*Glechoma hederacea*	B	B
	Dame's-rocket	*Hesperis matronalis*	AB	FP
	Yellow iris	*Iris pseudacorus*	AB	FP; B: BW; VP
	Moneywort	*Lysimachia nummularia*	A	FP; BW; VP
	Purple loosestrife	*Lythrum salicaria*	ABC	FP; BW
	Water forget-me-not	*Myosotis scorpioides*	D	FP; B; BW; VP
	Eurasian water-milfoil	*Myriophyllum spicatum*	AB	FP; B; BW; R
	Reed canary grass	*Phalaris arundinacea*	ABC	FP; B; BW; VP
	Common reed	*Phragmites australis*	ABC	FP; VP
	Curly pondweed	*Potamogeton crispus*	AB	B; R
	Water chestnut	*Trapa natans*	ABC	BW

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

*Occurrence Codes: FP=Floodplain; B=Bank; BW=Backwater; R=River; VP=Vernal Pool

Figures



Legend

- Dams
- Housatonic River Watershed
- Housatonic River

NOTE:
Basemap "Light Gray Canvas" from ESRI

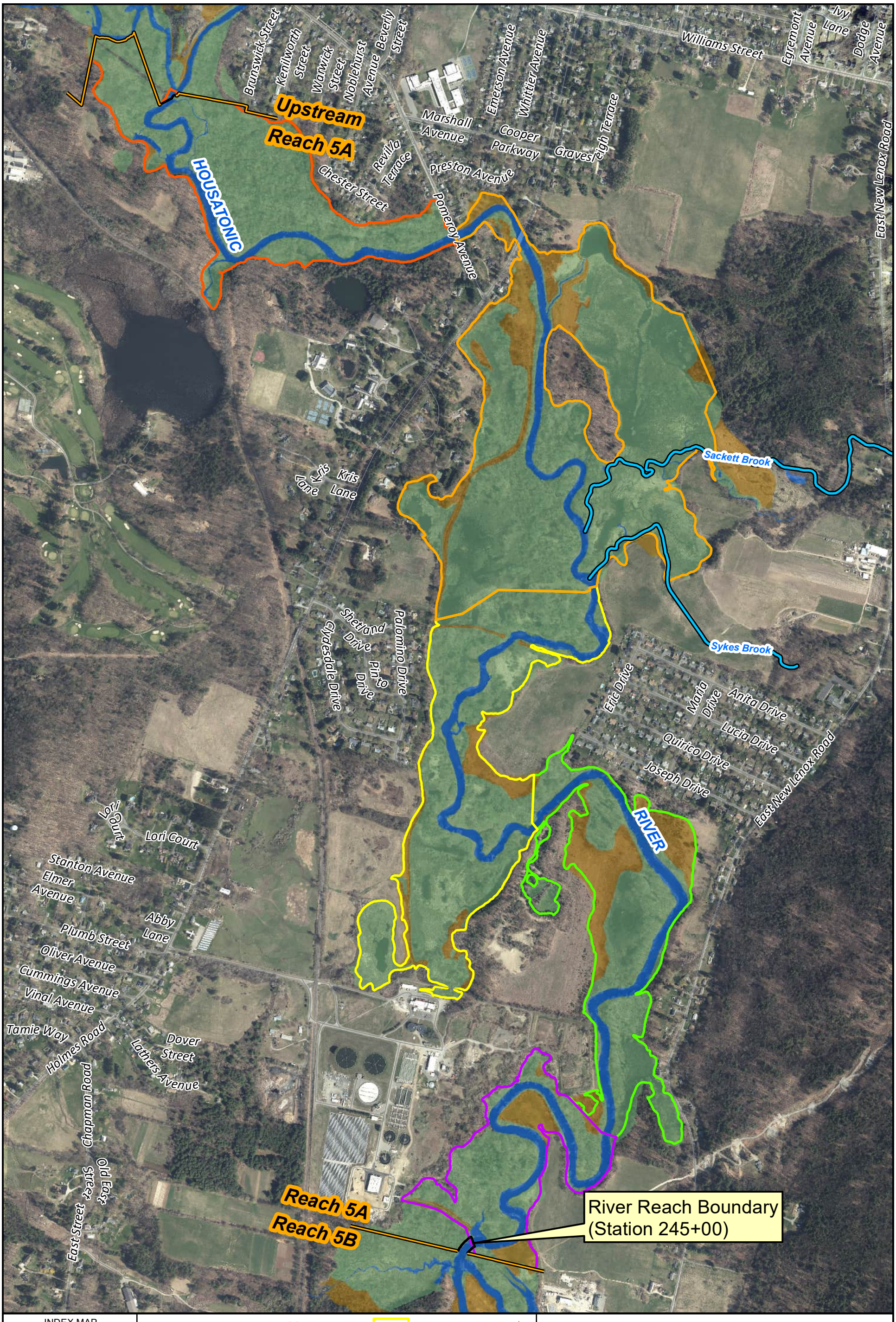
Housatonic Rest of River Site Plan

Housatonic River

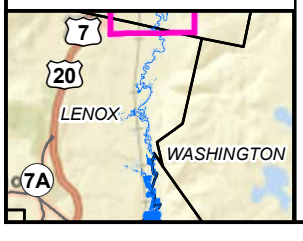
SCALE	DATE	PROJECT NO.
1:104,000	4/23/2026	60670015

AECOM

Figure 1-1



INDEX MAP



Tributaries
Housatonic River
Upland
Wetland

Year
Year 1
Year 2
Year 3
Year 4
Year 5

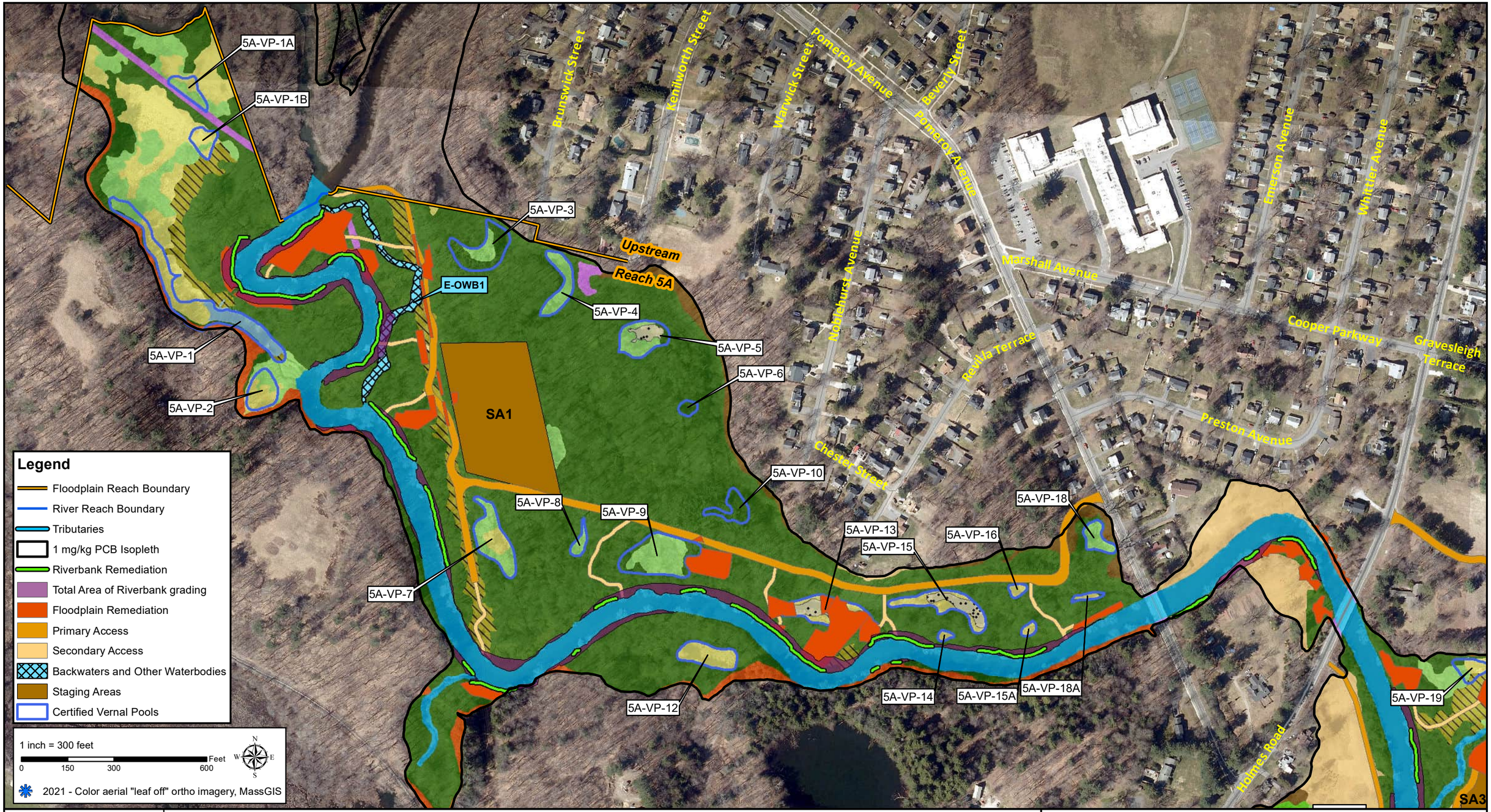
0 425 850 1,700 Feet

Reach 5A Limits of Remediation and Restoration
Housatonic River

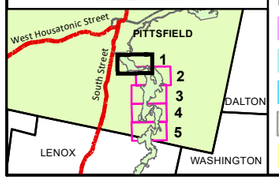
SCALE	DATE	PROJECT NO.
1:2,500	4/23/2026	60719336

AECOM

Figure 1-2



INDEX MAP



Natural Communities (2026)

- Developed / Disturbed (DVLP)
- Moderately alkaline lake/pond (MALP)
- Stream (STR)
- Deep emergent marsh (DEM)
- Shallow emergent marsh (SEM)
- Wet meadow (WMD)
- Shrub swamp (PSS)
- Red maple swamp (RMS)
- Transitional floodplain forest (TFF)
- High-terrace floodplain forest (HTFF)
- Cultural grasslands (CGL)
- Agricultural Field (AG)
- Successional Northern Hardwoods (SNH)
- Northern hardwoods-hemlock-white pine forest (NHWP)
- Red oak-sugar maple transition forest (RSMTF)

Reach 5A Natural Communities and Remediation Areas

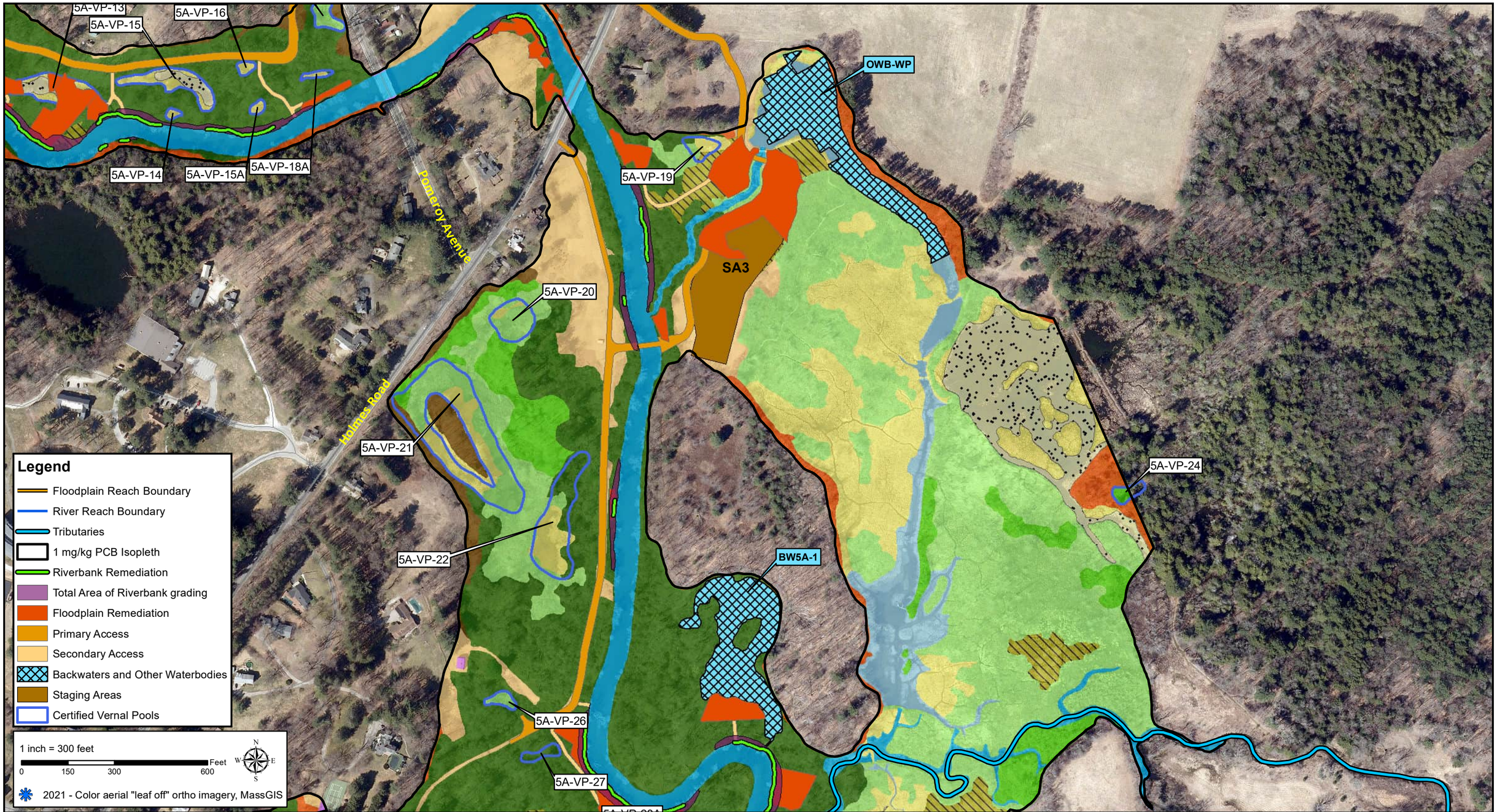
Housatonic River

SCALE	DATE	PROJECT NO.
1:3,600	4/11/2026	60670015

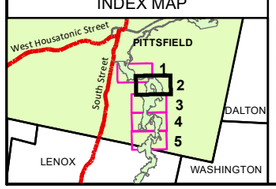
AECOM

Figure 3-1a

Map Sheet 1 of 5



INDEX MAP



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Reach 5A Natural Communities and Remediation Areas

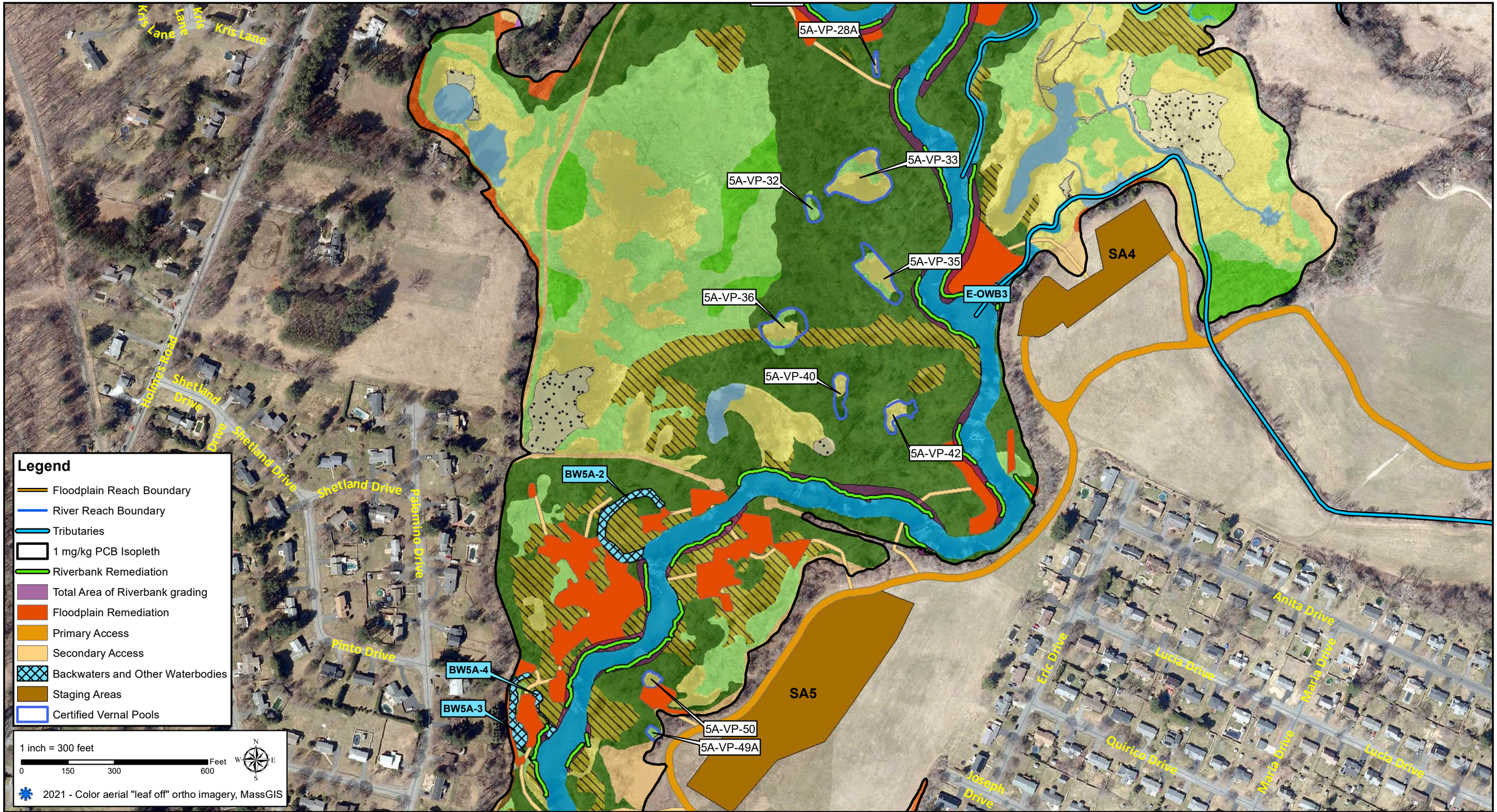
Housatonic River

SCALE	DATE	PROJECT NO.
1:3,600	4/11/2026	60670015

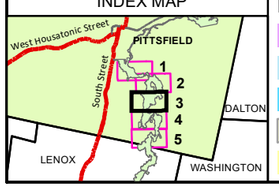
AECOM

Figure 3-1b

Map Sheet 2 of 5



INDEX MAP



Natural Communities (2026)

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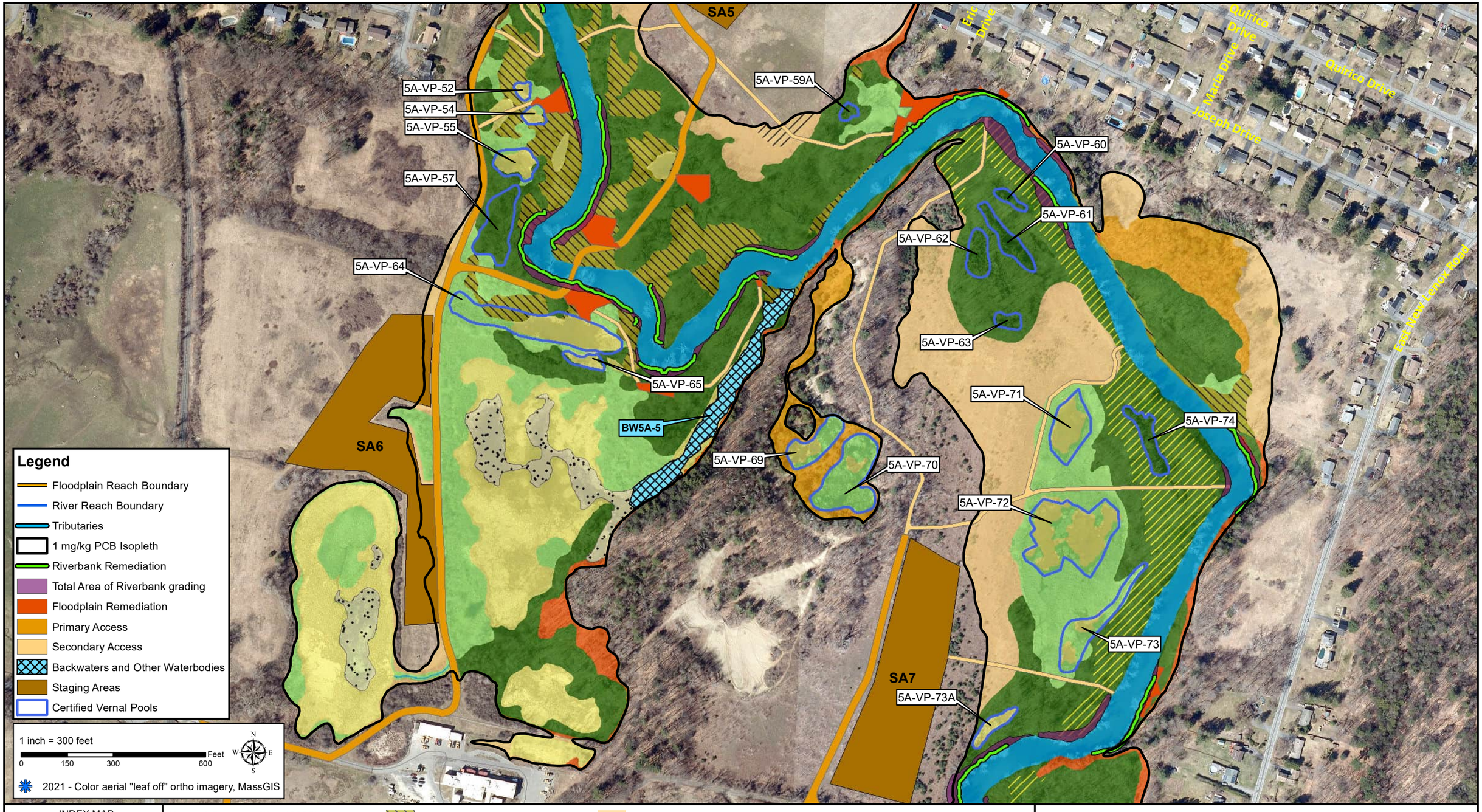
Reach 5A Natural Communities and Remediation Areas
Housatonic River

SCALE	DATE	PROJECT NO.
1:3,600	4/11/2026	60670015

AECOM

Figure 3-1c
Map Sheet 3 of 5



INDEX MAP

Natural Communities (2026)

- Developed / Disturbed (DVLP)
- Moderately alkaline lake/pond (MALP)
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- Red oak-sugar maple transition forest (RSMTF)

Reach 5A Natural Communities and Remediation Areas

Housatonic River

SCALE	DATE	PROJECT NO.
1:3,600	4/11/2026	60670015

AECOM

Figure 3-1d

Map Sheet 4 of 5

SA7

5A-VP-77

East Mayflower Road

5A-VP-80

5A-VP-79

5A-VP-81

SA10

5A-VP-83

Reach 5A

Reach 5B

BW5A-6

River Reach Boundary
(Station 245+00)

Legend

- Floodplain Reach Boundary
- River Reach Boundary
- Tributaries
- 1 mg/kg PCB Isopleth
- Riverbank Remediation
- Total Area of Riverbank grading
- Floodplain Remediation
- Primary Access
- Secondary Access
- Backwaters and Other Waterbodies
- Staging Areas
- Certified Vernal Pools

1 inch = 300 feet

0 150 300 600 Feet

N W E S

2021 - Color aerial "leaf off" ortho imagery, MassGIS

INDEX MAP

Natural Communities (2026)

- Developed / Disturbed (DVLP)
- Moderately alkaline lake/pond (MALP)
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Reach 5A Natural Communities and Remediation Areas

Housatonic River

SCALE	DATE	PROJECT NO.
1:3,600	4/11/2026	60670015

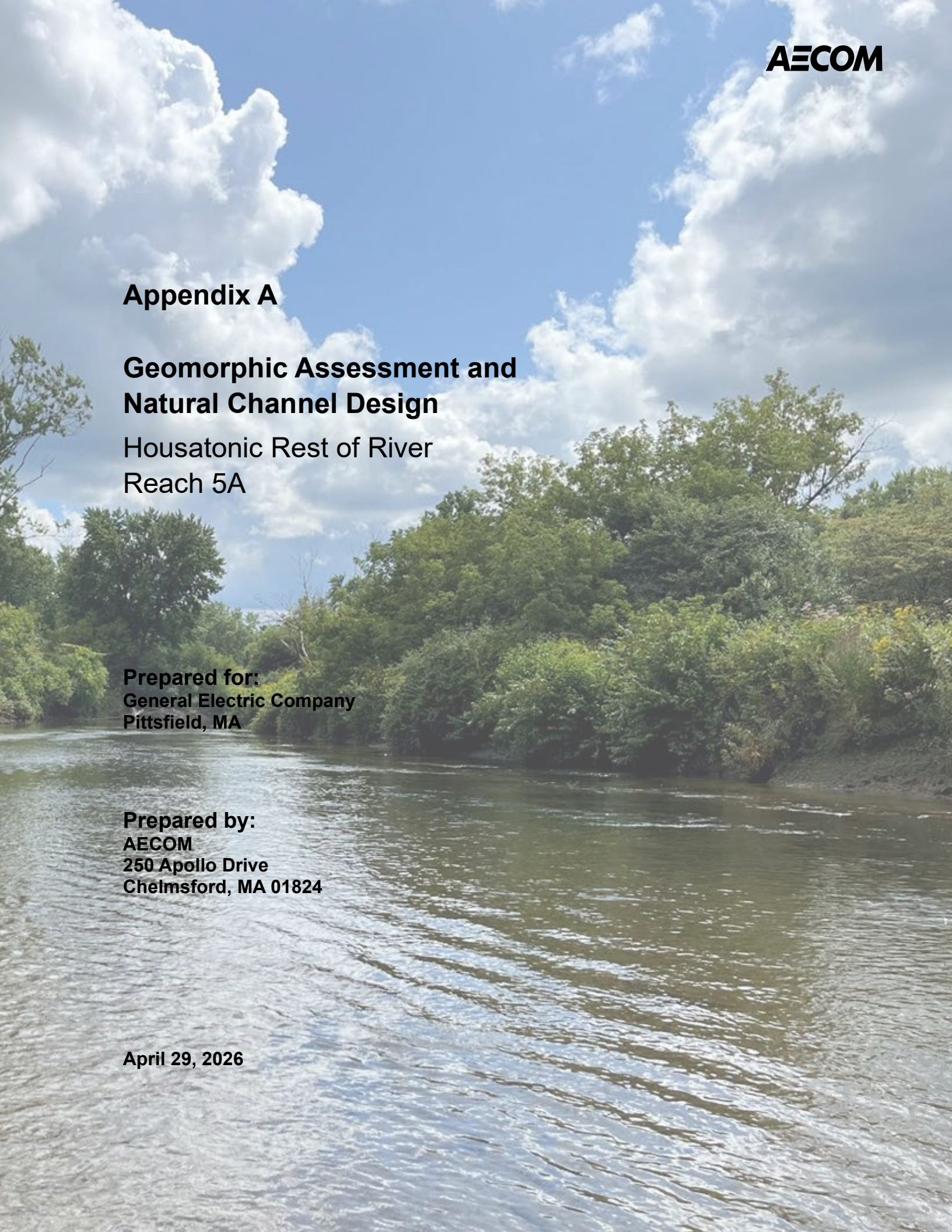
AECOM

Figure 3-1e

Map Sheet 5 of 5

Appendix A

Geomorphic Assessment and Natural Channel Design



Appendix A

Geomorphic Assessment and Natural Channel Design

Housatonic Rest of River
Reach 5A

Prepared for:
General Electric Company
Pittsfield, MA

Prepared by:
AECOM
250 Apollo Drive
Chelmsford, MA 01824

April 29, 2026

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Attachment A Cross-Section Data and Forms
Attachment B Particle Data
Attachment C Rosgen Level II and III Forms
Attachment D NCD-Based Design Drawings

1. Introduction

This appendix presents the findings of a geomorphic analysis of Reach 5A of the Housatonic Rest of River (ROR) and the use of that analysis in restoration design. This document is provided as Appendix A to the Reach 5A Restoration Plan. The analysis consisted of both a desktop assessment and field surveys. An initial desktop analysis was conducted to evaluate watershed conditions and estimate bankfull parameters for the study reach. Field investigations occurred in August 2024. Cross-sectional survey data were supplemented with desktop analysis to determine existing geomorphic parameters for Reach 5A.

The existing geomorphic condition and erodibility potential of the stream serve as the basis for incorporating Natural Channel Design (NCD) principles for the riverbank remediation design and evaluating areas where channel dimensions are unstable within the river system, pursuant to the Revised Final Resource Conservation and Recovery Act Permit Modification issued by EPA to GE on December 16, 2020 (Revised Final Permit).[1] The NCD approach uses principles of fluvial geomorphology and is founded on a scientific understanding of natural, stable river systems. The geomorphic results outlined in this report were used to determine stabilization options for the riverbank remediation areas and to develop proposed grading in areas where the channel is unstable.

1.1 Housatonic River Reach 5A Overview

Reach 5A (shown on Figure 1) encompasses approximately five miles, beginning at the confluence of the East and West Branches of the Housatonic River (the Confluence) and extending downstream to the Pittsfield Wastewater Treatment Plant (WWTP) discharge location for the river and to the Pittsfield/Lenox municipal boundary just south of the Pittsfield WWTP for the floodplain. The river channel in this reach is free-flowing, contains numerous meanders, and has riverbanks that are subject to erosion in places. Reach 5A also contains quiescent backwater areas adjacent and hydraulically connected to the main channel of the river.

The floodplain in Reach 5A covers approximately 370 acres, as defined laterally by the area between the riverbanks and the 1 milligram per kilogram (mg/kg) PCB isopleth, and ranges in width from 100 feet at its narrowest point to approximately 2,500 feet at its widest point (BBL and QEA, 2003). Land use along the river consists primarily of undeveloped floodplain and wetlands, with residential properties also present in several locations.

River stations were established for Reach 5A during the pre-design investigation (PDI) for sediments and riverbanks to provide a locational reference to support various investigations, remedial design, and construction. These stations are described in GE's *Revised Pre-Design Investigation Summary Report for Reach 5A Sediment and Riverbanks* (Revised PDI Report; Anchor QEA and AECOM, 2024), The stationing begins with Station 0+00 at the Confluence and extends to the downstream end of Reach 5A at Station 245+00 (located 24,500 feet from Station 0+00 or approximately 4.6 miles). River stations were established every approximately 100 feet along the approximate centerline of the river (as also shown on **Figure 1**).

[1] The Revised Final Permit notes that "NCD methods are described in Chapter 11, Rosgen Geomorphic Channel Design, of the Stream Restoration Handbook (Part 654) and in the NCD Review Checklist Manual."

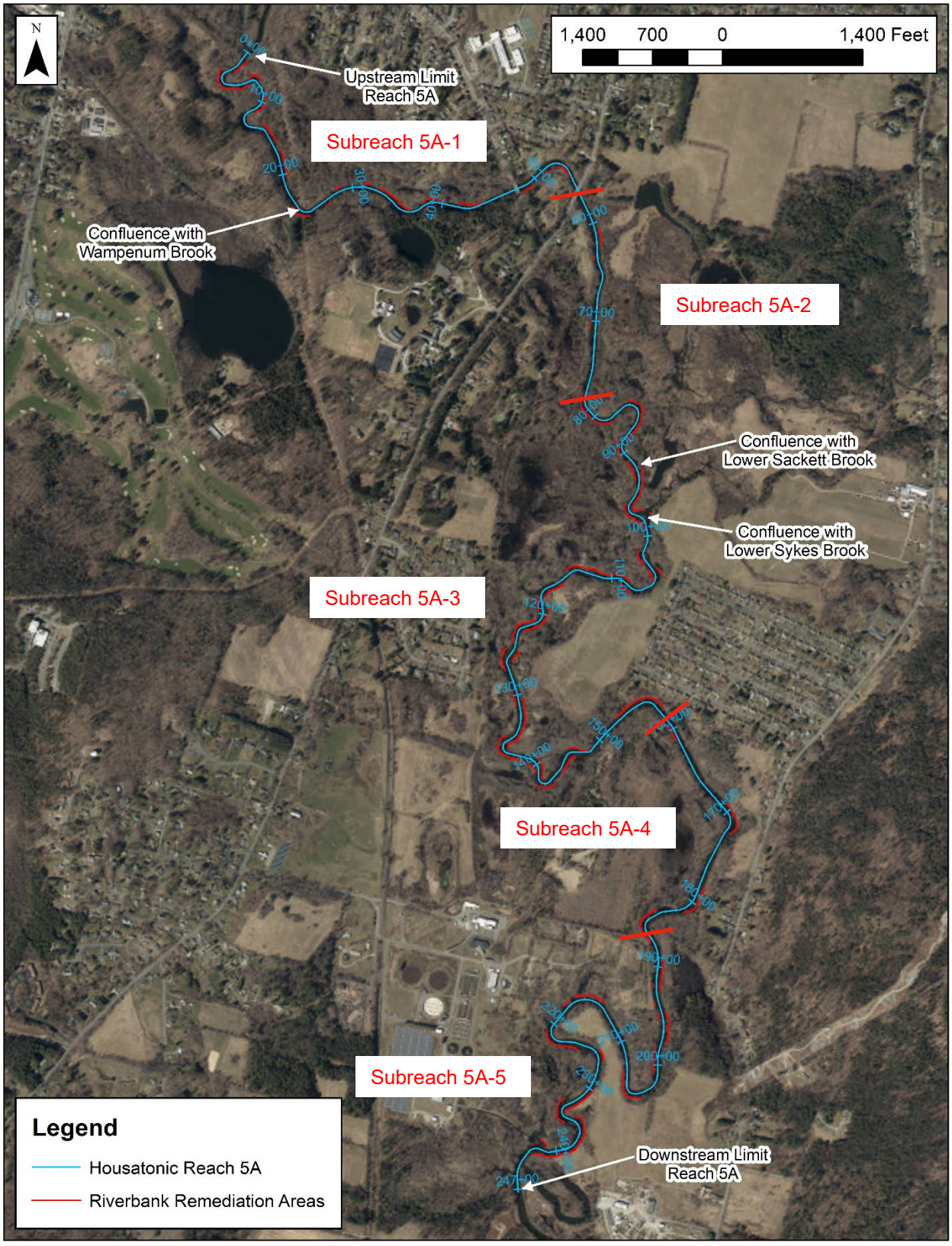

Figure 1: Reach 5A of the Housatonic River – Study Location Map

1.2 Subreach Descriptions

Reach 5A has been subdivided into five study subreaches that have been assigned unique identifiers due to their different fluvial geomorphic characteristics. The subreach segments are as follows:

- **Subreach 5A.1** (Station 0.0 to 58+00): This subreach extends from the Confluence downstream to the bridge at Holmes Road. It appears to be the most stable of the subreaches. The channel is moderately sinuous with an extensive active floodplain on at least one side of the channel. Riffles contain sands and gravels.
- **Subreach 5A.2** (Station 58+00 to 78+00): This subreach is relatively straight with no sinuosity. It consists primarily of riffles and runs with few deep pools. Riffles contain sands and gravels.
- **Subreach 5A.3** (Station 78+00 to 160+00): This subreach is moderately sinuous with an extensive floodplain. There are a number of old oxbow features within the floodplain in this subreach. There a several large woody debris piles within the channel, creating some channel instability.
- **Subreach 5A.4** (Station 160+00 to 189+00): This subreach is also relatively straight. The channel passes through an area of glacial till of unsorted material and is partially confined on the left side of the channel. Material along the banks consists of larger gravel and cobbles in many locations. Riffle material is primarily sands, although one unusual riffle was found that contains gravel and cobble.
- **Subreach 5A.5** (Station 189+00 to 246+00): This subreach is relatively sinuous with large but tight meander bends. The floodplain is confined in some spots due to the presence of fill. Few riffles were observed, but deep pools are present. Bed material consists primarily of sands and silts. Point bars within the meander bends are either absent or very steep.

1.3 Data Collection

Geomorphic field surveys performed in August 2024 collected the following data:

- Bankfull features were identified throughout the Reach 5A channel.
- Survey data were collected from representative cross-sections in each river subreach to be used in identifying existing bankfull dimensions. Bankfull elevations were determined and surveyed approximately every 1,000 feet along the entire length of Reach 5A. These survey points along with topobathymetric survey data were used to develop cross-sections. The cross-sectional data were analyzed using Rivermorph software to calculate various geomorphic parameters. The cross-sections are provided in Attachment A.
- Design data from each segment were collected to provide information for generating the proper dimension, pattern, and profile of the segment during design. Within each segment, longitudinal profile data were collected along roughly 500- to 600-foot lengths. Within each longitudinal profile, the start and endpoints of pools, riffles, and glides were identified and locations surveyed.
- Survey data were collected on other geomorphic features, including point bar slopes, pool dimensions, and riffle lengths/slopes. These data were collected from at least two profiles within each segment except one. At the most downstream segment, the water was too deep to enable features to be discerned for the survey. (For the latter segment, existing bathymetric data from the sonar survey were used to establish the longitudinal profile data.)
- Wolman pebble count and bar sample information were collected from four selected locations to properly assess the Rosgen stream type and perform sediment competence. The results of the pebble counts and bar samples are provided in Attachment B.

- Worksheets from the *River Stability Field Guide* (Rosgen 2008) were completed to the extent possible and are provided in Attachment C. Specifically, the following worksheets were completed to the extent possible: 2-2, 2-3, 2-4, 3-2, 3-3, 3-4, 3-5, 3-6, 3-7, 3-8, 3-9, 3-10, 3-14, 3-15, 3-16, 3-17, 3-18, 3-19, 3-20, and 3-21.

2. Watershed Characteristics

2.1 Watershed Description

Reach 5A of the Housatonic River is located within the New England physiographic province within the Housatonic (HUC8: 01100005) and Headwaters Housatonic River (HUC10: 0110000501) watersheds (**Figure 2**). The Headwaters Housatonic River watershed is approximately 284 square miles in size and contains multiple land uses that vary between urban, agriculture, forest, and wetlands, and waterbodies. The drainage area at the downstream limit of Reach 5A is characterized as rural, having only 5% impervious area. Urbanization within the watershed is concentrated largely within the City of Pittsfield, which is located upstream of Reach 5A. The study watershed contains multiple Western New England ecoregions, including the Taconic Mountains, Western New England Marble Valleys, and Berkshire Highlands.

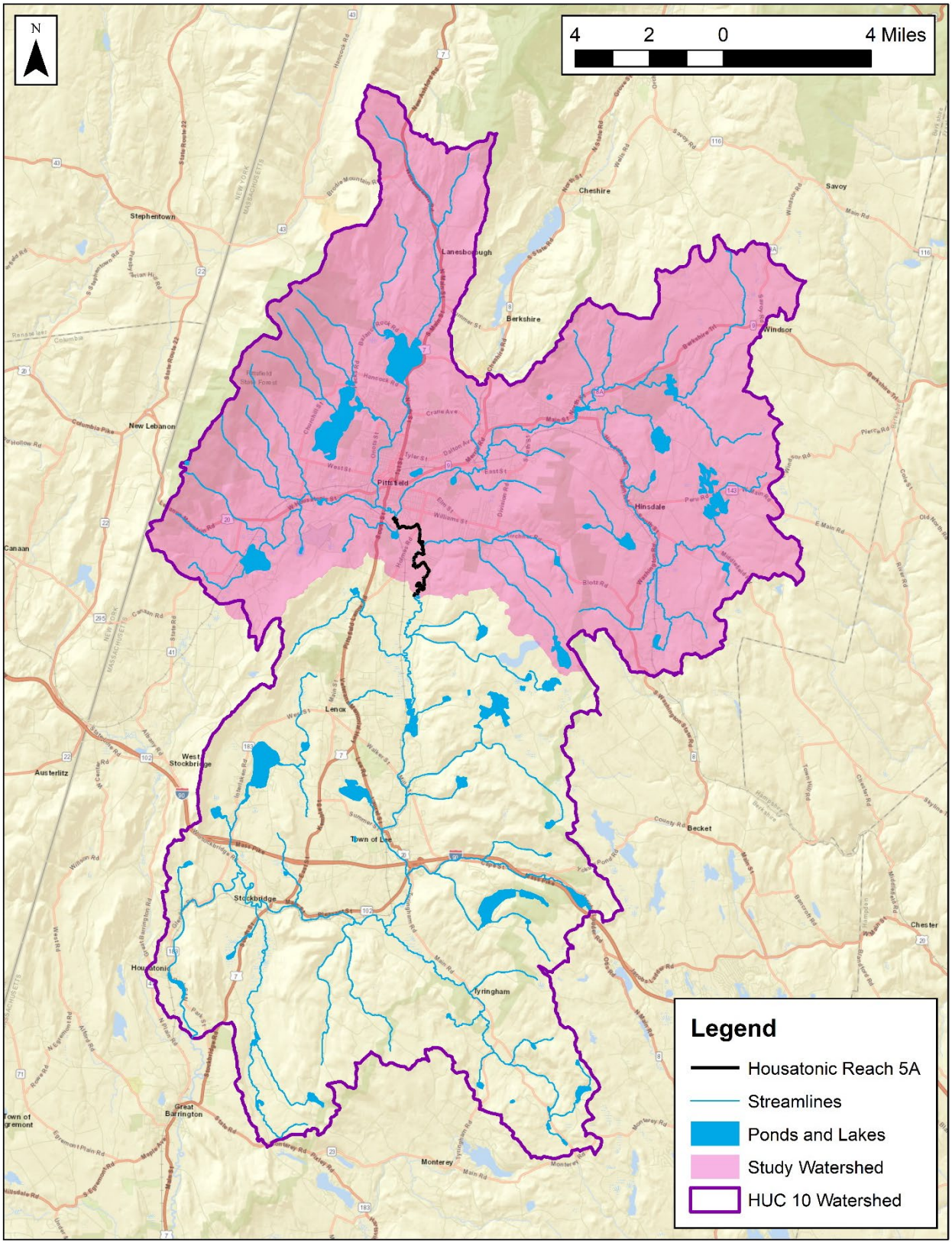

Figure 2: Hydrologic Unit Code Watershed Map - Headwaters Housatonic River (HUC10: 0110000501)

2.2 Drainage Area Assessment

Desktop analysis was conducted using the United States Geologic Survey (USGS) StreamStats online tool to evaluate the drainage area at the downstream limit of each study reach and at the upstream limit of Reach 5A. Drainage area information is summarized in **Table 1** below.

Table 1: Drainage Area Summary

Subreach	Drainage Area (sq. mi)
5A.1	131
5A.2	134
5A.3	143
5A.4	145
5A.5	146

2.3 Regional Curve Analysis

Regional curves developed for Massachusetts (Bent and Waite, 2013), the Catskills (Miller and Davis, 2003), and Stream Stats (USGS, 2019) were referenced to calibrate field measurements for bankfull dimensions. Regional curve calculations are provided in **Table 2** below. These are the bankfull areas and discharge rates that would be expected based on the drainage area and are based on averages calculated in the various reports.

Table 2: Regional Curve Calculations

		Stream Stats								
		Statewide SIR 2013		Appalachian Highlands Bieger 2015	New England Bieger 2015	USA Bieger 2015	Massachusetts		Catskills	
Subreach	Drainage Area (sq mi)	BKFA (sf)	BKFQ (cfs)	BKFA (sf)	BKFA (sf)	BKFA (sf)	BKFA (sf)	BKFQ (cfs)	BKFA (sf)	BKFQ (cfs)
5A.1	131	451	2010	534	416	238	434	1831	654	4376
5A.2	134	457	2050	542	421	241	441	1865	666	4463
5A.3	143	479	2160	567	435	249	461	1964	703	4723
5A.4	145	484	2180	573	438	251	466	1986	711	4780
5A.5	146	486	2200	576	440	252	468	1997	715	4809

Notes:
cfs – cubic feet per second; sf – square feet; sq mi – square miles
BKFA: Bankfull Area
BKFQ: Bankfull Discharge

The bankfull areas surveyed in the field (Section 3.1) resulted in a larger bankfull area than the Massachusetts regional curve predictions for bankfull area but are within the range of the 95% confidence interval. Bankfull areas are relatively similar to those calculated by the Appalachian Highlands curve, which covers a wide range of physiographic provinces ranging from the Adirondacks to the Blue Ridge Mountains and includes the project area.

2.4 Previous Geomorphology Data

Previous geomorphic assessments and data were provided in the following:

- The 2024 Revised PDI Report for Sediment and Riverbanks, which provided the Bank Erodibility Hazard Index (BEHI) and Near-Bank Stress (NBS) methods and results;
- Memorandum dated January 13, 2023 on Housatonic Reach 5A – Bankfull Determination (AECOM, 2023a); and
- Memorandum dated June 6, 2023 on Housatonic Reach 5A – Bankfull Flows (AECOM, 2023b).

3. Geomorphic Assessment

3.1 Geomorphic Data Summary

Twenty riffle cross-sections were identified and developed throughout the five subreaches to help classify the river channel and develop the geomorphic parameters. A summary of the data collected is provided in **Table 3**.

Table 3: Existing Cross-Section Geomorphic Parameters

Subreach	Bankfull Width (feet)	Mean Depth (feet)	Max Depth (feet)	Bankfull Cross Sectional Area (square feet)	D50 (mm)	D84 (mm)	Average Slope (feet/feet)	Rosgen Channel Type
5A.1 Range Average	93-119 99.6	4.9-6.5 5.95	7.7-8.6 8.2	552-611 588	9.89	19.64	0.0006	C4c
5A.2 Range Average	88-92 90	6.3-6.6 6.5	7.7-8.8 8.0	582-600 589	9.32	15.22	0.0002	C4c
5A.3 Range Average	86-163 121	3.7-6.4 5.1	6.9-8.3 7.6	500-617 578	9.27	18.54	0.0006	C4c
5A.4 Range Average	100-118 112	4.9-6.4 5.5	7.2-7.7 7.4	574-637 611	0.43	1.0	0.0003	C5c
5A.5 Range Average	101-108 104	5.1-5.6 5.3	7.0-7.6 7.4	518-566 551	0.75	0.92	0.0002	C5c

Notes:

mm = millimeters

The upper three river subreaches classify as a Rosgen C4c type channel in an unconfined lacustrine deposition valley (Valley Type VII). Rosgen C4 stream types are slightly entrenched, meandering, gravel-dominated, riffle-pool alluvial channels that occur on gentle gradients in broad valleys. They are characterized by well-developed floodplains typically constructed of alluvium.

The lower two subreaches classify as a Rosgen C5c type channel. Rosgen C5 stream types are slightly entrenched, meandering, sand-dominated, riffle-pool alluvial channels that occur on gentle gradients in broad valleys. They are likewise characterized by well-developed floodplains typically constructed of alluvium.

3.2 Subreach 5A.1

Subreach 5A.1 begins at the Confluence and extends downstream to the bridge at Holmes Road. The first 1,500 feet consist of three relatively tight meander bends with deep pools in each of the bends and short riffles between the pools. In the first part of the subreach, there is an extensive floodplain on both sides of the channel that is over 2,000 feet wide. At Station 13+00 a high bluff over 30 feet in height butts up against the channel on the right side (left and right designations are facing downstream) and continues

until about Station 26+00. There is a break in the bluff at Station 24+00, where a tributary from Morewood Lake flows into the river. From Station 26+00 to 36+00, the channel forms a large meander with floodplain on both sides of the channel, although it is much more extensive on the left side of the channel. At Station 36+00 the channel encounters another steep high bank that ranges from 15 to 40 feet in height along the right side of the channel. This high bank extends all the way to the Pomeroy Avenue bridge at Station 48+00. Extensive floodplain and wetlands are present on the left side of the channel. After passing beneath Pomeroy Avenue, the channel takes a sharp bend and then passes under the bridge at Holmes Road. The outside meander bend (left bank) is armored with riprap that extends downstream to the Holmes Road bridge. Residential areas are present on both sides of the river between the two bridges.

A total of six riffle cross-sections and two pool cross-sections were evaluated in this subreach to obtain the existing geomorphic range of values. Within the existing riffle dimensions, the bankfull mean depth (dbkf) in Subreach 5A.1 averaged 5.95 feet, bankfull width (Wbkf) is 99.6 feet, and the bankfull cross-sectional area (Abkf) averaged 588 square feet. Riffles contain sands and gravels. A pebble count performed at one representative riffle indicates that the 84th percentile grain size (D_{84}) was 19.6 millimeters (mm) and the median grain size (D_{50}) was 9.9 mm. Given a dbkf of 6.3 feet and an average water surface slope of 0.0006%, the sediment competence analysis indicated that the channel could move particles up to 53 mm (using the Rosgen Colorado data [Rosgen, 2006]).

The predominant BEHI/NBS combination in this subreach is Moderate-High/Low with a few banks rated High or Very High/High-Extreme. Based on the BANCS model, this subreach produces an estimated 558 tons of sediment per year with an average of 4.8 tons per 100 feet of riverbank.

3.3 Subreach 5A.2

This subreach begins at Holmes Road bridge and extends south for about 2,000 feet. Through this subreach, the channel is relatively straight with no sinuosity. It consists primarily of riffles and runs with few deep pools. Initially there is floodplain on both sides of the channel, but at around Station 66+00 the left bank rises to eight to 10 feet above the floodplain for about 600 feet until the left side opens up to the floodplain again. This reach ends at Station 78+00 right before the channel takes a sharp bend to the left. Land use on either side of the channel consists primarily of undeveloped woodland.

A total of three riffle cross-sections and two pool cross-sections were evaluated in this subreach to obtain the existing geomorphic range of values. Within the existing riffle dimensions, the bankfull mean depth in Subreach 5A.2 averaged 6.5 feet, bankfull width is 90 feet, and the bankfull cross-sectional area averaged 589 square feet. Riffles contain sands and gravels. A pebble count performed at one representative riffle indicates that the D_{84} was 15.2 mm and the D_{50} was 9.3 mm. Given a dbkf of 6.5 feet and an average water surface slope of 0.0002%, the sediment competence analysis indicated that the channel could move particles up to 24 mm (using the Rosgen Colorado data [Rosgen, 2006]).

The predominant BEHI/NBS combination in this subreach is Moderate/Low. Based on the BANCS model, this sub reach produces an estimated 117 tons of sediment per year with an average of 2.9 tons per 100 feet of riverbank.

3.4 Subreach 5A.3

Subreach 5A.3 is the longest of the five subreachs at 8,200 feet in length. The first 1,000 feet consist of two tight meander bends. At Station 93+00 a small tributary (Sackett Brook) flows in from the left, and at Station 99+00 a larger tributary (Sykes Brook) also flows in from the left. At the confluence of Sykes Brook, the channel is quite wide (130 to 140 feet) and a large center bar has formed. Wetlands and floodplain are present on both sides of the channel up to this point. Numerous oxbows and other evidence of abandoned channel are present in the floodplain. Just downstream of the confluence with Sykes Brook, the left bank becomes quite high (15 to 20 feet). This high bank on the left extends down to

about Station 109+00. The channel forms a tight meander bend through this section with the outside of the meander pushing up against the high terrace. A residential neighborhood is present on the terrace.

From Station 109+00 the channel continues to meander downstream with a modest floodplain on both sides. Extensive floodplain is present to the right of the channel with several oxbows and evidence of an abandoned channel. At about Station 128+00 the floodplain is constricted and only about 300 feet wide. Below this point the floodplain widens out slightly. but at Station 150+00 the channel butts up against a high bank (10 to 15 feet) on the right that is potentially composed of fill from the WWTP. At Station 157+00 the channel takes a sharp bend to right as it runs up against a neighborhood on a high left bank. The subreach ends at Station 160+00.

There are numerous large woody debris piles and central bars within the channel through this subreach. These occur at Station 79+00, 87+00, 99+00, 103+50, 109+50, 114+00, 115+00, 121+50, 127+00. These woody debris blocks and central bars contribute to bank erosion and channel instability throughout the subreach by redirecting flows towards the banks and locally increasing shear stress along the banks.

A total of three riffle cross-sections and two pool cross-sections were evaluated in this subreach to obtain the existing geomorphic range of values. Within the existing riffle dimensions, the bankfull mean depth in Subreach 5A.3 averaged 5.1 feet, bankfull width is 121 feet, and the bankfull cross-sectional area averaged 578 square feet. Riffles contain sands and gravels. A pebble count performed at one representative riffle indicates that the D_{84} was 18.5 mm and the D_{50} was 9.3 mm. Given a dbkf of 4.6 feet and an average water surface slope of 0.0006%, the sediment competence analysis indicated that the channel could move particles up to 60 mm (using the Rosgen Colorado data [Rosgen, 2006]).

BEHI and NBS are quite variable in this subreach, but trend toward the higher end of the spectrum. Based on the BANCS model, this subreach produces an estimated 894 tons of sediment per year with an average of 5.4 tons per 100 feet of riverbank. This subreach contributes about 38% of the total sediment load of Reach 5A.

3.5 Subreach 5A.4

Subreach 5A.4 is relatively straight with one slight meander bend at Station 172+00 near its midpoint. This subreach is about 2,000 feet in length. The defining characteristic of this subreach is that the channel passes through an area of glacial till of unsorted material. Material along the banks is different than in other subreaches and often consists of larger gravel and cobbles. The lower slopes of the banks are often armored with this cobbly material. The channel partially confined on the left side of the channel by a 10- to 15-foot high terrace. The right side of the channel contains an active floodplain. At the very end of the subreach, the channel has several slight meander bends and a small central bar is present at about Station 186+00.

A total of three riffle cross-sections and two pool cross-sections were evaluated in this subreach to obtain the existing geomorphic range of values. Within the existing riffle dimensions, the bankfull mean depth in Subreach 5A.4 averaged 5.5 feet, bankfull width is 112 feet, and the bankfull cross-sectional area averaged 611 square feet. Riffle material consists primarily of sands, although one unusual riffle was found that contained gravel and cobble. A pebble count performed at one representative riffle indicates that the D_{84} was 1.0 mm and the D_{50} was 0.43 mm. Because this is a sand-dominated system, Rosgen's sediment competence calculations do not apply as they are derived from gravel and cobble systems. It is assumed that the largest movable particle would be similar to that calculated for subreach 5A.3.

The predominant BEHI/NBS combination in this subreach is Moderate/Low. Based on the BANCS model, this subreach produces an estimated 258 tons of sediment per year with an average of 4.3 tons per 100 feet of riverbank.

3.6 Subreach 5A.5

Subreach 5A.5 is about 5,500 feet in length and consists of long sweeping meander bends. The floodplain is confined in some spots due to the presence of fill. Few riffles were observed, but deep pools are present. Point bars within the meander bends are either absent or very steep. At Station 202+00 the channel begins a large bend to the right. The left bank (on the outside of the meander bend) is high (about 10 feet) and relatively steep. The next large compound meander bend begins at Station 216+00 and extends for about 900 feet. A meander bend at 236+00 is short and tight.

For the most part, mid-channel and side bars are absent as are any significant debris blockages. However, at Station 238+00 near the end of the subreach, a small island is present along the right side of the channel. Sediment has built up to a height of about six feet from channel bed and the channel has widened to the left to accommodate the island.

A total of three riffle cross-sections and two pool cross-sections were evaluated in this subreach to obtain the existing geomorphic range of values. Within the existing riffle dimensions, the bankfull mean depth in Subreach 5A.5 averaged 5.3 feet, bankfull width is 104 feet, and the bankfull cross-sectional area averaged 551 square feet. Riffle material consists primarily of sands. A pebble count performed at one representative riffle indicates that the D_{84} was 0.92 mm and the D_{50} was 0.75 mm. Because this is a sand-dominated system, Rosgen's sediment competence calculations do not apply as they are derived from gravel and cobble systems. It is assumed that the largest movable particle would be similar to that calculated for subreach 5A.3.

While the predominant BEHI/NBS combination in this subreach is Moderate/Low, banks with higher rating combinations are not uncommon. The outside of the several of the meander bends is vertical and composed of a more sandy/silty material and are very erosional. Based on the BANCS model, this subreach produces an estimated 553 tons of sediment per year with an average of 5.0 tons per 100 feet of riverbank.

4. Geomorphic Design Criteria

4.1 Application of Reference Data

The NCD technique being implemented on Reach 5A requires a blend of ideal design conditions and existing conditions. The current alignment will remain mostly unaltered with only minor shifts in a few locations. The profile will be modified to increase stable riffle habitat and ensure that riffles and pools are located in appropriate sections of the alignment. Through most of the remediation area, only the channel bed and the bank on one side of the channel will be modified based on which locations have been identified for remediation in accordance with the Revised Final Permit conditions. Any banks that have not been identified for remediation will mostly remain undisturbed unless modifications to those banks are required to maintain stability of the remediated banks. This design approach is intended to improve overall stability in the reach while minimizing the impact of earthwork on the existing river channel and banks.

With this design approach in mind, reference data were used to design improved sections of the channel where required bank and channel grading made those improvements possible. Not all reference conditions are being consistently applied throughout Reach 5A. Rather, the design mimics existing conditions in areas where there is no notable instability. Mimicking existing conditions in these areas is not expected to cause any additional instability after construction as the majority of the remediation reach is expected to fall within reference parameters, and some natural variation is expected in any river channel. Some typical NCD parameters such as sinuosity, meander length ratio, and meander width ratio were not referenced in the proposed design due to the limitations with affecting the alignment geometry.

Reference data were derived from the Trout Creek reference published by Rosgen (2006). Trout Creek is a C4-type channel located in a terraced, alluvial valley in the Trail Creek Watershed in Colorado. Originally, it was estimated that reference data could be attained from the existing conditions on the Housatonic River, but no reference data that could be applied to the alignment and profile were found during the site assessment. Several stable riffle cross sections were identified to estimate the riffle bankfull dimensions, but other design data were taken from Trout Creek and typical C4 channel dimensions. The design parameters used to analyze the Housatonic are shown in **Table 4**. All design ratios are scaled to bankfull width, bankfull mean depth, or bankfull slope and are therefore unitless.

Table 4: Trout Creek C4 Reference Data Design Ratios

Design Parameter	Minimum	Mean	Maximum
Radius of Curvature Ratio	1.68	2.31	3.51
Pool to Pool Spacing Ratio	1.19	3.00	5.80
Curve Length Ratio	1.08	2.03	2.48
Riffle Length Ratio	0.46	1.25	4.45
Pool Length Ratio	0.46	0.95	1.48
Riffle Slope Ratio	0.65	1.02	1.23
Pool Slope Ratio	0.18	0.78	0.89
Riffle Width/Depth Ratio	12.0*	26.0*	40.0*
Pool Width/ Riffle Width Ratio	1.2*	1.43	1.7*
Max Pool Depth/ Mean Riffle Depth Ratio	1.5*	2.8	3.5*

*Trout Creek data supplemented with common C4 design ratios

4.2 Design Cross-Sections

Two design cross-sections were generated in the remediation reach -- one for the riffles and one for the pools -- in order to identify ideal channel widths and bank slopes. Each cross-section was applied to banks only where remediation was required, and therefore a consistent width/depth ratio and bankfull area was not achieved or considered necessary in the design. These base riffle and pool cross-sections were utilized throughout the design area because an analysis of existing geomorphic parameters did not show a significant and consistent increase in bankfull area throughout Reach 5A. However, the cross-sections were modified during the process of grading as needed to blend the proposed grading into the existing banks and maintain deeper pool depths where appropriate. Throughout the design, the toe of the cross-sections was used to tie into the identified existing “bottom of bank” that was delineated in the field. The proposed dimensions of those features are also outlined in **Table 5**, but these dimensions should be considered minimums, as they vary through the remediation area.

Table 5: Design Cross-Section Channel Parameters

Feature	Bankfull Width (feet)	Mean Depth (feet)	Max Depth (feet)	Bankfull Cross Sectional Area (square feet)	Width/ Depth Ratio	Entrenchment Ratio	Side Slope Range	Toe Width (feet)	Toe Max Depth (feet)
Riffle	110.0	5.4	7.5	592.5	20.4	12.7	0.03 – 0.30	60.0	2.0
Pool	130.0	Not Applicable	11.0	925.0	Not Applicable	Not Applicable	0.06 – 0.3	80.0	4.5

4.3 Alignment and Profile Design Parameters

After applying the proposed bankfull dimensions to the reference data shown in **Table 4**, idealized design channel alignment and profile parameters were identified and are listed in **Table 6**.

Table 6: Design Alignment and Profile Channel Parameters

Sub-reach	Proposed Bankfull Slope	Riffle Facet Slope	Pool Facet Slope	Radius of Curvature Range (feet)	Pool-to-Pool Spacing Range (feet)	Curve Length Range (feet)	Riffle Length Range (feet)	Pool Length Range (feet)	Riffle to Pool Ratio
5A-1	0.00054	0.00065							
5A-2	0.00013	0.00016							
5A-3	0.00037	0.00044	0.0001	185-386	131-638	119-273	51-490	51-163	60-40
5A-4	0.00040	0.00048							
5A-5	0.00019	0.00023							

By nature of the design methodology described above, the proposed grading does not consistently fall within the design ranges listed in **Table 6**. The actual alignment and profile parameters achieved by blending existing and proposed conditions are shown in **Table 7**. In cases where the proposed alignment and profile parameters cannot meet the design criteria, more robust stabilization measures will be employed to maintain geomorphic stability.

Table 7: Proposed 5A Alignment and Profile Channel Parameters

Radius of Curvature Range (feet)	Pool-to-Pool Spacing Range (feet)	Curve Length Range (feet)	Riffle Length Range (feet)	Pool Length Range (feet)	Riffle to Pool Ratio
88-2525	146-1327	21-681	36-701	54-596	46-54

5. River Channel and Riverbank Restoration Design

This section describes the restoration design criteria for the river channel and riverbanks. Restoration objectives and methods are described in the Reach 5A Restoration Plan and NCD-related Design Drawings are provided in Attachment D hereto.

Restoration planning for the river and riverbanks is driven by the Performance Standards in Section II.B.1.c.(1) of the Revised Final Permit. Baseline physical and ecological conditions documented in the Revised BRA Report provide the reference point for design (e.g., channel form and bed conditions,

riverbank habitat characteristics and features). Restoration will be implemented in coordination with remediation to support phased disturbance and progressive recovery and to reduce the magnitude and duration of habitat disruption to the extent feasible and consistent with remediation requirements.

5.1 River Channel Restoration

The design and restoration of the river channel and the riverbanks are closely tied together. This section describes the river channel restoration, focusing on the geomorphology of both the channel and banks. This section is virtually identical to Section 8.5.1 (through 8.5.1.3) of the Final RD/RA Work Plan, but is repeated here in order to be part of the Restoration Plan. Section 5.2 (Riverbank Stabilization/Restoration Design) provides additional details on the stabilization techniques used to restore the banks following remediation activities.

5.1.1 River Channel Design Goals

The primary goal of the river channel restoration design is to provide a stable channel profile (riffle/pool sequence) and to reduce excess bank erosion without eliminating the channel's natural sediment supply or degrading riverine habitat. The Revised Final Permit established criteria for the identification of the banks in Reach 5A that require remediation due to both their assessed erosion potential and their PCB concentration. Although overall river stability is a desirable outcome, the priority of the restoration design is to reduce erosion on the remediated banks identified based on the Revised Final Permit criteria, while banks not identified for remediation remain largely undisturbed except where modifications are required to maintain stability on the remediated banks. Bank grading and stabilization techniques were also applied in areas where river stability is a threat to infrastructure or property; however, not every bank that is erosional was modified as part of the design. Additional design goals for the river channel restoration include the following:

- Grade remediation banks to a stable dimension;
- Restore a stable channel bed morphology through the design reach that reduces near bank stress;
- Minimize channel modifications to ones that are necessary for erosion reduction in the bed and banks;
- Apply channel and bank structures to areas that require more robust stabilization in addition to grading;
- Stabilize areas where existing infrastructure encroaches on the river channel; and
- Ensure that any channel modifications do not create instability elsewhere in the river.

5.1.2 River Channel Design Methodology

The application of an NCD approach is required by the Revised Final Permit to achieve channel stability. This type of approach will ultimately make the river more geomorphologically functional and resilient, and will also improve aquatic habitat diversity by restoring key physical features such as riffles, pools, glides, and runs. NCD also aims to ensure that sediment transport is maintained through a river system and recognizes that some amount of erosion in river systems is essential for overall watershed stability. While excess sedimentation in rivers can cause the river to aggrade and erode at an unmanageable rate, traditional engineering solutions often over-harden rivers, preventing any sediment from being entrained in the water column and increasing stream power through hardened reaches, which often causes degradation and erosion downstream. NCD aims to achieve sediment equilibrium so that neither aggradation nor degradation occurs in the river.

Using NCD principles, practitioners apply stable river measurements and ratios to the dimension, pattern, and profile of a degraded river system based on several known river and valley types identified by

Rosgen (1996). These measurements are typically scaled according to bankfull dimensions and include parameters such as riffle length, riffle width-depth ratio, pool-to-pool spacing, pool depth and width, meander length and width, channel sinuosity, and radius of curvature.

There are also a variety of approaches that may be used to restore degraded river systems. Rosgen (1998) separates restoration approaches for incised streams into four “Priorities.” These approaches are summarized as follows.

- **Priority 1**: An incised stream is relocated at a higher elevation on the adjacent floodplain; this is the most stable approach to restoration for long-term stability but requires the greatest level of intervention.
- **Priority 2:** Channel incision is decreased by a combination of raising the bed and excavating a lower floodplain, creating reduced shear stresses and increased floodplain connectivity.
- **Priority 3**: A lower floodplain is established, but the channel bed elevation stays the same; this provides limited relief during higher flood flows and is typically reserved for projects that are laterally constrained or in very steep V-shaped valleys.
- **Priority 4**: The stream banks are stabilized in place, but none of the channel dimension, pattern, or profile is altered; this approach requires minimal earthwork and tree clearing but can incur additional maintenance.

For the Housatonic Reach 5A restoration design, a mix between the Priority 2 and Priority 4 approaches was taken. The channel alignment is mostly unaltered due to the size of the river and the difficulty associated with rerouting channel flow; however, the profile has been modified to increase stable riffle habitat in sections of the alignment that are already relatively straight. The overall slope of the existing channel does not change but fill material was added in some locations to allow riffle features to achieve a stable width and depth. Modifications that were made to the channel in accordance with this design methodology are listed below.

Alignment

- Moderate shifts in the location of the channel thalweg were made away from tall banks and valley edges where a stable channel width has not been achieved.
- Existing radii of curvature were smoothed in areas where feasible.
- Stable pool-to-pool spacing was applied based on reference data in areas where required bank modifications allow.

Cross-Section

- A partial bankfull cross-section was applied based on reference dimensions to banks that require remediation; in most areas, only one bank and the channel bottom were modified.
- A relatively consistent channel width was maintained and “pinch points” in the channel where flows below bankfull become constricted were reduced.
- Grading of remediation banks was smoothed into existing banks to reduce any sharp transitions.

- Side bar features were graded in areas where remediation is required on the inside of a bend.
- Inflow elevations of all tributaries were maintained.[2]

Profile

- A consistent bankfull slope was applied for each of the five defined sub-reaches in Reach 5A (described in Section 3.2 through 3.6 above).
- Reference facet slopes were applied to riffles, runs, pools, and glides with some exceptions where mimicking existing features is more beneficial for the design.
- The number of existing riffles was increased, mimicking a more stable C-type channel where riffle-pool habitat ratios are closer to 50-50.
- The proposed profile was simplified for ease of constructability and increased stability, removing micro-pools from the design.
- Modifications were made to ensure that pools are located in the bends and riffles in straight sections of the channel.

This design approach improves existing geomorphic conditions while minimizing the impact of earthwork on the existing river channel and banks.

5.1.3 River Channel Design Constraints

Several constraints impact the proposed design, including existing infrastructure, valley conditions, and overall constructability. In several locations along Reach 5A, the existing stream has eroded to the maximum extent that the valley width will allow. In locations where a remediation bank abuts the edge of the valley, it is not possible to grade the valley at a stable slope due to the large earthwork volume and area of disturbance that such an approach would require. In these locations, the design shifted the channel slightly away from the edge of the valley until a stable bankfull width was achieved. This sometimes required placement of a moderate amount of fill against the edge of the valley to establish a stable floodplain bench on the side of the channel.

There are also some locations within Reach 5A where bank grading is not recommended due to the presence of existing infrastructure such as stormwater outfalls, utility crossings, bridge abutments, and adjacent private property (see Section 8.1.1.3 of the Final RD/RA Work Plan). Existing floodplain habitat features such as vernal pools also limit the extent of bank grading done in some locations. In locations where extensive bank grading is not possible to achieve channel stability, supplementary bank structures and in-channel structures have been applied in the design to reduce erosion. In addition, improvements to the channel profile in some of these areas (described above) will benefit long-term stability.

5.2 Riverbank Stabilization/Restoration Design

As previously stated, the application of NCD principles means that the design and restoration of the riverbanks is closely linked to the design and restoration of the main river channel. Accordingly, this section provides a summary of riverbank grading and other riverbank stabilization measures that have been applied to riverbanks in Reach 5A. This section is identical to Section 9.5 of the Final RD/RA Work Plan, but is repeated here in order to be part of the Restoration Plan.

[2] One exception to this was for the Intermittent Side Channel, where the hydraulic connection to the main river channel will be eliminated by re-building the bank at the three locations where this side channel connects to the river, as described in the Final RD/RA Work Plan.

5.2.1 Riverbank Grading

The main goal of the riverbank grading is to reduce bank erosion and provide a stable bank following remedial activities. In general, riverbanks grading was specified at nearly a 3H:1V slope, with some exceptions in localized areas where that type of grading is not practicable. For example, in locations where a remediation bank abuts the edge of the valley, it is not practical to grade the valley at a stable slope due to the large earthwork volume and area of disturbance that approach would require. These areas were evaluated on a case-by-case basis and bank grading was developed based upon the final proposed stabilization treatment. The bank grading applied to riverbanks between Stations 0+00 and 48+00 is shown on Drawings SR1101 through SR1110 in Attachment D.

5.2.2 Riverbank Stabilization Toolbox Development

A critical component of the Reach 5A riverbank restoration design is to determine riverbank stabilization measures for banks that require remediation. A riverbank stabilization toolbox was developed to help guide and streamline the process of selecting a stabilization option for a particular bank. The toolbox encompassed a decision tree which was fed information about each bank location and output the ideal stabilization technique based on the results from the decision points. The outcome of the riverbank stabilization toolbox was used as a starting point, but ultimately the final stabilization treatment that was selected for each bank relied in part on engineering judgement. The following section describes the process for developing the toolbox and how the results were utilized to select the proposed bank stabilization treatment.

To build the toolbox, a list of applicable riverbank stabilization measures was developed based on industry standard NCD techniques. Riverbank stabilization measures were ranked from “softest,” which would require the least intervention to the bank or channel, to “hardest,” which would require the most intervention. The following list of potential riverbank stabilization techniques was developed as the basis for the toolbox, listed in order from those requiring least to most intervention:

- Coir Matting;
- Coir Matting with Rock Toe;
- Brush Mattress;
- Root Wads;
- Lunkers;
- J-hooks and Cross-vanes;
- Bendway Weir;
- Bioengineered Bags;
- Toe Wood; and
- Riprap.

Once this list of techniques was determined, the parameters to be used at each step of the decision tree were identified. The following general parameters were quantified or characterized for each remediation bank:

- **Alignment parameters:** The existing channel alignment of Reach 5A will be minimally altered for proposed conditions. The alignment parameters that were quantified included radius of curvature, delta angle, and chord length. For straight sections of the channel, these values were zero. The location of the bank in relation to the meander, which was either inside or outside the meander bend, was identified.

- **Erodibility assessment:** Although work to regrade and stabilize banks is being performed, the BEHI scores provided information on areas that are susceptible to erosion based on the current alignment of the channel. It is likely that many banks will continue to experience similar shear stresses even after the grading work is completed, although some forces will be alleviated by adjusting the thalweg (as described in Section 7.5.1.2). Therefore, the erodibility assessment scores were important to understanding the erodibility of each bank and the protection that would be required. Banks with higher BEHI scores tend to require harder armoring riverbank stabilization techniques.
- **Profile parameters**: The profile parameters were defined by the proximity of a bank to a riffle or pool or transitional features such as a run or glide. This was based on the proposed profile, since the locations of some riffles and pools were adjusted in the design to help stabilize conditions within Reach 5A where possible. Certain techniques require a minimum or maximum water depth to be installed properly, so characterizing the profile adjacent to the remediation bank was crucial for selecting the optimal stabilization measure.
- **Adjacent floodplain work**: Adjacent floodplain remediation was also considered within the decision tree to minimize excessive material removal where possible. Certain stabilization techniques require more excavation than others, so characterizing excavation that was already planned to occur adjacent to a remediation location helped inform the decision tree as to whether a technique could work in conjunction with this excavation.

Each parameter also has a quantitative cut-off or binary statement to inform the decision point whether to branch off along decision A or B. An example of a quantitative cut-off for the meander parameters would be whether a radius of curvature for a bend section is greater than 250 feet. If that is true, then the decision tree would branch towards a lower intervention technique. However, if the radius of curvature is greater than or equal to 250 feet, then the process would branch towards a higher intervention technique. An example of a binary statement is whether adjacent floodplain work is required at given bank location. If this is true, the decision tree would branch towards a higher intervention technique since excavation for a stabilization technique would be more desirable if floodplain excavation is already occurring. If the statement is false, the decision tree would branch towards a lower intervention technique. The final decision tree was developed to utilize a remediation bank input and accompanying data, feed it through the decision points, and select the best riverbank stabilization technique.

The following parameters were used at various points in the decision tree:

- Straight vs Bend:
  - Straight: Radius > 500 feet or Delta Angle < 25; and
  - Bend: Radius < 500 feet and Delta Angle > 25.
- Low vs High Erodibility:
  - Low: BEHI Moderate or Lower; and
  - High: BEHI High or Greater.
- Gentle vs Tight Curve:
  - Gentle: Radius > 250 feet or Delta Angle < 90; and
  - Tight: Radius ≤ 250 feet or Delta Angle ≥ 90.

- Short vs Long Bend:
  - Short: Chord Length < 100 feet; and
  - Long: Chord Length ≥ 100 feet.

The initial results of the toolbox were assessed and adjustments to the parameters were made to reach the current configuration of the decision tree. Additionally, adjustments were made to couple techniques that would require similar amounts of intervention but lend themselves to different priorities. For example, root wads and lunkers were coupled since they similarly protect the toe of the bank. Lunkers require specialized installation, while root wads are sometimes difficult to source. Therefore, alternatives were proposed and further refinements beyond the toolbox results were made where warranted, as discussed in the next paragraph. **Figure 3** provides an illustration of the final decision tree.

Once the toolbox results were in a place where no further decision tree adjustments could be reasonably made, refinements of selected bank treatments shifted to applying engineering judgment. One large component of this was grouping stabilization techniques along a continuous remediation reach for constructability (given that the toolbox does not account for constructability so identified bank treatments can vary over short distances). Additional considerations were also applied to refinement of the toolbox results, including:

- Consideration of adjacent infrastructure and proximity to residential areas to assess whether a harder armoring technique would be required;
- Review of proposed grading to determine whether a selected bank treatment technique was constructable; and
- Consideration of the availability of certain materials such as logs and root wads.

The finalized riverbank stabilization results are presented in the Design Drawings provided in Attachment D. Section 5.2.3 below provides additional details related to the various riverbank stabilization treatments that were considered.

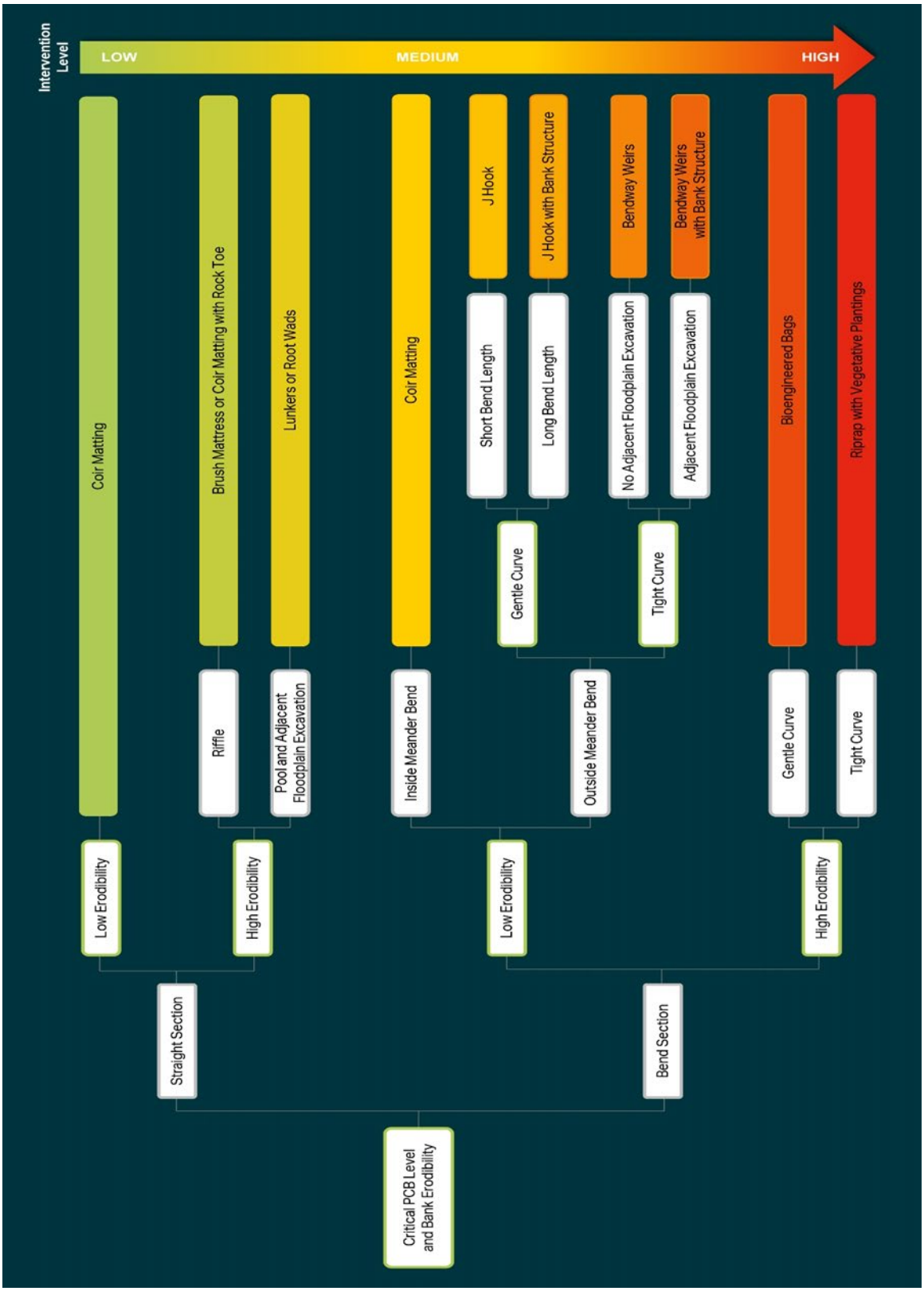

Figure 3: Bank Stabilization Decision Tree

5.2.3 Riverbank Stabilization Treatments

Bioengineering techniques include use of natural materials and riparian vegetation as a strategy to control bank erosion and promote longer-term stability of the river channel and banks, while attempting to minimize the adverse effects of stabilization when possible. Such techniques can be grouped into two basic categories: (1) those that reduce the force of water against a riverbank, and (2) those that increase a bank's resistance to the force of water. Both categories of bioengineering techniques employ riparian vegetation as a means of erosion control. Vegetative growth reduces local velocities against the bank, thereby reducing near bank shear stress. Over time, as the vegetation grows and matures, the hard mass provided by plant roots can provide protection from erosion and collapse and increase internal bank strength (Rosgen, 2006; Wynn *et al*., 2004).

Many of the techniques that are designed to reduce the force of water against a riverbank do so by directing flow away from banks. The structures used to direct flow away from a bank, such as vanes and bank spurs, are made of materials such as logs or native rock. Other examples of techniques to reduce the force of water against a bank include reshaping a bank to reduce its angle or constructing a bench which can reduce the shear stress affecting the lower portion of the bank.

Techniques designed to increase a bank's resistance to the force of water function in much the same way as traditional hardening techniques, such as use of gabions, riprap, and concrete, by "armoring" a riverbank with materials that are more resistant to the force of water than native soil. Natural materials, such as coir fiber, provide flow resistance while also serving as a substrate for plant growth, or incorporate interstitial space to provide ground contact for rooting plants.

In areas that are subject to greater instability where shear stress and channel velocities are higher, bioengineering techniques are unlikely to succeed (at least by themselves), and thus traditional hardening methods (e.g., use of riprap) are necessary to prevent bank soil erosion. However, bioengineering techniques and traditional hardening methods are not exclusive of each other. In areas where shear stress and channel velocities are relatively high, bioengineering can be used in conjunction with traditional hardening methods to provide the most effective strategy for bank stability.

In some cases, bank stabilization methods are applied to only discrete portions of the banks along a given stretch of a river, which reduces the adverse ecological impacts compared to stabilizing the banks throughout the entire reach. This partial or intermittent bank stabilization approach focuses on the areas with the greatest need for stabilization. Since many bioengineering techniques are specifically designed to reduce flow velocities, dissipate energy, and reduce erosional forces along the banks on which they are applied rather than simply deflecting the river's energy upstream or downstream, they are consistent with intermittent bank stabilization because they mean that the stabilization design for particular sections of riverbank can minimize energy displacement that could affect nearby riverbank segments.

The various bank stabilization techniques listed in Section 5.2.2 that have been considered for use on the banks in Reach 5A are described in more detail below. These descriptions include a general description of the types of conditions typically present in Reach 5A for which each technique is applicable.

5.2.3.1 Coir Matting

Coir fabric or coir matting is erosion control matting constructed of coconut fibers. The matting protects the banks while vegetation is established and biodegrades in about four to six years. Coir fabric is also used to construct a variety of other bioengineering systems, including pre-vegetated mats, pre-planted coir pillows, and vegetated geogrid. Coir matting is also used in conjunction with other techniques such as vanes and weirs to protect the bank between instream structures.

Coir matting is applicable in a variety of conditions in Reach 5A to protect banks while vegetation becomes established. This treatment can be used alone in depositional areas or on banks with low near-bank shear stress. This includes the inside of mender bends, straight reaches where the thalweg is in the center of the channel, or downstream of stable point bars. In such conditions, the bank will be graded to a low slope of 3:1 or less, covered in coir matting, and replanted with herbaceous and shrub vegetation.

Coir matting can also be used on the upper bank slopes (above bankfull elevation) on banks undergoing stabilization with riprap or compartmentalized placed fill.

5.2.3.2 Coir Matting with Rock Toe

Coir matting with rock toe is a stabilization technique that includes a bank of rock (stones) along the toe of the bank and coir matting along the upper portion of the bank (VDEC, 2022). This method provides more robust stabilization than utilizing coir matting alone by providing hard armoring at the normal water depth. The rock toe stabilizes the base of the bank and prevents erosion, while the coir matting protects the upper portion of the bank and allows vegetation to establish.

Coir matting with rock toe is typically installed along moderate to highly erodible banks that are adjacent to riffles or transitional features, such as runs or glides. They are also useful for areas where slightly more armoring is desired compared to simply applying coir matting along the entirety of the bank. Similar to the coir matting technique, where the core matting technique is used, slopes will be graded at 3:1 or less, covered in coir matting, and replanted with vegetation. The rock toe will be installed with the coir matting keyed in at the rock layer.

5.2.3.3 Brush Mattresses

Brush mattresses, also referred to as live brush mats or brush matting, is composed of live fascines and branch cuttings that cover a streambank and are secured with dead stout stakes and live stakes (NDEP, 2023). Brush mattresses protect the bank as vegetation takes time to establish, providing an enhanced stabilization technique compared to planting vegetation along a riverbank alone. In such cases, the bank will be graded back to a slope no steeper than 2:1, with 3:1 or less preferred. The live brush mats will layered perpendicular to flow along the bank and stakes will be driven into the bank at a specified spacing. Vegetative plantings can also be used in conjunction with the brush mattress, but other stabilization measures can be implemented as well, such as in-stream structures or toe protection.

Brush mattresses are typically installed along moderate to highly erodible banks adjacent to riffle features or inside meander bends, where sloping the bank at 3:1 is feasible or where banks are already at a slope of 2:1 or less.

5.2.3.4 Root Wads

Root wad revetments are composed of “root wads,” which are downed trees that are placed along a riverbank with the root mass (root ball) exposed towards the flow, and the stem or bole of the tree buried in the bank. Generally, the root system of the trees used as root wads is at least three feet in diameter. Root wads are often placed in clusters along the outer meander bends of a river to form a protective layer against high shear stress impacting the riverbanks.

Root wads are often used in conjunction with logs or boulders to create an integrated revetment, in which the root wad tree is laid on top of a footer log, to provide stability and achieve the desired angle that is necessary to maximize resistance to flow. Boulders are often placed between the root wads to minimize erosion or scour around the root wad, and to anchor the root wads to increase their tolerance to shear stress. Since root wad revetments have the potential for scour around the structure, particularly on the upper bank above the root wad, the placement of the root wad clusters is usually accompanied by vegetative plantings, brush layers, or matting to help stabilize the upper bank (Harman, 2004). Root wads is also a method of adding woody debris to the system for habitat.

When properly installed and given measures to minimize scour around the structure, root wads can provide a high level of stability in or near high stress bends. Root wads are typically installed along the outside of a meander bend, adjacent to a pool feature. For Reach 5A, they will be placed downstream of a J-hook on banks where the in-stream structure alone cannot fully protect the bank from erosional forces and additional stabilization is needed. These banks are characterized as moderately to highly erodible and are along long, gradual meander bends.

5.2.3.5 Lunkers

"Lunkers" stands for "Little Underwater Neighborhood Keepers Encompassing Rheotactic Salmonids" (Altschuld *et al*., 2017). A lunker is a box or crib structure constructed of logs that is anchored to the toe of the bank below water surface to provide habitat for aquatic life, particularly fish, and stabilize the toe of the bank. Lunkers can be used in conjunction with other stabilization techniques, such as installing coir matting or brush mattress along the upper portion of a streambank.

Because of the water depth requirements, lunkers are typically installed at deeper portions of the stream, such as pool features. Lunkers also require excavation along the toe of the bank to properly anchor the structure, so they are typically installed in areas where significant excavation may occur. These are highly specialized structures, so planned installation in Reach 5A is limited to areas where aquatic habitat is a priority.

5.2.3.6 J-Hooks and Cross Vanes

Both J-hooks and cross vanes are in-stream structures that deflect near-bank erosional forces away from unstable riverbanks. Differing from a single arm vane, a J-hook extends beyond the end of the vane at an angle towards the downstream direction to create a "J-hook" shape (Hickman and Thompson, 2016a). A log J-hook involves placement of a log with a root wad anchored into the bank, facing upstream, and angled on a downward slope from bankfull elevation at the bank to the channel bed elevation at the end of the log. A footer consisting of a second log or boulders is placed beneath the log. Filter fabric is often placed along the footer, and the area between the log and the bank is backfilled to prevent undercutting of the vane. A rock J-hook is of similar geometry but constructed of large boulder sized rock.

A cross vane is similar to a J-hook but, in addition to an arm that ties into the outer bend of the channel, it also has one that ties into the inside of the bend, providing protection on both banks and forming a more robust grade control feature in intermittent locations along the channel's profile. Like J-hooks, cross-vanes can consist of either logs or rocks.

J-hooks and cross vanes are typically installed at the upstream end of an outer meander bend or other unstable area of moderate to high near bank stress to deflect flow away from the bank and dissipate energy. They are installed upstream of a pool feature at a run. Where grading is proposed along the bank that the J-hook or cross vane is protecting, coir matting will be applied to protect and revegetate the bank. For longer meander bends, or along banks that require additional protection, these structures will be used in conjunction with root wads or a series of bendway weirs. For the most part, log-based and rock-based J-hooks and cross vanes can be used interchangeably. There are some circumstances in which it is difficult to install a log-based structure such as when the water is too deep or the bank is too low to adequately bury and anchor the log. There may be other situations where banks are too high or steep to be suitable for use of log-based structures. In these instances, rock-based J-hooks or cross vanes may be used rather than log-based structures.

5.2.3.7 Bendway Weir

Similar to a J-hook and cross vane, a bendway weir is an in-stream structure that deflects flow away from the riverbank and can be constructed out of logs or rocks. This structure is a single arm vane that linearly extends from the toe of the bank towards the thalweg of the stream (Hickman and Thompson, 2016b). A bendway weir is angled upstream into flow at approximately a 70 degree angle. Water flowing over the structure is redirected away from the bank and slowed down, promoting aquatic diversity and complexity within a downstream pool (Derrick, 2014).

Benway weirs are typically installed along an outer meander bend and can be installed in series for longer bend lengths. While J-hooks are typically constructed upstream of a pool feature along a run, bendway weirs can be constructed in series along the outside of a bend to continuously redirect flow throughout the meander feature. Bendway weirs can be used in conjunction with other riverbank stabilization techniques to provide additional erosion protection. Where riverbank grading is proposed, coir matting will be applied to protect the bank adjacent to the bendway weir structures. Considerations for the use of log versus rock are similar to those for J-hooks and cross vanes.

5.2.3.8 Bioengineered Bags

Use of bioengineered bags or compartmentalized fill consists of placing filled bags or tubes of organic material and stone on the riverbank to armor slopes. Envirolok™ is a trade name for a particular brand of bag. The bags are typically built into a wall unit using either straps or a locking spike to create a stable surface. The bags are composed of a synthetic material that is filled with a planting medium. Native plants are planted between the layers or lifts of bags to promote vegetation growth. The bags break down under UV exposure and can last from 10 years to over 50 years depending upon the amount of exposure (Envirolok, 2026).

Compartmentalized fill can be used on moderately steep banks or in areas of high to extreme shear stress. The banks undergoing such treatment are graded to a 2:1 slope or less, with bank soil removal as necessary. The compartmentalized fill is placed from the toe of the bank to bankfull elevation. Above bankfull, the bank is stabilized with a vegetative technique, including planting of herbaceous and shrub species. For Reach 5A, due to the specialization of this stabilization technique, proposed installation of bioengineered bags is limited to areas where riverbank grading of 3:1 or less is not feasible due to the amount of cut or fill that would be required or proximity of the bank to adjacent infrastructure.

5.2.3.9 Toe Wood

A toe wood structure incorporates native woody material into a submerged, undercut bank to replicate natural stable riverbank and to add flow resistance for bank protection. The toe material is composed of root wads that are cantilevered over foundation logs to provide an undercut bank for instream and overhead cover for aquatic habitat. The logs are placed on the lower one-half of the bank to ensure that the wood is submerged throughout the year to prevent wood deterioration. Woody materials are placed over and between the toe logs. Approximately 10 to 20 percent of the log and debris lengths are exposed to flow forces; the remaining lengths are buried deep and counter-buttressed with fill and vegetation to avoid buoyancy factor ensuring that the wood will remain intact throughout all flows including floods. Backfill is placed over the top of the toe material and planted with riparian vegetation up to bankfull stage.

Toe wood is typically installed along the outside of meander bends in reaches with deep pools so the toe wood can remain submerged. Toe wood has limited use in Reach 5A as it typically requires extensive excavation to the bank for installation and placement of the footer logs.

5.2.3.10 Riprap

Stone has long been used to provide immediate and permanent riverbank protection. One use of stone is riprap which consists of large angular rocks placed on the bank to reduce bank shear stress and erosion. Riprap is one of the most effective measures at the toe of a slope or unstable bank for preventing erosion. A primary advantage of riprap over vegetation is its immediate effectiveness with little to no establishment period. Riprap is typically placed on banks at a 2:1 slope but may be used on steeper bank slopes of up to 1.5:1. Stone size, shape, gradation, and density are all important design considerations.

In some situations, joint planting is combined with riprap to provide some vegetation. Joint planting refers to the insertion of plugs and/or live stakes between the rocks to encourage the growth of riparian vegetation. The planting of cuttings in riprap helps to provide longer-term stability once the vegetation becomes established.

The Revised Final Permit requires that riverbank reconstruction follow a hierarchy of approaches, with placement of riprap being the least preferred in that hierarchy. Therefore, in Reach 5A, riprap will be used only on banks that are under high to extreme near-bank shear stress. Also, because it is the hardest armoring technique, riprap will be used in limited areas where additional protection is required for adjacent infrastructure or utility crossings. In such areas, the bank will graded to the selected slope (with bank soil removal as necessary) and riprap placed from the toe of the bank to a maximum of bankfull elevation. Above bankfull elevation, other applicable bank treatments will be used, such as coir matting and joint plantings (where appropriate), to revegetate the banks with herbaceous and shrub vegetation.

5.2.4 Riverbank Stabilization Plan

Design Drawings detailing the locations and extents of the proposed riverbank stabilization structures in the first subreach (i.e., river Stations 0+00 to 48+00) are provided in Attachment D. A summary of those stabilization techniques is provided in **Table 8** below. Note that some of the possible stabilization techniques described above have not been used in this first subreach, but may be utilized in further downstream subreaches.

Table 8
Subreach 1 Bank Stabilization Techniques Summary

Stabilization Technique	Proposed River Stations Applied	Number of Separate Bank Applications	Total Length of Technique Applied (Linear Feet)	Length of Bank Protected by Technique (Linear Feet)
Coir matting	LB 0+00 – 4+94, LB 6+49 - 7+44, RB 3+02 – 4+20, RB 4+29 – 9+31, LB 8+44 – 12+41, LB 14+00 – 22+27, RB 13+50 – 18+14, RB 23+05 – 23+86, LB 23+46 – 25+77, RB 23+87 – 25+57, RB 26+36 – 33+51, LB 27+67 – 45+39, RB 38+60 – 39+51	13	5,957	5,957
Brush mattresses	LB 1+25 - 2+49, LB 9+47 - 10+98, LB 15+16 – 16+89, RB 22+82 – 23+87, LB 38+11 – 39+80,	5	722	722
J-hooks	RB 23+85, LB 28+20	2	Not Applicable	291*
Bendway weirs	RB 3+06, LB 8+87, RB 12+13, LB 14+66, LB 31+66,	5	Not Applicable	207*
Cross vanes	CH 6+97	1	Not Applicable	330*
Toe wood	RB 3+73 - 4+16, RB 4+35 – 4+84, LB 7+44 – 8+19	3	167	167
Riprap (above toe wood)	LB 7+39-8+44	1	105	105

Notes:
LB = Left Bank
RB = Right Bank
CH = In-Channel
*The length of bank protected is calculated based on the arm length of the structure and protects 1x the arm length upstream and 2x the arm length downstream of the structure.

In addition to the bank stabilization techniques listed above, the riverbanks will benefit from stabilization of riffle features in appropriate locations for the alignment. A list of existing and proposed riffles within the first subreach is provided in **Table 9** below. The existing and proposed stations listed are based on the existing and proposed alignments respectively. Existing riffles are listed in the same row as their proposed counterparts except in cases where a new riffle was added or an old riffle was removed.

Table 9
Subreach 1 Riffle Stabilization Summary

Existing Riffle Start Station	Existing Riffle End Station	Existing Riffle Length (Linear Feet)	Existing Riffle Notes	Proposed Riffle Start Station	Proposed Riffle End Station	Proposed Riffle Length (Linear Feet)	Proposed Riffle Notes
EX 0+12	EX 0+89	77	Good	PR 0+00	PR 1+25	125	Lengthened
				PR 5+81	PR 6+97	116	New
				PR 11+00	PR 11+91	91	New
EX 14+81	EX 15+51	70	In a Bend	Not Applicable	Not Applicable	Not Applicable	Replaced with Compound Bend Feature
EX 18+27	EX 22+12	385	Uncentered Thalweg	PR 17+59	PR 21+69	410	Shifted Slightly Upstream
EX 28+44	EX 29+18	74	Transverse	PR 26+65	PR 28+20	155	Shifted Upstream and Lengthened
EX 34+65	EX 36+35	170	Uncentered Thalweg	PR 34+14	PR 35+74	160	Similar Extents
EX 39+27	EX 39+62	35	Transverse, In a Bend	Not Applicable	Not Applicable	Not Applicable	Replaced with Compound Bend Feature
EX 41+10	EX 43+54	244	Extends into Bend with Shear Banks	PR 40+51	PR 42+08	157	Moved Riffle Upstream and Smoothed the Bend
EX 48+57	EX 52+57	400	Uncentered Thalweg	PR 47+00	PR 51+70	470	Extended start of Riffle Upstream of Bridge
Total Existing Riffle Length (Linear Feet)		1,455		Total Proposed Riffle Length (Linear Feet)		1,684	

Notes:

EX = Existing Riffle Start/End Station
PR = Proposed Riffle Start/End Station

6. References

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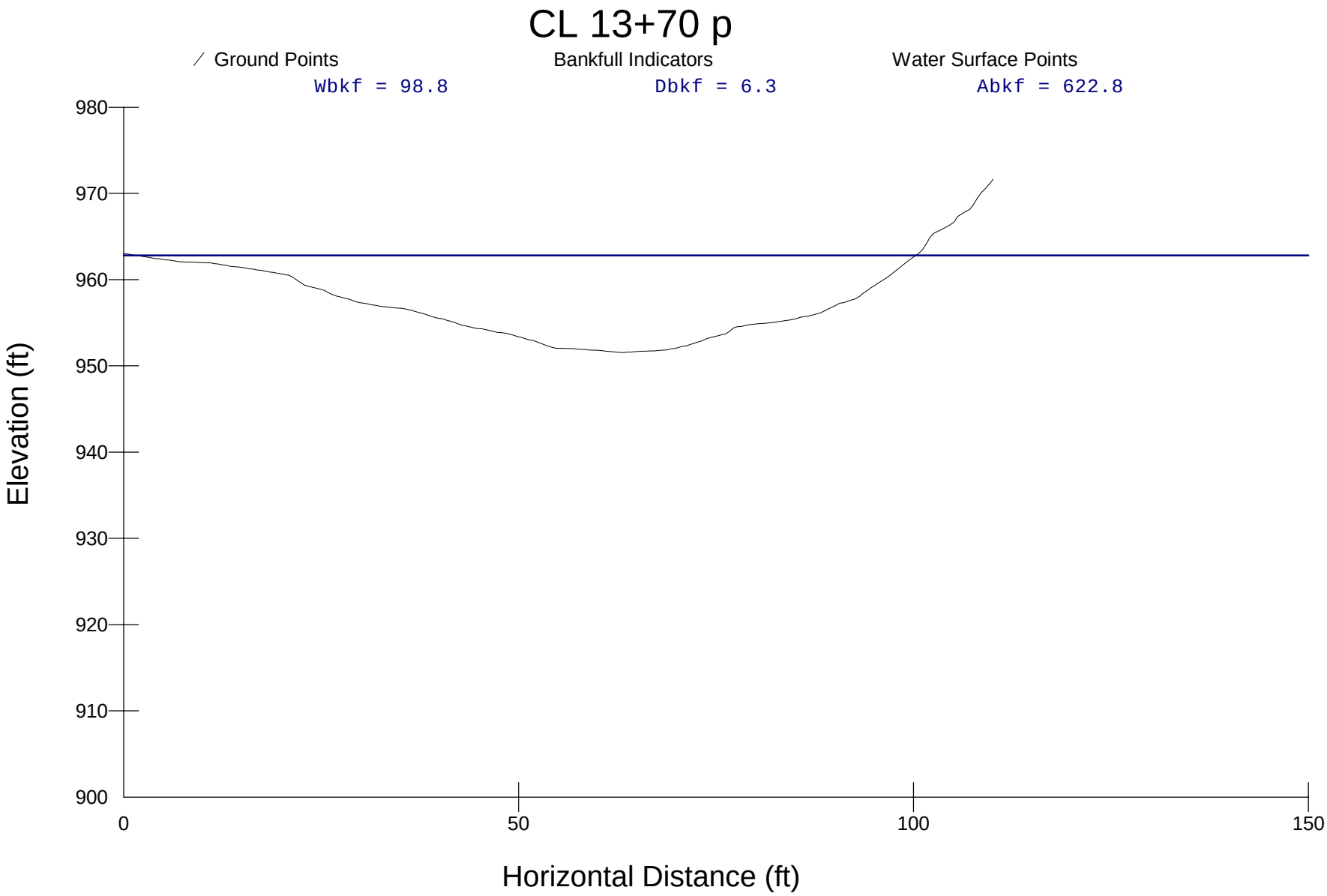
Attachment A Cross-Section Data and Forms


CL 13+70 p
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 98.8
Dbkf = 6.3
Abkf = 622.8
980
970
960
950
940
930
920
910
900
Elevation (ft)
0
50
100
150
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-1
Cross Section Name: CL 13+70 p
Survey Date: 01/25/2026

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	963	
0.5	0	962.97	
1	0	962.91	
1.49	0	962.84	BKF
1.99	0	962.76	
2.49	0	962.67	
2.99	0	962.6	
3.49	0	962.54	
3.98	0	962.47	
4.48	0	962.41	
4.98	0	962.36	
5.48	0	962.29	
5.98	0	962.23	
6.48	0	962.16	
6.97	0	962.11	
7.47	0	962.05	
7.97	0	962.02	
8.47	0	962.01	
8.97	0	962.01	
9.46	0	962	
9.96	0	961.99	
10.46	0	961.97	
10.96	0	961.94	
11.46	0	961.87	
11.95	0	961.79	
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13.45	0	961.57	
13.95	0	961.51	
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16.94	0	961.13	
17.43	0	961.07	
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18.43	0	960.91	
18.93	0	960.84	
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37.86	0	956.06	
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52.3	0	952.82	
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56.29	0	952.02	
56.79	0	952	

57.28	0	951.97
57.78	0	951.94
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64.76	0	951.65
65.25	0	951.67
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66.25	0	951.72
66.75	0	951.75
67.25	0	951.77
67.74	0	951.8
68.24	0	951.83
68.74	0	951.88
69.24	0	951.96
69.74	0	952.02
70.24	0	952.1
70.73	0	952.26
71.23	0	952.34
71.73	0	952.47
72.23	0	952.63
72.73	0	952.76
73.22	0	952.91
73.72	0	953.13
74.22	0	953.28
74.72	0	953.39
75.22	0	953.49
75.71	0	953.6
76.21	0	953.7
76.71	0	954.02
77.21	0	954.4
77.71	0	954.53
78.21	0	954.58
78.7	0	954.7
79.2	0	954.77
79.7	0	954.84
80.2	0	954.89
80.7	0	954.92
81.19	0	954.95
81.69	0	954.99
82.19	0	955.03
82.69	0	955.08
83.19	0	955.15
83.68	0	955.22
84.18	0	955.31
84.68	0	955.38
85.18	0	955.49
85.68	0	955.63
86.17	0	955.71
86.67	0	955.8
87.17	0	955.9
87.67	0	956.03
88.17	0	956.16
88.67	0	956.38
89.16	0	956.58
89.66	0	956.79

90.16	0	957.03
90.66	0	957.28
91.16	0	957.36
91.65	0	957.48
92.15	0	957.62
92.65	0	957.78
93.15	0	958.06
93.65	0	958.42
94.14	0	958.77
94.64	0	959.08
95.14	0	959.37
95.64	0	959.66
96.14	0	959.96
96.64	0	960.26
97.13	0	960.58
97.63	0	960.93
98.13	0	961.31
98.63	0	961.7
99.13	0	962.04
99.62	0	962.38
100.12	0	962.71
100.62	0	963.05
101.12	0	963.45
101.62	0	964.15
102.11	0	964.94
102.61	0	965.41
103.11	0	965.62
103.61	0	965.85
104.11	0	966.08
104.61	0	966.36
105.1	0	966.66
105.6	0	967.34
106.1	0	967.62
106.6	0	967.89
107.1	0	968.12
107.59	0	968.71
108.09	0	969.49
108.59	0	970.13
109.09	0	970.57
109.59	0	971.07
110.08	0	971.65

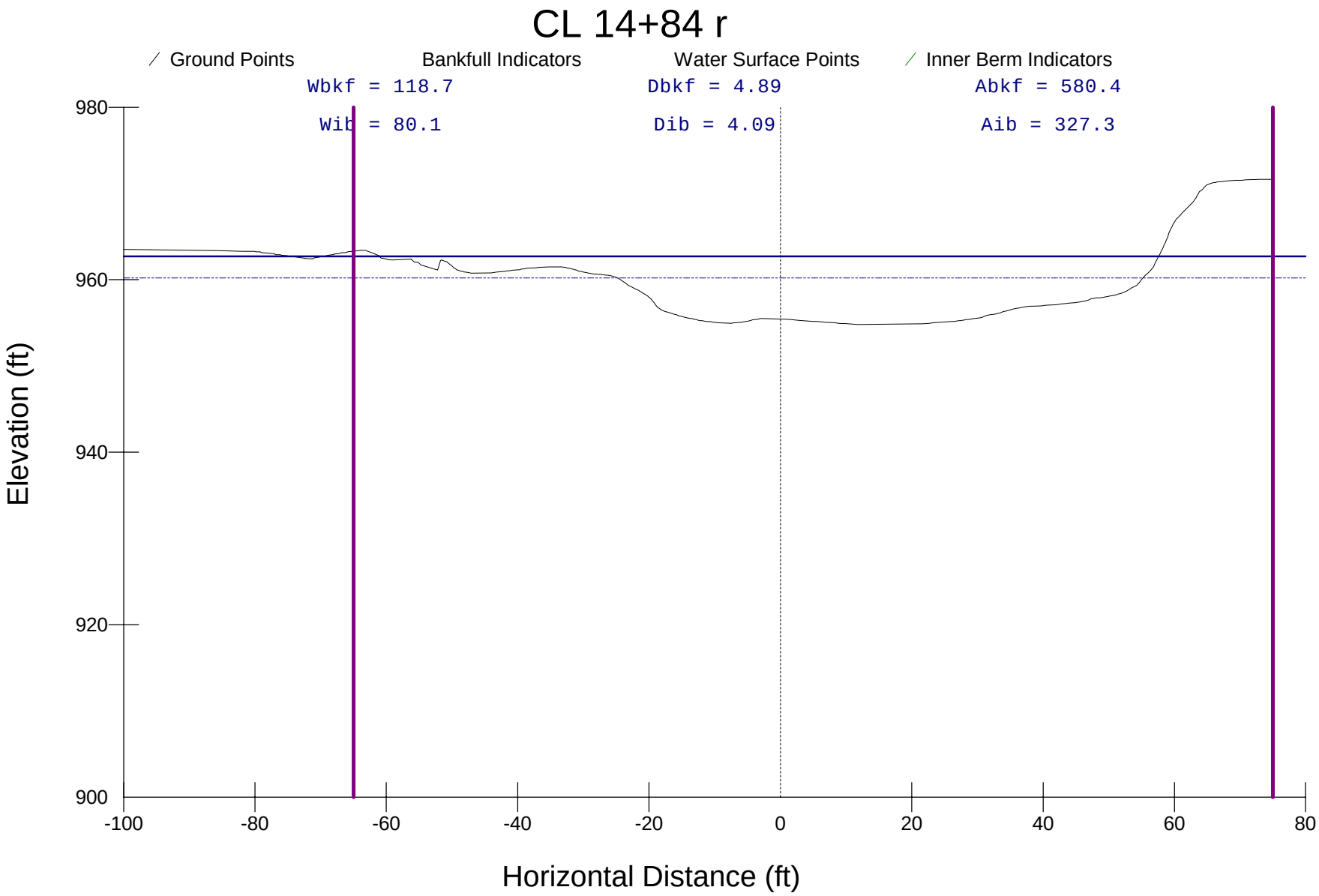
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	974.13	974.13	974.13
Bankfull Elevation (ft)	962.84	962.84	962.84
Floodprone Width (ft)	110.08	-----	-----
Bankfull Width (ft)	98.82	49.41	49.41
Entrenchment Ratio	1.11	-----	-----
Mean Depth (ft)	6.3	4.35	8.26
Maximum Depth (ft)	11.29	9.69	11.29
Width/Depth Ratio	15.69	11.36	5.98
Bankfull Area (sq ft)	622.84	214.95	407.89
Wetted Perimeter (ft)	102.72	60.34	61.77
Hydraulic Radius (ft)	6.06	3.56	6.6
Begin BKF Station	1.49	1.49	50.9
End BKF Station	100.31	50.9	100.31

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


CL 14+84 r
Ground Points
Bankfull Indicators
Water Surface Points
Inner Berm Indicators
Wbkf = 118.7
Wib = 80.1
Dbkf = 4.89
Dib = 4.09
Abkf = 580.4
Aib = 327.3
980
960
940
920
900
Elevation (ft)
-100
-80
-60
-40
-20
0
20
40
60
80
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-1
Cross Section Name: CL 14+84 r (field)
Survey Date: 11/17/2025

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
-100	0	963.53	
-85.79	0	963.38	
-81.78	0	963.31	
-80.12	0	963.29	
-79.81	0	963.23	
-79.21	0	963.21	
-79.11	0	963.19	
-78.82	0	963.11	
-78.21	0	963.09	
-77.21	0	962.99	
-77.07	0	962.96	
-76.85	0	962.91	
-76.21	0	962.88	
-76.06	0	962.85	
-75.87	0	962.81	
-75.21	0	962.78	
-75.04	0	962.75	
-74.89	0	962.71	
-74.21	0	962.68	
-73.21	0	962.57	
-72.21	0	962.46	
-71.93	0	962.44	
-71.21	0	962.42	
-70.95	0	962.52	
-70.21	0	962.61	
-69.96	0	962.67	
-69.21	0	962.74	
-68.94	0	962.81	
-68.21	0	962.88	
-67.99	0	962.94	
-67.93	0	962.96	
-67.21	0	963.01	
-67.01	0	963.07	
-66.91	0	963.1	
-66.21	0	963.15	
-66.03	0	963.2	
-65.89	0	963.24	
-65.21	0	963.29	
-63.86	0	963.41	
-63.21	0	963.4	
-62.21	0	963.11	
-61.21	0	962.82	
-61.1	0	962.74	bkf
-60.81	0	962.5	
-60.21	0	962.43	
-60.12	0	962.41	
-59.8	0	962.3	
-59.13	0	962.28	
-58.15	0	962.33	

-56.21	0	962.38
-56.18	0	962.36
-55.71	0	962.04
-55.2	0	962.02
-54.71	0	961.69
-52.17	0	961.11
-51.75	0	962.19
-51.67	0	962.29
-51.21	0	962.17
-51.16	0	962.15
-50.77	0	962.05
-50.71	0	962.03
-50.65	0	962
-50.27	0	961.75
-50.21	0	961.71
-50.14	0	961.66
-49.78	0	961.41
-49.71	0	961.36
-49.63	0	961.32
-49.29	0	961.17
-49.21	0	961.13
-49.13	0	961.11
-48.8	0	961.03
-48.71	0	961
-48.62	0	960.98
-48.31	0	960.93
-48.21	0	960.91
-48.11	0	960.89
-47.6	0	960.81
-47.09	0	960.77
-44.04	0	960.78
-43.71	0	960.81
-43.54	0	960.83
-43.38	0	960.85
-43.03	0	960.89
-42.21	0	960.95
-41.91	0	960.98
-41.71	0	961
-41.41	0	961.03
-41.21	0	961.05
-40.92	0	961.09
-39.94	0	961.15
-39.71	0	961.17
-39.45	0	961.22
-38.95	0	961.28
-38.71	0	961.3
-38.45	0	961.32
-37.44	0	961.36
-37.21	0	961.38
-36.93	0	961.4
-35.21	0	961.47
-33.21	0	961.47
-33.05	0	961.44
-32.86	0	961.41
-32.71	0	961.39
-32.55	0	961.37
-32.36	0	961.34
-32.21	0	961.32
-32.06	0	961.3
-31.85	0	961.27
-31.71	0	961.24
-31.57	0	961.22
-31.34	0	961.17
-31.21	0	961.14
-31.08	0	961.11
-30.83	0	961.03

-30.71	0	960.99	
-30.59	0	960.97	
-30.32	0	960.94	
-30.21	0	960.92	
-30.09	0	960.9	
-29.71	0	960.84	
-29.6	0	960.82	
-29.21	0	960.76	
-29.11	0	960.74	
-28.62	0	960.69	
-28.12	0	960.65	
-27.63	0	960.61	
-27.14	0	960.59	
-26.65	0	960.55	
-26.16	0	960.5	
-25.66	0	960.43	
-25.17	0	960.33	
-24.68	0	960.16	ib
-24.19	0	959.92	
-23.69	0	959.63	
-23.2	0	959.37	
-22.97	0	959.27	
-22.7	0	959.16	
-22.19	0	958.97	
-21.69	0	958.78	
-21.21	0	958.59	
-20.71	0	958.34	
-20.67	0	958.32	
-20.25	0	958.12	
-20.21	0	958.1	
-20.16	0	958.07	
-19.76	0	957.81	
-19.71	0	957.77	
-19.65	0	957.73	
-19.26	0	957.35	
-19.21	0	957.31	
-19.14	0	957.24	
-19	0	957.04	lew
-18.77	0	956.88	
-18.71	0	956.81	
-18.64	0	956.77	
-18.28	0	956.58	
-18.21	0	956.53	
-18.13	0	956.5	
-17.79	0	956.4	
-17.7	0	956.37	
-17.62	0	956.34	
-17.3	0	956.26	
-17.2	0	956.24	
-17.11	0	956.21	
-16.8	0	956.15	
-16.7	0	956.12	
-16.6	0	956.1	
-16.31	0	956.04	
-16.2	0	956.01	
-16.1	0	955.98	
-15.82	0	955.92	
-15.7	0	955.89	
-15.59	0	955.87	
-15.33	0	955.8	
-15.2	0	955.78	
-15.08	0	955.75	
-14.83	0	955.7	
-14.7	0	955.68	
-14.57	0	955.65	
-14.34	0	955.6	

-14.2	0	955.57
-14.06	0	955.55
-13.85	0	955.52
-13.7	0	955.5
-13.55	0	955.48
-13.36	0	955.45
-13.2	0	955.43
-13.05	0	955.4
-12.87	0	955.37
-12.7	0	955.34
-12.54	0	955.31
-12.37	0	955.28
-12.2	0	955.25
-11.88	0	955.22
-11.39	0	955.18
-10.9	0	955.14
-10.7	0	955.12
-10.4	0	955.09
-10.2	0	955.07
-9.91	0	955.04
-9.7	0	955.01
-9.42	0	954.99
-9.2	0	954.97
-7.45	0	954.96
-7.2	0	954.98
-6.95	0	955
-6.2	0	955.04
-5.93	0	955.06
-5.7	0	955.08
-5.42	0	955.12
-5.2	0	955.15
-4.92	0	955.2
-4.7	0	955.24
-4.5	0	955.28
-4.41	0	955.3
-4.2	0	955.34
-3.9	0	955.37
-3.7	0	955.39
-3.51	0	955.41
-3.39	0	955.43
-3.2	0	955.45
-2.88	0	955.48
0.92	0	955.42
1.41	0	955.37
2.89	0	955.28
4.85	0	955.18
5.35	0	955.15
6.33	0	955.1
6.82	0	955.07
7.32	0	955.04
7.81	0	955.02
8.3	0	954.99
8.45	0	954.97
8.8	0	954.94
9.31	0	954.92
9.82	0	954.9
10.3	0	954.86
11.34	0	954.83
11.85	0	954.8
21.59	0	954.86
22.3	0	954.91
22.58	0	954.93
22.8	0	954.95
23.07	0	954.97
23.3	0	954.99
23.56	0	955.01

26.3	0	955.15	
26.59	0	955.18	
27.1	0	955.23	
27.3	0	955.25	
27.61	0	955.28	
27.8	0	955.3	
27.99	0	955.32	
28.11	0	955.34	
28.62	0	955.38	
28.8	0	955.4	
28.97	0	955.42	
29.13	0	955.44	
29.3	0	955.46	
29.47	0	955.48	
29.64	0	955.5	
29.96	0	955.54	
30.15	0	955.56	
30.3	0	955.58	
30.65	0	955.62	
30.8	0	955.65	
30.94	0	955.7	
31.16	0	955.8	
31.44	0	955.86	
31.67	0	955.89	
31.93	0	955.92	
32.3	0	955.96	
32.42	0	955.98	
32.8	0	956.03	
32.91	0	956.05	
33.2	0	956.1	
33.3	0	956.12	
33.4	0	956.15	
33.7	0	956.23	
33.8	0	956.26	
33.9	0	956.28	
34.21	0	956.34	
34.3	0	956.36	
34.39	0	956.38	
34.72	0	956.45	
34.88	0	956.48	
35.37	0	956.57	
35.87	0	956.64	
36.36	0	956.71	
36.85	0	956.79	
37.34	0	956.86	
37.83	0	956.9	
39.31	0	956.95	
39.86	0	956.98	
40.31	0	957.01	
40.82	0	957.04	rew
41.83	0	957.09	
42.34	0	957.13	
42.85	0	957.18	
43.36	0	957.23	
43.87	0	957.27	
44.37	0	957.3	
44.88	0	957.33	
45.3	0	957.37	
45.39	0	957.39	
45.8	0	957.44	
45.9	0	957.46	
46.3	0	957.52	
46.41	0	957.54	
46.8	0	957.6	
46.92	0	957.64	
47.19	0	957.73	

47.3	0	957.77	
47.42	0	957.8	
47.68	0	957.83	
47.93	0	957.87	
48.44	0	957.9	
48.95	0	957.94	
49.3	0	957.97	
49.46	0	957.99	
49.65	0	958.02	
49.8	0	958.04	
49.96	0	958.06	
50.14	0	958.09	
50.3	0	958.11	
50.47	0	958.14	
50.63	0	958.16	
50.8	0	958.19	
50.98	0	958.22	
51.12	0	958.24	
51.3	0	958.27	
51.49	0	958.31	
51.62	0	958.35	
51.8	0	958.39	
52	0	958.44	
52.11	0	958.48	
52.3	0	958.54	
52.51	0	958.62	
52.6	0	958.64	
52.8	0	958.72	
53.01	0	958.81	
53.09	0	958.86	
53.3	0	958.95	
53.52	0	959.05	
53.59	0	959.07	
53.8	0	959.17	
54.08	0	959.26	
54.3	0	959.35	
54.54	0	959.58	
54.57	0	959.61	
54.8	0	959.85	
55.06	0	960.07	
55.3	0	960.29	ib
55.55	0	960.47	
55.8	0	960.65	
56.06	0	960.84	
56.3	0	961.01	
56.54	0	961.24	
56.57	0	961.27	
56.8	0	961.51	
57.03	0	961.85	
57.08	0	961.92	
57.3	0	962.27	
57.52	0	962.6	
57.59	0	962.69	bkf
57.8	0	963.02	
58.02	0	963.34	
58.09	0	963.44	
58.3	0	963.76	
58.51	0	964.13	
58.6	0	964.24	
58.8	0	964.6	
59	0	964.99	
59.11	0	965.29	
59.3	0	965.68	
59.49	0	965.95	
59.62	0	966.15	
59.8	0	966.41	

59.98	0	966.64
60.13	0	966.81
60.3	0	967.03
60.48	0	967.16
60.64	0	967.25
60.8	0	967.38
60.97	0	967.52
61.14	0	967.69
61.3	0	967.82
61.46	0	967.94
61.65	0	968.09
61.8	0	968.21
62.81	0	968.96
62.94	0	969.11
63.18	0	969.37
63.31	0	969.51
63.43	0	969.68
63.68	0	970.03
63.81	0	970.2
63.92	0	970.28
64.19	0	970.42
64.31	0	970.5
64.41	0	970.59
64.7	0	970.81
64.81	0	970.9
64.91	0	970.94
65.21	0	971.07
65.31	0	971.11
65.89	0	971.23
66.31	0	971.28
66.38	0	971.3
66.88	0	971.36
67.37	0	971.39
67.86	0	971.43
69.34	0	971.52
70.32	0	971.54
70.81	0	971.56
71.81	0	971.6
72.32	0	971.62
72.83	0	971.64
75	0	971.64

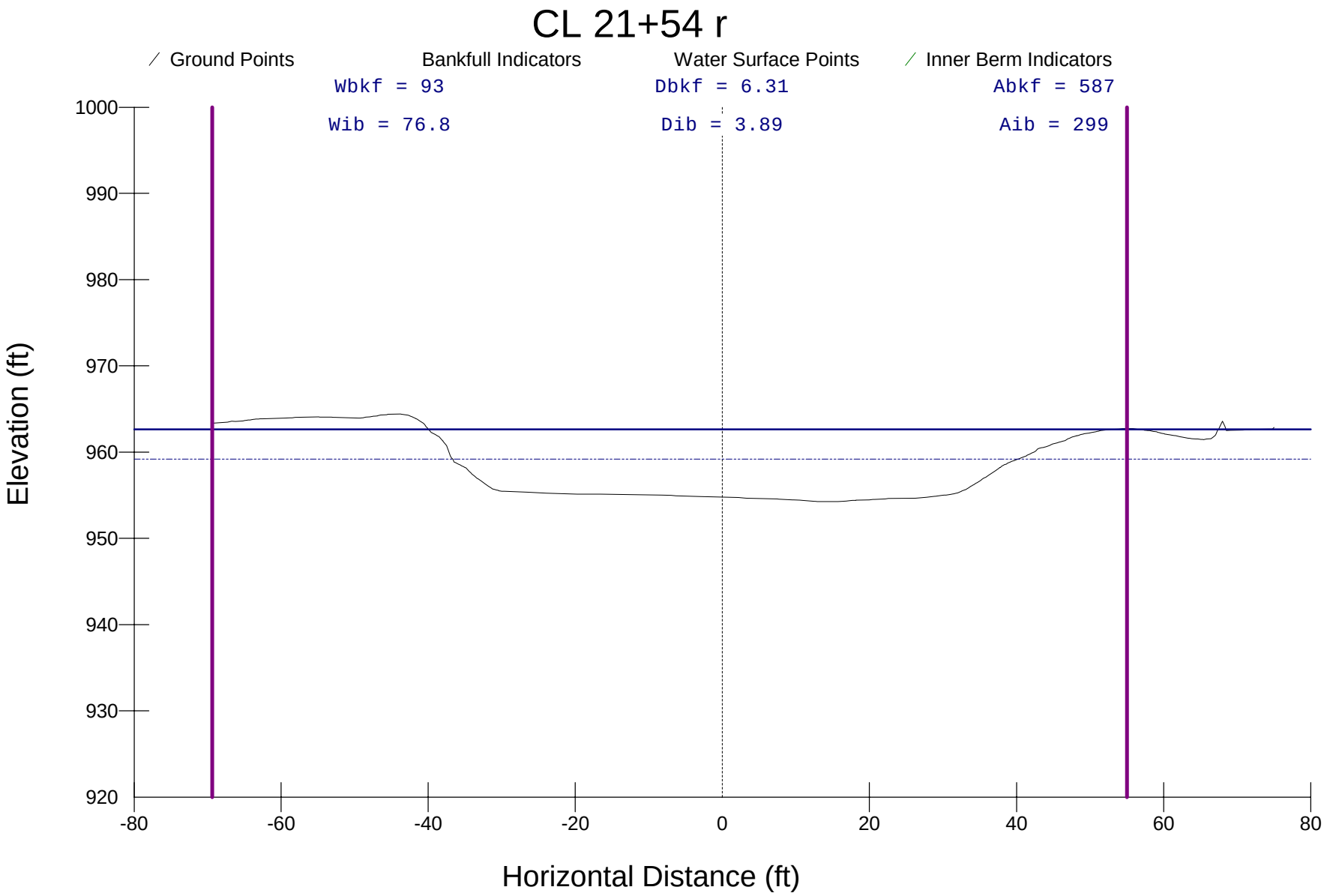
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	970.62	970.62	970.62
Bankfull Elevation (ft)	962.71	962.71	962.71
Floodprone Width (ft)	990	-----	-----
Bankfull Width (ft)	118.67	48.18	70.48
Entrenchment Ratio	8.34	-----	-----
Mean Depth (ft)	4.89	2.37	6.62
Maximum Depth (ft)	7.91	7.34	7.91
Width/Depth Ratio	24.27	20.35	10.65
Bankfull Area (sq ft)	580.44	114.06	466.37
Wetted Perimeter (ft)	123.47	58.33	79.82
Hydraulic Radius (ft)	4.7	1.96	5.84
Begin BKF Station	-61.06	-61.06	-12.88
End BKF Station	57.6	-12.88	57.6

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


CL 21+54 r
Ground Points
Bankfull Indicators
Water Surface Points
Inner Berm Indicators
Wbkf = 93
Dbkf = 6.31
Abkf = 587
Wib = 76.8
Dib = 3.89
Aib = 299
Elevation (ft)
1000
990
980
970
960
950
940
930
920
-80
-60
-40
-20
0
20
40
60
80
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-1
Cross Section Name: CL 21+54 r (field)
Survey Date: 11/17/2025

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
-69.35	0	963.37	
-69.15	0	963.38	
-67.26	0	963.49	
-66.74	0	963.57	
-66.22	0	963.56	
-65.17	0	963.62	
-64.95	0	963.66	
-64.89	0	963.67	
-64.65	0	963.7	
-64.49	0	963.72	
-64.2	0	963.74	
-64.09	0	963.75	
-63.69	0	963.81	
-63.61	0	963.82	
-63.45	0	963.83	
-63.08	0	963.84	
-62.89	0	963.86	
-62.49	0	963.88	
-59.43	0	963.96	
-58.78	0	963.99	
-58.48	0	964	
-58.07	0	964.01	
-54.87	0	964.08	
-54.73	0	964.07	
-53.16	0	964.04	
-52.86	0	964.02	
-52.64	0	964.01	
-49.5	0	963.95	
-49.25	0	963.96	
-48.98	0	963.98	
-48.85	0	964	
-48.48	0	964.04	
-47.94	0	964.11	
-47.41	0	964.16	
-47.24	0	964.18	
-46.89	0	964.22	
-46.84	0	964.23	
-46.44	0	964.3	
-46.37	0	964.31	
-45.64	0	964.36	
-45.48	0	964.37	
-45.32	0	964.38	
-43.76	0	964.41	
-43.63	0	964.4	
-42.71	0	964.28	
-42.49	0	964.2	
-42.43	0	964.18	
-42.19	0	964.09	
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-41.74	0	963.92	
-41.67	0	963.89	
-41.63	0	963.87	
-41.5	0	963.81	
-41.23	0	963.67	
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-40.1	0	962.77	
-40.02	0	962.69	bkf
-39.77	0	962.45	
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-39.58	0	962.28	
-39.06	0	962.05	
-38.82	0	961.92	
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-38.53	0	961.79	
-38.04	0	961.32	
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-37.22	0	960.13	
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-36.82	0	959.31	
-36.65	0	959.18	ib
-36.5	0	958.91	
-36.44	0	958.84	
-36.32	0	958.78	
-35.92	0	958.62	
-35.75	0	958.55	
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-35.4	0	958.4	
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-35	0	958.22	
-34.88	0	958.16	
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-34.01	0	957.45	
-33.83	0	957.31	
-33.61	0	957.15	
-33.51	0	957.08	
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-32.86	0	956.71	
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-31.74	0	956.01	
-31.6	0	955.93	
-31.26	0	955.74	
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-30.4	0	955.53	
-30.18	0	955.48	
-30	0	955.47	
-29.65	0	955.45	
-26.39	0	955.35	
-23.91	0	955.24	
-19.73	0	955.12	

-17.12	0	955.14	
-16.6	0	955.13	
-10.33	0	955.06	
-8.24	0	955.01	
-6.94	0	954.98	
-6.33	0	954.95	
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2.89	0	954.69	
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7.71	0	954.56	
9.52	0	954.49	
9.71	0	954.48	
10.51	0	954.43	
10.91	0	954.4	
12.52	0	954.3	
12.66	0	954.29	
12.92	0	954.27	
13.18	0	954.26	
15.73	0	954.26	
16.31	0	954.29	
16.83	0	954.33	
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17.73	0	954.39	
18.13	0	954.42	
18.15	0	954.43	
18.4	0	954.44	
19.97	0	954.48	
20.49	0	954.5	
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20.71	0	954.52	
22.14	0	954.59	
22.58	0	954.61	
26.24	0	954.66	
27.8	0	954.76	
28.85	0	954.86	
28.96	0	954.87	
29.89	0	954.99	
30.17	0	955.01	
30.42	0	955.03	
31.07	0	955.11	
31.37	0	955.15	
31.46	0	955.16	
31.77	0	955.23	
31.98	0	955.28	
32.5	0	955.45	
32.57	0	955.48	
32.8	0	955.55	
32.97	0	955.62	
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33.55	0	955.9	
33.78	0	956.03	
33.87	0	956.07	
34.07	0	956.17	
34.18	0	956.22	
34.53	0	956.41	
34.58	0	956.44	rew
35.12	0	956.72	
35.38	0	956.86	
35.64	0	957	
35.78	0	957.08	
36.16	0	957.3	
37.21	0	957.89	
37.39	0	957.99	
37.62	0	958.13	

37.73	0	958.2	
37.79	0	958.23	
37.98	0	958.36	
38.19	0	958.47	
38.25	0	958.51	
38.37	0	958.55	
38.59	0	958.63	
38.77	0	958.71	
38.99	0	958.79	
39.11	0	958.84	
39.3	0	958.91	
39.39	0	958.93	
39.71	0	959.02	
39.79	0	959.04	
39.86	0	959.07	
40.19	0	959.18	ib
40.34	0	959.24	
40.61	0	959.34	
40.86	0	959.43	
41.4	0	959.59	
41.44	0	959.62	
41.8	0	959.78	
41.91	0	959.82	
42.11	0	959.91	
42.2	0	959.95	
42.43	0	960.04	
42.6	0	960.14	
42.86	0	960.34	
42.95	0	960.4	
43	0	960.42	
43.17	0	960.46	
43.47	0	960.53	
43.61	0	960.55	
43.8	0	960.58	
44	0	960.62	
44.52	0	960.8	
44.61	0	960.84	
44.9	0	960.93	
45.01	0	960.97	
45.04	0	960.98	
45.41	0	961.05	
45.56	0	961.09	
45.81	0	961.16	
45.85	0	961.17	
46.09	0	961.23	
46.21	0	961.26	
46.62	0	961.33	
47.01	0	961.55	
47.13	0	961.6	
47.35	0	961.68	
47.41	0	961.7	
47.65	0	961.77	
47.82	0	961.81	
48.1	0	961.87	
48.18	0	961.89	
48.22	0	961.9	
48.35	0	961.93	
48.7	0	962.02	
48.85	0	962.05	
49.02	0	962.08	
49.22	0	962.12	
49.74	0	962.2	
49.82	0	962.22	
50.26	0	962.29	
50.79	0	962.37	
51.02	0	962.41	

51.09	0	962.43	
51.31	0	962.47	
51.43	0	962.48	
52.63	0	962.6	bkf
52.88	0	962.63	
53.92	0	962.69	
54.44	0	962.71	
55.49	0	962.72	
55.84	0	962.7	
56.53	0	962.65	
57.06	0	962.59	
57.44	0	962.55	
57.58	0	962.54	
57.84	0	962.51	
58.1	0	962.49	
58.64	0	962.39	
58.72	0	962.38	
59.05	0	962.34	
59.14	0	962.32	
59.33	0	962.27	
59.45	0	962.24	
59.67	0	962.19	
59.85	0	962.16	
60.08	0	962.13	
60.19	0	962.11	
60.25	0	962.1	
60.65	0	962.03	
60.71	0	962.01	
61.23	0	961.94	
61.45	0	961.92	
61.57	0	961.91	
61.76	0	961.89	
62.28	0	961.78	
62.32	0	961.77	
62.66	0	961.72	
63.32	0	961.64	
63.46	0	961.62	
63.86	0	961.57	
64.37	0	961.52	
64.57	0	961.51	
64.66	0	961.5	
65.06	0	961.48	
65.32	0	961.47	
65.41	0	961.46	
65.86	0	961.5	
66.46	0	961.57	
66.67	0	961.7	
66.82	0	961.82	
66.98	0	961.93	
67.07	0	962.03	
67.36	0	962.48	
67.47	0	962.64	
67.5	0	962.68	
67.56	0	962.79	
67.87	0	963.3	
68.02	0	963.59	
68.27	0	963.1	
68.31	0	963.01	
68.55	0	962.51	
69.07	0	962.54	
70.82	0	962.57	
71.16	0	962.59	
71.68	0	962.6	
72.2	0	962.63	
74.29	0	962.68	
74.81	0	962.69	

75 0 962.85

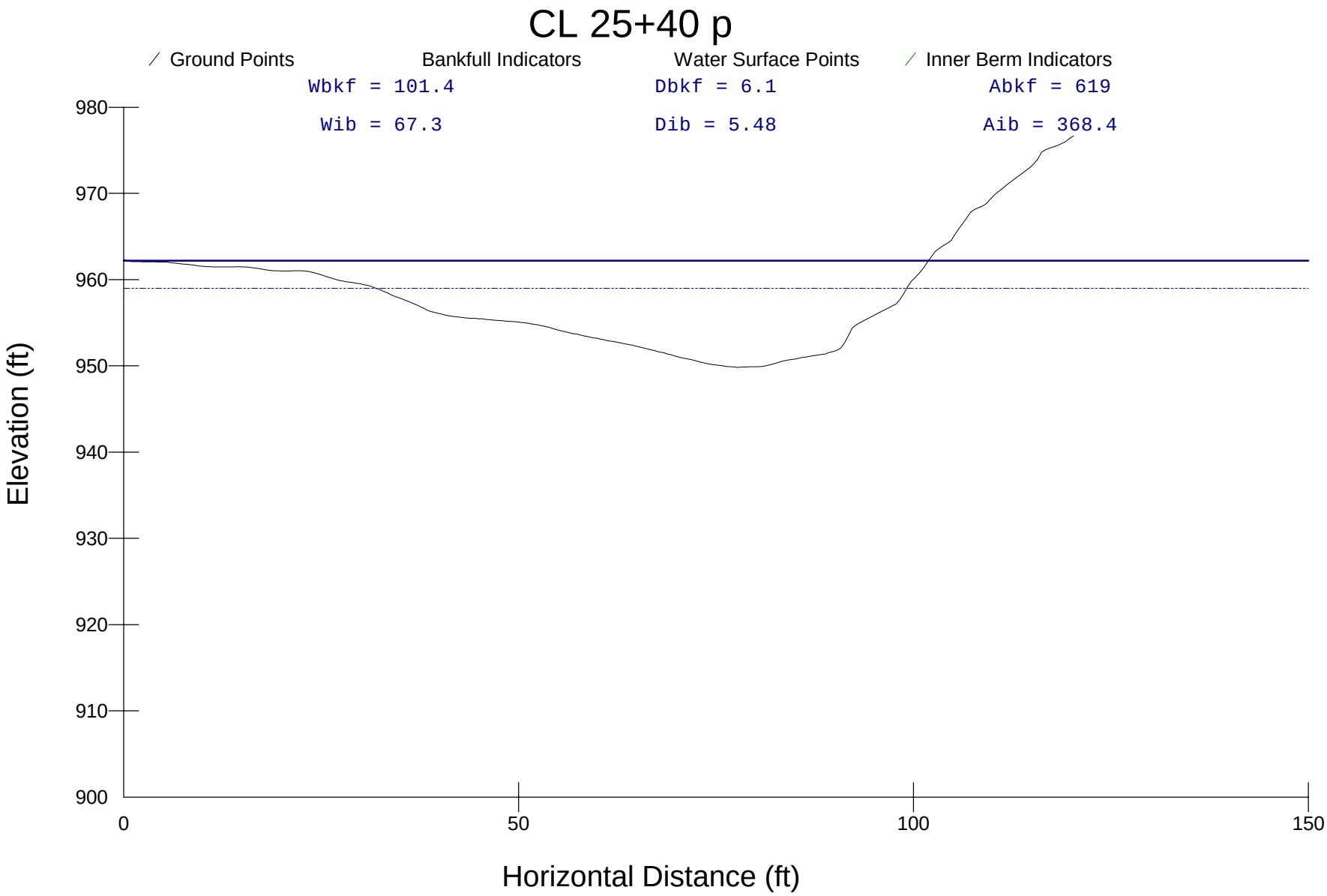
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	971.02	971.02	971.02
Bankfull Elevation (ft)	962.64	962.64	962.64
Floodprone Width (ft)	1200	-----	-----
Bankfull Width (ft)	93.02	39.97	53.05
Entrenchment Ratio	12.9	-----	-----
Mean Depth (ft)	6.31	6.7	6.02
Maximum Depth (ft)	8.38	7.87	8.38
Width/Depth Ratio	14.74	5.97	8.81
Bankfull Area (sq ft)	586.96	267.63	319.34
Wetted Perimeter (ft)	97.36	50.62	62.48
Hydraulic Radius (ft)	6.03	5.29	5.11
Begin BKF Station	-39.97	-39.97	0
End BKF Station	53.05	0	53.05

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


CL 25+40 p
Ground Points
Bankfull Indicators
Water Surface Points
Inner Berm Indicators
Wbkf = 101.4
Dbkf = 6.1
Abkf = 619
Wib = 67.3
Dib = 5.48
Aib = 368.4
980
970
960
950
940
930
920
910
900
Elevation (ft)
0
50
100
150
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-1
Cross Section Name: CL 25+40 p
Survey Date: 01/25/2026

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	962.3	
0.5	0	962.19	BKF
1	0	962.1	
1.5	0	962.09	
2	0	962.08	
2.49	0	962.07	
2.99	0	962.06	
3.49	0	962.05	
3.99	0	962.05	
4.49	0	962.04	
4.99	0	962.03	
5.49	0	962.01	
5.99	0	961.96	
6.48	0	961.92	
6.98	0	961.87	
7.48	0	961.82	
7.98	0	961.77	
8.48	0	961.72	
8.98	0	961.66	
9.48	0	961.6	
9.98	0	961.55	
10.47	0	961.52	
10.97	0	961.5	
11.47	0	961.49	
11.97	0	961.48	
12.47	0	961.47	
12.97	0	961.47	
13.47	0	961.48	
13.97	0	961.49	
14.46	0	961.5	
14.96	0	961.49	
15.46	0	961.47	
15.96	0	961.42	
16.46	0	961.36	
16.96	0	961.29	
17.46	0	961.23	
17.96	0	961.15	
18.45	0	961.09	
18.95	0	961.06	
19.45	0	961.03	
19.95	0	961.02	
20.45	0	961.01	
20.95	0	961.02	
21.45	0	961.04	
21.95	0	961.05	
22.44	0	961.05	
22.94	0	961.01	
23.44	0	960.92	
23.94	0	960.82	

24.44	0	960.71	
24.94	0	960.58	
25.44	0	960.43	
25.94	0	960.28	
26.43	0	960.12	
26.93	0	960	
27.43	0	959.9	
27.93	0	959.8	
28.43	0	959.73	
28.93	0	959.67	
29.43	0	959.61	
29.93	0	959.51	
30.42	0	959.42	
30.92	0	959.33	
31.42	0	959.19	
31.92	0	959.03	IB
32.42	0	958.85	
32.92	0	958.66	
33.42	0	958.42	
33.92	0	958.21	
34.41	0	958.05	
34.91	0	957.89	
35.41	0	957.72	
35.91	0	957.54	
36.41	0	957.34	
36.91	0	957.14	
37.41	0	956.94	
37.91	0	956.71	
38.4	0	956.47	
38.9	0	956.29	
39.4	0	956.17	
39.9	0	956.06	
40.4	0	955.96	
40.9	0	955.87	
41.4	0	955.79	
41.9	0	955.72	
42.39	0	955.67	
42.89	0	955.61	
43.39	0	955.57	
43.89	0	955.54	
44.39	0	955.51	
44.89	0	955.47	
45.39	0	955.44	
45.89	0	955.4	
46.38	0	955.35	
46.88	0	955.32	
47.38	0	955.28	
47.88	0	955.23	
48.38	0	955.2	
48.88	0	955.17	
49.38	0	955.12	
49.88	0	955.08	
50.37	0	955.03	
50.87	0	954.97	
51.37	0	954.9	
51.87	0	954.83	
52.37	0	954.76	
52.87	0	954.67	
53.37	0	954.58	
53.87	0	954.47	
54.36	0	954.34	
54.86	0	954.2	
55.36	0	954.08	
55.86	0	953.97	
56.36	0	953.85	
56.86	0	953.75	

57.36	0	953.66
57.86	0	953.57
58.35	0	953.46
58.85	0	953.37
59.35	0	953.29
59.85	0	953.19
60.35	0	953.1
60.85	0	953.01
61.35	0	952.93
61.85	0	952.86
62.34	0	952.78
62.84	0	952.69
63.34	0	952.59
63.84	0	952.49
64.34	0	952.4
64.84	0	952.31
65.34	0	952.19
65.84	0	952.08
66.33	0	951.97
66.83	0	951.86
67.33	0	951.74
67.83	0	951.62
68.33	0	951.52
68.83	0	951.4
69.33	0	951.27
69.83	0	951.14
70.32	0	951.03
70.82	0	950.91
71.32	0	950.81
71.82	0	950.73
72.32	0	950.62
72.82	0	950.5
73.32	0	950.39
73.82	0	950.28
74.31	0	950.2
74.81	0	950.13
75.31	0	950.07
75.81	0	950.01
76.31	0	949.95
76.81	0	949.89
77.31	0	949.85
77.81	0	949.83
78.3	0	949.87
78.8	0	949.88
79.3	0	949.89
79.8	0	949.9
80.3	0	949.91
80.8	0	949.94
81.3	0	950.01
81.8	0	950.11
82.3	0	950.24
82.79	0	950.39
83.29	0	950.53
83.79	0	950.62
84.29	0	950.7
84.79	0	950.78
85.29	0	950.86
85.79	0	950.94
86.29	0	951.03
86.78	0	951.11
87.28	0	951.18
87.78	0	951.26
88.28	0	951.32
88.78	0	951.4
89.28	0	951.52
89.78	0	951.65

90.28	0	951.79	
90.77	0	952.08	
91.27	0	952.7	
91.77	0	953.56	
92.27	0	954.42	
92.77	0	954.76	
93.27	0	955.04	
93.77	0	955.28	
94.27	0	955.52	
94.76	0	955.75	
95.26	0	955.99	
95.76	0	956.22	
96.26	0	956.46	WS
96.76	0	956.7	
97.26	0	956.93	
97.76	0	957.17	
98.26	0	957.65	
98.75	0	958.37	
99.25	0	959.15	
99.75	0	959.85	
100.25	0	960.28	
100.75	0	960.79	
101.25	0	961.38	
101.75	0	961.99	
102.25	0	962.65	
102.74	0	963.26	
103.24	0	963.64	
103.74	0	963.91	
104.24	0	964.19	
104.74	0	964.54	
105.24	0	965.23	
105.74	0	965.92	
106.24	0	966.51	
106.73	0	967.16	
107.23	0	967.83	
107.73	0	968.17	
108.23	0	968.34	
108.73	0	968.53	
109.23	0	968.82	
109.73	0	969.32	
110.23	0	969.82	
110.72	0	970.2	
111.22	0	970.56	
111.72	0	970.92	
112.22	0	971.29	
112.72	0	971.64	
113.22	0	971.96	
113.72	0	972.28	
114.22	0	972.64	
114.71	0	973	
115.21	0	973.37	
115.71	0	973.94	
116.21	0	974.77	
116.71	0	975.07	
117.21	0	975.22	
117.71	0	975.38	
118.21	0	975.57	
118.7	0	975.75	
119.2	0	975.98	
119.7	0	976.31	
120.2	0	976.67	
120.7	0	977	
121.2	0	977.31	
121.7	0	977.63	
122.2	0	977.97	
122.69	0	978.33	

123.13	0	978.48
123.56	0	978.57

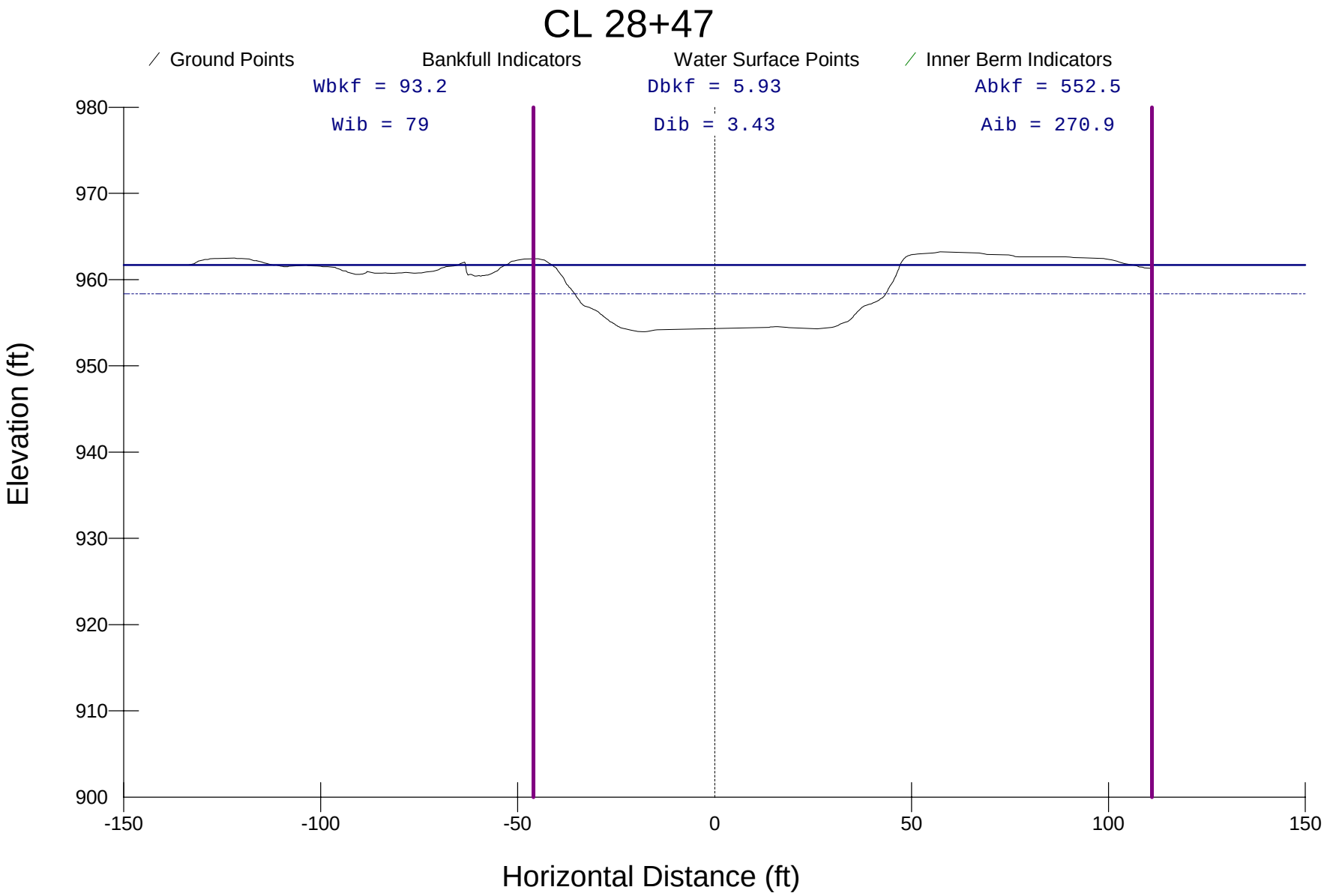
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	974.55	974.55	974.55
Bankfull Elevation (ft)	962.19	962.19	962.19
Floodprone Width (ft)	116.08	-----	-----
Bankfull Width (ft)	101.4	50.7	50.7
Entrenchment Ratio	1.14	-----	-----
Mean Depth (ft)	6.1	2.91	9.3
Maximum Depth (ft)	12.36	7.27	12.36
Width/Depth Ratio	16.62	17.42	5.45
Bankfull Area (sq ft)	619	147.57	471.44
Wetted Perimeter (ft)	107.44	58.88	63.09
Hydraulic Radius (ft)	5.76	2.51	7.47
Begin BKF Station	0.5	0.5	51.2
End BKF Station	101.9	51.2	101.9

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


CL 28+47
Ground Points
Bankfull Indicators
Water Surface Points
Inner Berm Indicators
Wbkf = 93.2
Wib = 79
Dbkf = 5.93
Dib = 3.43
Abkf = 552.5
Aib = 270.9
980
970
960
950
940
930
920
910
900
-150
-100
-50
0
50
100
150
Elevation (ft)
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-1
Cross Section Name: CL 28+47 r (field)
Survey Date: 11/17/2025

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
-133.41	0	961.72	
-133.34	0	961.74	
-131.98	0	961.89	
-131.91	0	961.9	
-131.24	0	962.09	
-131.2	0	962.11	
-131.14	0	962.12	
-129.77	0	962.27	
-129.47	0	962.36	
-128.64	0	962.36	
-128.12	0	962.42	
-126.87	0	962.45	
-126.25	0	962.46	
-126.2	0	962.46	
-126.13	0	962.46	
-121.88	0	962.48	
-121.25	0	962.47	
-120.01	0	962.46	
-118.13	0	962.39	
-116.91	0	962.2	
-116.89	0	962.19	
-116.26	0	962.2	
-116.19	0	962.18	
-116.1	0	962.16	
-115.01	0	962.06	
-114.43	0	961.94	
-113.6	0	961.89	
-113.14	0	961.8	
-111.92	0	961.67	
-111.89	0	961.67	
-111.27	0	961.7	
-111.09	0	961.67	
-110.02	0	961.57	
-109.76	0	961.55	
-109.42	0	961.5	
-108.58	0	961.5	
-108.33	0	961.52	
-108.15	0	961.54	
-103.57	0	961.65	
-103.16	0	961.63	
-101.28	0	961.59	
-101.06	0	961.58	
-100.04	0	961.56	
-99.41	0	961.53	
-98.16	0	961.5	
-96.29	0	961.4	
-96.19	0	961.37	
-96.05	0	961.33	
-95.04	0	961.2	

-94.76	0	961.12
-94.42	0	961.05
-93.54	0	961.02
-93.17	0	960.88
-91.3	0	960.64
-91.19	0	960.62
-91.04	0	960.61
-90.05	0	960.61
-89.76	0	960.64
-89.43	0	960.63
-88.53	0	960.79
-88.33	0	960.88
-88.18	0	960.92
-86.31	0	960.77
-86.02	0	960.75
-85.06	0	960.77
-84.44	0	960.76
-83.51	0	960.78
-83.19	0	960.77
-81.31	0	960.73
-81.01	0	960.75
-80.07	0	960.78
-79.44	0	960.8
-78.5	0	960.83
-78.19	0	960.83
-76.32	0	960.76
-75.99	0	960.76
-75.07	0	960.79
-74.45	0	960.78
-73.49	0	960.86
-73.2	0	960.89
-71.33	0	960.98
-71.18	0	961.01
-70.98	0	961.05
-70.08	0	961.15
-69.46	0	961.32
-68.47	0	961.43
-68.21	0	961.5
-66.34	0	961.59
-66.18	0	961.6
-65.09	0	961.69
-64.75	0	961.8
-64.47	0	961.89
-63.46	0	962.01
-63.32	0	961.92
-63.22	0	961.66
-62.96	0	960.9
-62.63	0	960.54
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-62.59	0	960.54
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-61.89	0	960.6
-61.79	0	960.6
-61.18	0	960.47
-60.95	0	960.44
-60.46	0	960.44
-59.75	0	960.45
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-58.68	0	960.45
-58.45	0	960.47
-58.32	0	960.49
-58.22	0	960.5
-57.96	0	960.53
-57.61	0	960.55

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-54.48	0	961.35	
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-53.86	0	961.52	
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-52.96	0	961.69	
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-44.74	0	962.41	
-44.03	0	962.36	
-43.67	0	962.32	
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-43.32	0	962.28	
-43.25	0	962.27	
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-42.62	0	962.1	
-42.57	0	962.09	
-41.89	0	961.89	
-41.74	0	961.83	
-41.38	0	961.72	bkf
-41.17	0	961.66	
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-40.75	0	961.51	
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-40.13	0	961.3	
-40.1	0	961.29	
-40.06	0	961.27	
-39.74	0	961.04	
-39.39	0	960.8	
-39.03	0	960.57	
-38.88	0	960.49	
-38.67	0	960.37	
-38.39	0	960.23	
-38.31	0	960.16	
-37.96	0	959.8	
-37.63	0	959.5	
-37.6	0	959.48	
-37.56	0	959.46	
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-37.01	0	959.21	
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-35.89	0	958.58	
-35.76	0	958.51	
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-35.13	0	958.11	
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-35.05	0	958.05	
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-34.22	0	957.47	
-34.03	0	957.35	
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-33.31	0	957.02	
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-28.89	0	955.98	
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14.17	0	954.5	
14.56	0	954.51	
14.79	0	954.51	
15.41	0	954.54	
16.04	0	954.54	
18.43	0	954.47	

18.85	0	954.44	
26.02	0	954.31	
29.77	0	954.48	
30.28	0	954.5	
30.39	0	954.51	
31.01	0	954.61	
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31.64	0	954.76	
32.06	0	954.86	
32.26	0	954.91	
32.42	0	954.94	
33.49	0	955.09	
33.51	0	955.1	
33.85	0	955.17	
34.13	0	955.25	
34.21	0	955.29	
34.56	0	955.43	
34.76	0	955.5	
34.92	0	955.58	
35.14	0	955.69	
35.28	0	955.77	
35.38	0	955.84	
35.64	0	955.96	
35.99	0	956.12	
36.01	0	956.13	
36.35	0	956.3	
36.63	0	956.45	
36.71	0	956.47	
36.81	0	956.52	
37.06	0	956.63	
37.26	0	956.74	
37.42	0	956.81	
37.65	0	956.87	
37.88	0	956.93	
38.14	0	956.97	
38.48	0	957.01	
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40.28	0	957.33	
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41	0	957.46	
41.35	0	957.53	
41.62	0	957.59	
41.71	0	957.61	
42.07	0	957.73	
42.25	0	957.8	
42.66	0	957.93	
42.78	0	957.97	
42.87	0	958	
43.14	0	958.16	
43.49	0	958.4	ib
43.5	0	958.4	
43.85	0	958.69	
44.12	0	958.93	
44.21	0	959	
44.33	0	959.11	
44.57	0	959.3	
44.74	0	959.4	
44.92	0	959.51	
45.17	0	959.67	
45.28	0	959.77	
45.37	0	959.84	

45.64	0	960.09	
45.99	0	960.44	
46	0	960.44	
46	0	960.45	
46.35	0	960.83	
46.62	0	961.13	
46.71	0	961.24	
46.84	0	961.41	
47.07	0	961.7	bkf
47.24	0	961.86	
47.67	0	962.19	
47.78	0	962.26	
47.86	0	962.31	
48.14	0	962.46	
48.43	0	962.58	
48.49	0	962.61	
48.85	0	962.71	
49.11	0	962.77	
49.57	0	962.83	
49.74	0	962.86	
49.93	0	962.89	
50.18	0	962.91	
50.36	0	962.92	
50.64	0	962.93	
51.61	0	962.98	
55.35	0	963.09	
55.98	0	963.13	
56.6	0	963.19	
57.22	0	963.24	
67.21	0	963.06	
68.56	0	962.97	
69.08	0	962.94	
74.7	0	962.85	
75.65	0	962.79	
75.95	0	962.76	
76.08	0	962.73	
76.36	0	962.68	
77.19	0	962.66	
77.43	0	962.66	
77.75	0	962.65	
79.07	0	962.63	
80.31	0	962.63	
81.1	0	962.64	
82.77	0	962.64	
83.6	0	962.63	
85.29	0	962.63	
86.11	0	962.65	
87.18	0	962.64	
87.44	0	962.63	
87.78	0	962.64	
88.62	0	962.64	
88.87	0	962.63	
89.05	0	962.64	
90.29	0	962.61	
90.29	0	962.61	
91.12	0	962.58	
93.63	0	962.53	
98.87	0	962.46	
99.04	0	962.44	
100.91	0	962.29	
101.15	0	962.23	
102.16	0	962.15	
102.78	0	962.01	
104.03	0	961.88	
105.9	0	961.74	
107.15	0	961.61	

107.77	0	961.47
108.67	0	961.43
109.02	0	961.36
111.01	0	961.3

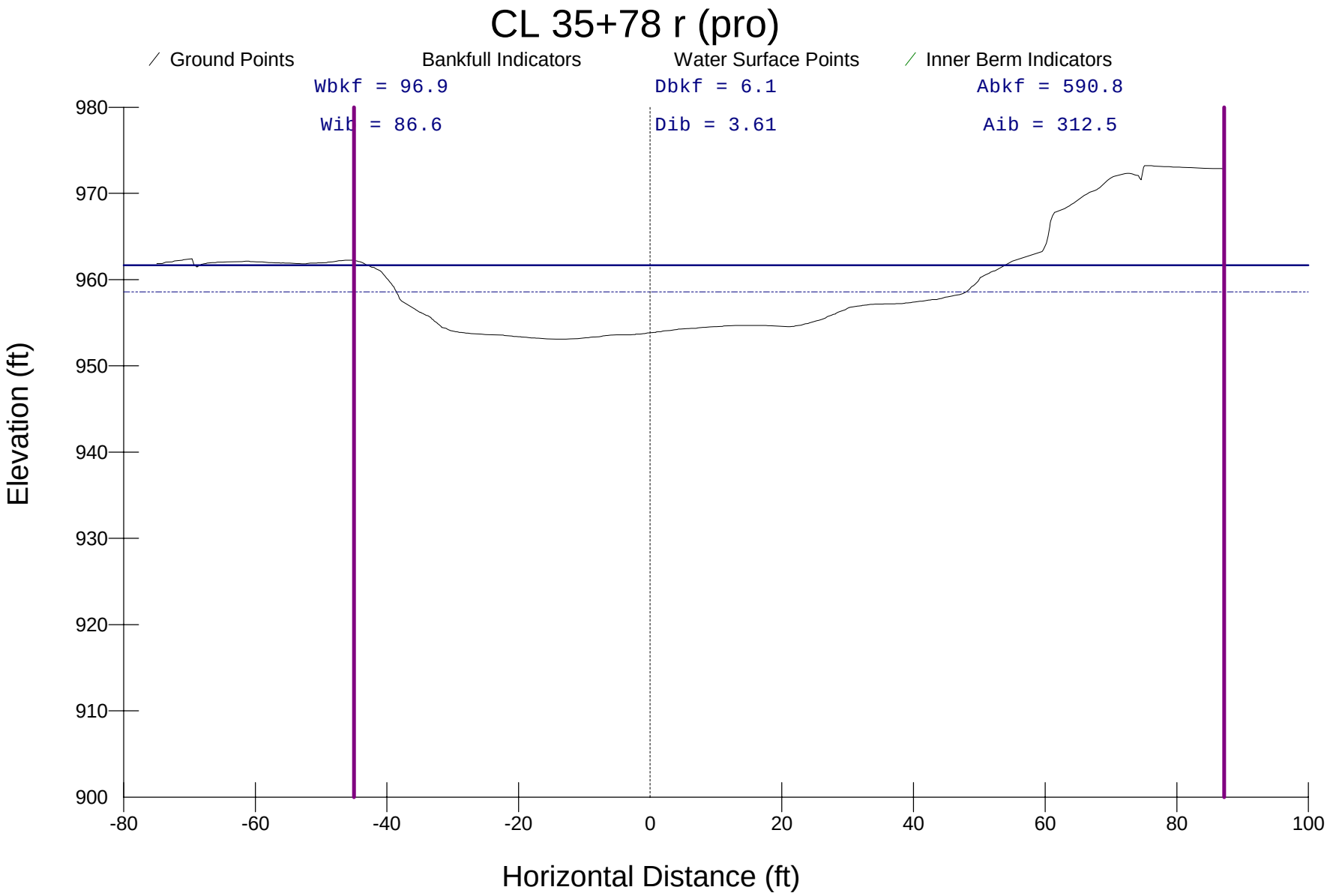
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	969.45	969.45	969.45
Bankfull Elevation (ft)	961.71	961.71	961.71
Floodprone Width (ft)	1400	-----	-----
Bankfull Width (ft)	93.25	28.18	124.18
Entrenchment Ratio	15.01	-----	-----
Mean Depth (ft)	5.93	5.5	6.11
Maximum Depth (ft)	7.74	7.74	7.52
Width/Depth Ratio	15.73	5.13	20.32
Bankfull Area (sq ft)	552.5	154.83	397.67
Wetted Perimeter (ft)	97.49	37.46	75.06
Hydraulic Radius (ft)	5.67	4.13	5.3
Begin BKF Station	-41.35	-41.35	-13.17
End BKF Station	111.01	-13.17	111.01

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


CL 35+78 r (pro)
Ground Points
Bankfull Indicators
Water Surface Points
Inner Berm Indicators
Wbkf = 96.9
Wib = 86.6
Dbkf = 6.1
Dib = 3.61
Abkf = 590.8
Aib = 312.5
Elevation (ft)
980
970
960
950
940
930
920
910
900
-80
-60
-40
-20
0
20
40
60
80
100
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-1
Cross Section Name: CL 35+78 r (pro)
Survey Date: 11/18/2025

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
-75	0	961.86	
-74.93	0	961.88	
-74.17	0	961.89	
-73.6	0	962.02	
-72.65	0	962.07	
-72.27	0	962.16	
-71.14	0	962.25	
-70.94	0	962.3	
-69.62	0	962.43	
-69.61	0	962.43	
-69.61	0	962.4	
-69.53	0	962.23	
-69.26	0	961.63	
-68.94	0	961.56	
-68.91	0	961.49	
-68.86	0	961.49	
-68.55	0	961.62	
-68.28	0	961.74	
-68.2	0	961.76	
-68.11	0	961.78	
-67.84	0	961.83	
-67.61	0	961.87	
-67.49	0	961.89	
-67.35	0	961.91	
-66.95	0	961.96	
-66.59	0	961.98	
-66.07	0	961.99	
-65.72	0	962.01	
-64.95	0	962.04	
-64.28	0	962.05	
-62.04	0	962.1	
-61.47	0	962.12	
-60.96	0	962.12	
-60.76	0	962.11	
-60.4	0	962.09	
-59.77	0	962.07	
-59.01	0	962.05	
-58.96	0	962.05	
-57.92	0	962	
-57.57	0	961.99	
-57.5	0	961.99	
-56.96	0	961.96	
-56.74	0	961.96	
-56.51	0	961.95	
-56.3	0	961.94	
-56.15	0	961.93	
-55.8	0	961.94	
-55.44	0	961.92	
-55.23	0	961.92	

-55.09	0	961.92	
-54.73	0	961.91	
-53.67	0	961.89	
-53.64	0	961.89	
-53.32	0	961.88	
-52.95	0	961.86	
-52.31	0	961.86	
-52.25	0	961.86	
-52.2	0	961.87	
-51.64	0	961.9	
-51.55	0	961.91	
-51.19	0	961.92	
-50.97	0	961.93	
-50.68	0	961.93	
-50.48	0	961.94	
-49.92	0	961.96	
-49.17	0	962	
-48.98	0	962.01	
-48.31	0	962.06	
-48	0	962.1	
-47.65	0	962.14	
-47.29	0	962.19	
-46.98	0	962.21	
-46.94	0	962.22	
-46.32	0	962.25	
-46.23	0	962.26	
-45.88	0	962.26	
-45.65	0	962.26	
-45.38	0	962.25	
-44.98	0	962.24	
-44.81	0	962.21	
-44.62	0	962.16	
-44.46	0	962.13	
-44.32	0	962.11	
-44.11	0	962.08	
-43.75	0	962	
-43.65	0	961.95	
-43.4	0	961.84	
-43.1	0	961.69	
-43.04	0	961.67	
-42.99	0	961.66	bkf
-42.69	0	961.59	
-42.35	0	961.46	
-42.33	0	961.46	
-42.32	0	961.46	
-42.14	0	961.42	
-41.98	0	961.39	
-41.66	0	961.26	
-41.59	0	961.24	
-41.27	0	961.13	
-40.99	0	961	
-40.92	0	960.95	
-40.83	0	960.9	
-40.56	0	960.65	
-40.33	0	960.43	
-40.21	0	960.32	
-40.07	0	960.2	
-39.85	0	959.99	
-39.5	0	959.66	
-39.32	0	959.51	
-39.15	0	959.33	
-38.99	0	959.14	
-38.79	0	958.88	
-38.56	0	958.57	
-38.44	0	958.39	
-38.33	0	958.2	

-38.08	0	957.77	
-37.8	0	957.53	
-35.67	0	956.53	
-35.6	0	956.51	
-35.53	0	956.47	
-35	0	956.22	
-34.89	0	956.2	
-34.77	0	956.16	
-34.54	0	956.09	
-34.34	0	956	
-34.19	0	955.93	
-34.01	0	955.87	
-33.83	0	955.82	
-33.67	0	955.79	
-33.48	0	955.68	
-33.35	0	955.63	lew
-33.26	0	955.53	
-33.12	0	955.43	
-33	0	955.39	
-32.77	0	955.2	
-32.5	0	955.06	
-32.41	0	954.99	
-32.34	0	954.96	
-32.06	0	954.77	
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-31.71	0	954.5	
-31.67	0	954.48	
-31.01	0	954.35	
-31	0	954.35	
-30.98	0	954.34	
-30.64	0	954.2	
-30.34	0	954.1	
-30.29	0	954.09	
-30.23	0	954.07	
-29.68	0	953.99	
-29.58	0	953.98	
-29.47	0	953.96	
-29.23	0	953.93	
-29.01	0	953.9	
-28.87	0	953.9	
-28.71	0	953.88	
-28.52	0	953.87	
-28.35	0	953.85	
-28.16	0	953.82	
-27.95	0	953.8	
-27.81	0	953.79	
-27.68	0	953.77	
-27.2	0	953.75	
-25.68	0	953.69	
-25.02	0	953.64	
-22.49	0	953.56	
-22.36	0	953.55	
-22.14	0	953.54	
-21.08	0	953.45	
-21.03	0	953.45	
-20.72	0	953.43	
-20.38	0	953.41	
-20.36	0	953.41	
-20.01	0	953.4	
-19.69	0	953.37	
-19.62	0	953.36	
-18.95	0	953.31	
-18.86	0	953.31	
-18.36	0	953.27	
-18.24	0	953.26	
-18.1	0	953.25	

-17.53	0	953.23
-17.35	0	953.22
-17.03	0	953.2
-15.7	0	953.14
-14.32	0	953.11
-13.28	0	953.1
-13.04	0	953.1
-12.8	0	953.11
-12.22	0	953.12
-11.04	0	953.16
-9.74	0	953.26
-9.38	0	953.28
-9.05	0	953.31
-8.68	0	953.34
-8.38	0	953.36
-7.71	0	953.4
-7.61	0	953.41
-7.5	0	953.43
-7.26	0	953.46
-7.05	0	953.49
-6.9	0	953.5
-6.74	0	953.52
-6.55	0	953.53
-5.98	0	953.56
-5.84	0	953.57
-5.13	0	953.59
-5.05	0	953.6
-2.95	0	953.62
-2.65	0	953.63
-2.39	0	953.64
-2.3	0	953.65
-2.19	0	953.66
-1.94	0	953.67
-1.72	0	953.68
-1.59	0	953.68
-1.24	0	953.73
-1.06	0	953.74
-0.88	0	953.76
-0.39	0	953.81
-0.17	0	953.83
0	0	953.84
0.08	0	953.85
0.18	0	953.86
0.27	0	953.87
0.54	0	953.88
0.84	0	953.91
0.89	0	953.92
0.94	0	953.92
1.24	0	953.95
1.59	0	953.98
1.6	0	953.98
1.6	0	953.98
1.95	0	954.04
2.31	0	954.08
2.35	0	954.09
3.02	0	954.13
3.72	0	954.19
4.08	0	954.23
4.26	0	954.25
4.43	0	954.26
4.62	0	954.27
5.6	0	954.32
5.85	0	954.34
6.2	0	954.36
6.9	0	954.38
6.91	0	954.38

6.93	0	954.38	
7.27	0	954.4	
7.59	0	954.43	
7.65	0	954.43	
7.98	0	954.46	
8.26	0	954.47	
9.04	0	954.5	
9.75	0	954.54	
9.93	0	954.55	
10.1	0	954.56	
10.68	0	954.59	
10.81	0	954.6	
10.92	0	954.6	
11.16	0	954.62	
12.23	0	954.65	
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13.58	0	954.7	
13.64	0	954.7	
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17.5	0	954.68	
17.58	0	954.68	
17.9	0	954.67	
18.24	0	954.65	
18.25	0	954.65	
18.91	0	954.62	
20.9	0	954.56	
21.08	0	954.56	
21.29	0	954.56	
21.57	0	954.57	
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22.05	0	954.63	
22.15	0	954.64	
22.23	0	954.65	
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23.92	0	954.91	
24.23	0	954.97	
24.98	0	955.18	
25.08	0	955.2	
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25.56	0	955.29	
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26.4	0	955.5	
26.59	0	955.57	
26.75	0	955.64	rew
26.89	0	955.7	
27.11	0	955.78	
27.56	0	955.9	
27.82	0	955.98	
28.11	0	956.05	
28.17	0	956.07	
28.52	0	956.21	
28.87	0	956.32	
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29.59	0	956.5	
29.62	0	956.51	
29.94	0	956.64	
30.22	0	956.76	
30.3	0	956.78	
30.38	0	956.79	
30.65	0	956.82	

31.55	0	956.95	
31.71	0	956.96	
31.9	0	956.97	
32.07	0	956.99	
32.22	0	957.01	
32.42	0	957.03	
32.65	0	957.05	
32.78	0	957.07	
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33.84	0	957.13	
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34.55	0	957.16	
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36.21	0	957.19	
36.88	0	957.2	
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37.96	0	957.22	
38.21	0	957.23	
38.72	0	957.28	
38.8	0	957.29	
38.87	0	957.29	
39.15	0	957.32	
39.47	0	957.35	
39.51	0	957.35	
39.54	0	957.36	
39.86	0	957.39	
40.23	0	957.43	
40.99	0	957.47	
41.28	0	957.48	
41.53	0	957.51	
42.34	0	957.62	
42.5	0	957.65	
42.87	0	957.7	
43.4	0	957.7	
43.53	0	957.7	
43.76	0	957.75	
44.11	0	957.81	
44.2	0	957.83	
44.86	0	957.96	
45.18	0	958.01	
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46.59	0	958.22	
46.86	0	958.25	
46.95	0	958.26	
47.05	0	958.28	
47.3	0	958.32	
47.52	0	958.38	
47.81	0	958.49	
48.01	0	958.59	ib
48.19	0	958.68	
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48.56	0	958.94	
48.72	0	959.07	
48.86	0	959.21	
49.07	0	959.31	
49.32	0	959.44	
49.43	0	959.51	
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49.78	0	959.81
50.08	0	960.18
50.14	0	960.23
50.19	0	960.26
50.84	0	960.54
50.84	0	960.54
51.2	0	960.66
51.55	0	960.8
51.59	0	960.81
52.18	0	961
52.26	0	961.02
52.35	0	961.05
55	0	962.12
59.5	0	963.25
59.7	0	963.44
60.06	0	963.99
60.17	0	964.23
60.41	0	965.03
60.69	0	966.14
60.77	0	966.55
60.84	0	966.8
61.12	0	967.42
61.44	0	967.81
61.47	0	967.83
61.5	0	967.84
62.2	0	968.02
62.96	0	968.24
63.25	0	968.37
63.72	0	968.57
63.95	0	968.7
64.31	0	968.88
64.47	0	968.95
65.99	0	969.78
66.08	0	969.82
66.43	0	969.98
66.75	0	970.11
67.5	0	970.33
67.85	0	970.45
68.16	0	970.59
68.21	0	970.62
68.26	0	970.65
69.49	0	971.54
69.62	0	971.61
69.78	0	971.69
69.98	0	971.78
70.33	0	971.94
70.53	0	972.01
72.15	0	972.28
72.46	0	972.32
72.81	0	972.35
72.81	0	972.35
72.81	0	972.35
73.17	0	972.26
73.48	0	972.19
73.52	0	972.18
73.56	0	972.17
73.87	0	972.13
74.15	0	972.07
74.23	0	971.99
74.32	0	971.78
74.58	0	971.56
74.81	0	972.44
74.94	0	973.01
75.08	0	973.22
76.14	0	973.2
76.59	0	973.16

77.47	0	973.15
78.11	0	973.11
78.87	0	973.1
79.47	0	973.06
80.38	0	973.05
80.8	0	973.02
81.9	0	972.99
82.13	0	972.98
83.41	0	972.94
83.46	0	972.94
84.13	0	972.93
84.17	0	972.93
85.46	0	972.89
85.69	0	972.88
86.79	0	972.86
87.18	0	972.83

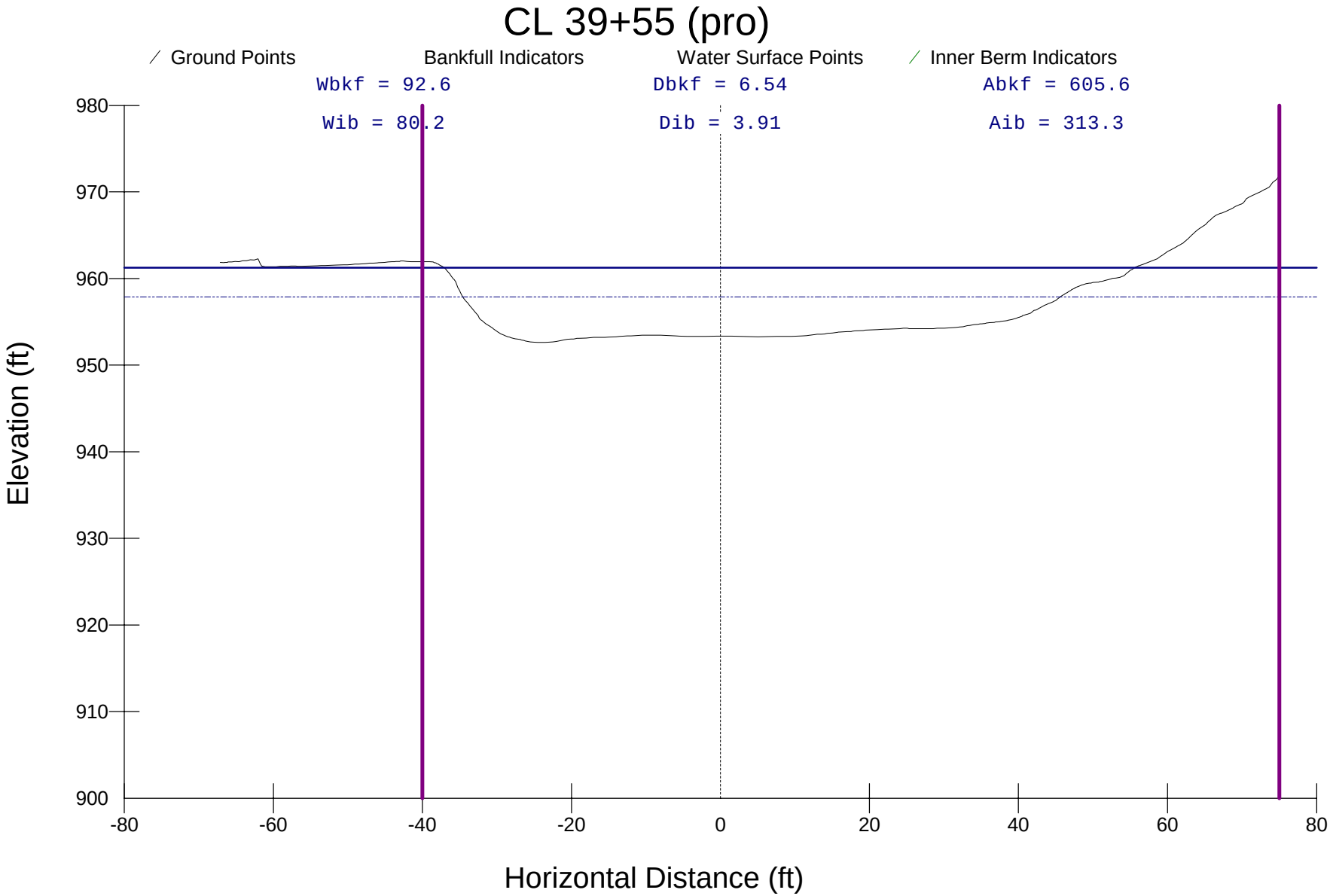
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	970.22	970.22	970.22
Bankfull Elevation (ft)	961.66	961.66	961.66
Floodprone Width (ft)	560	-----	-----
Bankfull Width (ft)	96.85	23.12	73.73
Entrenchment Ratio	5.78	-----	-----
Mean Depth (ft)	6.1	5.84	6.18
Maximum Depth (ft)	8.56	8.27	8.56
Width/Depth Ratio	15.88	3.96	11.93
Bankfull Area (sq ft)	590.75	134.98	455.77
Wetted Perimeter (ft)	100.8	33.94	83.4
Hydraulic Radius (ft)	5.86	3.98	5.46
Begin BKF Station	-42.99	-42.99	-19.87
End BKF Station	53.86	-19.87	53.86

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


CL 39+55 (pro)
Ground Points
Bankfull Indicators
Water Surface Points
Inner Berm Indicators
Wbkf = 92.6
Wib = 80.2
Dbkf = 6.54
Dib = 3.91
Abkf = 605.6
Aib = 313.3
980
970
960
950
940
930
920
910
900
Elevation (ft)
-80
-60
-40
-20
0
20
40
60
80
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-1
Cross Section Name: CL 39+55 r (field)
Survey Date: 11/18/2025

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
-67.12	0	961.87	
-67.09	0	961.87	
-66.59	0	961.86	
-66.53	0	961.87	
-66.17	0	961.89	
-66.09	0	961.9	
-65.59	0	961.9	
-65.09	0	961.98	
-64.59	0	961.97	
-64.09	0	962.05	
-63.59	0	962.05	
-63.09	0	962.16	
-62.58	0	962.15	
-62.08	0	962.28	
-61.91	0	961.98	
-61.75	0	961.73	
-61.58	0	961.44	
-61.08	0	961.37	
-60.96	0	961.37	
-60.69	0	961.37	
-60.58	0	961.37	
-60.08	0	961.38	
-60.01	0	961.38	
-59.63	0	961.38	
-59.08	0	961.39	
-59.06	0	961.39	
-58.59	0	961.42	
-58.58	0	961.42	
-58.57	0	961.42	
-58.11	0	961.42	
-58.04	0	961.42	
-57.64	0	961.43	
-57.58	0	961.43	
-57.51	0	961.43	
-56.98	0	961.43	
-56.69	0	961.42	
-56.45	0	961.42	
-56.22	0	961.42	
-55.07	0	961.43	
-54.07	0	961.47	
-53.57	0	961.5	
-53.07	0	961.52	
-51.57	0	961.57	
-50.57	0	961.59	
-50.06	0	961.6	
-49.58	0	961.63	
-49.06	0	961.65	
-49.02	0	961.66	
-48.63	0	961.67	

-48.56	0	961.67	
-47.56	0	961.74	
-47.06	0	961.77	
-46.56	0	961.78	
-46.06	0	961.81	
-45.83	0	961.83	
-45.79	0	961.83	
-45.06	0	961.88	
-44.56	0	961.93	
-44.06	0	961.96	
-43.89	0	961.96	
-43.71	0	961.97	
-43.55	0	961.98	
-43.42	0	961.99	
-43.18	0	962	
-43.05	0	962	
-42.94	0	962.01	
-42.55	0	962.02	
-42.05	0	961.99	
-41.99	0	961.98	
-41.55	0	961.97	
-40.55	0	961.96	
-40.05	0	961.96	
-39.99	0	961.96	
-39.05	0	961.94	
-38.55	0	961.9	
-38.4	0	961.86	
-38.2	0	961.8	
-38.05	0	961.75	
-37.87	0	961.67	
-37.73	0	961.6	
-37.54	0	961.52	
-37.34	0	961.42	
-37.25	0	961.38	
-37.04	0	961.27	bkf
-36.81	0	961.03	
-36.78	0	961	
-36.54	0	960.76	
-36.3	0	960.49	
-36.28	0	960.46	
-36.04	0	960.2	
-35.83	0	959.95	
-35.75	0	959.87	
-35.54	0	959.64	
-35.36	0	959.28	
-35.22	0	958.99	
-35.04	0	958.64	
-34.88	0	958.39	
-34.69	0	958.08	
-34.54	0	957.84	
-34.41	0	957.69	
-34.16	0	957.42	
-34.04	0	957.29	
-33.93	0	957.18	
-33.63	0	956.87	
-33.46	0	956.7	
-33.1	0	956.33	
-33.04	0	956.27	
-32.99	0	956.22	
-32.57	0	955.8	
-32.54	0	955.77	
-32.51	0	955.74	
-32.3	0	955.4	lew
-32.06	0	955.21	
-32.04	0	955.18	
-32.04	0	955.18	

-32.03	0	955.18
-31.56	0	954.85
-31.54	0	954.83
-31.5	0	954.8
-31.09	0	954.58
-31.03	0	954.54
-30.53	0	954.26
-30.44	0	954.2
-30.14	0	954.01
-30.03	0	953.94
-29.91	0	953.87
-29.67	0	953.72
-29.53	0	953.64
-29.38	0	953.58
-29.19	0	953.52
-29.03	0	953.46
-28.85	0	953.39
-28.72	0	953.34
-28.53	0	953.27
-28.32	0	953.23
-28.24	0	953.21
-28.03	0	953.16
-27.53	0	953.07
-27.03	0	952.98
-26.82	0	952.94
-26.73	0	952.91
-26.35	0	952.84
-26.2	0	952.81
-26.03	0	952.78
-25.53	0	952.7
-25.03	0	952.65
-24.52	0	952.62
-24.45	0	952.62
-24.02	0	952.61
-23.52	0	952.63
-22.52	0	952.7
-22.02	0	952.75
-21.02	0	952.92
-20.52	0	952.98
-20.02	0	953.01
-19.83	0	953.03
-19.71	0	953.04
-19.52	0	953.06
-19.24	0	953.09
-19.02	0	953.1
-18.01	0	953.15
-17.01	0	953.19
-16.51	0	953.2
-15.51	0	953.22
-15.01	0	953.24
-14.01	0	953.29
-13.51	0	953.31
-13.01	0	953.34
-12.51	0	953.37
-12	0	953.39
-11.5	0	953.42
-10.5	0	953.46
-10	0	953.47
-9.5	0	953.47
-8	0	953.45
-5.99	0	953.38
-5.49	0	953.35
-4.49	0	953.31
-3.99	0	953.3
-2.99	0	953.3
-1.99	0	953.31

-0.49	0	953.35
0	0	953.35
1.52	0	953.35
5.02	0	953.29
7.53	0	953.3
8.53	0	953.32
9.03	0	953.32
9.53	0	953.33
11.03	0	953.39
11.53	0	953.42
12.03	0	953.47
12.05	0	953.47
12.53	0	953.52
12.54	0	953.52
13	0	953.55
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13.48	0	953.57
13.54	0	953.58
14.04	0	953.62
14.13	0	953.63
14.42	0	953.67
14.54	0	953.68
15.04	0	953.73
15.73	0	953.79
15.85	0	953.81
16.04	0	953.82
16.54	0	953.85
17.04	0	953.88
17.54	0	953.91
17.74	0	953.93
17.85	0	953.94
18.04	0	953.95
19.04	0	954
19.17	0	954
19.44	0	954.03
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22.05	0	954.14
22.55	0	954.16
24.05	0	954.23
24.55	0	954.24
25.05	0	954.24
25.33	0	954.23
26.06	0	954.22
26.56	0	954.21
27.06	0	954.22
27.23	0	954.22
27.4	0	954.22
27.56	0	954.21
28.06	0	954.22
28.56	0	954.23
29.06	0	954.25
30.06	0	954.26
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34.81	0	954.76
34.83	0	954.76
35.07	0	954.78
35.28	0	954.8
35.36	0	954.82
35.57	0	954.84

35.76	0	954.87	
35.89	0	954.88	
36.07	0	954.9	
36.71	0	954.95	
36.95	0	954.98	
37.07	0	954.99	
37.18	0	955	
37.48	0	955.03	
37.57	0	955.04	
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39.58	0	955.39	
39.61	0	955.4	
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40.08	0	955.54	
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40.5	0	955.69	
40.58	0	955.73	
40.67	0	955.75	
40.97	0	955.83	
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41.2	0	955.89	
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41.73	0	956.09	
41.92	0	956.23	
42.08	0	956.32	
42.26	0	956.38	
42.4	0	956.4	rew
42.58	0	956.47	
42.79	0	956.58	
42.87	0	956.62	
43.08	0	956.74	
43.32	0	956.83	
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43.82	0	957.03	
43.85	0	957.04	
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44.38	0	957.22	
44.58	0	957.29	
44.77	0	957.38	
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45.44	0	957.78	
45.59	0	957.88	ib
45.72	0	957.95	
45.97	0	958.1	
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47.59	0	958.92	
47.61	0	958.93	
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55.6	0	961.27	bkf
55.67	0	961.3	
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58.71	0	962.35	
58.99	0	962.54	
59.24	0	962.68	
59.46	0	962.78	
59.61	0	962.86	
59.77	0	962.96	
59.94	0	963.07	
60.11	0	963.18	
60.3	0	963.26	
60.41	0	963.3	
60.61	0	963.39	
61.11	0	963.61	
61.36	0	963.75	
61.36	0	963.75	
61.61	0	963.89	
61.83	0	964	
61.89	0	964.03	
62.11	0	964.14	
62.31	0	964.27	
62.42	0	964.36	
62.61	0	964.48	
62.78	0	964.62	
62.95	0	964.77	

63.11	0	964.9
63.26	0	965.02
63.48	0	965.22
63.61	0	965.34
63.73	0	965.41
64.02	0	965.62
64.12	0	965.69
65.12	0	966.29
65.15	0	966.31
65.61	0	966.66
65.62	0	966.66
66.1	0	967.08
66.12	0	967.09
66.14	0	967.1
66.58	0	967.35
66.62	0	967.37
67.12	0	967.53
67.2	0	967.55
67.52	0	967.66
67.73	0	967.73
68	0	967.83
68.12	0	967.87
68.26	0	967.93
68.47	0	968.03
68.62	0	968.08
68.79	0	968.17
68.95	0	968.24
69.12	0	968.33
69.62	0	968.51
69.85	0	968.6
69.89	0	968.61
70.13	0	968.7
70.37	0	968.97
70.38	0	968.99
70.63	0	969.25
70.84	0	969.36
70.91	0	969.41
71.13	0	969.52
72.13	0	969.9
72.26	0	969.95
72.51	0	970.06
72.74	0	970.16
73.04	0	970.29
73.13	0	970.33
73.63	0	970.56
73.69	0	970.63
74.13	0	971.12
74.16	0	971.14
74.63	0	971.48
74.63	0	971.48
74.64	0	971.48
75	0	971.88

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	969.93	969.93	969.93
Bankfull Elevation (ft)	961.27	961.27	961.27
Floodprone Width (ft)	310	-----	-----
Bankfull Width (ft)	92.64	32.01	60.63
Entrenchment Ratio	3.35	-----	-----
Mean Depth (ft)	6.54	7.24	6.16
Maximum Depth (ft)	8.66	8.66	7.98

Width/Depth Ratio	14.17	4.42	9.84
Bankfull Area (sq ft)	605.62	231.85	373.78
Wetted Perimeter (ft)	97.57	43.49	69.95
Hydraulic Radius (ft)	6.21	5.33	5.34
Begin BKF Station	-37.04	-37.04	-5.03
End BKF Station	55.6	-5.03	55.6

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-1
Cross Section Name: CL 40+50 p
Survey Date: 01/25/2026

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	959.47	
0.5	0	959.42	
1	0	959.4	
1.5	0	959.4	
2	0	959.39	
2.49	0	959.39	
2.99	0	959.4	
3.49	0	959.41	
3.99	0	959.42	
4.49	0	959.43	
4.99	0	959.45	
5.49	0	959.48	
5.99	0	959.51	
6.49	0	959.53	
6.98	0	959.58	
7.48	0	959.63	
7.98	0	959.67	
8.48	0	959.71	
8.98	0	959.72	
9.48	0	959.74	
9.98	0	959.76	
10.48	0	959.77	
10.97	0	959.78	
11.47	0	959.78	
11.97	0	959.77	
12.47	0	959.76	
12.97	0	959.74	
13.47	0	959.73	
13.97	0	959.71	
14.47	0	959.7	
14.97	0	959.7	
15.46	0	959.71	
15.96	0	959.74	
16.46	0	959.78	
16.96	0	959.83	
17.46	0	959.89	
17.96	0	959.97	
18.46	0	960.05	
18.96	0	960.11	
19.46	0	960.2	
19.95	0	960.32	
20.45	0	960.47	
20.95	0	960.64	
21.45	0	960.73	
21.95	0	960.91	
22.45	0	961.02	
22.95	0	961.09	
23.45	0	961.05	
23.94	0	960.88	

24.44	0	960.57	
24.94	0	960.16	
25.44	0	959.7	
25.94	0	959.4	
26.44	0	959.23	
26.94	0	959.01	
27.44	0	958.68	
27.94	0	958.19	
28.43	0	957.4	
28.93	0	956.89	
29.43	0	956.74	
29.93	0	956.57	
30.43	0	956.2	
30.93	0	955.77	
31.43	0	955.5	
31.93	0	955.28	WS
32.43	0	955.06	
32.92	0	954.85	
33.42	0	954.54	
33.92	0	954.14	
34.42	0	953.6	
34.92	0	953.1	
35.42	0	952.58	
35.92	0	952.24	
36.42	0	951.87	
36.92	0	951.63	
37.41	0	951.43	
37.91	0	951.28	
38.41	0	951.17	
38.91	0	951.1	
39.41	0	951.06	
39.91	0	951.01	
40.41	0	950.96	
40.91	0	950.91	
41.4	0	950.89	
41.9	0	950.88	
42.4	0	950.88	
42.9	0	950.88	
43.4	0	950.88	
43.9	0	950.89	
44.4	0	950.89	
44.9	0	950.9	
45.4	0	950.91	
45.89	0	950.91	
46.39	0	950.9	
46.89	0	950.88	
47.39	0	950.87	
47.89	0	950.85	
48.39	0	950.83	
48.89	0	950.8	
49.39	0	950.77	
49.89	0	950.75	
50.38	0	950.73	
50.88	0	950.71	
51.38	0	950.71	
51.88	0	950.72	
52.38	0	950.73	
52.88	0	950.76	
53.38	0	950.78	
53.88	0	950.83	
54.37	0	950.9	
54.87	0	950.97	
55.37	0	951.05	
55.87	0	951.11	
56.37	0	951.18	
56.87	0	951.26	

57.37	0	951.35	
57.87	0	951.43	
58.37	0	951.48	
58.86	0	951.56	
59.36	0	951.63	
59.86	0	951.69	
60.36	0	951.77	
60.86	0	951.83	
61.36	0	951.87	
61.86	0	951.93	
62.36	0	951.99	
62.86	0	952.06	
63.35	0	952.12	
63.85	0	952.17	
64.35	0	952.26	
64.85	0	952.35	
65.35	0	952.44	
65.85	0	952.57	
66.35	0	952.64	
66.85	0	952.71	
67.35	0	952.76	
67.84	0	952.83	
68.34	0	952.9	
68.84	0	952.95	
69.34	0	953.02	
69.84	0	953.1	
70.34	0	953.17	
70.84	0	953.27	
71.34	0	953.36	
71.83	0	953.51	
72.33	0	953.65	
72.83	0	953.75	
73.33	0	953.86	
73.83	0	953.98	
74.33	0	954.09	
74.83	0	954.19	
75.33	0	954.31	
75.83	0	954.39	
76.32	0	954.45	
76.82	0	954.49	
77.32	0	954.52	
77.82	0	954.57	
78.32	0	954.63	
78.82	0	954.67	
79.32	0	954.73	
79.82	0	954.76	
80.32	0	954.86	
80.81	0	954.99	
81.31	0	955.07	
81.81	0	955.26	
82.31	0	955.5	
82.81	0	955.7	
83.31	0	955.88	
83.81	0	956.04	
84.31	0	956.22	
84.8	0	956.42	
85.3	0	956.59	
85.8	0	956.72	
86.3	0	956.82	
86.8	0	957	
87.3	0	957.33	
87.8	0	957.53	
88.3	0	957.69	
88.8	0	957.88	
89.29	0	958.05	
89.79	0	958.28	IB

90.29	0	958.46	
90.79	0	958.61	
91.29	0	958.77	
91.79	0	958.95	
92.29	0	959.07	
92.79	0	959.16	
93.29	0	959.2	
93.78	0	959.22	
94.28	0	959.21	
94.78	0	959.18	
95.28	0	959.13	
95.78	0	959.12	
96.28	0	959.06	
96.78	0	959	
97.28	0	958.94	
97.78	0	958.87	
98.27	0	958.83	
98.77	0	958.81	
99.27	0	958.81	
99.77	0	958.82	
100.27	0	958.85	
100.77	0	958.93	
101.27	0	959.03	
101.77	0	959.15	
102.26	0	959.38	
102.76	0	959.63	
103.26	0	960.11	
103.76	0	960.58	
104.26	0	960.8	
104.76	0	961.02	
105.26	0	961.26	
105.76	0	961.47	BKF
106.26	0	961.67	
106.75	0	961.87	
107.25	0	962.09	
107.75	0	962.32	
108.25	0	962.55	
108.75	0	962.79	
109.25	0	963.02	
109.75	0	963.23	
110.25	0	963.41	
110.75	0	963.59	
111.24	0	963.8	
111.74	0	964.13	
112.24	0	964.51	
112.74	0	964.87	
113.24	0	965.11	
113.74	0	965.3	
114.24	0	965.46	
114.74	0	965.68	
115.23	0	966.16	
115.73	0	966.65	
116.23	0	966.87	
116.73	0	967.08	
117.23	0	967.33	
117.73	0	967.62	
118.23	0	968.08	
118.73	0	968.61	
119.23	0	969.24	

Cross Sectional Geometry

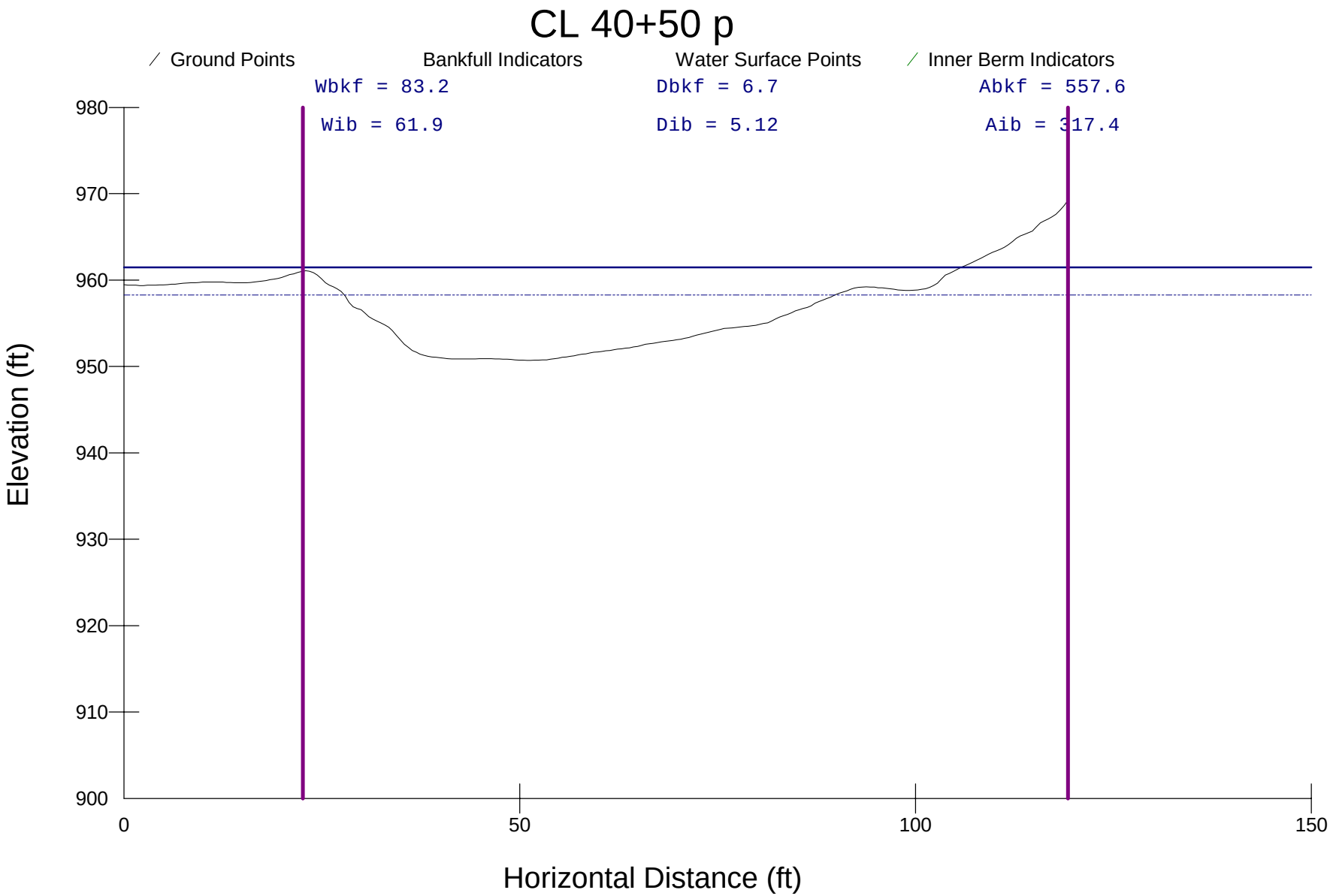
	Channel	Left	Right

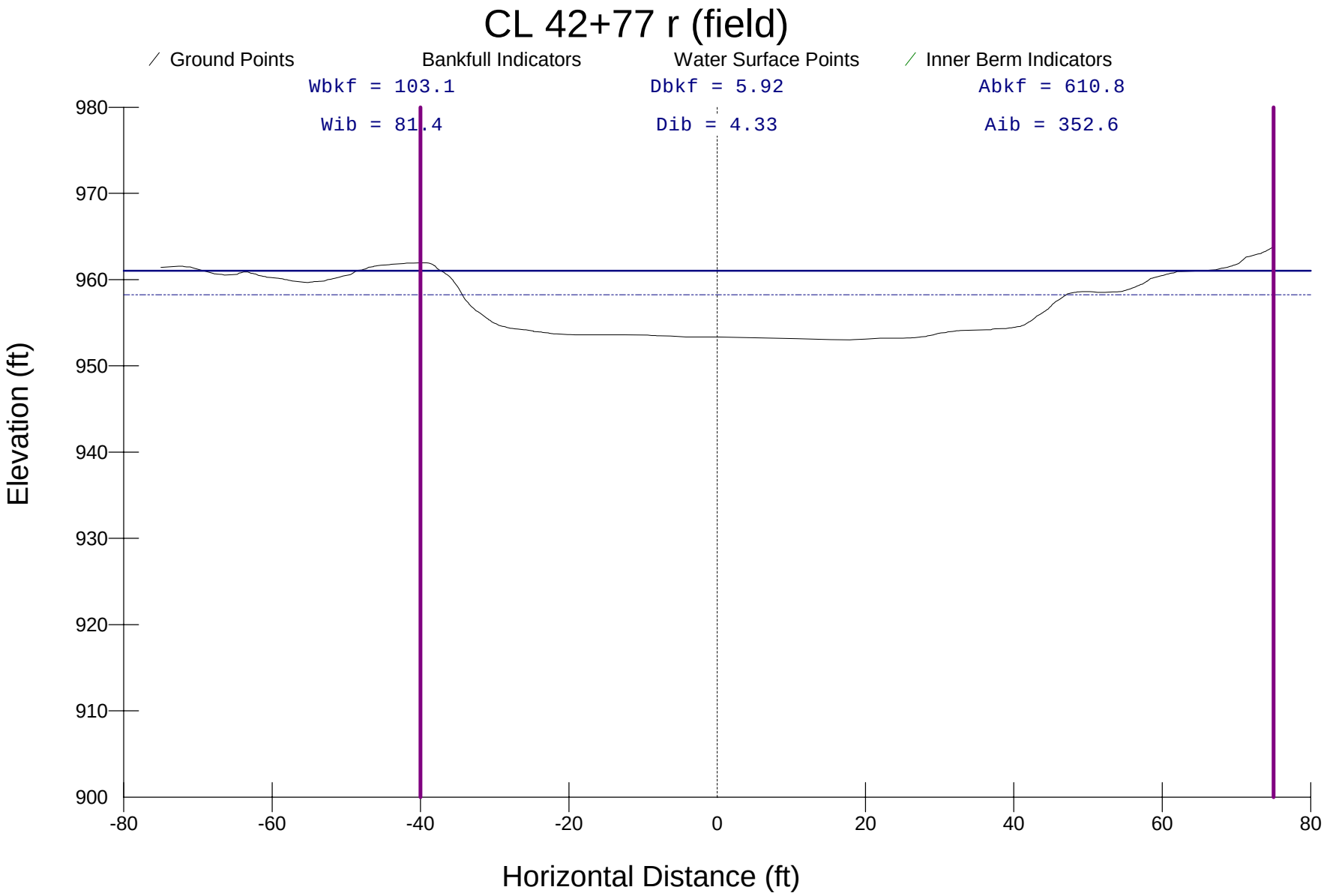
Floodprone Elevation (ft)	972.23	972.23	972.23
Bankfull Elevation (ft)	961.47	961.47	961.47
Floodprone Width (ft)	119.23	-----	-----
Bankfull Width (ft)	83.16	41.58	41.58
Entrenchment Ratio	1.43	-----	-----
Mean Depth (ft)	6.7	8.4	5.01
Maximum Depth (ft)	10.76	10.76	9.24
Width/Depth Ratio	12.41	4.95	8.3
Bankfull Area (sq ft)	557.58	349.1	208.48
Wetted Perimeter (ft)	88.8	54.71	52.57
Hydraulic Radius (ft)	6.28	6.38	3.97
Begin BKF Station	22.6	22.6	64.18
End BKF Station	105.76	64.18	105.76

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


CL 40+50 p
Ground Points
Bankfull Indicators
Water Surface Points
Inner Berm Indicators
Wbkf = 83.2
Dbkf = 6.7
Abkf = 557.6
Wib = 61.9
Dib = 5.12
Aib = 317.4
980
970
960
950
940
930
920
910
900
Elevation (ft)
0
50
100
150
Horizontal Distance (ft)


CL 42+77 r (field)
Ground Points
Bankfull Indicators
Water Surface Points
Inner Berm Indicators
Wbkf = 103.1
Wib = 81.4
Dbkf = 5.92
Dib = 4.33
Abkf = 610.8
Aib = 352.6
980
970
960
950
940
930
920
910
900
Elevation (ft)
-80
-60
-40
-20
0
20
40
60
80
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-1
Cross Section Name: CL 42+77 r (field)
Survey Date: 11/19/2025

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
-75	0	961.42	
-72.58	0	961.57	
-72.55	0	961.57	
-72.03	0	961.57	
-71.82	0	961.53	
-71.75	0	961.51	
-71.52	0	961.47	
-71.01	0	961.48	
-70.55	0	961.34	
-67.92	0	960.72	
-67.79	0	960.7	
-67.59	0	960.7	
-67.41	0	960.66	
-66.9	0	960.62	
-66.76	0	960.61	
-66.44	0	960.53	
-66.38	0	960.53	
-64.68	0	960.61	
-64.42	0	960.74	
-64.33	0	960.78	
-64.27	0	960.8	
-63.85	0	960.89	
-63.81	0	960.9	
-63.3	0	960.91	
-62.79	0	960.73	
-62.61	0	960.71	
-62.41	0	960.69	
-62.27	0	960.68	
-62.19	0	960.64	
-61.84	0	960.49	
-61.77	0	960.47	
-61.76	0	960.46	
-61.73	0	960.46	
-61.36	0	960.42	
-61.25	0	960.4	
-61.06	0	960.37	
-60.94	0	960.35	
-60.73	0	960.3	
-60.22	0	960.25	
-59.28	0	960.17	
-59.19	0	960.16	
-59.04	0	960.14	
-58.87	0	960.11	
-58.68	0	960.09	
-58.45	0	960.05	
-58.37	0	960.04	
-58.16	0	960.01	
-58.03	0	959.99	
-57.7	0	959.92	

-57.65	0	959.91
-57.49	0	959.89
-57.2	0	959.86
-57.14	0	959.85
-55.96	0	959.74
-55.68	0	959.7
-55.59	0	959.69
-55.31	0	959.68
-55.12	0	959.68
-55.08	0	959.68
-55.01	0	959.69
-54.71	0	959.74
-54.57	0	959.75
-54.34	0	959.76
-54.29	0	959.76
-54.05	0	959.78
-53.88	0	959.79
-53.66	0	959.81
-53.54	0	959.82
-53.46	0	959.82
-53.05	0	959.85
-53.03	0	959.86
-52.99	0	959.86
-52.63	0	959.97
-52.51	0	960
-52.22	0	960.04
-52	0	960.06
-51.8	0	960.1
-51.65	0	960.14
-51.48	0	960.17
-51.38	0	960.2
-50.97	0	960.3
-50.97	0	960.3
-50.97	0	960.3
-50.46	0	960.41
-49.94	0	960.5
-49.72	0	960.53
-49.43	0	960.57
-49.31	0	960.63
-48.96	0	960.84
-48.92	0	960.86
-48.78	0	960.92
-48.47	0	961.06
-48.4	0	961.08
-47.89	0	961.13
-47.64	0	961.19
-47.61	0	961.2
-47.37	0	961.26
-47.23	0	961.31
-46.94	0	961.43
-46.86	0	961.46
-46.81	0	961.46
-46.4	0	961.52
-46.35	0	961.52
-46.27	0	961.54
-45.98	0	961.59
-45.83	0	961.61
-45.32	0	961.65
-44.81	0	961.71
-44.73	0	961.71
-44.32	0	961.74
-44.29	0	961.75
-44.25	0	961.75
-43.9	0	961.77
-42.24	0	961.87
-41.82	0	961.9

-41.72	0	961.9	
-41.21	0	961.92	
-40.99	0	961.93	
-40.89	0	961.93	
-40.18	0	961.96	
-39.33	0	961.95	
-39.15	0	961.95	
-38.91	0	961.92	
-38.87	0	961.91	
-38.64	0	961.87	
-38.5	0	961.81	
-38.2	0	961.67	
-38.13	0	961.64	
-38.08	0	961.61	
-37.9	0	961.45	
-37.67	0	961.25	
-37.61	0	961.22	
-37.52	0	961.17	
-37.25	0	961.03	bkf
-36.85	0	960.82	
-36.84	0	960.81	
-36.59	0	960.67	
-36.42	0	960.58	
-36.07	0	960.37	
-36.01	0	960.3	
-35.72	0	960.02	
-35.59	0	959.87	
-35.56	0	959.84	
-35.04	0	959.24	
-34.83	0	958.96	
-34.76	0	958.87	
-34.53	0	958.55	
-34.34	0	958.22	ib
-34.16	0	957.97	
-34.02	0	957.73	
-33.93	0	957.64	
-33.55	0	957.3	
-33.51	0	957.27	
-33.5	0	957.26	
-33.49	0	957.25	
-33.1	0	956.88	
-32.99	0	956.8	
-32.82	0	956.67	
-32.68	0	956.56	
-32.48	0	956.41	
-32.26	0	956.29	
-32.14	0	956.23	
-31.96	0	956.13	
-31.45	0	955.8	
-31.43	0	955.79	
-31.02	0	955.5	
-30.93	0	955.44	
-30.8	0	955.36	
-30.6	0	955.26	lew
-30.42	0	955.14	
-30.19	0	955.02	
-30.13	0	955	
-29.91	0	954.91	
-29.77	0	954.86	
-29.45	0	954.72	
-29.39	0	954.7	
-29.36	0	954.69	
-28.88	0	954.59	
-28.78	0	954.57	
-28.52	0	954.5	
-28.37	0	954.46	

-28.11	0	954.42
-28.11	0	954.42
-27.85	0	954.38
-27.69	0	954.36
-27.44	0	954.33
-27.28	0	954.31
-26.82	0	954.27
-26.31	0	954.23
-26.03	0	954.2
-25.8	0	954.17
-25.28	0	954.11
-25.2	0	954.1
-24.84	0	954.04
-24.78	0	954.03
-24.77	0	954.03
-24.75	0	954.02
-24.37	0	953.96
-24.26	0	953.95
-23.95	0	953.93
-23.74	0	953.92
-23.54	0	953.9
-23.23	0	953.86
-22.71	0	953.81
-22.71	0	953.81
-22.67	0	953.8
-22.29	0	953.75
-22.2	0	953.74
-22.06	0	953.73
-21.87	0	953.72
-21.69	0	953.71
-20.15	0	953.64
-19.8	0	953.63
-19.12	0	953.62
-18.09	0	953.61
-18.02	0	953.61
-17.72	0	953.61
-17.58	0	953.61
-16.55	0	953.6
-16.47	0	953.6
-16.14	0	953.6
-15.01	0	953.59
-13.47	0	953.6
-12.44	0	953.59
-9.4	0	953.55
-9.36	0	953.55
-8.84	0	953.54
-8.57	0	953.53
-8.33	0	953.52
-8.16	0	953.51
-7.94	0	953.5
-7.82	0	953.49
-6.27	0	953.45
-4.73	0	953.37
-4.22	0	953.36
0	0	953.35
10.68	0	953.17
15.3	0	953.06
17.87	0	953.04
18.38	0	953.06
19.93	0	953.11
20.44	0	953.14
21.98	0	953.19
22.49	0	953.21
24.55	0	953.21
25.06	0	953.22
25.58	0	953.23

26.09	0	953.25	
26.34	0	953.26	
26.6	0	953.28	
27.12	0	953.33	
27.17	0	953.33	
27.59	0	953.39	
27.63	0	953.4	
28.15	0	953.44	
28.38	0	953.48	
28.42	0	953.49	
28.66	0	953.53	
29.17	0	953.61	
29.25	0	953.63	
29.57	0	953.71	
29.66	0	953.74	
29.69	0	953.74	
30.2	0	953.81	
30.71	0	953.85	
30.91	0	953.89	
31.07	0	953.92	
31.23	0	953.96	
31.33	0	953.97	
31.74	0	954.02	
31.75	0	954.02	
32.16	0	954.05	
32.26	0	954.06	
32.41	0	954.07	
32.57	0	954.08	
32.77	0	954.1	
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36.37	0	954.17	
36.45	0	954.17	
36.73	0	954.19	
36.88	0	954.2	
37.12	0	954.24	
37.15	0	954.24	
37.39	0	954.28	
38.42	0	954.32	
38.81	0	954.34	
38.93	0	954.34	
39.45	0	954.4	
39.64	0	954.42	
39.96	0	954.47	
40.06	0	954.48	
40.45	0	954.54	
40.48	0	954.54	
40.48	0	954.54	
40.89	0	954.6	
40.99	0	954.62	
41.15	0	954.68	
41.3	0	954.73	
41.5	0	954.81	
41.72	0	954.93	
41.83	0	954.98	
42.02	0	955.08	
42.13	0	955.14	
42.5	0	955.34	rew
42.53	0	955.36	
42.55	0	955.37	
42.96	0	955.67	
43.04	0	955.74	
43.56	0	956.01	
43.8	0	956.13	
43.84	0	956.16	
44.07	0	956.28	
44.21	0	956.35	

44.52	0	956.54	
44.59	0	956.58	
44.81	0	956.78	
45.04	0	956.98	
45.1	0	957.03	
45.19	0	957.11	
45.46	0	957.33	
45.61	0	957.46	
46.13	0	957.72	
46.64	0	958.03	
46.71	0	958.07	
47.12	0	958.29	
47.15	0	958.31	ib
47.67	0	958.42	
48.18	0	958.53	
48.37	0	958.55	
48.55	0	958.57	
48.7	0	958.59	
48.78	0	958.59	
49.2	0	958.6	
49.72	0	958.61	
50.24	0	958.6	
50.75	0	958.57	
51.26	0	958.54	
51.78	0	958.55	
52.29	0	958.53	
53.36	0	958.56	
53.77	0	958.58	
53.83	0	958.58	
53.93	0	958.59	
54.19	0	958.61	
54.35	0	958.62	
54.6	0	958.66	
54.86	0	958.71	
55.02	0	958.75	
55.37	0	958.86	
55.43	0	958.87	
55.85	0	958.99	
55.89	0	959	
56.27	0	959.12	
56.4	0	959.16	
56.62	0	959.25	
56.68	0	959.27	
56.91	0	959.37	
57.1	0	959.43	
57.29	0	959.5	
57.43	0	959.55	
57.51	0	959.59	
57.86	0	959.79	
57.93	0	959.82	
57.94	0	959.83	
57.97	0	959.85	
58.34	0	960.07	
58.46	0	960.12	
58.64	0	960.17	
58.76	0	960.21	
58.97	0	960.26	
59.48	0	960.35	
59.59	0	960.38	
59.98	0	960.45	
60	0	960.45	
60.01	0	960.45	
60.04	0	960.46	
60.42	0	960.58	
60.51	0	960.61	
60.66	0	960.63	

60.84	0	960.67	
61.02	0	960.71	
61.25	0	960.75	
61.54	0	960.8	
62.05	0	960.92	
62.5	0	960.95	
62.57	0	960.95	
63.59	0	960.99	
65.65	0	961.03	
65.82	0	961.05	
66.04	0	961.06	bkf
66.24	0	961.08	
66.66	0	961.12	
66.68	0	961.12	
67.19	0	961.17	
67.7	0	961.27	
67.9	0	961.3	
68.05	0	961.32	
68.22	0	961.35	
68.32	0	961.36	
68.73	0	961.42	
68.73	0	961.42	
69.24	0	961.55	
69.4	0	961.59	
69.57	0	961.65	
69.76	0	961.7	
70.27	0	961.87	
70.4	0	961.96	
70.74	0	962.2	
70.79	0	962.23	
70.81	0	962.25	
71.23	0	962.56	
71.3	0	962.61	
71.42	0	962.64	
71.64	0	962.69	
71.81	0	962.73	
72.89	0	962.96	
73.1	0	963	
73.31	0	963.05	
73.35	0	963.07	
73.43	0	963.1	
73.72	0	963.21	
73.87	0	963.27	
74.11	0	963.4	
74.14	0	963.42	
74.38	0	963.53	
74.55	0	963.6	
74.78	0	963.69	
74.97	0	963.76	
75	0	963.78	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	969.06	969.06	969.06
Bankfull Elevation (ft)	961.05	961.05	961.05
Floodprone Width (ft)	490	-----	-----
Bankfull Width (ft)	103.11	34.99	68.12
Entrenchment Ratio	4.75	-----	-----
Mean Depth (ft)	5.92	6.47	5.64
Maximum Depth (ft)	8.01	7.69	8.01
Width/Depth Ratio	17.42	5.41	12.08
Bankfull Area (sq ft)	610.8	226.42	384.39

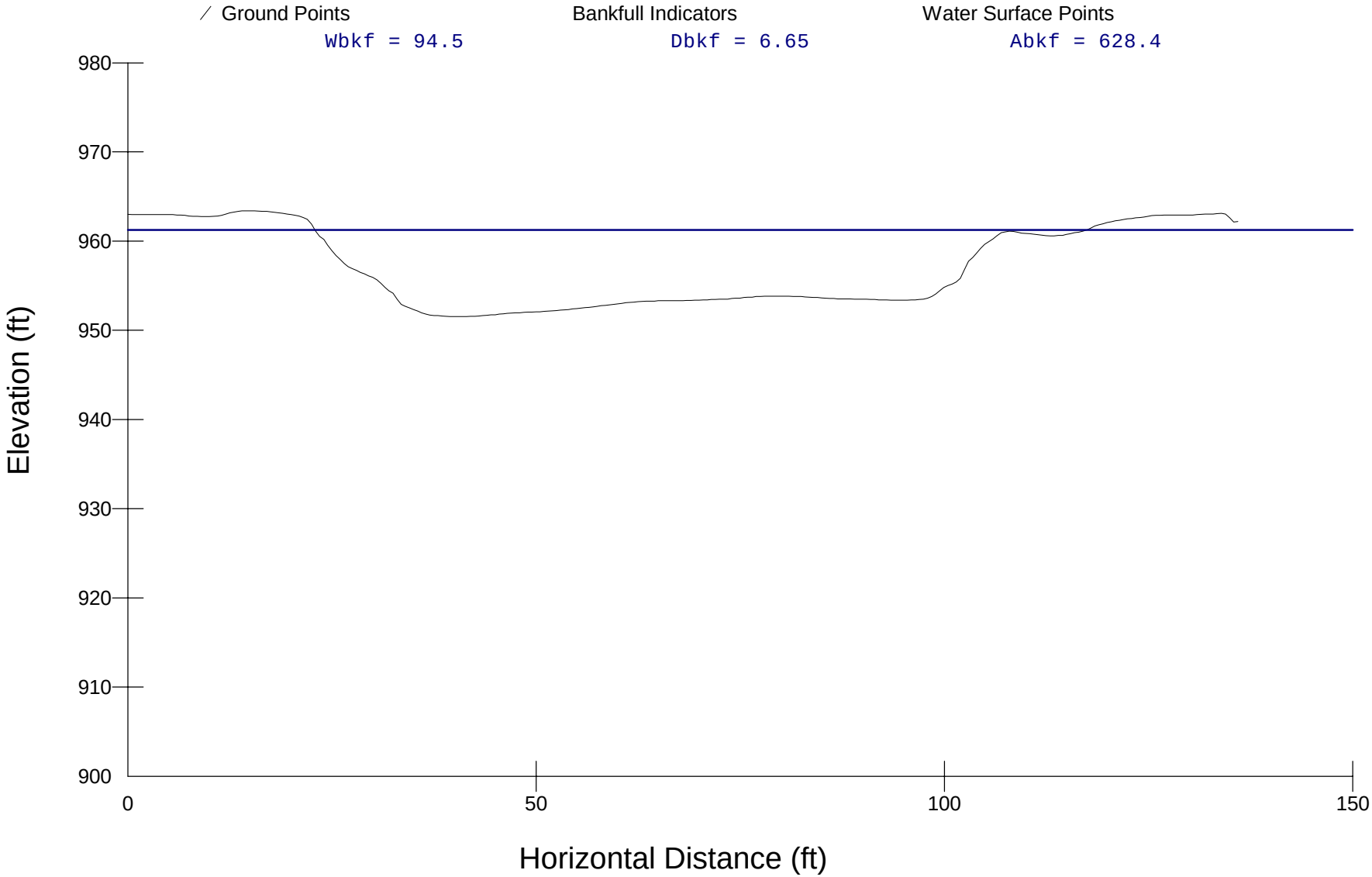
Wetted Perimeter (ft)	107.21	45.19	77.4
Hydraulic Radius (ft)	5.7	5.01	4.97
Begin BKF Station	-37.29	-37.29	-2.3
End BKF Station	65.82	-2.3	65.82

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

62+00 Pool


Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 94.5
Dbkf = 6.65
Abkf = 628.4
980
970
960
950
940
930
920
910
900
Elevation (ft)
0
50
100
150
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-2
Cross Section Name: 62+00 Pool
Survey Date: 01/25/2026

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	962.99	
0.5	0	962.98	
1	0	962.98	
1.5	0	962.97	
2	0	962.98	
2.5	0	962.98	
3	0	962.98	
3.5	0	962.98	
4	0	962.98	
4.5	0	962.98	
5	0	962.97	
5.5	0	962.96	
6	0	962.95	
6.5	0	962.93	
7	0	962.89	
7.49	0	962.84	
7.99	0	962.8	
8.49	0	962.78	
8.99	0	962.76	
9.49	0	962.75	
9.99	0	962.76	
10.49	0	962.8	
10.99	0	962.84	
11.49	0	962.91	
11.99	0	963.03	
12.49	0	963.17	
12.99	0	963.27	
13.49	0	963.35	
13.99	0	963.39	
14.49	0	963.4	
14.99	0	963.4	
15.49	0	963.39	
15.99	0	963.38	
16.49	0	963.35	
16.99	0	963.32	
17.49	0	963.28	
17.99	0	963.23	
18.49	0	963.19	
18.99	0	963.11	
19.49	0	963.04	
19.99	0	962.97	
20.49	0	962.9	
20.99	0	962.82	
21.49	0	962.66	
21.98	0	962.45	
22.48	0	961.9	
22.98	0	961.11	
23.48	0	960.54	
23.98	0	960.21	

24.48	0	959.57
24.98	0	958.93
25.48	0	958.41
25.98	0	957.96
26.48	0	957.5
26.98	0	957.14
27.48	0	956.92
27.98	0	956.72
28.48	0	956.52
28.98	0	956.32
29.48	0	956.12
29.98	0	955.92
30.48	0	955.67
30.98	0	955.29
31.48	0	954.8
31.98	0	954.45
32.48	0	954.16
32.98	0	953.46
33.48	0	952.9
33.98	0	952.68
34.48	0	952.51
34.98	0	952.32
35.48	0	952.15
35.98	0	951.96
36.47	0	951.82
36.97	0	951.71
37.47	0	951.66
37.97	0	951.63
38.47	0	951.59
38.97	0	951.56
39.47	0	951.54
39.97	0	951.53
40.47	0	951.53
40.97	0	951.53
41.47	0	951.54
41.97	0	951.56
42.47	0	951.58
42.97	0	951.61
43.47	0	951.65
43.97	0	951.69
44.47	0	951.74
44.97	0	951.77
45.47	0	951.81
45.97	0	951.85
46.47	0	951.9
46.97	0	951.92
47.47	0	951.96
47.97	0	951.98
48.47	0	952.01
48.97	0	952.04
49.47	0	952.05
49.97	0	952.07
50.47	0	952.08
50.97	0	952.11
51.46	0	952.14
51.96	0	952.18
52.46	0	952.21
52.96	0	952.25
53.46	0	952.3
53.96	0	952.35
54.46	0	952.39
54.96	0	952.44
55.46	0	952.49
55.96	0	952.54
56.46	0	952.59
56.96	0	952.64

57.46	0	952.7
57.96	0	952.76
58.46	0	952.8
58.96	0	952.85
59.46	0	952.91
59.96	0	952.96
60.46	0	953.03
60.96	0	953.09
61.46	0	953.13
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62.46	0	953.21
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63.96	0	953.29
64.46	0	953.29
64.96	0	953.3
65.46	0	953.31
65.95	0	953.32
66.45	0	953.33
66.95	0	953.33
67.45	0	953.33
67.95	0	953.33
68.45	0	953.34
68.95	0	953.36
69.45	0	953.38
69.95	0	953.4
70.45	0	953.42
70.95	0	953.44
71.45	0	953.45
71.95	0	953.46
72.45	0	953.48
72.95	0	953.49
73.45	0	953.51
73.95	0	953.55
74.45	0	953.59
74.95	0	953.62
75.45	0	953.66
75.95	0	953.7
76.45	0	953.73
76.95	0	953.78
77.45	0	953.8
77.95	0	953.82
78.45	0	953.83
78.95	0	953.83
79.45	0	953.84
79.95	0	953.84
80.44	0	953.83
80.94	0	953.82
81.44	0	953.8
81.94	0	953.79
82.44	0	953.77
82.94	0	953.74
83.44	0	953.72
83.94	0	953.69
84.44	0	953.67
84.94	0	953.63
85.44	0	953.59
85.94	0	953.57
86.44	0	953.55
86.94	0	953.54
87.44	0	953.53
87.94	0	953.52
88.44	0	953.52
88.94	0	953.51
89.44	0	953.5
89.94	0	953.49

90.44	0	953.48	
90.94	0	953.47	
91.44	0	953.46	
91.94	0	953.44	
92.44	0	953.42	
92.94	0	953.41	
93.44	0	953.4	
93.94	0	953.4	
94.44	0	953.39	
94.93	0	953.39	
95.43	0	953.4	
95.93	0	953.41	
96.43	0	953.43	
96.93	0	953.46	
97.43	0	953.51	
97.93	0	953.6	
98.43	0	953.77	
98.93	0	954.07	
99.43	0	954.48	
99.93	0	954.81	WS
100.43	0	955.02	
100.93	0	955.21	
101.43	0	955.41	
101.93	0	955.83	
102.43	0	956.76	
102.93	0	957.75	
103.43	0	958.19	
103.93	0	958.64	
104.43	0	959.2	
104.93	0	959.64	
105.43	0	959.95	
105.93	0	960.25	
106.43	0	960.61	
106.93	0	960.93	
107.43	0	961.05	
107.93	0	961.1	
108.43	0	961.08	
108.93	0	961	
109.42	0	960.91	
109.92	0	960.85	
110.42	0	960.82	
110.92	0	960.78	
111.42	0	960.73	
111.92	0	960.67	
112.42	0	960.62	
112.92	0	960.59	
113.42	0	960.59	
113.92	0	960.63	
114.42	0	960.66	
114.92	0	960.74	
115.42	0	960.84	
115.92	0	960.93	
116.42	0	961.01	
116.92	0	961.11	
117.42	0	961.28	BKF
117.92	0	961.49	
118.42	0	961.69	
118.92	0	961.86	
119.42	0	961.97	
119.92	0	962.08	
120.42	0	962.17	
120.92	0	962.27	
121.42	0	962.36	
121.92	0	962.43	
122.42	0	962.48	
122.92	0	962.54	

123.42	0	962.6
123.92	0	962.66
124.41	0	962.73
124.91	0	962.8
125.41	0	962.86
125.91	0	962.9
126.41	0	962.91
126.91	0	962.93
127.41	0	962.94
127.91	0	962.94
128.41	0	962.95
128.91	0	962.95
129.41	0	962.94
129.91	0	962.93
130.41	0	962.94
130.91	0	962.97
131.41	0	963.01
131.91	0	963.03
132.41	0	963.04
132.91	0	963.05
133.41	0	963.08
133.91	0	963.12
134.41	0	963.05
134.91	0	962.62
135.41	0	962.15
135.91	0	962.2

Cross Sectional Geometry

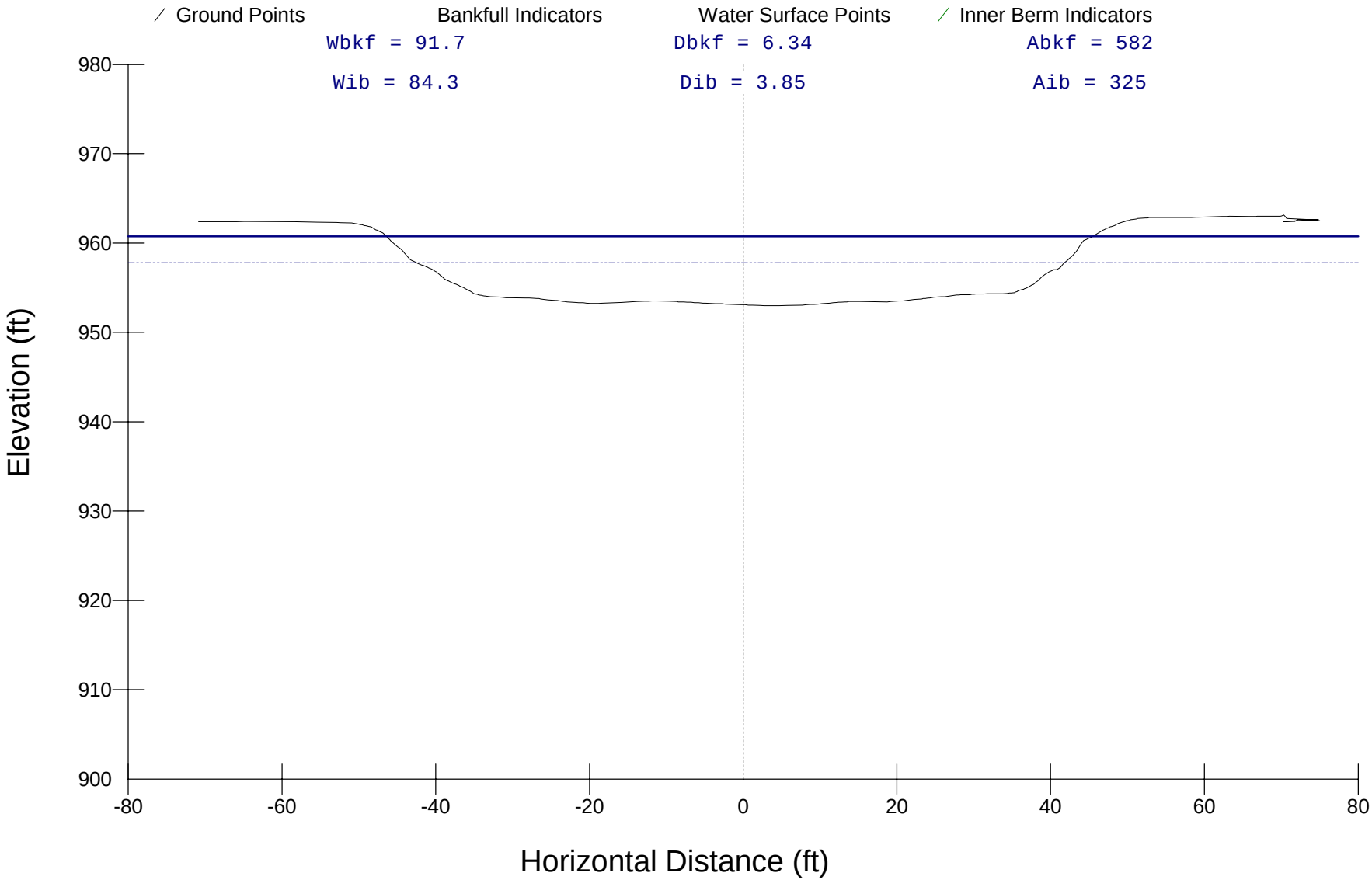
	Channel	Left	Right
Floodprone Elevation (ft)	971.03	971.03	971.03
Bankfull Elevation (ft)	961.28	961.28	961.28
Floodprone Width (ft)	135.91	-----	-----
Bankfull Width (ft)	94.55	47.28	47.27
Entrenchment Ratio	1.44	-----	-----
Mean Depth (ft)	6.65	7.87	5.42
Maximum Depth (ft)	9.75	9.75	7.89
Width/Depth Ratio	14.22	6.01	8.72
Bankfull Area (sq ft)	628.43	372	256.44
Wetted Perimeter (ft)	101.11	58.63	58.22
Hydraulic Radius (ft)	6.22	6.34	4.4
Begin BKF Station	22.87	22.87	70.15
End BKF Station	117.42	70.15	117.42

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

63+69 Riffle


Ground Points
Bankfull Indicators
Water Surface Points
Inner Berm Indicators
Wbkf = 91.7
Dbkf = 6.34
Abkf = 582
Wib = 84.3
Dib = 3.85
Aib = 325
980
970
960
950
940
930
920
910
900
Elevation (ft)
-80
-60
-40
-20
0
20
40
60
80
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-2
Cross Section Name: 63+69 Riffle
Survey Date: 11/19/2025

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
-70.87	0	962.38	
-68.43	0	962.38	
-66.93	0	962.37	
-66.43	0	962.37	
-65.93	0	962.39	
-64.93	0	962.41	
-64.43	0	962.42	
-58.71	0	962.4	
-58.62	0	962.4	
-58.41	0	962.4	
-55.41	0	962.35	
-52.9	0	962.3	
-52.4	0	962.29	
-50.9	0	962.23	
-50.4	0	962.18	
-50.15	0	962.14	
-50.14	0	962.14	
-49.9	0	962.1	
-49.67	0	962.06	
-49.62	0	962.05	
-49.2	0	961.96	
-49.08	0	961.94	
-48.73	0	961.87	
-48.55	0	961.83	
-48.39	0	961.8	
-48.26	0	961.73	
-48.01	0	961.6	
-47.89	0	961.54	
-47.79	0	961.49	
-47.48	0	961.39	
-47.39	0	961.35	
-46.89	0	961.15	
-46.84	0	961.11	
-46.41	0	960.78	bkf
-46.39	0	960.76	
-46.37	0	960.75	
-45.9	0	960.32	
-45.89	0	960.31	
-45.88	0	960.3	
-45.43	0	959.94	
-45.39	0	959.9	
-44.89	0	959.56	
-44.81	0	959.51	
-44.49	0	959.29	
-44.39	0	959.23	
-44.27	0	959.11	
-44.02	0	958.86	
-43.38	0	958.2	
-43.2	0	958.12	

-43.07	0	958.05	
-42.88	0	957.96	
-42.67	0	957.87	
-42.6	0	957.84	ib
-42.38	0	957.74	
-41.88	0	957.55	
-41.66	0	957.5	
-41.6	0	957.49	
-41.38	0	957.43	
-41.19	0	957.35	
-41.06	0	957.31	
-40.88	0	957.23	
-40.72	0	957.16	
-40.53	0	957.09	
-40.38	0	957.03	
-40.25	0	956.96	
-39.99	0	956.81	
-39.88	0	956.75	
-39.77	0	956.67	
-39.46	0	956.44	
-39.38	0	956.37	
-39.3	0	956.32	
-38.92	0	956.03	
-38.87	0	955.99	
-38.83	0	955.97	
-38.39	0	955.78	
-38.37	0	955.77	
-38.36	0	955.77	
-37.87	0	955.58	
-37.85	0	955.58	
-37.42	0	955.42	
-37.37	0	955.41	
-37.32	0	955.39	
-36.95	0	955.24	
-36.87	0	955.21	
-36.78	0	955.17	
-36.48	0	955.06	
-36.37	0	955.02	
-36.25	0	954.96	
-36	0	954.83	lew
-35.71	0	954.7	
-35.53	0	954.62	
-35.37	0	954.55	
-35.18	0	954.45	
-35.06	0	954.38	
-34.87	0	954.29	
-34.64	0	954.25	
-34.59	0	954.24	
-34.37	0	954.2	
-34.12	0	954.16	
-34.11	0	954.16	
-33.86	0	954.12	
-33.65	0	954.09	
-33.57	0	954.08	
-33.36	0	954.05	
-32.86	0	954	
-31.86	0	953.95	
-31.36	0	953.93	
-30.86	0	953.9	
-30.36	0	953.89	
-28.35	0	953.87	
-27.85	0	953.86	
-27.35	0	953.84	
-26.85	0	953.8	
-26.62	0	953.77	
-26.58	0	953.77	

-26.35	0	953.74
-26.11	0	953.72
-26.09	0	953.71
-25.35	0	953.65
-24.85	0	953.62
-24.35	0	953.56
-24.22	0	953.55
-23.34	0	953.47
-23.28	0	953.46
-22.88	0	953.43
-22.84	0	953.42
-21.81	0	953.36
-21.4	0	953.33
-20.84	0	953.3
-20.34	0	953.27
-19.84	0	953.25
-18.83	0	953.25
-18.33	0	953.26
-15.83	0	953.35
-13.82	0	953.46
-12.82	0	953.49
-12.32	0	953.51
-11.82	0	953.52
-11.32	0	953.52
-9.62	0	953.49
-8.67	0	953.46
-8.44	0	953.44
-7.73	0	953.42
-7.31	0	953.4
-6.81	0	953.37
-6.31	0	953.33
-5.81	0	953.31
-5.23	0	953.28
-4.9	0	953.27
-3.63	0	953.22
-3.49	0	953.21
-3.3	0	953.2
-2.8	0	953.19
-2.3	0	953.17
-0.3	0	953.11
0	0	953.1
0.2	0	953.09
0.7	0	953.07
1.21	0	953.06
2.21	0	953.02
2.71	0	953
3.71	0	952.98
4.21	0	952.98
4.71	0	952.99
5.71	0	953.01
7.72	0	953.07
8.22	0	953.1
8.72	0	953.13
9.22	0	953.15
9.23	0	953.15
9.72	0	953.17
10.22	0	953.21
10.72	0	953.25
11.23	0	953.28
11.73	0	953.33
12.23	0	953.35
12.42	0	953.37
12.53	0	953.38
12.73	0	953.39
13.23	0	953.43
13.47	0	953.44

13.73	0	953.45	
14.73	0	953.46	
15.23	0	953.46	
18.74	0	953.43	
19.24	0	953.45	
19.74	0	953.48	
20.24	0	953.52	
20.44	0	953.53	
20.54	0	953.53	
20.74	0	953.54	
21.24	0	953.58	
21.75	0	953.63	
22.25	0	953.67	
22.75	0	953.71	
23.25	0	953.76	
23.37	0	953.77	
23.65	0	953.79	
23.75	0	953.8	
23.84	0	953.81	
24.18	0	953.85	
24.25	0	953.86	
24.75	0	953.92	
24.78	0	953.92	
25.75	0	953.99	
25.79	0	953.99	
26.2	0	954.01	
26.25	0	954.02	
27.76	0	954.17	
27.93	0	954.19	
28.08	0	954.2	
28.26	0	954.21	
28.46	0	954.21	
28.55	0	954.22	
29.49	0	954.23	
29.76	0	954.24	
29.97	0	954.25	
30.07	0	954.26	
30.26	0	954.28	
30.44	0	954.28	
30.6	0	954.29	
30.76	0	954.29	
31.26	0	954.3	
31.77	0	954.32	
32.27	0	954.32	
32.77	0	954.33	
33.77	0	954.33	
34.34	0	954.36	
34.68	0	954.39	
34.77	0	954.39	
34.88	0	954.4	
35.15	0	954.43	
35.27	0	954.45	
35.41	0	954.5	
35.62	0	954.59	
35.77	0	954.65	
36.27	0	954.79	
36.48	0	954.85	rew
36.56	0	954.88	
36.78	0	954.95	
37.28	0	955.18	
37.5	0	955.28	
37.55	0	955.3	
37.78	0	955.4	
37.98	0	955.55	
38.09	0	955.62	
38.28	0	955.76	

38.45	0	955.9	
38.62	0	956.05	
38.78	0	956.17	
39.28	0	956.5	
39.39	0	956.55	
39.69	0	956.71	
39.78	0	956.75	
39.86	0	956.79	
40.23	0	956.96	
40.28	0	956.98	
40.33	0	957	
40.76	0	957.01	
40.78	0	957.02	
40.8	0	957.03	
41.12	0	957.21	
41.27	0	957.31	
41.28	0	957.32	
41.3	0	957.33	
41.75	0	957.8	ib
41.79	0	957.83	
42.29	0	958.17	
42.37	0	958.23	
42.69	0	958.47	
42.79	0	958.55	
42.9	0	958.65	
43.16	0	958.89	
43.29	0	959.01	
43.44	0	959.21	
43.63	0	959.49	
43.79	0	959.71	
43.97	0	959.91	
44.1	0	960.06	
44.29	0	960.28	
44.51	0	960.37	
44.57	0	960.39	
45.04	0	960.59	
45.04	0	960.59	
45.29	0	960.7	bkf
46.8	0	961.43	
46.93	0	961.49	
47.18	0	961.59	
47.3	0	961.65	
47.4	0	961.68	
47.71	0	961.79	
47.8	0	961.83	
47.87	0	961.85	
48.25	0	961.96	
48.3	0	961.98	
48.34	0	962	
48.78	0	962.21	
48.8	0	962.21	
48.81	0	962.22	
49.29	0	962.34	
49.3	0	962.34	
49.8	0	962.47	
49.85	0	962.48	
50.23	0	962.55	
50.3	0	962.58	
50.39	0	962.59	
50.7	0	962.65	
50.92	0	962.68	
51.17	0	962.73	
51.3	0	962.75	
51.81	0	962.8	
52.31	0	962.83	
52.53	0	962.84	

52.58	0	962.84
52.81	0	962.85
57.3	0	962.85
58.32	0	962.86
58.94	0	962.88
59.18	0	962.9
60.32	0	962.94
62.33	0	962.97
62.48	0	962.97
62.69	0	962.98
62.83	0	962.98
62.95	0	962.98
63.22	0	962.99
63.33	0	962.99
65.83	0	962.96
65.9	0	962.96
66.25	0	962.96
66.33	0	962.96
66.43	0	962.97
66.72	0	962.98
66.84	0	962.99
68.34	0	963.02
69.84	0	963
70.02	0	963.05
70.18	0	963.09
70.34	0	963.14
70.49	0	962.98
70.71	0	962.75
73.35	0	962.63
73.38	0	962.63
73.79	0	962.63
73.85	0	962.63
74.35	0	962.63
74.85	0	962.6
70.26	0	962.41
70.6	0	962.43
70.76	0	962.44
71.64	0	962.43
71.77	0	962.44
71.82	0	962.46
71.92	0	962.49
72.16	0	962.59
72.35	0	962.62
72.88	0	962.61
72.94	0	962.61
73.11	0	962.59
75	0	962.48

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	968.5	968.5	968.5
Bankfull Elevation (ft)	960.74	960.74	960.74
Floodprone Width (ft)	1570	-----	-----
Bankfull Width (ft)	91.73	45.98	45.75
Entrenchment Ratio	17.12	-----	-----
Mean Depth (ft)	6.34	6.33	6.36
Maximum Depth (ft)	7.76	7.63	7.76
Width/Depth Ratio	14.47	7.27	7.19
Bankfull Area (sq ft)	582.01	290.82	291.19
Wetted Perimeter (ft)	95.8	55.54	55.52
Hydraulic Radius (ft)	6.08	5.24	5.24
Begin BKF Station	-46.36	-46.36	-0.38

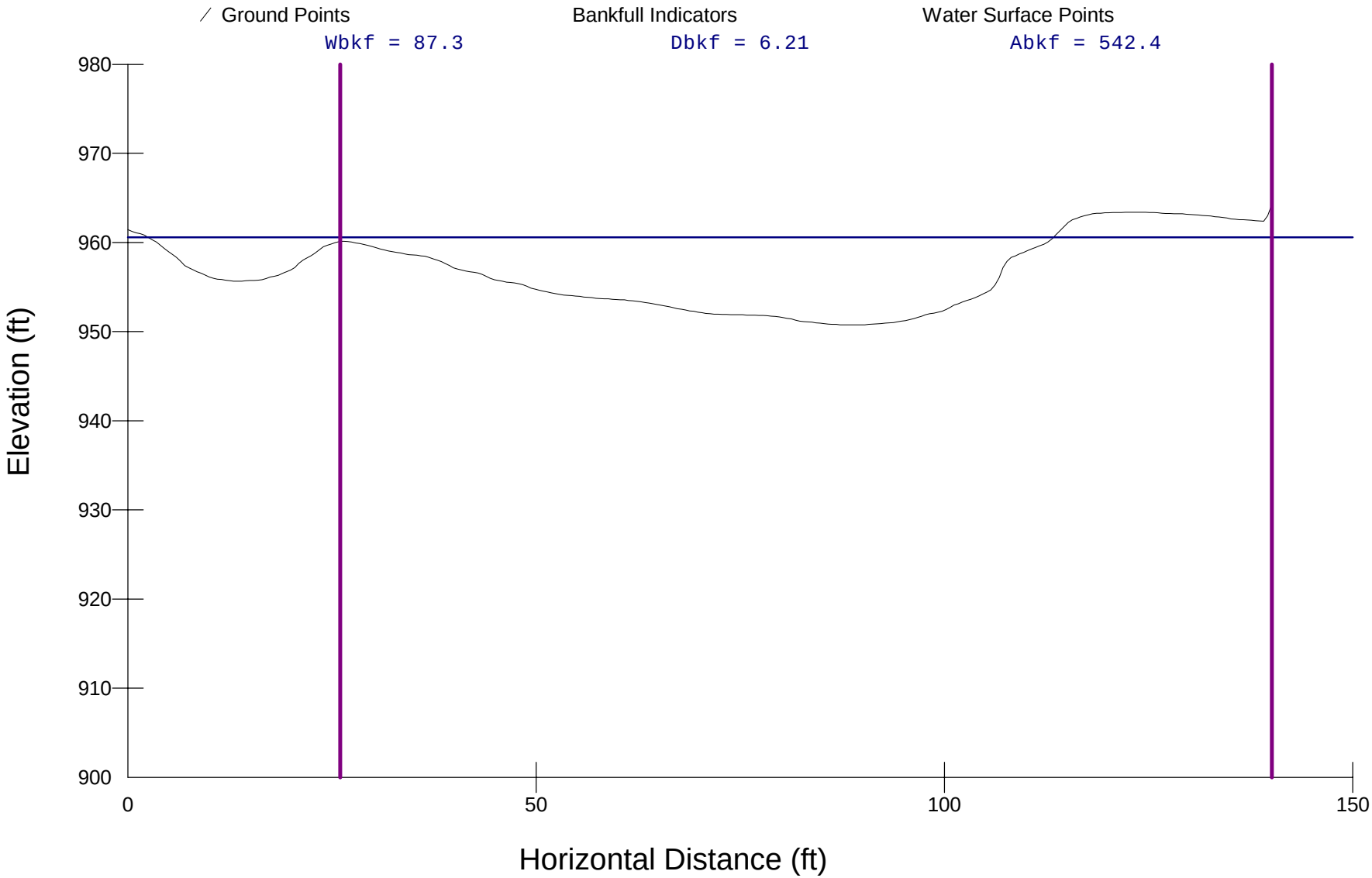
End BKF Station	45.37	-0.38	45.37

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

64+75 Pool


Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 87.3
Dbkf = 6.21
Abkf = 542.4
980
970
960
950
940
930
920
910
900
Elevation (ft)
0
50
100
150
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-2
Cross Section Name: 64+75 Pool
Survey Date: 01/25/2026

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	961.44	
0.5	0	961.27	
1	0	961.08	
1.5	0	961	
1.99	0	960.84	
2.49	0	960.58	BKF
2.99	0	960.31	
3.49	0	960.06	
3.99	0	959.72	
4.49	0	959.31	
4.98	0	958.97	
5.48	0	958.66	
5.98	0	958.31	
6.48	0	957.87	
6.98	0	957.42	
7.48	0	957.15	
7.98	0	956.95	
8.47	0	956.72	
8.97	0	956.54	
9.47	0	956.35	
9.97	0	956.16	
10.47	0	955.99	
10.97	0	955.89	
11.47	0	955.84	
11.96	0	955.78	
12.46	0	955.71	
12.96	0	955.67	
13.46	0	955.68	
13.96	0	955.69	
14.46	0	955.72	
14.95	0	955.74	
15.45	0	955.76	
15.95	0	955.78	
16.45	0	955.83	
16.95	0	955.98	
17.45	0	956.13	
17.95	0	956.23	
18.44	0	956.34	
18.94	0	956.56	
19.44	0	956.73	
19.94	0	956.9	
20.44	0	957.19	
20.94	0	957.68	
21.43	0	958.04	
21.93	0	958.3	
22.43	0	958.55	
22.93	0	958.81	
23.43	0	959.16	
23.93	0	959.51	

24.43	0	959.72	
24.92	0	959.86	
25.42	0	960	
25.92	0	960.1	
26.42	0	960.12	
26.92	0	960.11	
27.42	0	960.06	
27.92	0	959.97	
28.41	0	959.88	
28.91	0	959.79	
29.41	0	959.67	
29.91	0	959.54	
30.41	0	959.4	
30.91	0	959.28	
31.4	0	959.17	
31.9	0	959.05	
32.4	0	958.96	
32.9	0	958.9	
33.4	0	958.82	
33.9	0	958.72	
34.4	0	958.66	
34.89	0	958.6	
35.39	0	958.56	
35.89	0	958.52	
36.39	0	958.45	
36.89	0	958.33	
37.39	0	958.19	
37.88	0	958.04	
38.38	0	957.84	
38.88	0	957.63	
39.38	0	957.43	
39.88	0	957.16	
40.38	0	957	
40.88	0	956.9	
41.37	0	956.8	
41.87	0	956.72	
42.37	0	956.64	
42.87	0	956.57	
43.37	0	956.42	
43.87	0	956.23	
44.36	0	956	
44.86	0	955.83	
45.36	0	955.74	
45.86	0	955.66	
46.36	0	955.58	
46.86	0	955.51	
47.36	0	955.44	
47.85	0	955.37	
48.35	0	955.28	
48.85	0	955.1	
49.35	0	954.89	WS
49.85	0	954.76	
50.35	0	954.66	
50.85	0	954.56	
51.34	0	954.46	
51.84	0	954.35	
52.34	0	954.24	
52.84	0	954.19	
53.34	0	954.13	
53.84	0	954.07	
54.33	0	954.04	
54.83	0	953.99	
55.33	0	953.95	
55.83	0	953.91	
56.33	0	953.85	
56.83	0	953.81	

57.33	0	953.76
57.82	0	953.72
58.32	0	953.69
58.82	0	953.67
59.32	0	953.65
59.82	0	953.62
60.32	0	953.58
60.81	0	953.55
61.31	0	953.5
61.81	0	953.45
62.31	0	953.41
62.81	0	953.36
63.31	0	953.29
63.81	0	953.21
64.3	0	953.14
64.8	0	953.05
65.3	0	952.95
65.8	0	952.87
66.3	0	952.79
66.8	0	952.7
67.3	0	952.6
67.79	0	952.51
68.29	0	952.44
68.79	0	952.35
69.29	0	952.28
69.79	0	952.2
70.29	0	952.13
70.78	0	952.06
71.28	0	952.02
71.78	0	951.98
72.28	0	951.97
72.78	0	951.94
73.28	0	951.92
73.78	0	951.91
74.27	0	951.9
74.77	0	951.89
75.27	0	951.89
75.77	0	951.88
76.27	0	951.87
76.77	0	951.86
77.26	0	951.84
77.76	0	951.82
78.26	0	951.79
78.76	0	951.75
79.26	0	951.7
79.76	0	951.63
80.26	0	951.57
80.75	0	951.51
81.25	0	951.42
81.75	0	951.29
82.25	0	951.18
82.75	0	951.12
83.25	0	951.09
83.75	0	951.05
84.24	0	951
84.74	0	950.95
85.24	0	950.9
85.74	0	950.85
86.24	0	950.82
86.74	0	950.8
87.23	0	950.78
87.73	0	950.78
88.23	0	950.78
88.73	0	950.77
89.23	0	950.77
89.73	0	950.78

90.23	0	950.79
90.72	0	950.82
91.22	0	950.85
91.72	0	950.88
92.22	0	950.91
92.72	0	950.94
93.22	0	950.98
93.71	0	951.04
94.21	0	951.1
94.71	0	951.17
95.21	0	951.23
95.71	0	951.35
96.21	0	951.46
96.71	0	951.59
97.2	0	951.75
97.7	0	951.89
98.2	0	952
98.7	0	952.08
99.2	0	952.18
99.7	0	952.31
100.19	0	952.49
100.69	0	952.74
101.19	0	952.98
101.69	0	953.15
102.19	0	953.3
102.69	0	953.48
103.19	0	953.64
103.68	0	953.8
104.18	0	954
104.68	0	954.21
105.18	0	954.44
105.68	0	954.71
106.18	0	955.22
106.68	0	956.09
107.17	0	957.2
107.67	0	957.87
108.17	0	958.31
108.67	0	958.52
109.17	0	958.71
109.67	0	958.89
110.16	0	959.08
110.66	0	959.26
111.16	0	959.45
111.66	0	959.63
112.16	0	959.82
112.66	0	960.06
113.16	0	960.44
113.65	0	960.88
114.15	0	961.33
114.65	0	961.77
115.15	0	962.25
115.65	0	962.56
116.15	0	962.73
116.64	0	962.87
117.14	0	963
117.64	0	963.13
118.14	0	963.23
118.64	0	963.28
119.14	0	963.3
119.64	0	963.32
120.13	0	963.34
120.63	0	963.36
121.13	0	963.37
121.63	0	963.38
122.13	0	963.4
122.63	0	963.42

123.13	0	963.42
123.62	0	963.42
124.12	0	963.41
124.62	0	963.41
125.12	0	963.38
125.62	0	963.36
126.12	0	963.33
126.61	0	963.29
127.11	0	963.27
127.61	0	963.25
128.11	0	963.24
128.61	0	963.23
129.11	0	963.21
129.61	0	963.18
130.1	0	963.14
130.6	0	963.11
131.1	0	963.08
131.6	0	963.05
132.1	0	963
132.6	0	962.96
133.09	0	962.91
133.59	0	962.87
134.09	0	962.83
134.59	0	962.75
135.09	0	962.66
135.59	0	962.6
136.09	0	962.58
136.58	0	962.57
137.08	0	962.54
137.58	0	962.5
138.08	0	962.45
138.58	0	962.42
139.08	0	962.4
139.58	0	963.02
140.07	0	964.28

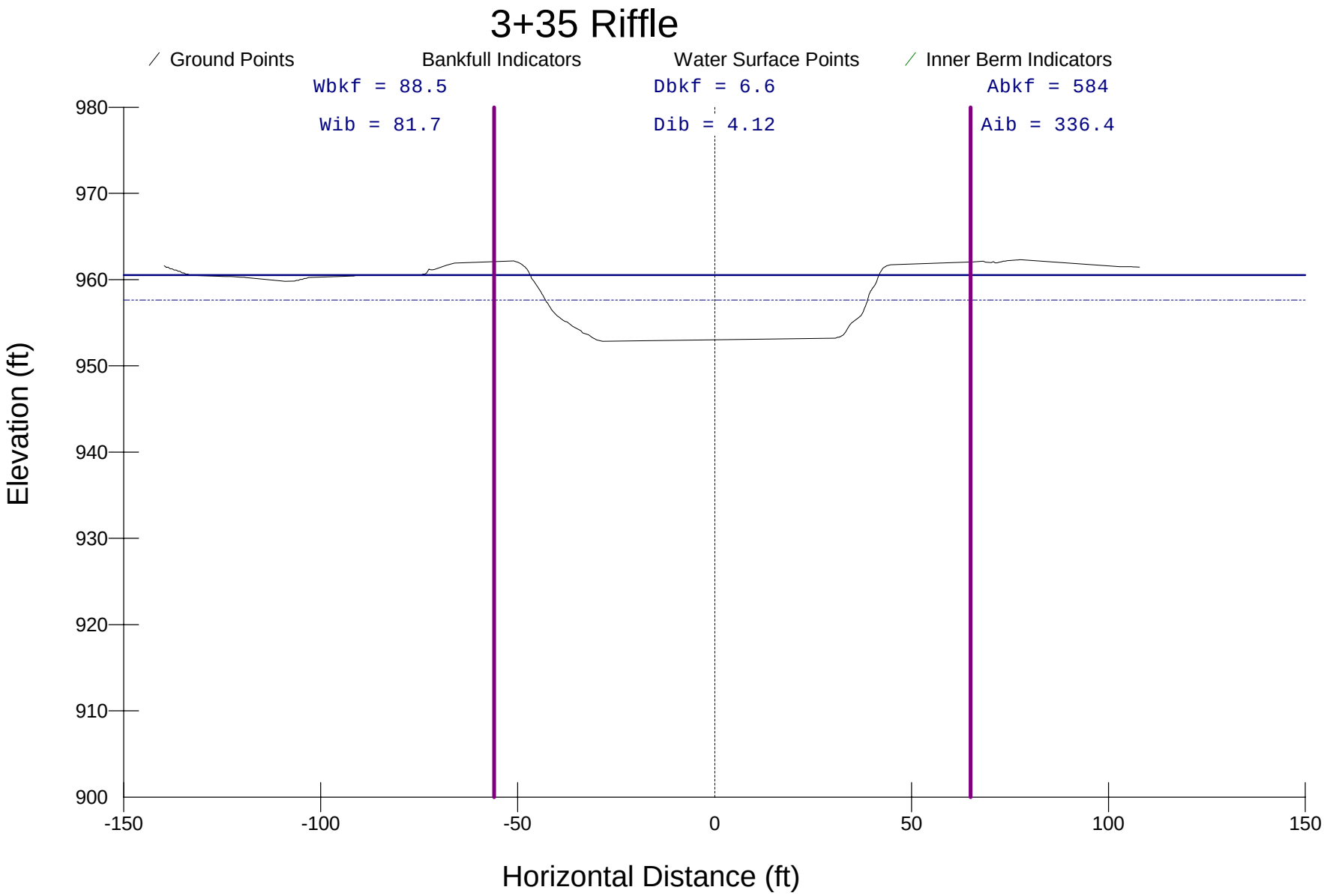
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	970.39	970.39	970.39
Bankfull Elevation (ft)	960.58	960.58	960.58
Floodprone Width (ft)	140.07	-----	-----
Bankfull Width (ft)	87.32	43.66	43.66
Entrenchment Ratio	1.6	-----	-----
Mean Depth (ft)	6.21	4.77	7.65
Maximum Depth (ft)	9.81	8.36	9.81
Width/Depth Ratio	14.06	9.15	5.71
Bankfull Area (sq ft)	542.35	208.38	333.97
Wetted Perimeter (ft)	91.9	53.42	55.19
Hydraulic Radius (ft)	5.9	3.9	6.05
Begin BKF Station	26	26	69.66
End BKF Station	113.32	69.66	113.32

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


3+35 Riffle
Ground Points
Bankfull Indicators
Water Surface Points
Inner Berm Indicators
Wbkf = 88.5
Wib = 81.7
Dbkf = 6.6
Dib = 4.12
Abkf = 584
Aib = 336.4
Elevation (ft)
980
970
960
950
940
930
920
910
900
-150
-100
-50
0
50
100
150
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-2
Cross Section Name: 73+35 Riffle
Survey Date: 11/19/2025

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
-139.71	0	961.64	
-139.68	0	961.63	
-139.26	0	961.45	
-139.21	0	961.42	
-138.71	0	961.43	
-138.2	0	961.27	
-137.7	0	961.28	
-137.2	0	961.12	
-136.7	0	961.12	
-136.2	0	960.96	
-135.7	0	960.96	
-135.2	0	960.79	
-134.7	0	960.79	
-134.2	0	960.64	
-133.69	0	960.64	
-133.19	0	960.49	
-124.17	0	960.36	
-123.67	0	960.36	
-123.17	0	960.34	
-122.67	0	960.34	
-120.16	0	960.28	
-119.66	0	960.28	
-119.53	0	960.27	
-119.28	0	960.27	
-119.16	0	960.26	
-109.64	0	959.85	
-109.14	0	959.81	
-106.63	0	959.86	
-106.39	0	959.89	
-106.38	0	959.89	
-106.13	0	959.92	
-105.63	0	959.93	
-105.13	0	960.04	
-104.63	0	960.04	
-104.13	0	960.15	
-103.63	0	960.15	
-103.13	0	960.26	
-93.61	0	960.38	
-92.1	0	960.42	
-91.6	0	960.42	
-91.1	0	960.45	
-90.6	0	960.45	
-90.1	0	960.48	
-74.56	0	960.5	
-74.06	0	960.64	
-73.56	0	960.64	
-73.06	0	960.79	
-73.02	0	960.82	
-72.57	0	961.2	

-72.56	0	961.21	
-72.55	0	961.21	
-72.06	0	961.14	
-71.56	0	961.16	
-71.06	0	961.2	
-68.55	0	961.59	
-68.05	0	961.68	
-66.04	0	961.92	
-51.01	0	962.17	
-50.51	0	962.11	
-50.01	0	962.04	TOB
-49.51	0	961.92	
-49.01	0	961.78	
-48.51	0	961.62	
-48.41	0	961.57	
-48.12	0	961.47	
-48	0	961.41	
-47.87	0	961.32	
-47.65	0	961.21	
-47.18	0	960.87	
-47	0	960.73	
-46.8	0	960.53	bkf
-46.71	0	960.42	
-46.5	0	960.22	
-46.26	0	960.05	
-46.24	0	960.03	
-46	0	959.87	
-45.5	0	959.57	
-45	0	959.23	
-44	0	958.49	
-43.89	0	958.4	
-43.58	0	958.17	
-43.49	0	958.1	
-43.42	0	958.05	
-43.04	0	957.72	
-42.99	0	957.68	
-42.95	0	957.65	ib
-42.5	0	957.35	
-42.49	0	957.35	
-42.48	0	957.34	
-41.99	0	956.95	
-41.97	0	956.93	
-41.54	0	956.66	
-41.49	0	956.62	
-40.99	0	956.34	
-39.99	0	955.83	
-39.49	0	955.68	
-39.28	0	955.6	
-39.19	0	955.57	
-38.48	0	955.31	
-37.98	0	955.18	
-37.48	0	955.1	
-35.98	0	954.57	lew
-33.97	0	954.09	
-33.47	0	953.83	
-31.97	0	953.61	
-30.97	0	953.28	
-30.27	0	953.1	
-29.96	0	953.03	
-29.46	0	952.96	
-28.46	0	952.86	
30.67	0	953.2	
31.27	0	953.3	
31.59	0	953.33	
31.67	0	953.35	
31.74	0	953.37	

32.12	0	953.44	
32.17	0	953.45	
32.21	0	953.46	
32.66	0	953.58	
32.67	0	953.58	
32.68	0	953.58	
33.17	0	953.86	
33.2	0	953.88	
33.62	0	954.21	
33.68	0	954.26	
34.18	0	954.63	rew
34.27	0	954.68	
34.56	0	954.88	
34.68	0	954.94	
36.68	0	955.62	
36.91	0	955.73	
36.96	0	955.75	
37.18	0	955.86	
37.68	0	956.27	
38.19	0	956.75	
38.32	0	956.92	
38.57	0	957.26	
38.69	0	957.41	
38.79	0	957.59	ib
39.1	0	958.08	
39.19	0	958.22	
39.69	0	958.72	
39.73	0	958.75	
40.18	0	959.04	
40.19	0	959.04	
40.2	0	959.05	
40.69	0	959.36	
40.72	0	959.38	
41.14	0	959.8	
41.19	0	959.84	
41.25	0	959.92	
41.61	0	960.41	
41.69	0	960.52	bkf
41.79	0	960.61	
42.08	0	960.84	
42.19	0	960.95	
42.7	0	961.3	
43.2	0	961.48	
43.4	0	961.53	
43.49	0	961.55	
43.7	0	961.61	
44.7	0	961.75	
65.75	0	962.07	
68.25	0	962.15	
68.75	0	962.04	
70.26	0	961.99	
70.76	0	962.1	
70.78	0	962.1	
71.21	0	961.97	
71.26	0	961.96	
71.76	0	961.97	
72.26	0	962.04	
72.76	0	962.05	
73.26	0	962.13	
73.76	0	962.13	
74.27	0	962.2	
76.77	0	962.27	
76.85	0	962.28	
77.22	0	962.29	
77.27	0	962.3	
77.77	0	962.3	

102.83	0	961.51
102.99	0	961.52
103.15	0	961.52
103.33	0	961.53
104.83	0	961.53
105.33	0	961.51
105.84	0	961.51
106.34	0	961.49
106.84	0	961.49
107.85	0	961.46

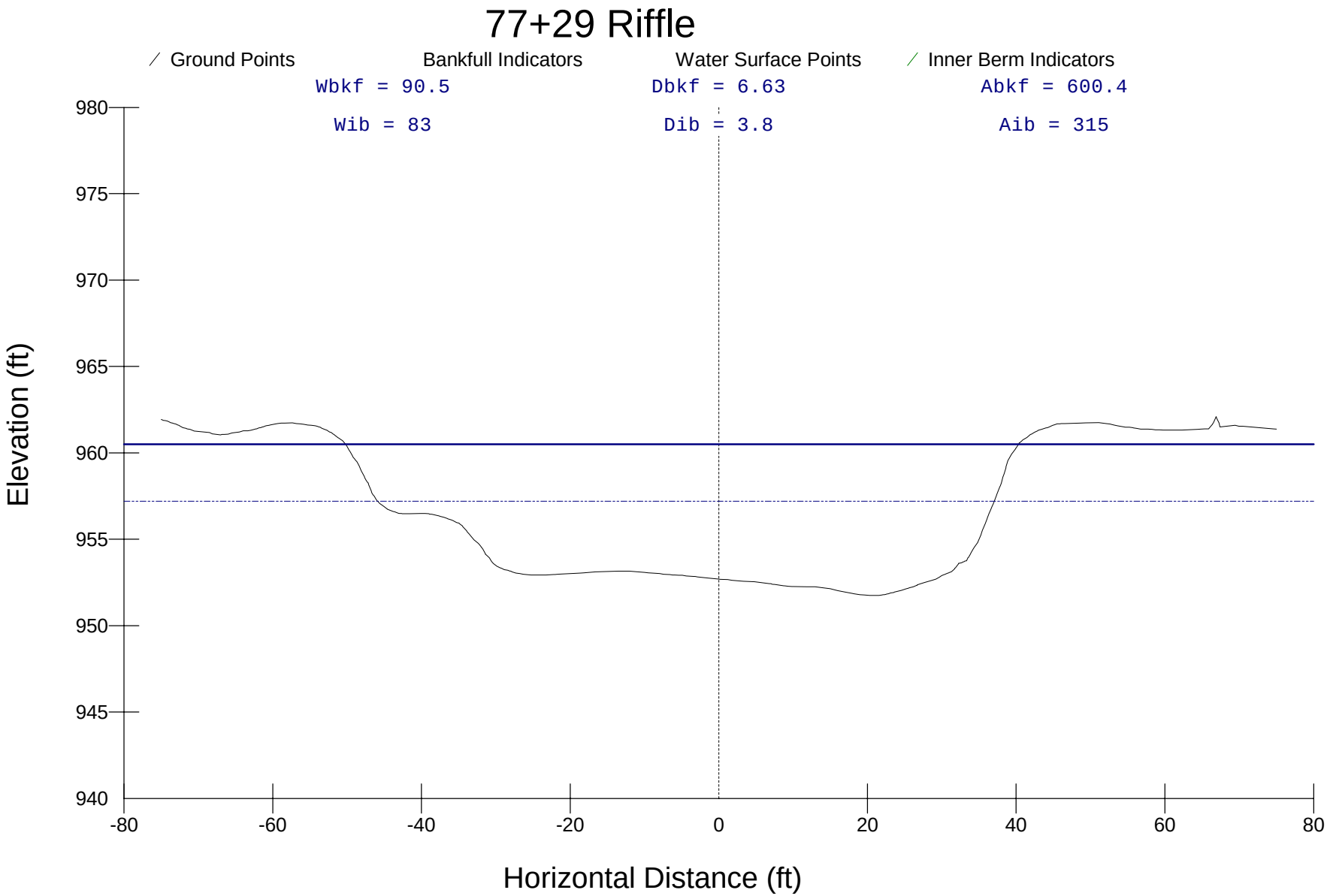
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	968.2	968.2	968.2
Bankfull Elevation (ft)	960.53	960.53	960.53
Floodprone Width (ft)	610	-----	-----
Bankfull Width (ft)	88.5	19.12	69.38
Entrenchment Ratio	6.89	-----	-----
Mean Depth (ft)	6.6	5.03	7.03
Maximum Depth (ft)	7.67	7.67	7.67
Width/Depth Ratio	13.41	3.8	9.87
Bankfull Area (sq ft)	584.01	96.16	487.85
Wetted Perimeter (ft)	93.12	28.71	79.73
Hydraulic Radius (ft)	6.27	3.35	6.12
Begin BKF Station	-46.8	-46.8	-27.68
End BKF Station	41.7	-27.68	41.7

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


77+29 Riffle
Ground Points
Bankfull Indicators
Water Surface Points
Inner Berm Indicators
Wbkf = 90.5
Dbkf = 6.63
Abkf = 600.4
Wib = 83
Dib = 3.8
Aib = 315
Elevation (ft)
980
975
970
965
960
955
950
945
940
-80
-60
-40
-20
0
20
40
60
80
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-2
Cross Section Name: 77+29 Riffle
Survey Date: 11/19/2025

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
-75	0	961.93	
-74.96	0	961.93	
-74.82	0	961.91	
-74.65	0	961.89	
-74.53	0	961.88	
-74.19	0	961.84	
-74.14	0	961.83	
-74.11	0	961.83	
-73.63	0	961.74	
-73.56	0	961.73	
-73.25	0	961.7	
-73.12	0	961.68	
-72.93	0	961.65	
-72.83	0	961.63	
-72.61	0	961.59	
-72.4	0	961.54	
-72.3	0	961.52	
-72.1	0	961.47	
-71.6	0	961.41	
-71.55	0	961.4	
-71.09	0	961.35	
-70.58	0	961.27	
-68.56	0	961.17	
-68.54	0	961.17	
-68.52	0	961.17	
-68.13	0	961.11	
-68.03	0	961.1	
-67.52	0	961.07	
-67.01	0	961.05	
-66.85	0	961.06	
-66.5	0	961.07	
-66	0	961.09	
-65.99	0	961.09	
-65.49	0	961.15	
-64.98	0	961.18	
-64.47	0	961.22	
-63.96	0	961.28	
-63.86	0	961.28	
-63.45	0	961.29	
-63.33	0	961.29	
-63	0	961.31	
-62.94	0	961.31	
-62.22	0	961.39	
-62.15	0	961.4	
-61.92	0	961.43	
-61.72	0	961.46	
-61.59	0	961.47	
-61.41	0	961.5	
-61.3	0	961.51	

-60.96	0	961.56	
-60.9	0	961.57	
-60.44	0	961.6	
-60.39	0	961.61	
-59.89	0	961.65	
-59.38	0	961.7	
-58.87	0	961.72	
-58.36	0	961.72	
-57.45	0	961.73	
-57.34	0	961.73	
-56.83	0	961.71	
-56.32	0	961.68	
-55.81	0	961.65	
-55.32	0	961.62	
-54.79	0	961.59	
-54.28	0	961.57	
-54.03	0	961.54	
-54.02	0	961.54	
-53.78	0	961.51	
-53.61	0	961.48	
-53.39	0	961.43	
-53.18	0	961.39	
-52.76	0	961.33	
-52.76	0	961.32	
-52.75	0	961.32	
-52.73	0	961.32	
-52.33	0	961.21	
-52.25	0	961.2	
-52.13	0	961.17	
-51.9	0	961.11	
-51.74	0	961.06	
-51.5	0	960.98	
-51.47	0	960.97	
-51.23	0	960.89	
-51.04	0	960.84	
-50.87	0	960.78	
-50.72	0	960.74	
-50.62	0	960.7	
-50.24	0	960.52	
-50.21	0	960.51	
-50.19	0	960.49	bkf
-50.08	0	960.42	
-49.7	0	960.15	
-49.61	0	960.08	
-49.34	0	959.88	
-49.19	0	959.75	
-48.98	0	959.64	
-48.91	0	959.61	
-48.68	0	959.49	
-48.48	0	959.32	
-48.35	0	959.21	
-48.18	0	959.06	
-48.06	0	958.97	
-47.72	0	958.65	
-47.67	0	958.61	
-47.63	0	958.56	
-47.43	0	958.42	
-47.2	0	958.28	
-47.16	0	958.26	
-47.09	0	958.18	
-46.77	0	957.82	
-46.65	0	957.68	
-46.46	0	957.55	
-46.35	0	957.49	
-46.14	0	957.34	
-45.92	0	957.21	ib

-45.83	0	957.18	
-45.63	0	957.08	
-45.49	0	957.04	
-45.2	0	956.95	
-45.12	0	956.93	
-45.07	0	956.92	
-44.78	0	956.82	
-44.64	0	956.76	
-44.61	0	956.76	
-44.57	0	956.75	
-44.21	0	956.67	
-44.1	0	956.65	
-43.94	0	956.63	
-43.78	0	956.6	
-43.59	0	956.58	
-43.36	0	956.55	
-43.08	0	956.51	
-42.93	0	956.5	
-42.68	0	956.49	
-42.57	0	956.48	
-42.5	0	956.48	
-42.07	0	956.47	
-41.56	0	956.47	
-40.03	0	956.5	
-39.52	0	956.49	
-39.01	0	956.47	
-38.9	0	956.46	
-38.66	0	956.45	
-38.5	0	956.44	
-37.8	0	956.36	
-37.64	0	956.34	
-37.48	0	956.33	
-36.97	0	956.27	
-36.52	0	956.2	
-36.46	0	956.19	
-35.96	0	956.11	
-35.75	0	956.07	
-35.67	0	956.05	
-35.45	0	956	
-35.24	0	955.97	
-35.12	0	955.95	
-34.94	0	955.93	
-34.82	0	955.88	
-34.49	0	955.76	
-34.43	0	955.74	
-34.39	0	955.72	
-33.92	0	955.49	
-33.86	0	955.45	
-33.53	0	955.28	
-33.41	0	955.22	
-32.9	0	954.97	
-32.39	0	954.78	
-32.25	0	954.71	
-31.97	0	954.57	
-31.88	0	954.52	lew
-31.83	0	954.49	
-31.53	0	954.26	
-31.4	0	954.16	
-31.37	0	954.14	
-31.34	0	954.13	
-30.97	0	953.97	
-30.86	0	953.91	
-30.71	0	953.82	
-30.54	0	953.72	
-30.36	0	953.61	
-30.12	0	953.53	

-30.08	0	953.52
-29.85	0	953.44
-29.34	0	953.34
-29.26	0	953.33
-28.84	0	953.25
-28.83	0	953.25
-28.41	0	953.2
-28.32	0	953.19
-28.19	0	953.17
-27.98	0	953.15
-27.81	0	953.12
-27.3	0	953.05
-26.79	0	953.01
-26.28	0	952.98
-25.26	0	952.94
-24.75	0	952.93
-24.57	0	952.93
-24.25	0	952.94
-23.23	0	952.94
-22.21	0	952.96
-22	0	952.96
-21.7	0	952.97
-21.15	0	952.99
-18.64	0	953.05
-18.14	0	953.06
-16.61	0	953.11
-13.55	0	953.16
-12.03	0	953.15
-10.04	0	953.08
-9.99	0	953.08
-9.48	0	953.06
-8.97	0	953.04
-8.46	0	953.02
-7.95	0	953.01
-7.44	0	952.98
-6.76	0	952.95
-6.63	0	952.95
-6.2	0	952.94
-6.13	0	952.93
-5.92	0	952.93
-5.41	0	952.91
-5.35	0	952.91
-4.9	0	952.91
-4.39	0	952.89
-3.37	0	952.84
-3.21	0	952.84
-2.86	0	952.83
-1.33	0	952.75
0	0	952.7
0.19	0	952.69
1.21	0	952.66
1.72	0	952.63
3.25	0	952.57
4.78	0	952.53
6.81	0	952.43
7.04	0	952.42
7.11	0	952.41
7.32	0	952.4
7.47	0	952.39
8.34	0	952.34
8.75	0	952.31
8.85	0	952.31
9.36	0	952.28
9.87	0	952.27
10.03	0	952.27
11.9	0	952.25

12.92	0	952.24	
13.43	0	952.23	
13.94	0	952.2	
14.96	0	952.13	
15.98	0	952.02	
17	0	951.93	
17.5	0	951.9	
18.01	0	951.86	
18.14	0	951.85	
19	0	951.8	
19.54	0	951.77	
20.28	0	951.76	
20.56	0	951.75	
21.58	0	951.76	
21.99	0	951.78	
22.09	0	951.79	
22.23	0	951.8	
22.41	0	951.81	
22.6	0	951.83	
22.84	0	951.85	
23.1	0	951.88	
23.27	0	951.9	
23.49	0	951.92	
23.61	0	951.94	
24.55	0	952.04	
25.14	0	952.12	
25.38	0	952.16	
25.4	0	952.16	
25.65	0	952.19	
26.16	0	952.24	
26.26	0	952.26	
26.64	0	952.34	
26.67	0	952.34	
26.69	0	952.35	
27.18	0	952.42	
27.69	0	952.5	
28.71	0	952.63	
29.21	0	952.7	
29.68	0	952.81	
29.72	0	952.82	
29.79	0	952.84	
30.1	0	952.91	
30.42	0	952.97	
30.53	0	952.99	
30.74	0	953.03	
30.96	0	953.06	
31.06	0	953.08	
31.25	0	953.11	
31.38	0	953.16	
31.69	0	953.29	
31.76	0	953.32	
31.81	0	953.35	
32.24	0	953.59	
32.27	0	953.6	
32.32	0	953.61	
32.67	0	953.65	
32.78	0	953.68	
32.95	0	953.7	
33.09	0	953.73	
33.29	0	953.76	
33.52	0	953.93	
33.58	0	953.96	
33.8	0	954.12	
33.95	0	954.23	
34.21	0	954.42	
34.37	0	954.54	rew

34.82	0	954.83	
34.84	0	954.85	
35.23	0	955.26	
35.32	0	955.35	
35.47	0	955.52	
35.65	0	955.72	
35.83	0	955.92	
36.08	0	956.2	
36.1	0	956.22	
36.34	0	956.52	
36.51	0	956.66	
36.73	0	956.89	
36.94	0	957.08	
37.36	0	957.55	
37.36	0	957.55	
37.36	0	957.55	
37.38	0	957.57	
37.79	0	958.02	
37.87	0	958.1	
37.99	0	958.25	
38.22	0	958.59	
38.38	0	958.78	
38.62	0	959.15	
38.64	0	959.19	
38.89	0	959.56	
39.4	0	959.95	
39.5	0	960.01	
39.88	0	960.23	
39.91	0	960.25	
39.93	0	960.26	
40.35	0	960.53	bkf
40.42	0	960.57	
40.51	0	960.6	
40.78	0	960.7	
40.92	0	960.75	
41.14	0	960.81	
41.21	0	960.83	
41.43	0	960.89	
41.94	0	961.07	
42.06	0	961.09	
42.49	0	961.19	
42.92	0	961.29	
42.96	0	961.3	
43.47	0	961.37	
43.98	0	961.44	
44.2	0	961.47	
44.49	0	961.52	
44.62	0	961.54	
44.92	0	961.59	
45	0	961.61	
45.05	0	961.62	
45.51	0	961.68	
45.55	0	961.68	
45.91	0	961.69	
46.02	0	961.7	
46.33	0	961.7	
46.53	0	961.71	
48.56	0	961.72	
49.32	0	961.73	
51.11	0	961.75	
52.13	0	961.7	
52.64	0	961.66	
52.74	0	961.65	
53.11	0	961.61	
53.14	0	961.61	
53.59	0	961.57	

54.67	0	961.49
54.87	0	961.48
55	0	961.48
55.18	0	961.48
55.69	0	961.46
55.73	0	961.45
56.2	0	961.42
56.71	0	961.38
57.73	0	961.38
58.24	0	961.35
58.74	0	961.34
59.14	0	961.34
59.25	0	961.34
59.76	0	961.33
60.43	0	961.32
60.78	0	961.32
61.71	0	961.33
62.31	0	961.33
64.35	0	961.36
64.85	0	961.38
65.36	0	961.39
65.55	0	961.4
65.87	0	961.4
65.98	0	961.44
66.35	0	961.63
66.38	0	961.64
66.41	0	961.66
66.53	0	961.76
66.83	0	962.03
66.89	0	962.11
66.98	0	961.99
67.26	0	961.73
67.4	0	961.51
69.44	0	961.59
69.95	0	961.54
70.46	0	961.54
74.53	0	961.4
75	0	961.37

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	969.27	969.27	969.27
Bankfull Elevation (ft)	960.51	960.51	960.51
Floodprone Width (ft)	1100	-----	-----
Bankfull Width (ft)	90.53	45.31	45.22
Entrenchment Ratio	12.15	-----	-----
Mean Depth (ft)	6.63	5.89	7.38
Maximum Depth (ft)	8.76	7.6	8.76
Width/Depth Ratio	13.65	7.7	6.13
Bankfull Area (sq ft)	600.43	266.79	333.64
Wetted Perimeter (ft)	95.56	54.86	55.91
Hydraulic Radius (ft)	6.28	4.86	5.97
Begin BKF Station	-50.21	-50.21	-4.9
End BKF Station	40.32	-4.9	40.32

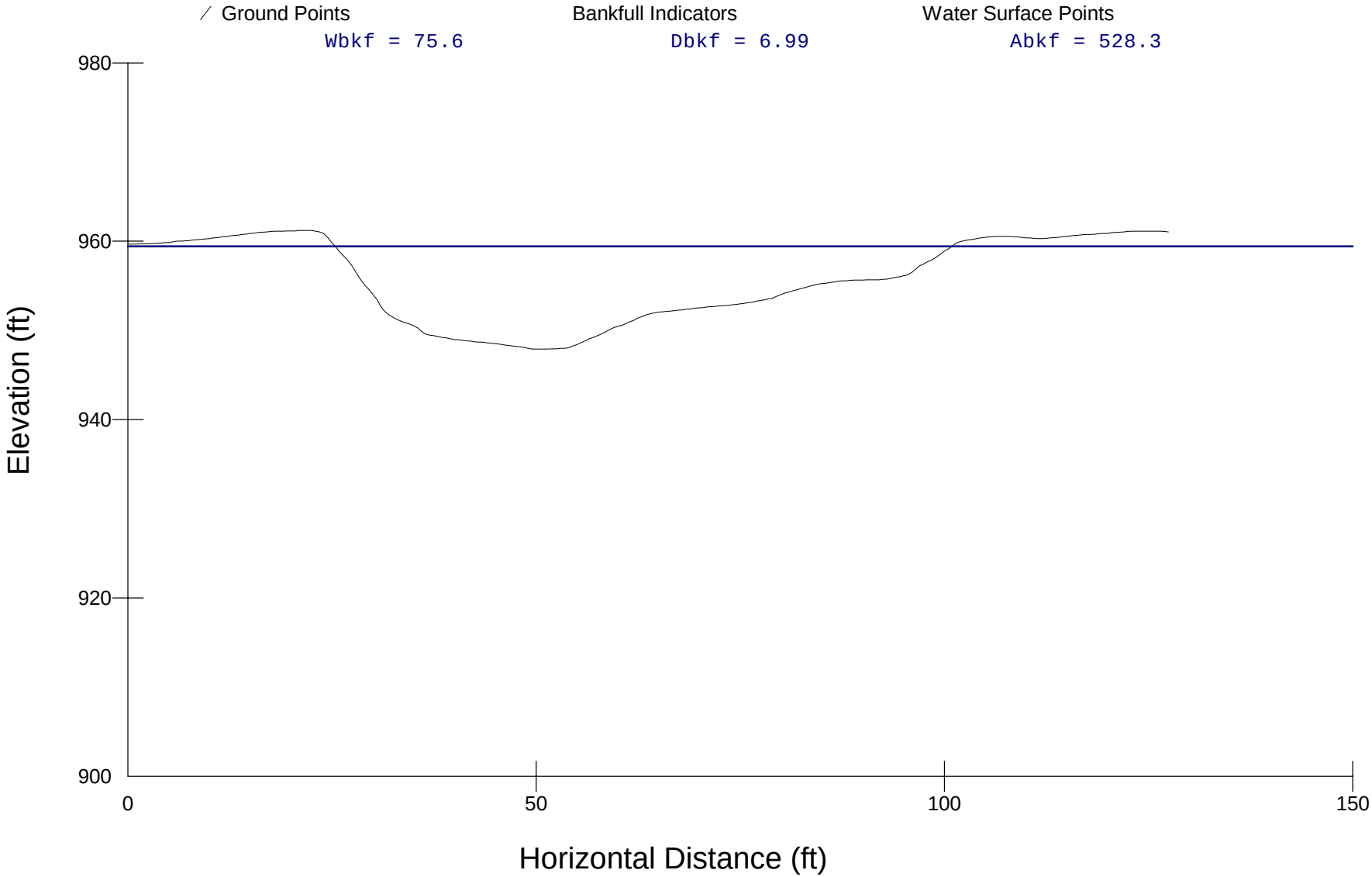
Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side

Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

86+25 Pool


Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 75.6
Dbkf = 6.99
Abkf = 528.3
980
960
940
920
900
Elevation (ft)
0
50
100
150
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-3
Cross Section Name: 86+25 Pool
Survey Date: 01/25/2026

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	959.66	
0.5	0	959.66	
1	0	959.67	
1.5	0	959.69	
2	0	959.71	
2.5	0	959.73	
3	0	959.75	
3.5	0	959.78	
4	0	959.79	
4.5	0	959.83	
5	0	959.86	
5.5	0	959.92	
6	0	959.99	
6.5	0	960.01	
7	0	960.04	
7.5	0	960.08	
8	0	960.13	
8.5	0	960.17	
8.99	0	960.22	
9.49	0	960.26	
9.99	0	960.29	
10.49	0	960.34	
10.99	0	960.39	
11.49	0	960.45	
11.99	0	960.51	
12.49	0	960.57	
12.99	0	960.63	
13.49	0	960.68	
13.99	0	960.74	
14.49	0	960.78	
14.99	0	960.85	
15.49	0	960.91	
15.99	0	960.96	
16.49	0	961	
16.99	0	961.05	
17.49	0	961.09	
17.99	0	961.11	
18.49	0	961.12	
18.99	0	961.13	
19.49	0	961.14	
19.99	0	961.15	
20.49	0	961.16	
20.99	0	961.18	
21.49	0	961.19	
21.99	0	961.2	
22.49	0	961.18	
22.99	0	961.13	
23.49	0	961.06	
23.99	0	960.81	

24.49	0	960.36
24.99	0	959.83
25.49	0	959.3
25.99	0	958.77
26.49	0	958.28
26.98	0	957.8
27.48	0	957.16
27.98	0	956.41
28.48	0	955.74
28.98	0	955.08
29.48	0	954.63
29.98	0	954.03
30.48	0	953.47
30.98	0	952.66
31.48	0	952.09
31.98	0	951.76
32.48	0	951.48
32.98	0	951.22
33.48	0	951.01
33.98	0	950.86
34.48	0	950.69
34.98	0	950.52
35.48	0	950.25
35.98	0	949.85
36.48	0	949.56
36.98	0	949.45
37.48	0	949.38
37.98	0	949.3
38.48	0	949.22
38.98	0	949.14
39.48	0	949.07
39.98	0	948.97
40.48	0	948.94
40.98	0	948.88
41.48	0	948.81
41.98	0	948.77
42.48	0	948.71
42.98	0	948.68
43.48	0	948.65
43.98	0	948.6
44.48	0	948.55
44.97	0	948.51
45.47	0	948.45
45.97	0	948.37
46.47	0	948.32
46.97	0	948.26
47.47	0	948.2
47.97	0	948.15
48.47	0	948.09
48.97	0	947.99
49.47	0	947.92
49.97	0	947.91
50.47	0	947.91
50.97	0	947.92
51.47	0	947.92
51.97	0	947.93
52.47	0	947.94
52.97	0	947.96
53.47	0	947.99
53.97	0	948.04
54.47	0	948.25
54.97	0	948.43
55.47	0	948.61
55.97	0	948.81
56.47	0	949.02
56.97	0	949.22

57.47	0	949.39	
57.97	0	949.59	
58.47	0	949.83	
58.97	0	950.07	
59.47	0	950.29	
59.97	0	950.43	
60.47	0	950.57	
60.97	0	950.77	
61.47	0	950.95	
61.97	0	951.13	
62.46	0	951.39	
62.96	0	951.55	
63.46	0	951.74	
63.96	0	951.88	
64.46	0	951.97	
64.96	0	952.03	
65.46	0	952.09	
65.96	0	952.13	
66.46	0	952.17	
66.96	0	952.21	
67.46	0	952.26	
67.96	0	952.31	
68.46	0	952.36	
68.96	0	952.42	
69.46	0	952.47	
69.96	0	952.51	
70.46	0	952.56	
70.96	0	952.61	
71.46	0	952.66	
71.96	0	952.71	
72.46	0	952.74	
72.96	0	952.78	
73.46	0	952.82	
73.96	0	952.86	
74.46	0	952.9	
74.96	0	952.96	
75.46	0	953.02	
75.96	0	953.09	
76.46	0	953.18	
76.96	0	953.26	
77.46	0	953.34	
77.96	0	953.42	
78.46	0	953.53	
78.96	0	953.62	
79.46	0	953.84	
79.96	0	954.01	
80.45	0	954.17	
80.95	0	954.3	
81.45	0	954.43	
81.95	0	954.56	WS
82.45	0	954.69	
82.95	0	954.8	
83.45	0	954.94	
83.95	0	955.05	
84.45	0	955.15	
84.95	0	955.23	
85.45	0	955.29	
85.95	0	955.35	
86.45	0	955.41	
86.95	0	955.5	
87.45	0	955.55	
87.95	0	955.58	
88.45	0	955.6	
88.95	0	955.63	
89.45	0	955.65	
89.95	0	955.65	

90.45	0	955.66	
90.95	0	955.66	
91.45	0	955.67	
91.95	0	955.69	
92.45	0	955.71	
92.95	0	955.75	
93.45	0	955.82	
93.95	0	955.91	
94.45	0	956.01	
94.95	0	956.11	
95.45	0	956.23	
95.95	0	956.46	
96.45	0	956.88	
96.95	0	957.23	
97.45	0	957.45	
97.94	0	957.7	
98.44	0	957.9	
98.94	0	958.17	
99.44	0	958.49	
99.94	0	958.85	
100.44	0	959.12	
100.94	0	959.42	BKF
101.44	0	959.79	
101.94	0	959.95	
102.44	0	960.06	
102.94	0	960.14	
103.44	0	960.21	
103.94	0	960.28	
104.44	0	960.37	
104.94	0	960.41	
105.44	0	960.46	
105.94	0	960.5	
106.44	0	960.52	
106.94	0	960.54	
107.44	0	960.54	
107.94	0	960.53	
108.44	0	960.5	
108.94	0	960.46	
109.44	0	960.41	
109.94	0	960.37	
110.44	0	960.34	
110.94	0	960.32	
111.44	0	960.3	
111.94	0	960.3	
112.44	0	960.31	
112.94	0	960.34	
113.44	0	960.38	
113.94	0	960.44	
114.44	0	960.49	
114.94	0	960.54	
115.44	0	960.59	
115.93	0	960.64	
116.43	0	960.67	
116.93	0	960.71	
117.43	0	960.74	
117.93	0	960.77	
118.43	0	960.79	
118.93	0	960.82	
119.43	0	960.85	
119.93	0	960.88	
120.43	0	960.92	
120.93	0	960.96	
121.43	0	961	
121.93	0	961.03	
122.43	0	961.07	
122.93	0	961.1	

123.43	0	961.12
123.93	0	961.13
124.43	0	961.13
124.93	0	961.13
125.43	0	961.13
125.93	0	961.13
126.43	0	961.12
126.93	0	961.07
127.43	0	961.06

Cross Sectional Geometry

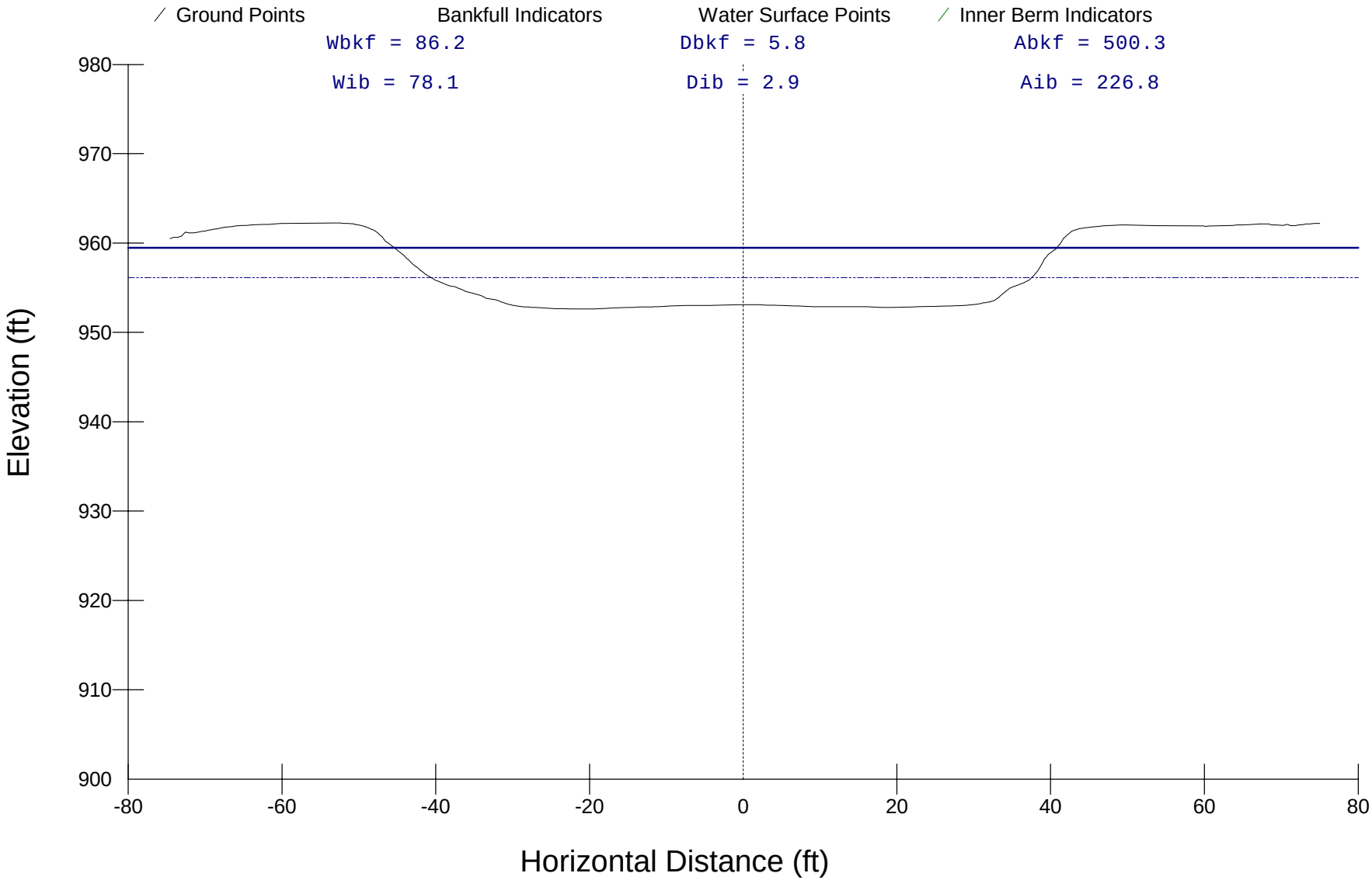
	Channel	Left	Right
Floodprone Elevation (ft)	970.93	970.93	970.93
Bankfull Elevation (ft)	959.42	959.42	959.42
Floodprone Width (ft)	127.43	-----	-----
Bankfull Width (ft)	75.56	37.78	37.78
Entrenchment Ratio	1.69	-----	-----
Mean Depth (ft)	6.99	9.09	4.89
Maximum Depth (ft)	11.51	11.51	7.79
Width/Depth Ratio	10.81	4.16	7.73
Bankfull Area (sq ft)	528.27	343.42	184.85
Wetted Perimeter (ft)	81.82	50.5	46.91
Hydraulic Radius (ft)	6.46	6.8	3.94
Begin BKF Station	25.38	25.38	63.16
End BKF Station	100.94	63.16	100.94

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

92+64 Riffle


Ground Points
Bankfull Indicators
Water Surface Points
Inner Berm Indicators
Wbkf = 86.2
Dbkf = 5.8
Abkf = 500.3
Wib = 78.1
Dib = 2.9
Aib = 226.8
980
970
960
950
940
930
920
910
900
Elevation (ft)
-80
-60
-40
-20
0
20
40
60
80
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-3
Cross Section Name: 92+64 Riffle
Survey Date: 11/19/2025

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
-74.56	0	960.5	
-74.43	0	960.54	
-74.18	0	960.61	
-74.06	0	960.64	
-73.56	0	960.64	
-73.06	0	960.79	
-73.02	0	960.82	
-72.57	0	961.2	
-72.56	0	961.21	
-72.55	0	961.21	
-72.06	0	961.14	
-72.03	0	961.14	
-71.61	0	961.15	
-71.56	0	961.16	
-71.06	0	961.2	
-70.42	0	961.3	
-70.2	0	961.33	
-70.05	0	961.35	
-69.89	0	961.38	
-69.73	0	961.41	
-69.55	0	961.44	
-69.35	0	961.47	
-69.26	0	961.49	
-68.81	0	961.55	
-68.79	0	961.56	
-68.55	0	961.59	
-68.32	0	961.63	
-68.27	0	961.64	
-68.05	0	961.68	
-67.85	0	961.71	
-67.74	0	961.72	
-67.38	0	961.76	
-67.2	0	961.78	
-67.05	0	961.8	
-66.55	0	961.85	
-66.04	0	961.92	
-65.54	0	961.96	
-65.04	0	961.98	
-64.56	0	962	
-64.52	0	962	
-64.09	0	962.03	
-64.04	0	962.03	
-62.54	0	962.08	
-62.21	0	962.09	
-61.83	0	962.11	
-61.74	0	962.11	
-61.03	0	962.14	
-60.53	0	962.17	
-60.03	0	962.19	

-59.53	0	962.22	
-52.51	0	962.24	
-52.01	0	962.22	
-51.51	0	962.2	
-51.01	0	962.17	
-50.94	0	962.17	
-50.56	0	962.12	
-50.51	0	962.11	
-50.01	0	962.04	
-49.53	0	961.93	
-49.51	0	961.92	
-49.48	0	961.91	
-49.06	0	961.79	
-49.01	0	961.78	
-48.51	0	961.62	
-48.41	0	961.57	
-48.12	0	961.47	
-48	0	961.41	
-47.87	0	961.32	
-47.65	0	961.21	
-47.5	0	961.1	
-47.34	0	960.98	
-47.18	0	960.87	
-47	0	960.73	
-46.8	0	960.53	
-46.71	0	960.42	
-46.5	0	960.22	
-46.26	0	960.05	
-46.24	0	960.03	
-46	0	959.87	
-45.5	0	959.57	bkf
-45	0	959.23	
-44	0	958.49	
-43.89	0	958.4	
-43.58	0	958.17	
-43.49	0	958.1	
-43.42	0	958.05	
-43.04	0	957.72	
-42.99	0	957.68	
-42.95	0	957.65	
-42.5	0	957.35	
-42.49	0	957.35	
-42.48	0	957.34	
-42.01	0	956.97	
-41.99	0	956.95	
-41.97	0	956.93	
-41.54	0	956.66	
-41.49	0	956.62	
-41.43	0	956.58	
-41.07	0	956.39	
-40.99	0	956.34	
-40.49	0	956.09	
-40.36	0	956.02	ib
-40.13	0	955.9	
-39.99	0	955.83	
-39.82	0	955.78	
-39.66	0	955.73	
-39.49	0	955.68	
-39.28	0	955.6	
-39.19	0	955.57	
-38.98	0	955.48	
-38.75	0	955.4	
-38.72	0	955.39	
-38.48	0	955.31	
-37.98	0	955.18	
-37.79	0	955.15	

-37.48	0	955.1	
-36.98	0	954.92	
-36.85	0	954.87	
-36.6	0	954.79	
-36.38	0	954.72	
-36.06	0	954.6	
-35.98	0	954.57	
-35.91	0	954.55	
-35.52	0	954.47	
-35.48	0	954.46	
-34.47	0	954.21	
-34.45	0	954.21	
-34.03	0	954.1	
-33.97	0	954.09	
-33.91	0	954.05	
-33.56	0	953.88	lew
-33.47	0	953.83	
-32.47	0	953.69	
-32.3	0	953.67	
-32.15	0	953.64	
-31.97	0	953.61	
-31.77	0	953.54	
-31.68	0	953.51	
-31.47	0	953.44	
-31.23	0	953.36	
-31.21	0	953.36	
-30.97	0	953.28	
-30.47	0	953.15	
-30.27	0	953.1	
-30.15	0	953.08	
-29.96	0	953.03	
-29.8	0	953.01	
-29.62	0	952.98	
-29.46	0	952.96	
-28.96	0	952.9	
-28.46	0	952.86	
-27.96	0	952.84	
-27.45	0	952.81	
-26.96	0	952.79	
-26.93	0	952.79	
-26.51	0	952.76	
-26.46	0	952.76	
-25.96	0	952.72	
-24.95	0	952.68	
-24.45	0	952.67	
-24.25	0	952.67	
-24.16	0	952.67	
-23.95	0	952.66	
-23.45	0	952.65	
-22.45	0	952.63	
-21.45	0	952.63	
-20.94	0	952.62	
-20.44	0	952.62	
-19.44	0	952.64	
-17.94	0	952.69	
-16.94	0	952.74	
-14.93	0	952.79	
-14.77	0	952.79	
-14.43	0	952.81	
-13.43	0	952.83	
-12.43	0	952.84	
-11.92	0	952.85	
-11.42	0	952.87	
-10.92	0	952.89	
-10.42	0	952.92	
-9.42	0	952.96	

-8.42	0	953	
-7.41	0	953.02	
-6.41	0	953.04	
-4.41	0	953.03	
-0.67	0	953.1	
-0.4	0	953.11	
0	0	953.11	
0.1	0	953.11	
2.11	0	953.11	
3.11	0	953.07	
3.67	0	953.06	
4.03	0	953.05	
4.11	0	953.05	
4.61	0	953.04	
5.11	0	953.01	
6.62	0	952.96	
7.12	0	952.94	
9.12	0	952.87	
13.13	0	952.87	
15.64	0	952.89	
16.14	0	952.88	
16.64	0	952.86	
18.14	0	952.8	
18.64	0	952.8	
19.14	0	952.8	
22.15	0	952.85	
22.65	0	952.87	
24.15	0	952.92	
24.66	0	952.93	
26.66	0	952.95	
27.16	0	952.95	
27.66	0	952.97	
28.16	0	953	
28.66	0	953.03	
29.17	0	953.06	
29.67	0	953.1	
30.17	0	953.14	
30.34	0	953.16	
30.51	0	953.18	
30.67	0	953.2	
30.81	0	953.22	
31.05	0	953.27	
31.27	0	953.3	
31.59	0	953.33	
31.67	0	953.35	
31.74	0	953.37	
32.12	0	953.44	
32.17	0	953.45	
32.21	0	953.46	
32.66	0	953.58	
32.67	0	953.58	
32.68	0	953.58	
33.15	0	953.85	
33.17	0	953.86	
33.2	0	953.88	rew
33.62	0	954.21	
33.68	0	954.26	
33.74	0	954.3	
34.09	0	954.56	
34.18	0	954.63	
34.27	0	954.68	
34.56	0	954.88	
34.68	0	954.94	
35.18	0	955.12	
35.35	0	955.17	
35.5	0	955.23	

35.68	0	955.29	
35.88	0	955.36	
35.97	0	955.39	
36.42	0	955.53	
36.44	0	955.54	
36.68	0	955.62	
36.91	0	955.73	
36.96	0	955.75	
37.18	0	955.86	
37.68	0	956.27	ib
37.85	0	956.43	
38.03	0	956.6	
38.19	0	956.75	
38.32	0	956.92	
38.57	0	957.26	
38.69	0	957.41	
38.79	0	957.59	
39.1	0	958.08	
39.19	0	958.22	
39.26	0	958.29	
39.64	0	958.67	
39.69	0	958.72	
39.73	0	958.75	
40.18	0	959.04	
40.19	0	959.04	
40.2	0	959.05	
40.36	0	959.15	
40.67	0	959.35	
40.69	0	959.36	
40.72	0	959.38	bkf
41.14	0	959.8	
41.19	0	959.84	
41.25	0	959.92	
41.61	0	960.41	
41.69	0	960.52	
41.79	0	960.61	
42.08	0	960.84	
42.19	0	960.95	
42.33	0	961.04	
42.55	0	961.2	
42.7	0	961.3	
42.86	0	961.36	
43.02	0	961.42	
43.2	0	961.48	
43.4	0	961.53	
43.49	0	961.55	
43.7	0	961.61	
44.2	0	961.68	
44.43	0	961.71	
44.47	0	961.72	
44.7	0	961.75	
45.7	0	961.83	
46.31	0	961.89	
46.62	0	961.92	
46.7	0	961.93	
47.21	0	961.96	
49.21	0	962.03	
49.71	0	962.03	
53.72	0	961.97	
59.93	0	961.9	
60.04	0	961.89	
60.74	0	961.9	
61.24	0	961.92	
62.28	0	961.94	
62.73	0	961.95	
62.74	0	961.96	

63.74	0	961.98
64.24	0	962.01
64.63	0	962.03
64.74	0	962.03
65.75	0	962.07
66.25	0	962.1
67.25	0	962.14
67.45	0	962.14
68.25	0	962.15
68.39	0	962.12
68.63	0	962.07
68.75	0	962.04
68.86	0	962.03
69.17	0	962.01
69.25	0	962.01
70.26	0	961.99
70.76	0	962.1
70.78	0	962.1
71.21	0	961.97
71.26	0	961.96
71.76	0	961.97
72.26	0	962.04
72.76	0	962.05
73.26	0	962.13
73.76	0	962.13
74	0	962.16
74.03	0	962.17
74.27	0	962.2
74.77	0	962.21
74.97	0	962.22
75	0	962.22

Cross Sectional Geometry

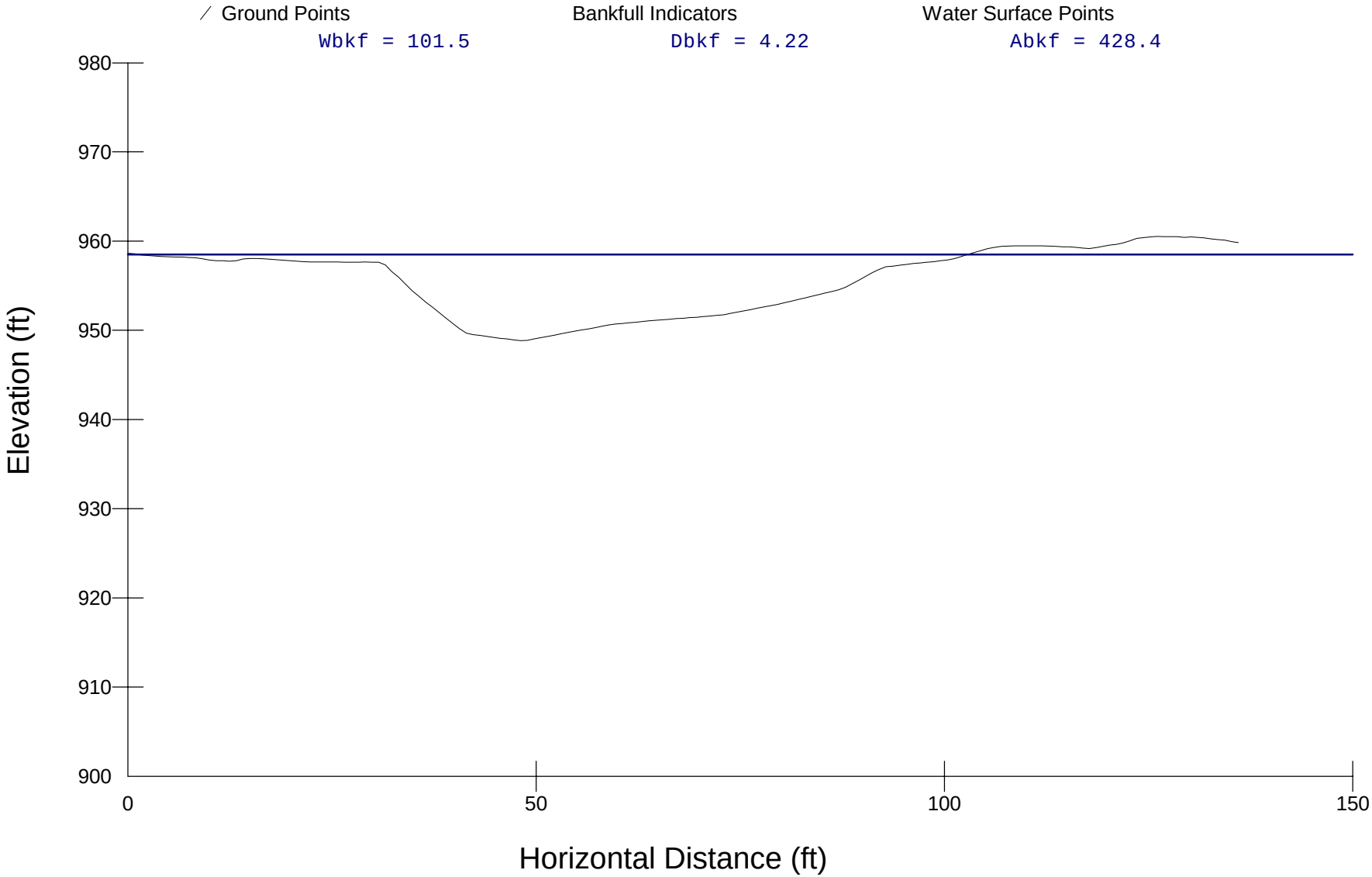
	Channel	Left	Right
Floodprone Elevation (ft)	966.34	966.34	966.34
Bankfull Elevation (ft)	959.48	959.48	959.48
Floodprone Width (ft)	2600	-----	-----
Bankfull Width (ft)	86.19	43.1	43.09
Entrenchment Ratio	30.17	-----	-----
Mean Depth (ft)	5.8	5.71	5.9
Maximum Depth (ft)	6.86	6.86	6.68
Width/Depth Ratio	14.86	7.55	7.3
Bankfull Area (sq ft)	500.32	245.92	254.4
Wetted Perimeter (ft)	89.99	51.1	51.71
Hydraulic Radius (ft)	5.56	4.81	4.92
Begin BKF Station	-45.37	-45.37	-2.27
End BKF Station	40.82	-2.27	40.82

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

101+79 Pool


Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 101.5
Dbkf = 4.22
Abkf = 428.4
980
970
960
950
940
930
920
910
900
Elevation (ft)
0
50
100
150
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-3
Cross Section Name: 101+79 Pool
Survey Date: 01/25/2026

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	958.65	
0.83	0	958.58	
1.66	0	958.43	
2.49	0	958.39	
3.32	0	958.34	
4.15	0	958.29	
4.97	0	958.25	
5.8	0	958.22	
6.63	0	958.2	
7.46	0	958.18	
8.29	0	958.13	
9.12	0	958.02	
9.95	0	957.9	
10.78	0	957.8	
11.61	0	957.8	
12.44	0	957.74	
13.27	0	957.83	
14.1	0	957.98	
14.92	0	958.07	
15.75	0	958.08	
16.58	0	958.03	
17.41	0	957.97	
18.24	0	957.91	
19.07	0	957.86	
19.9	0	957.8	
20.73	0	957.75	
21.56	0	957.69	
22.39	0	957.67	
23.22	0	957.68	
24.05	0	957.67	
24.87	0	957.66	
25.7	0	957.66	
26.53	0	957.65	
27.36	0	957.65	
28.19	0	957.65	
29.02	0	957.66	
29.85	0	957.65	
30.68	0	957.63	
31.51	0	957.36	
32.34	0	956.58	
33.17	0	955.91	
34	0	955.2	
34.82	0	954.45	
35.65	0	953.79	
36.48	0	953.18	
37.31	0	952.58	
38.14	0	951.98	
38.97	0	951.38	
39.8	0	950.78	

40.63	0	950.19	
41.46	0	949.68	
42.29	0	949.51	
43.12	0	949.42	
43.95	0	949.32	
44.77	0	949.22	
45.6	0	949.12	
46.43	0	949.02	
47.26	0	948.93	
48.09	0	948.85	
48.92	0	948.9	
49.75	0	949.04	
50.58	0	949.18	
51.41	0	949.32	
52.24	0	949.46	
53.07	0	949.6	
53.89	0	949.74	
54.72	0	949.89	
55.55	0	950.03	
56.38	0	950.17	
57.21	0	950.31	
58.04	0	950.46	
58.87	0	950.6	
59.7	0	950.71	
60.53	0	950.78	
61.36	0	950.85	
62.19	0	950.91	
63.02	0	950.98	
63.84	0	951.05	
64.67	0	951.12	
65.5	0	951.18	
66.33	0	951.24	
67.16	0	951.3	
67.99	0	951.36	
68.82	0	951.42	
69.65	0	951.48	
70.48	0	951.54	
71.31	0	951.61	
72.14	0	951.67	
72.97	0	951.76	
73.79	0	951.89	
74.62	0	952.04	
75.45	0	952.18	
76.28	0	952.33	
77.11	0	952.47	
77.94	0	952.62	
78.77	0	952.76	
79.6	0	952.93	
80.43	0	953.11	
81.26	0	953.28	
82.09	0	953.46	WS
82.92	0	953.63	
83.74	0	953.81	
84.57	0	953.99	
85.4	0	954.17	
86.23	0	954.35	
87.06	0	954.54	
87.89	0	954.83	
88.72	0	955.22	
89.55	0	955.64	
90.38	0	956.06	
91.21	0	956.49	
92.04	0	956.88	
92.86	0	957.13	
93.69	0	957.21	
94.52	0	957.3	

95.35	0	957.38	
96.18	0	957.47	
97.01	0	957.55	
97.84	0	957.64	
98.67	0	957.72	
99.5	0	957.81	
100.33	0	957.88	
101.16	0	958.02	
101.99	0	958.25	
102.81	0	958.49	BKF
103.64	0	958.72	
104.47	0	958.95	
105.3	0	959.15	
106.13	0	959.3	
106.96	0	959.41	
107.79	0	959.46	
108.62	0	959.5	
109.45	0	959.49	
110.28	0	959.49	
111.11	0	959.48	
111.94	0	959.47	
112.76	0	959.45	
113.59	0	959.42	
114.42	0	959.37	
115.25	0	959.37	
116.08	0	959.3	
116.91	0	959.22	
117.74	0	959.16	
118.57	0	959.26	
119.4	0	959.41	
120.23	0	959.54	
121.06	0	959.63	
121.89	0	959.8	
122.71	0	960.02	
123.54	0	960.33	
124.37	0	960.39	
125.2	0	960.47	
126.03	0	960.54	
126.86	0	960.5	
127.69	0	960.5	
128.52	0	960.5	
129.35	0	960.44	
130.18	0	960.46	
131.01	0	960.42	
131.84	0	960.36	
132.66	0	960.24	
133.49	0	960.16	
134.32	0	960.09	
135.15	0	959.97	
135.98	0	959.84	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	968.13	968.13	968.13
Bankfull Elevation (ft)	958.49	958.49	958.49
Floodprone Width (ft)	1530	-----	-----
Bankfull Width (ft)	101.48	50.74	50.74
Entrenchment Ratio	15.08	-----	-----
Mean Depth (ft)	4.22	3.31	5.13
Maximum Depth (ft)	9.64	9.64	9.06
Width/Depth Ratio	24.05	15.31	9.89
Bankfull Area (sq ft)	428.44	168.14	260.3

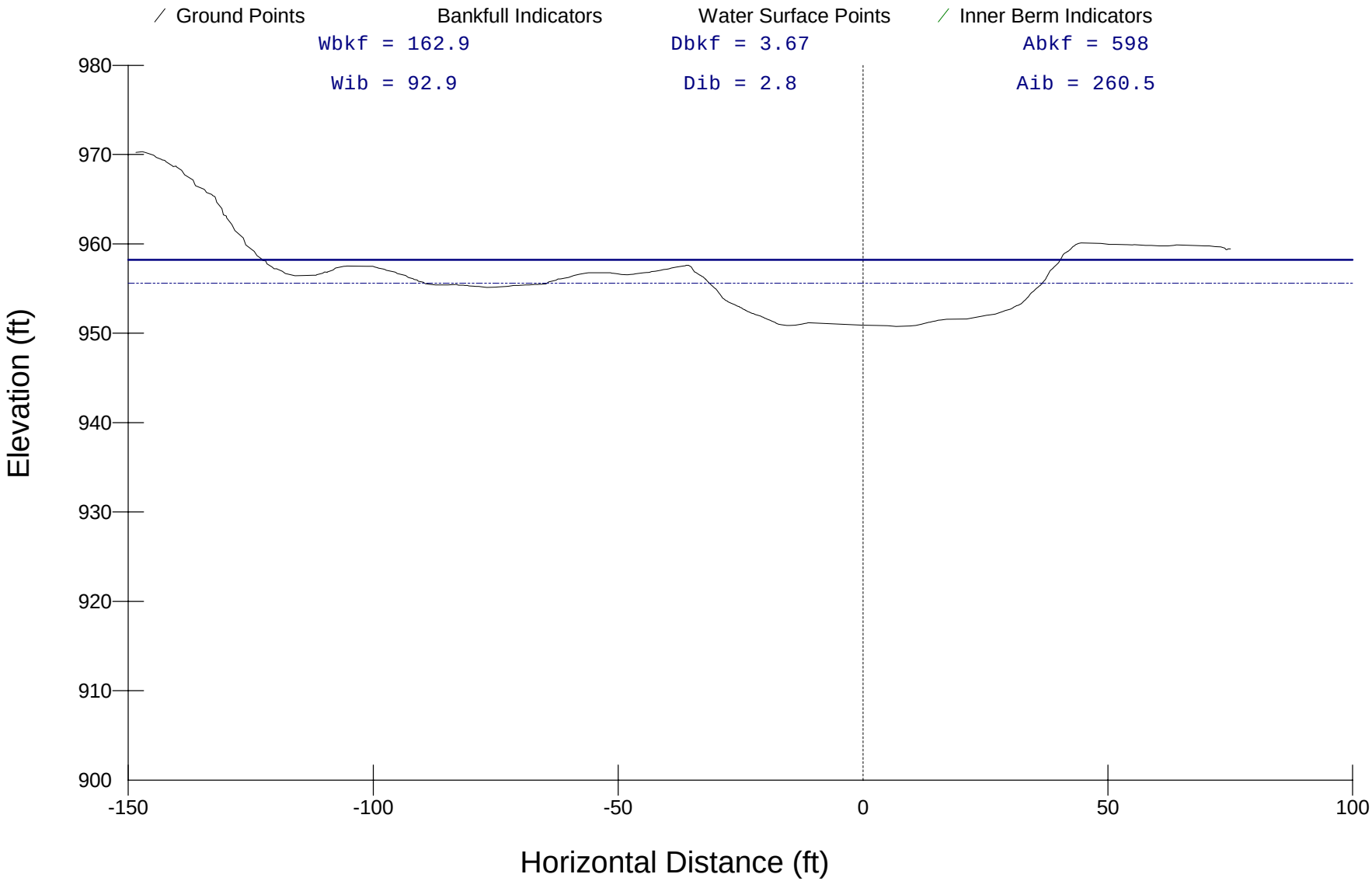
Wetted Perimeter (ft)	105.44	62.66	60.9
Hydraulic Radius (ft)	4.06	2.68	4.27
Begin BKF Station	1.33	1.33	52.07
End BKF Station	102.81	52.07	102.81

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

104+45 Riffle



RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-3
Cross Section Name: 104+45 Riffle
Survey Date: 11/19/2025

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
-148.43	0	970.24	
-147.11	0	970.33	
-146.54	0	970.22	
-144.82	0	969.95	
-144.62	0	969.86	
-144.27	0	969.67	
-143.24	0	969.45	
-143.11	0	969.38	
-142.54	0	969.35	
-142.21	0	969.17	
-140.95	0	968.75	
-140.82	0	968.68	
-140.25	0	968.72	
-140.21	0	968.69	
-140.15	0	968.64	
-139.1	0	968.22	
-138.53	0	967.72	
-136.81	0	967.14	
-136.54	0	966.83	
-136.5	0	966.79	
-136.24	0	966.51	
-134.53	0	966.14	
-134.33	0	966.01	
-133.98	0	965.77	
-132.95	0	965.53	
-132.86	0	965.46	
-132.81	0	965.42	
-132.24	0	965.28	
-132.12	0	965.07	
-131.92	0	964.69	
-130.89	0	963.96	
-130.52	0	963.26	
-129.95	0	963.1	
-129.86	0	962.94	
-128.8	0	962.16	
-128.23	0	961.51	
-126.52	0	960.68	
-126.24	0	960.29	
-125.94	0	959.87	
-124.23	0	959.17	
-123.69	0	958.67	
-122.66	0	958.28	
-122.51	0	958.14	
-121.94	0	958.1	
-121.63	0	957.78	
-120.61	0	957.43	
-120.22	0	957.25	
-119.65	0	957.22	
-119.58	0	957.18	

-118.51	0	956.96
-117.93	0	956.68
-115.95	0	956.44
-113.93	0	956.47
-112.21	0	956.52
-111.64	0	956.52
-111.54	0	956.54
-110.32	0	956.71
-109.92	0	956.87
-109.35	0	956.84
-109.29	0	956.86
-108.21	0	957.08
-107.64	0	957.29
-105.92	0	957.49
-105.65	0	957.49
-105.35	0	957.51
-101.34	0	957.5
-101.24	0	957.49
-100.03	0	957.47
-99.77	0	957.44
-99.63	0	957.4
-99.05	0	957.34
-99	0	957.32
-97.91	0	957.21
-97.57	0	957.12
-97.34	0	957.05
-95.62	0	956.87
-95.36	0	956.8
-95.05	0	956.7
-93.33	0	956.46
-93.15	0	956.4
-92.83	0	956.24
-91.8	0	956.12
-91.62	0	956.04
-91.04	0	955.95
-90.95	0	955.91
-90.77	0	955.83
-89.75	0	955.71
-89.48	0	955.6
-89.33	0	955.55
-88.72	0	955.48
-87.27	0	955.42
-85.32	0	955.41
-84.75	0	955.43
-83.03	0	955.44
-82.54	0	955.4
-81.52	0	955.37
-81.32	0	955.35
-80.75	0	955.34
-80.49	0	955.32
-79.46	0	955.29
-79.03	0	955.25
-78.46	0	955.23
-78.43	0	955.23
-77.31	0	955.18
-76.74	0	955.12
-75.02	0	955.16
-74.45	0	955.21
-72.74	0	955.25
-72.26	0	955.29
-71.23	0	955.34
-71.02	0	955.36
-70.45	0	955.35
-70.36	0	955.35
-68.89	0	955.41
-68.73	0	955.42

-68.16	0	955.42
-67.01	0	955.45
-66.44	0	955.47
-64.73	0	955.51
-64.48	0	955.6
-64.15	0	955.73
-62.64	0	955.93
-62.27	0	956.07
-61.97	0	956.09
-61.87	0	956.09
-61.54	0	956.11
-60.72	0	956.17
-60.15	0	956.27
-58.96	0	956.48
-57.86	0	956.6
-57.86	0	956.6
-56.76	0	956.71
-56.72	0	956.72
-56.02	0	956.77
-55.8	0	956.77
-51.57	0	956.75
-51.24	0	956.74
-51	0	956.73
-50.14	0	956.65
-49.28	0	956.59
-48.3	0	956.56
-47.93	0	956.56
-47.57	0	956.58
-46.83	0	956.63
-46.42	0	956.67
-44.7	0	956.78
-44.13	0	956.8
-43.89	0	956.81
-43.56	0	956.85
-43.15	0	956.9
-42.99	0	956.92
-42.41	0	956.95
-41.27	0	957.04
-40.7	0	957.12
-40.12	0	957.16
-39.55	0	957.24
-39.11	0	957.29
-38.01	0	957.42
-36.69	0	957.54
-36.25	0	957.57
-36.12	0	957.59
-35.8	0	957.59
-35.55	0	957.59
-35.43	0	957.56
-35.23	0	957.49
-35.06	0	957.42
-34.98	0	957.37
-34.7	0	957.11
-34.66	0	957.09
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-34.33	0	956.86
-34.2	0	956.83
-33.83	0	956.71
-33.59	0	956.62
-33.23	0	956.51
-33.17	0	956.49
-32.86	0	956.38
-32.69	0	956.32
-32.49	0	956.23
-32.14	0	956.06
-32.12	0	956.05

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-29.18	0	954.35	
-29.05	0	954.25	
-28.81	0	954.06	
-28.68	0	953.97	
-28.45	0	953.87	
-28.11	0	953.72	
-28.02	0	953.69	
-27.71	0	953.6	
-27.54	0	953.54	
-26.98	0	953.4	
-26.97	0	953.39	
-26.39	0	953.25	
-26.24	0	953.21	
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-25.25	0	952.97	
-25.14	0	952.93	
-24.77	0	952.84	
-24.68	0	952.82	
-24.4	0	952.71	
-24.35	0	952.7	
-24.1	0	952.62	
-24.04	0	952.6	
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-23.53	0	952.45	
-23.3	0	952.39	
-22.93	0	952.3	
-22.56	0	952.23	
-22.39	0	952.21	
-22.2	0	952.17	
-21.83	0	952.07	
-21.82	0	952.07	
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-20.82	0	951.9	
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-11.9	0	951.1	
-11.52	0	951.14	
-11.17	0	951.16	
0	0	950.93	
2.79	0	950.89	
5.07	0	950.83	
6.79	0	950.78	
9.65	0	950.81	
10.16	0	950.85	
10.79	0	950.89	
11.94	0	951.02	
12.51	0	951.11	
13.08	0	951.16	
13.1	0	951.17	
13.47	0	951.23	
13.66	0	951.26	
14.23	0	951.32	
14.8	0	951.4	
15.37	0	951.45	
15.94	0	951.51	
17.09	0	951.57	
21.09	0	951.62	
21.19	0	951.62	
24.53	0	951.95	
25.23	0	952.01	
25.67	0	952.04	
26.81	0	952.13	
27.07	0	952.17	
27.96	0	952.35	
28.54	0	952.45	
29.1	0	952.56	
30.01	0	952.7	
30.25	0	952.75	
30.61	0	952.86	
30.74	0	952.9	
31.11	0	953.01	
31.39	0	953.08	
31.48	0	953.1	
31.64	0	953.13	
31.85	0	953.18	
31.96	0	953.21	
32.22	0	953.29	
32.37	0	953.36	
32.54	0	953.43	
32.58	0	953.45	
32.67	0	953.5	
32.95	0	953.63	
33.11	0	953.71	
33.68	0	954.03	
33.69	0	954.03	
34.05	0	954.31	
34.25	0	954.44	
34.42	0	954.54	
34.82	0	954.74	
35.16	0	954.92	
35.4	0	955.03	
35.75	0	955.18	
35.97	0	955.27	
36.24	0	955.4	
36.26	0	955.41	
36.54	0	955.57	ib
36.63	0	955.62	
36.99	0	955.84	
37.11	0	955.92	

37.36	0	956.13	
37.53	0	956.28	
37.68	0	956.42	
37.73	0	956.46	
38.26	0	957.02	
38.47	0	957.14	
38.82	0	957.32	
38.83	0	957.33	
39.57	0	957.69	
39.87	0	957.86	
39.97	0	957.92	
40.1	0	958.04	
40.3	0	958.2	bkf
40.55	0	958.45	
40.67	0	958.61	
40.9	0	958.81	
41.04	0	958.91	
41.12	0	958.94	
41.69	0	959.13	
41.77	0	959.16	
41.93	0	959.21	
42.14	0	959.3	
42.26	0	959.38	
42.83	0	959.68	
42.88	0	959.71	
42.95	0	959.75	
43.24	0	959.86	
43.41	0	959.91	
43.98	0	960.05	
44.55	0	960.09	
48.56	0	960.07	
50.27	0	959.96	
50.84	0	959.94	
51.42	0	959.96	
51.7	0	959.97	
53.7	0	959.91	
53.91	0	959.91	
55.01	0	959.9	
55.42	0	959.91	
57.71	0	959.85	
58.85	0	959.84	
60.52	0	959.77	
60.57	0	959.77	
62.29	0	959.78	
62.86	0	959.81	
63.43	0	959.85	
64	0	959.88	
68.58	0	959.8	
69.7	0	959.77	
70.3	0	959.77	
70.73	0	959.76	
71.92	0	959.71	
72.01	0	959.71	
73.02	0	959.65	
73.73	0	959.57	
73.76	0	959.56	
73.82	0	959.53	
74.13	0	959.39	
74.3	0	959.37	
74.5	0	959.43	
74.84	0	959.45	
75	0	959.46	

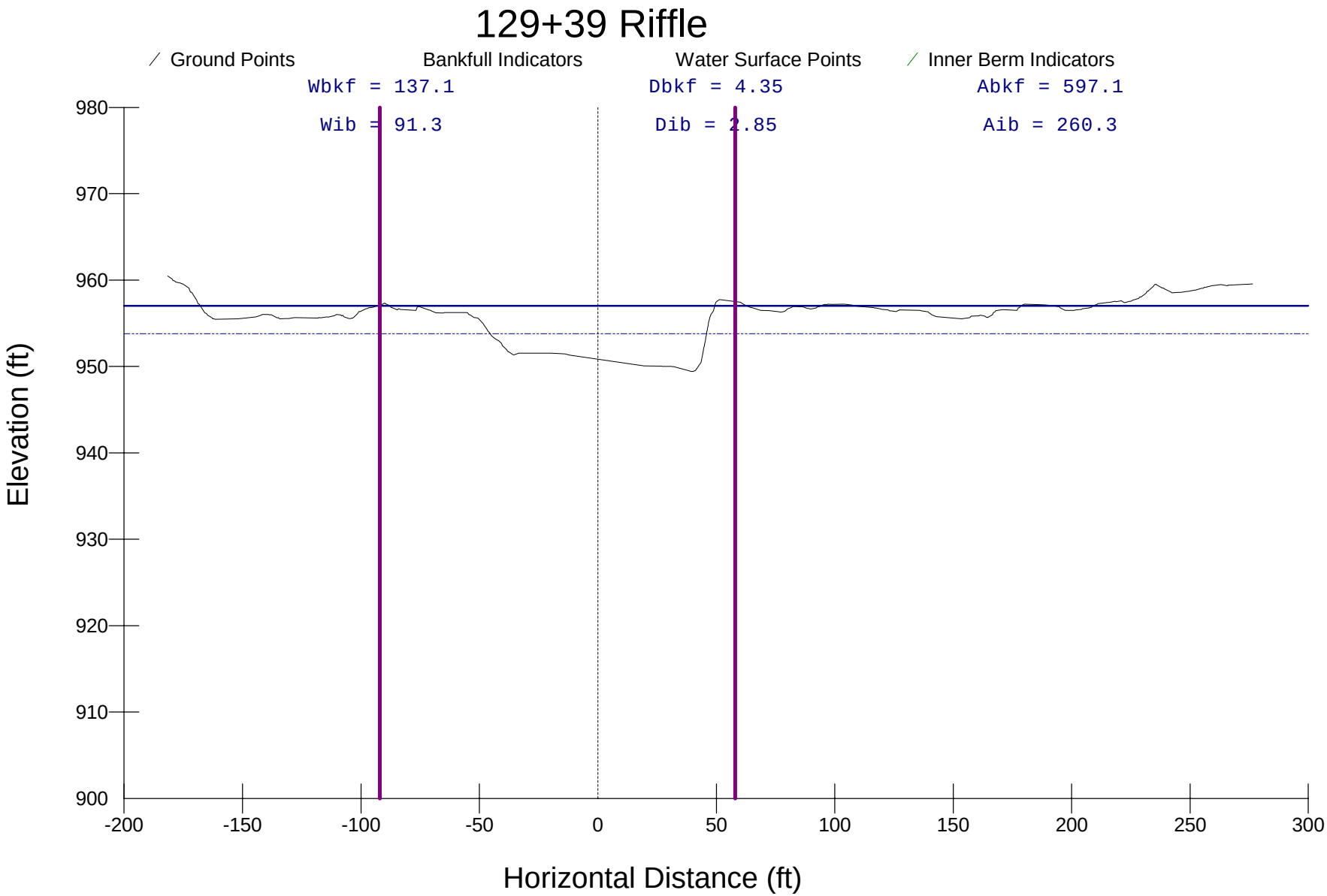
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	965.62	965.62	965.62
Bankfull Elevation (ft)	958.2	958.2	958.2
Floodprone Width (ft)	1530	-----	-----
Bankfull Width (ft)	162.87	125.13	37.74
Entrenchment Ratio	9.39	-----	-----
Mean Depth (ft)	3.67	3.04	5.77
Maximum Depth (ft)	7.42	7.33	7.42
Width/Depth Ratio	44.38	41.18	6.54
Bankfull Area (sq ft)	598.05	380.23	217.82
Wetted Perimeter (ft)	166.85	134.77	46.7
Hydraulic Radius (ft)	3.58	2.82	4.66
Begin BKF Station	-122.57	-122.57	2.56
End BKF Station	40.3	2.56	40.3

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


129+39 Riffle
Ground Points
Bankfull Indicators
Water Surface Points
Inner Berm Indicators
Wbkf = 137.1
Wib = 91.3
Dbkf = 4.35
Dib = 2.85
Abkf = 597.1
Aib = 260.3
Elevation (ft)
980
970
960
950
940
930
920
910
900
-200
-150
-100
-50
0
50
100
150
200
250
300
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-3
Cross Section Name: 129+39 Riffle
Survey Date: 11/19/2025

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
-181.48	0	960.45	
-179.72	0	960.15	
-179.3	0	959.95	
-178.78	0	959.92	
-178.25	0	959.78	
-176.33	0	959.68	
-176.16	0	959.65	
-175.64	0	959.61	
-175.11	0	959.54	
-172.5	0	959.05	
-172.31	0	958.89	
-172.2	0	958.79	
-171.97	0	958.62	
-171.45	0	958.6	
-169.36	0	957.71	
-168.84	0	957.26	
-168.31	0	957.24	
-165.8	0	956.23	
-165.7	0	956.17	
-165.17	0	956.13	
-164.65	0	955.91	
-162.74	0	955.6	
-162.56	0	955.53	
-162.03	0	955.51	
-161.8	0	955.48	
-161.51	0	955.47	
-151.57	0	955.52	
-151.05	0	955.55	
-148.95	0	955.61	
-148.43	0	955.61	
-147.91	0	955.65	
-144.25	0	955.73	
-142.15	0	955.91	
-141.63	0	956.02	
-141	0	956.03	
-138.97	0	956.02	
-138.49	0	955.98	
-137.97	0	956.01	
-137.8	0	955.99	
-137.44	0	955.91	
-135.35	0	955.65	
-134.83	0	955.66	
-134.3	0	955.54	
-131.69	0	955.55	
-131.17	0	955.58	
-130.64	0	955.57	
-128.55	0	955.64	
-128.03	0	955.66	
-118.09	0	955.61	

-117.86	0	955.65	
-117.81	0	955.66	
-117.56	0	955.69	
-117.04	0	955.65	
-116.9	0	955.65	
-114.95	0	955.72	
-114.42	0	955.74	
-113.81	0	955.71	
-111.28	0	955.89	
-110.76	0	955.94	
-110.24	0	956.05	
-108.41	0	955.95	
-108.14	0	955.87	
-107.62	0	955.91	
-107.1	0	955.75	
-105.01	0	955.57	
-104.48	0	955.56	
-104.24	0	955.57	
-104.21	0	955.57	
-103.96	0	955.6	
-103.44	0	955.6	
-101.34	0	956.11	
-100.82	0	956.37	
-100.3	0	956.37	
-97.81	0	956.68	
-97.68	0	956.7	
-97.16	0	956.73	
-96.63	0	956.81	
-94.83	0	956.87	
-94.54	0	956.91	
-94.02	0	956.94	
-93.49	0	957.01	
-91.41	0	957.18	
-91.4	0	957.18	
-90.88	0	957.19	
-90.36	0	957.32	
-89.83	0	957.33	TOB
-89.81	0	957.32	
-87.74	0	957.02	bkf
-87.22	0	956.82	
-86.69	0	956.81	
-84.58	0	956.56	
-84.21	0	956.66	
-84.08	0	956.68	
-83.41	0	956.63	
-77.01	0	956.49	
-76.75	0	956.49	
-76.61	0	956.62	
-76.26	0	956.91	
-76.23	0	956.94	
-75.18	0	956.89	
-71.41	0	956.55	
-70.47	0	956.49	
-70.21	0	956.45	
-68.38	0	956.22	
-65.24	0	956.19	
-64.72	0	956.26	
-55.3	0	956.27	
-55.09	0	956.21	
-55.01	0	956.2	
-54.61	0	956.07	
-54.33	0	956.01	
-54.25	0	955.99	
-53.73	0	955.97	
-52.16	0	955.69	
-51.64	0	955.69	

-50.59	0	955.6	
-48.5	0	954.98	
-47.81	0	954.73	
-47.41	0	954.58	
-47.01	0	954.4	
-46.93	0	954.36	
-46.77	0	954.28	
-46.61	0	954.22	
-46.41	0	954.12	
-46.21	0	954.05	
-45.88	0	953.95	ib
-44.84	0	953.55	
-43.42	0	953.24	
-43.27	0	953.21	
-42.74	0	953.13	
-42.62	0	953.11	
-41.82	0	952.99	
-40.65	0	952.69	
-40.62	0	952.67	
-40.22	0	952.42	
-40.13	0	952.38	
-38.62	0	952.02	
-38.45	0	951.95	
-38.22	0	951.85	
-38.04	0	951.78	
-37.82	0	951.73	
-37.51	0	951.67	
-36.99	0	951.62	
-36.22	0	951.45	
-35.94	0	951.39	
-35.42	0	951.34	
-33.33	0	951.52	
-19.72	0	951.53	
-13.82	0	951.47	
-11.88	0	951.32	
19.52	0	950.1	
26.84	0	950.04	
27.36	0	950.01	
31.03	0	950.01	
31.55	0	949.98	
32.07	0	949.99	
38.35	0	949.5	
39.4	0	949.42	
40.44	0	949.43	
40.97	0	949.5	
41	0	949.51	
41.38	0	949.61	
41.49	0	949.64	
41.71	0	949.7	
41.77	0	949.72	
43.58	0	950.5	
44.11	0	951.19	
44.17	0	951.3	
44.57	0	951.93	
44.63	0	952.01	
44.97	0	952.44	
45.15	0	952.65	
45.37	0	952.97	
45.49	0	953.16	
45.68	0	953.45	
45.77	0	953.61	ib
46.09	0	954.08	
46.17	0	954.19	
46.2	0	954.24	
46.25	0	954.32	
46.57	0	954.85	

46.72	0	955.08	
46.97	0	955.38	
47	0	955.4	
47.25	0	955.65	
47.37	0	955.72	
47.76	0	956.02	
47.77	0	956.02	
48.17	0	956.18	
48.29	0	956.24	
48.82	0	956.46	
48.97	0	956.63	
49.34	0	957.04	bkf
49.37	0	957.08	
49.77	0	957.39	
49.86	0	957.43	
50.39	0	957.56	
50.57	0	957.6	
51.43	0	957.76	
60.33	0	957.44	
60.85	0	957.33	
62.42	0	957.09	
64.57	0	956.85	
65.37	0	956.79	
65.56	0	956.78	
68.7	0	956.5	
72.36	0	956.47	
76.55	0	956.34	
77.07	0	956.3	
78.11	0	956.31	
78.97	0	956.39	
79.16	0	956.42	
79.37	0	956.47	
79.68	0	956.56	
79.77	0	956.59	
80.05	0	956.66	
81.78	0	956.82	
82.3	0	956.94	
82.82	0	956.96	
83.35	0	956.95	
85.14	0	956.9	
85.44	0	956.89	
85.96	0	956.92	
86.49	0	956.91	
88.58	0	956.73	
89.1	0	956.74	
89.63	0	956.64	
90.15	0	956.65	
90.17	0	956.66	
92.24	0	956.78	
92.76	0	956.91	
93.29	0	956.89	
95.38	0	957.15	
95.77	0	957.16	
95.9	0	957.18	
96.43	0	957.16	
96.57	0	957.16	
96.92	0	957.21	
96.95	0	957.22	
98.97	0	957.18	
103.77	0	957.24	
105.84	0	957.16	
106.37	0	957.12	
106.89	0	957.13	
108.98	0	957.02	
109.51	0	956.97	
110.03	0	956.98	

110.55	0	956.93
112.31	0	956.9
115.79	0	956.84
116.31	0	956.84
116.83	0	956.77
117.35	0	956.77
119.45	0	956.67
119.97	0	956.63
120.49	0	956.62
122.59	0	956.53
123.11	0	956.45
123.63	0	956.44
125.89	0	956.37
126.77	0	956.48
126.97	0	956.52
127.16	0	956.52
127.3	0	956.54
136.19	0	956.51
136.56	0	956.44
136.71	0	956.42
139.47	0	956.32
139.85	0	956.2
140.38	0	956.16
140.9	0	956.01
142.96	0	955.8
153.46	0	955.51
156.45	0	955.62
156.56	0	955.64
156.59	0	955.65
157.12	0	955.69
157.64	0	955.82
160.26	0	955.86
160.78	0	955.87
161.3	0	955.93
161.55	0	955.93
163.4	0	955.83
163.92	0	955.7
164.44	0	955.7
164.56	0	955.69
166.64	0	956.01
166.96	0	956.19
167.06	0	956.25
167.58	0	956.28
167.76	0	956.36
168	0	956.42
168.11	0	956.46
170.16	0	956.56
170.2	0	956.56
170.72	0	956.59
171.24	0	956.57
177	0	956.52
177.52	0	956.76
178.05	0	956.85
178.53	0	957.07
180.22	0	957.22
188.71	0	957.11
190.6	0	957.08
190.96	0	957.06
191.13	0	957.06
191.65	0	957.03
192.11	0	957.05
194.16	0	956.96
194.27	0	956.94
194.79	0	956.93
195.31	0	956.75
197.36	0	956.5

201.07	0	956.5
201.59	0	956.54
202.11	0	956.55
204.21	0	956.62
204.56	0	956.68
204.73	0	956.7
205.25	0	956.69
205.36	0	956.72
207.39	0	956.78
207.76	0	956.82
207.87	0	956.84
208.39	0	956.88
208.91	0	957.03
210.78	0	957.2
211.01	0	957.26
214.67	0	957.39
215.19	0	957.42
215.72	0	957.41
215.75	0	957.41
217.81	0	957.53
218.33	0	957.56
218.86	0	957.5
219.27	0	957.52
220.97	0	957.61
221.47	0	957.51
221.99	0	957.45
222.15	0	957.41
222.45	0	957.39
222.52	0	957.38
224.61	0	957.57
225.13	0	957.55
225.66	0	957.66
228.27	0	957.89
228.8	0	958.08
229.32	0	958.07
231.41	0	958.47
231.75	0	958.64
231.94	0	958.74
232.46	0	958.74
232.55	0	958.78
234.55	0	959.26
234.95	0	959.46
235.07	0	959.5
235.6	0	959.51
235.75	0	959.49
236.12	0	959.41
238.21	0	959.1
238.74	0	959.1
239.26	0	958.96
241.88	0	958.66
242.4	0	958.54
245.02	0	958.56
245.54	0	958.59
246.06	0	958.59
248.68	0	958.68
249.2	0	958.68
251.82	0	958.84
252.34	0	958.84
252.86	0	958.91
254.96	0	959.04
255.48	0	959.06
256	0	959.14
256.53	0	959.16
258.62	0	959.32
259.14	0	959.38
259.67	0	959.39

262.8	0	959.5
263.33	0	959.47
265.42	0	959.39
265.94	0	959.39
266.15	0	959.41
266.47	0	959.42
276.41	0	959.56

Cross Sectional Geometry

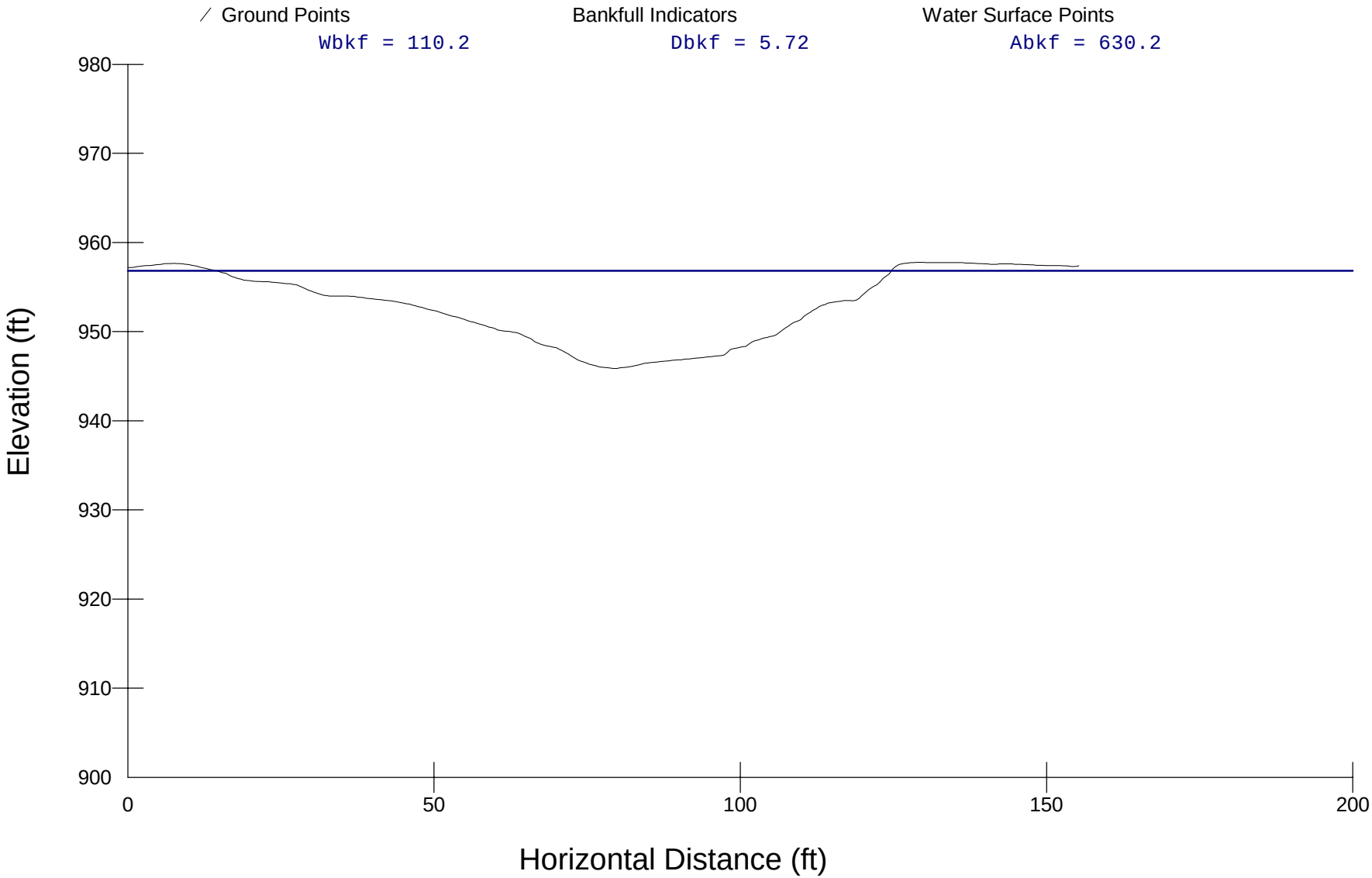
	Channel	Left	Right
Floodprone Elevation (ft)	964.64	964.64	964.64
Bankfull Elevation (ft)	957.03	957.03	957.03
Floodprone Width (ft)	580	-----	-----
Bankfull Width (ft)	137.14	73.43	63.71
Entrenchment Ratio	4.23	-----	-----
Mean Depth (ft)	4.35	2.68	6.28
Maximum Depth (ft)	7.61	5.69	7.61
Width/Depth Ratio	31.53	27.4	10.14
Bankfull Area (sq ft)	597.06	196.81	400.25
Wetted Perimeter (ft)	141.55	80.01	72.65
Hydraulic Radius (ft)	4.22	2.46	5.51
Begin BKF Station	-87.81	-87.81	-14.38
End BKF Station	49.33	-14.38	49.33

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

137+80 Pool


Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 110.2
Dbkf = 5.72
Abkf = 630.2
980
970
960
950
940
930
920
910
900
Elevation (ft)
0
50
100
150
200
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-3
Cross Section Name: 137+80 Pool
Survey Date: 01/25/2026

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	957.18	
0.5	0	957.19	
1	0	957.24	
1.5	0	957.31	
2	0	957.35	
2.5	0	957.38	
3	0	957.4	
3.5	0	957.42	
3.99	0	957.45	
4.49	0	957.48	
4.99	0	957.52	
5.49	0	957.57	
5.99	0	957.62	
6.49	0	957.63	
6.99	0	957.65	
7.49	0	957.66	
7.99	0	957.65	
8.49	0	957.64	
8.99	0	957.6	
9.49	0	957.56	
9.99	0	957.51	
10.49	0	957.45	
10.99	0	957.38	
11.49	0	957.29	
11.98	0	957.21	
12.48	0	957.13	
12.98	0	957.04	
13.48	0	956.98	
13.98	0	956.92	
14.48	0	956.83	BKF
14.98	0	956.74	
15.48	0	956.63	
15.98	0	956.53	
16.48	0	956.38	
16.98	0	956.18	
17.48	0	956.06	
17.98	0	955.98	
18.48	0	955.9	
18.98	0	955.8	
19.47	0	955.74	
19.97	0	955.7	
20.47	0	955.67	
20.97	0	955.63	
21.47	0	955.62	
21.97	0	955.6	
22.47	0	955.6	
22.97	0	955.59	
23.47	0	955.57	
23.97	0	955.54	

24.47	0	955.5	
24.97	0	955.46	
25.47	0	955.43	
25.97	0	955.4	
26.47	0	955.37	
26.97	0	955.32	
27.46	0	955.27	
27.96	0	955.12	
28.46	0	954.98	
28.96	0	954.85	
29.46	0	954.67	
29.96	0	954.53	
30.46	0	954.41	
30.96	0	954.28	
31.46	0	954.17	
31.96	0	954.09	
32.46	0	954.05	
32.96	0	954.02	
33.46	0	954.02	
33.96	0	954.02	
34.46	0	954.02	
34.95	0	954.01	
35.45	0	954.01	
35.95	0	953.99	
36.45	0	953.98	
36.95	0	953.95	
37.45	0	953.91	
37.95	0	953.87	
38.45	0	953.81	
38.95	0	953.75	
39.45	0	953.71	
39.95	0	953.68	
40.45	0	953.65	
40.95	0	953.62	
41.45	0	953.58	
41.95	0	953.54	
42.45	0	953.5	
42.94	0	953.45	
43.44	0	953.41	
43.94	0	953.36	
44.44	0	953.28	
44.94	0	953.19	
45.44	0	953.13	
45.94	0	953.09	
46.44	0	952.99	
46.94	0	952.9	
47.44	0	952.79	
47.94	0	952.73	
48.44	0	952.64	
48.94	0	952.53	
49.44	0	952.44	
49.94	0	952.37	
50.43	0	952.28	
50.93	0	952.18	
51.43	0	952.07	
51.93	0	951.96	
52.43	0	951.85	
52.93	0	951.75	
53.43	0	951.68	
53.93	0	951.61	
54.43	0	951.51	
54.93	0	951.39	WS
55.43	0	951.26	
55.93	0	951.14	
56.43	0	951.05	
56.93	0	950.96	

57.43	0	950.86
57.93	0	950.76
58.42	0	950.66
58.92	0	950.53
59.42	0	950.44
59.92	0	950.33
60.42	0	950.21
60.92	0	950.13
61.42	0	950.09
61.92	0	950.06
62.42	0	950
62.92	0	949.95
63.42	0	949.9
63.92	0	949.78
64.42	0	949.62
64.92	0	949.47
65.42	0	949.33
65.91	0	949.19
66.41	0	948.9
66.91	0	948.73
67.41	0	948.58
67.91	0	948.47
68.41	0	948.4
68.91	0	948.35
69.41	0	948.27
69.91	0	948.18
70.41	0	948.04
70.91	0	947.86
71.41	0	947.68
71.91	0	947.5
72.41	0	947.26
72.91	0	947.06
73.41	0	946.84
73.9	0	946.71
74.4	0	946.6
74.9	0	946.48
75.4	0	946.35
75.9	0	946.26
76.4	0	946.15
76.9	0	946.07
77.4	0	946.02
77.9	0	945.97
78.4	0	945.93
78.9	0	945.91
79.4	0	945.89
79.9	0	945.88
80.4	0	945.96
80.9	0	945.99
81.39	0	946.03
81.89	0	946.07
82.39	0	946.12
82.89	0	946.19
83.39	0	946.29
83.89	0	946.39
84.39	0	946.46
84.89	0	946.49
85.39	0	946.53
85.89	0	946.56
86.39	0	946.6
86.89	0	946.63
87.39	0	946.66
87.89	0	946.7
88.39	0	946.73
88.89	0	946.77
89.38	0	946.8
89.88	0	946.84

90.38	0	946.87
90.88	0	946.91
91.38	0	946.94
91.88	0	946.97
92.38	0	947.01
92.88	0	947.04
93.38	0	947.08
93.88	0	947.11
94.38	0	947.15
94.88	0	947.18
95.38	0	947.21
95.88	0	947.25
96.38	0	947.28
96.87	0	947.31
97.37	0	947.41
97.87	0	947.67
98.37	0	947.96
98.87	0	948.08
99.37	0	948.15
99.87	0	948.23
100.37	0	948.3
100.87	0	948.33
101.37	0	948.61
101.87	0	948.86
102.37	0	948.98
102.87	0	949.08
103.37	0	949.18
103.87	0	949.27
104.37	0	949.37
104.86	0	949.45
105.36	0	949.51
105.86	0	949.66
106.36	0	949.89
106.86	0	950.18
107.36	0	950.41
107.86	0	950.61
108.36	0	950.88
108.86	0	951.05
109.36	0	951.17
109.86	0	951.36
110.36	0	951.72
110.86	0	951.96
111.36	0	952.15
111.86	0	952.36
112.35	0	952.58
112.85	0	952.81
113.35	0	952.96
113.85	0	953.06
114.35	0	953.19
114.85	0	953.28
115.35	0	953.33
115.85	0	953.37
116.35	0	953.43
116.85	0	953.49
117.35	0	953.49
117.85	0	953.48
118.35	0	953.45
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119.35	0	953.73
119.85	0	954.03
120.34	0	954.36
120.84	0	954.67
121.34	0	954.9
121.84	0	955.09
122.34	0	955.28
122.84	0	955.59

123.34	0	956
123.84	0	956.25
124.34	0	956.51
124.84	0	957.01
125.34	0	957.32
125.84	0	957.52
126.34	0	957.59
126.84	0	957.67
127.34	0	957.72
127.83	0	957.74
128.33	0	957.76
128.83	0	957.77
129.33	0	957.77
129.83	0	957.77
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130.83	0	957.76
131.33	0	957.76
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134.33	0	957.73
134.83	0	957.74
135.33	0	957.74
135.82	0	957.74
136.32	0	957.73
136.82	0	957.72
137.32	0	957.71
137.82	0	957.7
138.32	0	957.68
138.82	0	957.65
139.32	0	957.63
139.82	0	957.6
140.32	0	957.58
140.82	0	957.57
141.32	0	957.56
141.82	0	957.57
142.32	0	957.58
142.82	0	957.59
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144.31	0	957.58
144.81	0	957.57
145.31	0	957.56
145.81	0	957.55
146.31	0	957.53
146.81	0	957.52
147.31	0	957.5
147.81	0	957.48
148.31	0	957.46
148.81	0	957.45
149.31	0	957.44
149.81	0	957.43
150.31	0	957.43
150.81	0	957.43
151.3	0	957.42
151.8	0	957.42
152.3	0	957.41
152.8	0	957.39
153.3	0	957.37
153.8	0	957.34
154.3	0	957.32
154.8	0	957.33
155.3	0	957.38

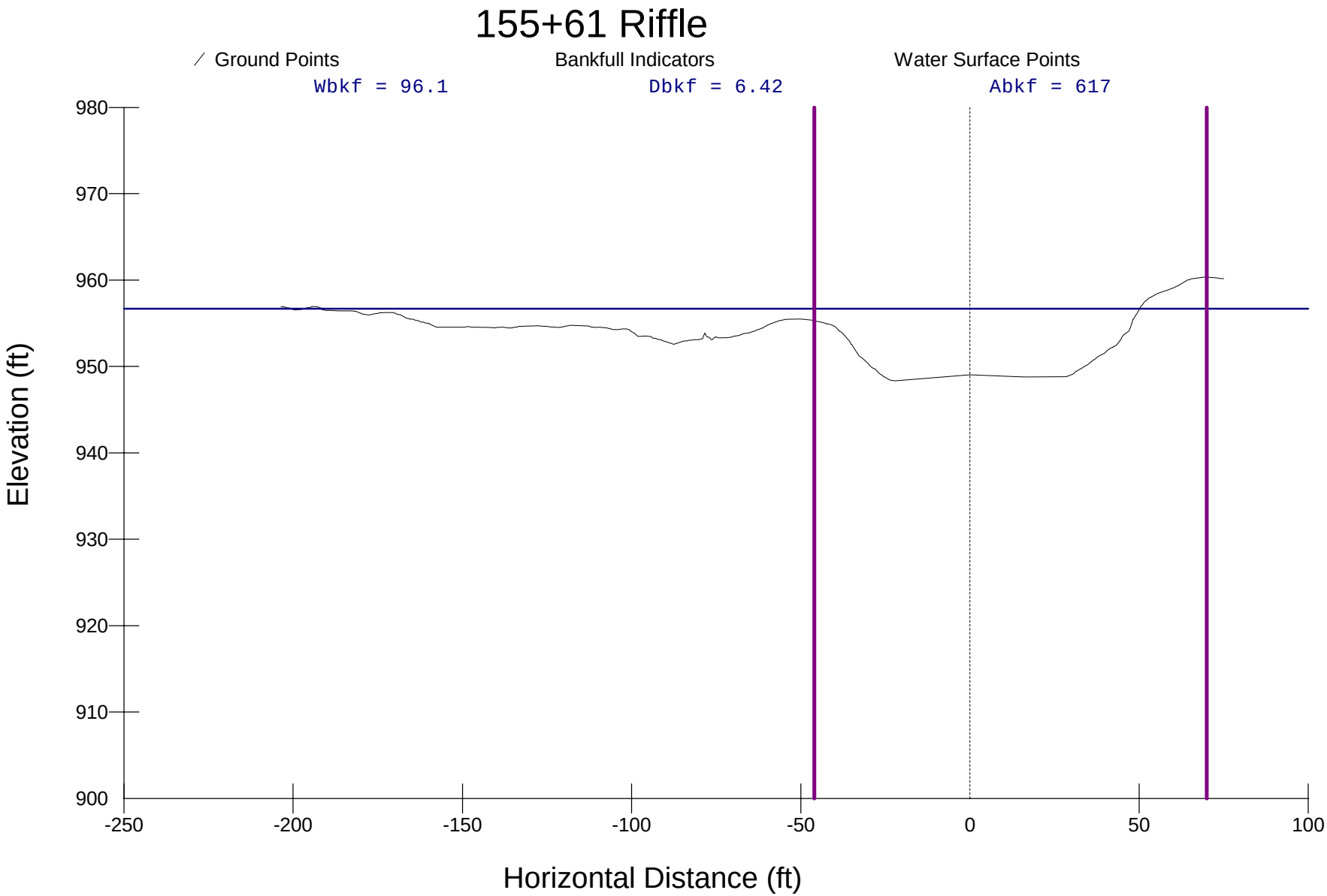
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	967.78	967.78	967.78
Bankfull Elevation (ft)	956.83	956.83	956.83
Floodprone Width (ft)	1300	-----	-----
Bankfull Width (ft)	110.18	55.09	55.09
Entrenchment Ratio	11.8	-----	-----
Mean Depth (ft)	5.72	3.8	7.64
Maximum Depth (ft)	10.95	8.59	10.95
Width/Depth Ratio	19.26	14.48	7.21
Bankfull Area (sq ft)	630.23	209.61	420.62
Wetted Perimeter (ft)	113.63	64.6	66.21
Hydraulic Radius (ft)	5.55	3.24	6.35
Begin BKF Station	14.48	14.48	69.57
End BKF Station	124.66	69.57	124.66

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


155+61 Riffle
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 96.1
Dbkf = 6.42
Abkf = 617
980
970
960
950
940
930
920
910
900
Elevation (ft)
-250
-200
-150
-100
-50
0
50
100
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-3
Cross Section Name: 155+61 Riffle
Survey Date: 01/19/2026

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
-203.62	0	956.94	
-203.48	0	956.92	
-202.66	0	956.89	
-202.39	0	956.86	
-202.16	0	956.82	
-201.14	0	956.75	
-200.83	0	956.7	
-199.51	0	956.56	
-197.43	0	956.62	
-197.32	0	956.65	
-196.01	0	956.77	
-195.8	0	956.81	
-194.87	0	956.85	
-194.59	0	956.89	
-194.27	0	956.96	
-193.51	0	956.94	
-193.18	0	956.93	
-192.89	0	956.9	
-191.98	0	956.79	
-191.56	0	956.62	
-190.34	0	956.52	
-190.24	0	956.5	
-188.93	0	956.5	
-188.17	0	956.47	
-186.65	0	956.45	
-185.12	0	956.43	
-182.83	0	956.45	
-181.31	0	956.39	
-180.97	0	956.29	
-179.78	0	956.13	
-179.64	0	956.09	
-177.66	0	955.95	
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-175.01	0	956.15	
-174.75	0	956.18	
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-173.02	0	956.27	
-172.16	0	956.25	
-171.7	0	956.27	
-170.63	0	956.26	
-170.49	0	956.26	
-170.37	0	956.24	
-169.1	0	956.04	

-169.08	0	956.03
-169.05	0	956.02
-168.39	0	956.01
-168.37	0	956
-167.06	0	955.7
-166.95	0	955.66
-166.82	0	955.62
-165.74	0	955.51
-165.53	0	955.48
-164.42	0	955.46
-164.11	0	955.39
-163.77	0	955.33
-163	0	955.31
-162.43	0	955.18
-161.48	0	955.12
-161.28	0	955.08
-161.1	0	955.06
-159.95	0	955
-159.86	0	954.98
-159.78	0	954.95
-157.79	0	954.59
-157.73	0	954.57
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-154.61	0	954.54
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-149.28	0	954.53
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-149.19	0	954.54
-148.52	0	954.62
-148.52	0	954.62
-148.51	0	954.62
-147.1	0	954.53
-146.99	0	954.53
-145.87	0	954.53
-141.65	0	954.51
-140.12	0	954.49
-139.92	0	954.5
-138.6	0	954.53
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-136.31	0	954.47
-135.28	0	954.48
-134.79	0	954.54
-133.96	0	954.54
-133.29	0	954.64
-132.5	0	954.63
-132.21	0	954.66
-127.33	0	954.72
-127.16	0	954.7
-126.01	0	954.67
-125.63	0	954.64
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-123.35	0	954.58
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-121.58	0	954.52
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-120.05	0	954.63
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-92.84	0	953.28
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-90.92	0	952.98
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-87.5	0	952.58
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-79.11	0	953.19
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44.29	0	952.97	ib
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64.69	0	960.04
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73.3	0	960.23
73.42	0	960.22
75	0	960.16

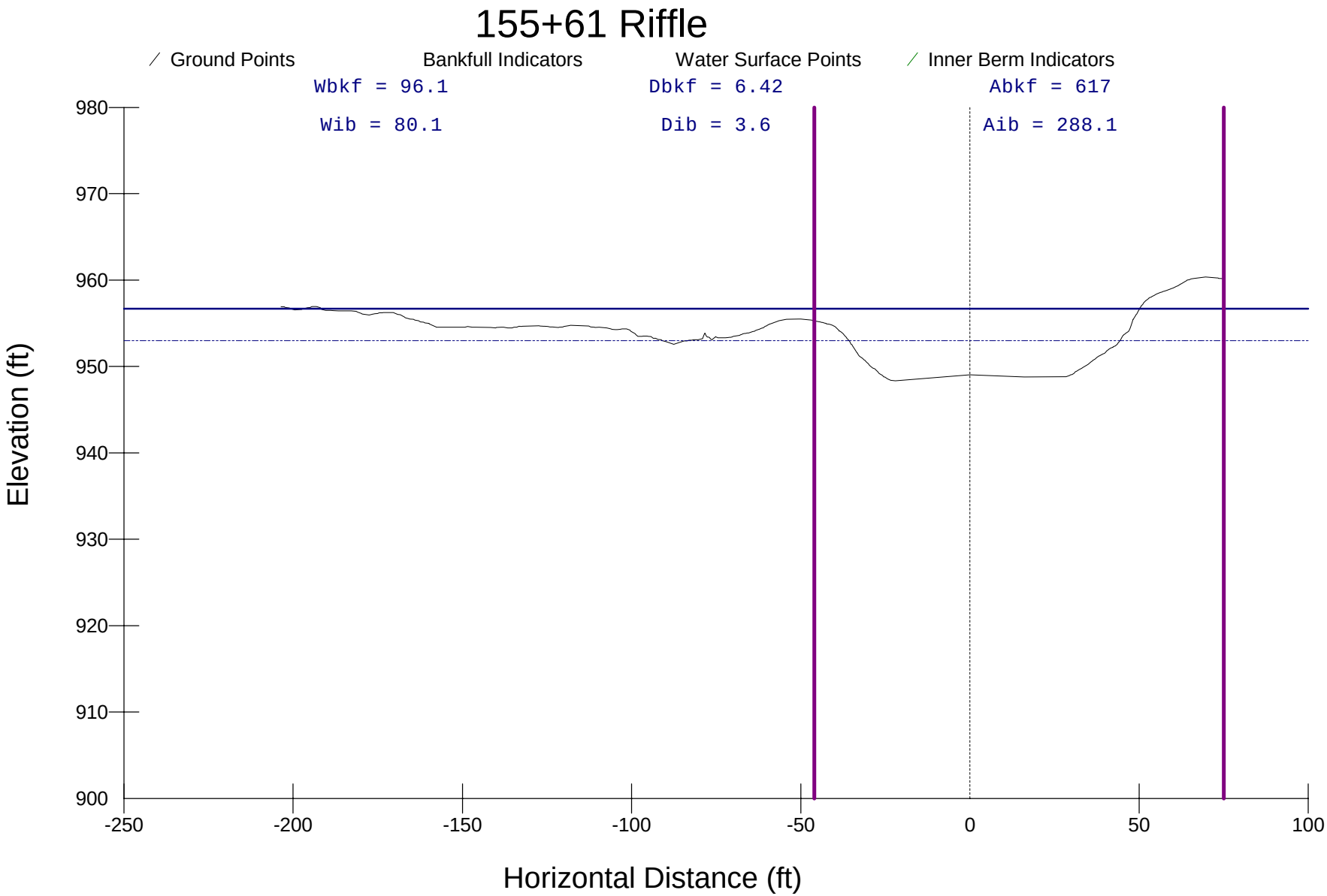
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	965.01	965.01	965.01
Bankfull Elevation (ft)	956.68	956.68	956.68
Floodprone Width (ft)	1400	-----	-----
Bankfull Width (ft)	96.13	48.56	47.57
Entrenchment Ratio	14.56	-----	-----
Mean Depth (ft)	6.42	6.35	6.49
Maximum Depth (ft)	8.33	8.33	7.89
Width/Depth Ratio	14.97	7.65	7.33
Bankfull Area (sq ft)	617.01	308.16	308.85
Wetted Perimeter (ft)	100.65	58.96	57.08
Hydraulic Radius (ft)	6.13	5.23	5.41
Begin BKF Station	-46	-46	2.56
End BKF Station	50.13	2.56	50.13

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


155+61 Riffle
Ground Points
Bankfull Indicators
Water Surface Points
Inner Berm Indicators
Wbkf = 96.1
Dbkf = 6.42
Abkf = 617
Wib = 80.1
Dib = 3.6
Aib = 288.1
980
970
960
950
940
930
920
910
900
Elevation (ft)
-250
-200
-150
-100
-50
0
50
100
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-4
Cross Section Name: 155+61 Riffle
Survey Date: 11/19/2025

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
-203.62	0	956.94	
-203.48	0	956.92	
-202.66	0	956.89	
-202.39	0	956.86	
-202.16	0	956.82	
-201.14	0	956.75	
-200.83	0	956.7	
-199.51	0	956.56	
-197.43	0	956.62	
-197.32	0	956.65	
-196.01	0	956.77	
-195.8	0	956.81	
-194.87	0	956.85	
-194.59	0	956.89	
-194.27	0	956.96	
-193.51	0	956.94	
-193.18	0	956.93	
-192.89	0	956.9	
-191.98	0	956.79	
-191.56	0	956.62	
-190.34	0	956.52	
-190.24	0	956.5	
-188.93	0	956.5	
-188.17	0	956.47	
-186.65	0	956.45	
-185.12	0	956.43	
-182.83	0	956.45	
-181.31	0	956.39	
-180.97	0	956.29	
-179.78	0	956.13	
-179.64	0	956.09	
-177.66	0	955.95	
-177.58	0	955.96	
-177.49	0	955.97	
-176.33	0	956.06	
-176.16	0	956.08	
-175.97	0	956.11	
-175.01	0	956.15	
-174.75	0	956.18	
-174.44	0	956.23	
-173.68	0	956.23	
-173.33	0	956.26	
-173.02	0	956.27	
-172.16	0	956.25	
-171.7	0	956.27	
-170.63	0	956.26	
-170.49	0	956.26	
-170.37	0	956.24	
-169.1	0	956.04	

-169.08	0	956.03
-169.05	0	956.02
-168.39	0	956.01
-168.37	0	956
-167.06	0	955.7
-166.95	0	955.66
-166.82	0	955.62
-165.74	0	955.51
-165.53	0	955.48
-164.42	0	955.46
-164.11	0	955.39
-163.77	0	955.33
-163	0	955.31
-162.43	0	955.18
-161.48	0	955.12
-161.28	0	955.08
-161.1	0	955.06
-159.95	0	955
-159.86	0	954.98
-159.78	0	954.95
-157.79	0	954.59
-157.73	0	954.57
-157.66	0	954.56
-156.14	0	954.55
-154.61	0	954.54
-152.33	0	954.54
-150.8	0	954.53
-149.28	0	954.53
-149.23	0	954.53
-149.19	0	954.54
-148.52	0	954.62
-148.52	0	954.62
-148.51	0	954.62
-147.1	0	954.53
-146.99	0	954.53
-145.87	0	954.53
-141.65	0	954.51
-140.12	0	954.49
-139.92	0	954.5
-138.6	0	954.53
-137.93	0	954.55
-137.84	0	954.54
-136.6	0	954.49
-136.47	0	954.48
-136.31	0	954.47
-135.28	0	954.48
-134.79	0	954.54
-133.96	0	954.54
-133.29	0	954.64
-132.5	0	954.63
-132.21	0	954.66
-127.33	0	954.72
-127.16	0	954.7
-126.01	0	954.67
-125.63	0	954.64
-124.69	0	954.62
-124.11	0	954.58
-123.35	0	954.58
-122.7	0	954.53
-121.82	0	954.52
-121.58	0	954.52
-121.37	0	954.54
-120.3	0	954.59
-120.05	0	954.63
-118.77	0	954.73
-118.75	0	954.73

-118.73	0	954.73
-118.04	0	954.75
-112.67	0	954.68
-112.37	0	954.62
-112.1	0	954.58
-110.95	0	954.53
-110.78	0	954.52
-109.62	0	954.53
-107.4	0	954.49
-107.33	0	954.47
-106.14	0	954.38
-105.8	0	954.31
-104.82	0	954.27
-104.28	0	954.27
-103.5	0	954.29
-102.83	0	954.35
-101.99	0	954.38
-101.73	0	954.38
-101.51	0	954.36
-100.47	0	954.21
-100.19	0	954.06
-98.94	0	953.78
-98.86	0	953.73
-98.2	0	953.49
-98.19	0	953.49
-98.18	0	953.49
-96.87	0	953.51
-96.65	0	953.52
-95.35	0	953.53
-95.13	0	953.5
-94.23	0	953.46
-93.6	0	953.29
-92.84	0	953.28
-92.24	0	953.12
-91.31	0	953.08
-90.92	0	952.98
-89.79	0	952.88
-89.59	0	952.83
-87.56	0	952.58
-87.5	0	952.58
-85.98	0	952.78
-84.45	0	952.94
-83.63	0	952.95
-83.3	0	953.02
-82.97	0	953.07
-82.16	0	953.07
-81.64	0	953.08
-80.64	0	953.09
-80.32	0	953.11
-79.11	0	953.19
-79	0	953.2
-78.7	0	953.57
-78.35	0	953.86
-78.34	0	953.87
-78.33	0	953.87
-77.99	0	953.62
-77.67	0	953.43
-77.63	0	953.42
-77.28	0	953.41
-77.01	0	953.36
-76.92	0	953.32
-76.82	0	953.28
-76.57	0	953.18
-76.35	0	953.11
-76.21	0	953.12
-76.06	0	953.14

-75.86	0	953.19
-75.69	0	953.26
-75.51	0	953.34
-75.3	0	953.4
-75.15	0	953.45
-75.02	0	953.42
-74.8	0	953.37
-74.54	0	953.32
-74.44	0	953.31
-74.36	0	953.31
-72.25	0	953.31
-71.49	0	953.35
-71.05	0	953.38
-70.9	0	953.39
-70.72	0	953.4
-70.54	0	953.41
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-67	0	953.78
-66.91	0	953.79
-66.65	0	953.82
-66.42	0	953.83
-66.29	0	953.83
-66.15	0	953.85
-65.75	0	953.88
-65.58	0	953.88
-65.38	0	953.9
-64.16	0	954.05
-63.86	0	954.08
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-63.46	0	954.15
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-63.1	0	954.22
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-62.33	0	954.29
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-61.12	0	954.49
-60.46	0	954.65
-60.27	0	954.7
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-47.86	0	955.43
-47.15	0	955.38
-47.08	0	955.37
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-46.44	0	955.32

-46.32	0	955.31	
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-44.03	0	955.13	
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-41.92	0	954.9	
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-34.88	0	952.51	
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-31.56	0	950.87	
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-29.78	0	950.17	
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-28.01	0	949.67	

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-26.69	0	949.13	
-26.24	0	949.03	
-25.89	0	948.95	
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-25.36	0	948.79	
-25.18	0	948.76	
-24.47	0	948.59	
-24.04	0	948.51	
-23.44	0	948.43	
-22.7	0	948.36	
-22.68	0	948.36	
-22.05	0	948.35	
0	0	949.02	
15.94	0	948.79	
16.36	0	948.79	
28.27	0	948.81	
28.42	0	948.82	
29.41	0	948.96	
29.76	0	949.02	
30.11	0	949.08	
30.71	0	949.23	
31.18	0	949.38	
31.53	0	949.46	
32.23	0	949.64	
33	0	949.81	
33.3	0	949.87	
34.9	0	950.24	
35.79	0	950.57	
36.14	0	950.68	
36.22	0	950.7	
36.88	0	950.84	
37.54	0	951.08	
37.56	0	951.08	
38.21	0	951.23	
38.34	0	951.25	
38.62	0	951.3	
38.98	0	951.38	
39.1	0	951.41	
39.33	0	951.46	
39.53	0	951.51	
39.86	0	951.58	
40.04	0	951.64	
40.39	0	951.78	
40.62	0	951.88	
40.75	0	951.91	
40.86	0	951.95	
41.1	0	952	
41.52	0	952.1	
42.15	0	952.24	
42.17	0	952.24	
42.18	0	952.25	
42.84	0	952.37	
42.91	0	952.38	
43.23	0	952.49	
43.5	0	952.6	
43.67	0	952.68	
44.17	0	952.91	
44.29	0	952.97	ib
44.44	0	953.07	
44.65	0	953.2	
44.83	0	953.33	
45	0	953.45	
45.2	0	953.58	

45.36	0	953.63	
45.49	0	953.68	
45.71	0	953.74	
45.96	0	953.83	
46.77	0	954.05	
46.81	0	954.06	
47.13	0	954.24	
47.41	0	954.54	
47.48	0	954.61	
47.48	0	954.61	
47.49	0	954.62	
47.84	0	955.07	
48.14	0	955.41	
48.19	0	955.44	
48.25	0	955.47	
48.54	0	955.64	
48.9	0	955.9	
49.01	0	955.96	
49.25	0	956.07	
49.46	0	956.24	
49.61	0	956.37	
50.13	0	956.68	bkf
50.32	0	956.82	
50.54	0	956.96	
50.67	0	957.04	
50.79	0	957.09	
51.03	0	957.21	
51.3	0	957.38	
51.38	0	957.42	
51.45	0	957.45	
52.06	0	957.66	
52.09	0	957.66	
52.11	0	957.67	
52.77	0	957.89	
52.8	0	957.9	
52.83	0	957.91	
53.15	0	957.98	
53.51	0	958.05	
53.59	0	958.07	
53.86	0	958.14	
54.1	0	958.19	
54.35	0	958.23	
54.92	0	958.36	
55.11	0	958.4	
56.34	0	958.59	
56.7	0	958.63	
56.75	0	958.64	
57.05	0	958.68	
57.4	0	958.72	
57.41	0	958.72	
58.07	0	958.79	
58.11	0	958.8	
59.18	0	958.96	
59.4	0	959	
60.06	0	959.09	
60.6	0	959.2	
60.95	0	959.27	
61.3	0	959.34	
61.38	0	959.35	
61.66	0	959.41	
61.98	0	959.49	
62.01	0	959.5	
62.04	0	959.51	
62.37	0	959.57	
63.79	0	959.89	
64.03	0	959.95	

64.14	0	959.98
64.49	0	960.02
64.69	0	960.04
65.36	0	960.13
66.27	0	960.21
69.6	0	960.35
73	0	960.26
73.3	0	960.23
73.42	0	960.22
75	0	960.16

Cross Sectional Geometry

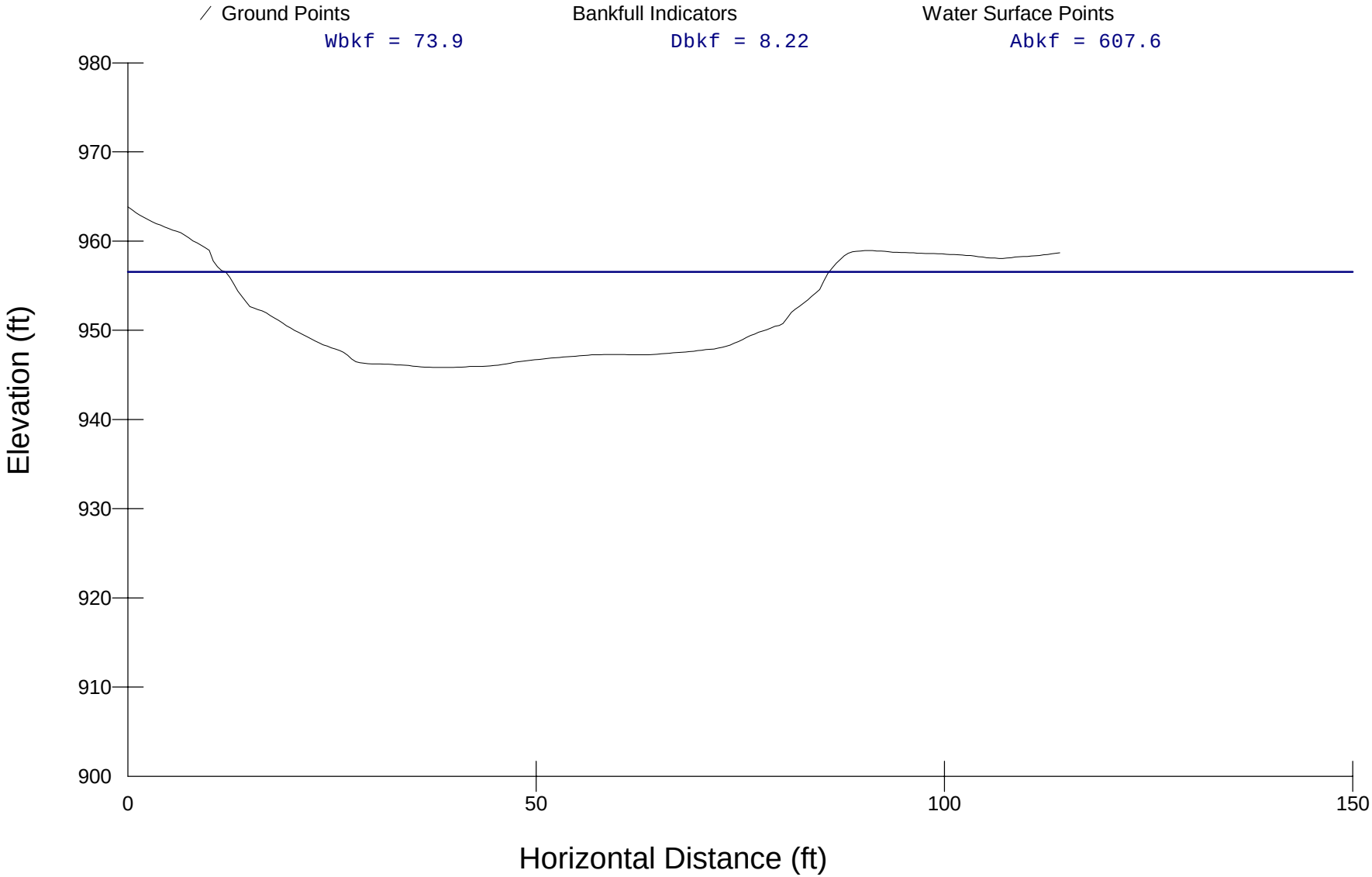
	Channel	Left	Right
Floodprone Elevation (ft)	965.01	965.01	965.01
Bankfull Elevation (ft)	956.68	956.68	956.68
Floodprone Width (ft)	1400	-----	-----
Bankfull Width (ft)	96.13	29.42	66.71
Entrenchment Ratio	14.56	-----	-----
Mean Depth (ft)	6.42	5.35	6.89
Maximum Depth (ft)	8.33	8.33	8.16
Width/Depth Ratio	14.97	5.5	9.68
Bankfull Area (sq ft)	617.01	157.32	459.69
Wetted Perimeter (ft)	100.65	40.28	76.69
Hydraulic Radius (ft)	6.13	3.91	5.99
Begin BKF Station	-46	-46	-16.58
End BKF Station	50.13	-16.58	50.13

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

161+65 Pool


Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 73.9
Dbkf = 8.22
Abkf = 607.6
980
970
960
950
940
930
920
910
900
Elevation (ft)
0
50
100
150
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-4
Cross Section Name: 161+65 Pool
Survey Date: 01/25/2026

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	963.84	
0.5	0	963.54	
1	0	963.19	
1.5	0	962.9	
1.99	0	962.64	
2.49	0	962.42	
2.99	0	962.17	
3.49	0	961.97	
3.99	0	961.79	
4.49	0	961.6	
4.98	0	961.42	
5.48	0	961.23	
5.98	0	961.11	
6.48	0	960.93	
6.98	0	960.67	
7.48	0	960.36	
7.97	0	960.04	
8.47	0	959.8	
8.97	0	959.53	
9.47	0	959.26	
9.97	0	958.97	
10.47	0	957.78	
10.96	0	957.11	
11.46	0	956.73	
11.96	0	956.56	BKF
12.46	0	955.93	
12.96	0	955.25	
13.46	0	954.4	
13.95	0	953.81	
14.45	0	953.21	
14.95	0	952.66	
15.45	0	952.49	
15.95	0	952.33	
16.45	0	952.18	
16.95	0	951.97	
17.44	0	951.64	
17.94	0	951.4	
18.44	0	951.13	
18.94	0	950.81	WS
19.44	0	950.51	
19.94	0	950.26	
20.43	0	949.99	
20.93	0	949.75	
21.43	0	949.51	
21.93	0	949.27	
22.43	0	949.04	
22.93	0	948.81	
23.42	0	948.58	
23.92	0	948.39	

24.42	0	948.22
24.92	0	948.05
25.42	0	947.89
25.92	0	947.72
26.41	0	947.53
26.91	0	947.22
27.41	0	946.79
27.91	0	946.5
28.41	0	946.37
28.91	0	946.32
29.4	0	946.28
29.9	0	946.25
30.4	0	946.23
30.9	0	946.22
31.4	0	946.21
31.9	0	946.19
32.39	0	946.16
32.89	0	946.14
33.39	0	946.12
33.89	0	946.08
34.39	0	946.04
34.89	0	945.99
35.39	0	945.95
35.88	0	945.92
36.38	0	945.89
36.88	0	945.86
37.38	0	945.85
37.88	0	945.84
38.38	0	945.83
38.87	0	945.83
39.37	0	945.83
39.87	0	945.84
40.37	0	945.86
40.87	0	945.89
41.37	0	945.92
41.86	0	945.93
42.36	0	945.94
42.86	0	945.95
43.36	0	945.96
43.86	0	945.98
44.36	0	946.01
44.85	0	946.05
45.35	0	946.1
45.85	0	946.17
46.35	0	946.24
46.85	0	946.32
47.35	0	946.41
47.84	0	946.48
48.34	0	946.53
48.84	0	946.59
49.34	0	946.65
49.84	0	946.7
50.34	0	946.75
50.84	0	946.79
51.33	0	946.85
51.83	0	946.9
52.33	0	946.92
52.83	0	946.95
53.33	0	946.99
53.83	0	947.04
54.32	0	947.07
54.82	0	947.11
55.32	0	947.15
55.82	0	947.18
56.32	0	947.21
56.82	0	947.24

57.31	0	947.26
57.81	0	947.27
58.31	0	947.29
58.81	0	947.29
59.31	0	947.29
59.81	0	947.29
60.3	0	947.28
60.8	0	947.28
61.3	0	947.27
61.8	0	947.24
62.3	0	947.24
62.8	0	947.25
63.29	0	947.26
63.79	0	947.27
64.29	0	947.3
64.79	0	947.33
65.29	0	947.36
65.79	0	947.39
66.29	0	947.42
66.78	0	947.46
67.28	0	947.49
67.78	0	947.53
68.28	0	947.58
68.78	0	947.61
69.28	0	947.65
69.77	0	947.71
70.27	0	947.77
70.77	0	947.82
71.27	0	947.87
71.77	0	947.92
72.27	0	948.01
72.76	0	948.09
73.26	0	948.18
73.76	0	948.35
74.26	0	948.57
74.76	0	948.74
75.26	0	948.95
75.75	0	949.23
76.25	0	949.42
76.75	0	949.58
77.25	0	949.78
77.75	0	949.95
78.25	0	950.09
78.74	0	950.28
79.24	0	950.43
79.74	0	950.56
80.24	0	950.79
80.74	0	951.38
81.24	0	952.01
81.74	0	952.37
82.23	0	952.71
82.73	0	953.05
83.23	0	953.43
83.73	0	953.79
84.23	0	954.2
84.73	0	954.57
85.22	0	955.55
85.72	0	956.4
86.22	0	956.98
86.72	0	957.51
87.22	0	957.92
87.72	0	958.37
88.21	0	958.65
88.71	0	958.78
89.21	0	958.86
89.71	0	958.92

90.21	0	958.95
90.71	0	958.95
91.2	0	958.93
91.7	0	958.92
92.2	0	958.89
92.7	0	958.85
93.2	0	958.8
93.7	0	958.77
94.19	0	958.75
94.69	0	958.73
95.19	0	958.71
95.69	0	958.69
96.19	0	958.67
96.69	0	958.65
97.18	0	958.64
97.68	0	958.63
98.18	0	958.62
98.68	0	958.6
99.18	0	958.59
99.68	0	958.57
100.18	0	958.54
100.67	0	958.51
101.17	0	958.49
101.67	0	958.47
102.17	0	958.44
102.67	0	958.41
103.17	0	958.38
103.66	0	958.33
104.16	0	958.26
104.66	0	958.2
105.16	0	958.15
105.66	0	958.12
106.16	0	958.1
106.65	0	958.06
107.15	0	958.07
107.65	0	958.09
108.15	0	958.15
108.65	0	958.21
109.15	0	958.26
109.64	0	958.29
110.14	0	958.3
110.64	0	958.33
111.14	0	958.36
111.64	0	958.4
112.14	0	958.45
112.63	0	958.51
113.13	0	958.59
113.63	0	958.64
114.13	0	958.7

Cross Sectional Geometry

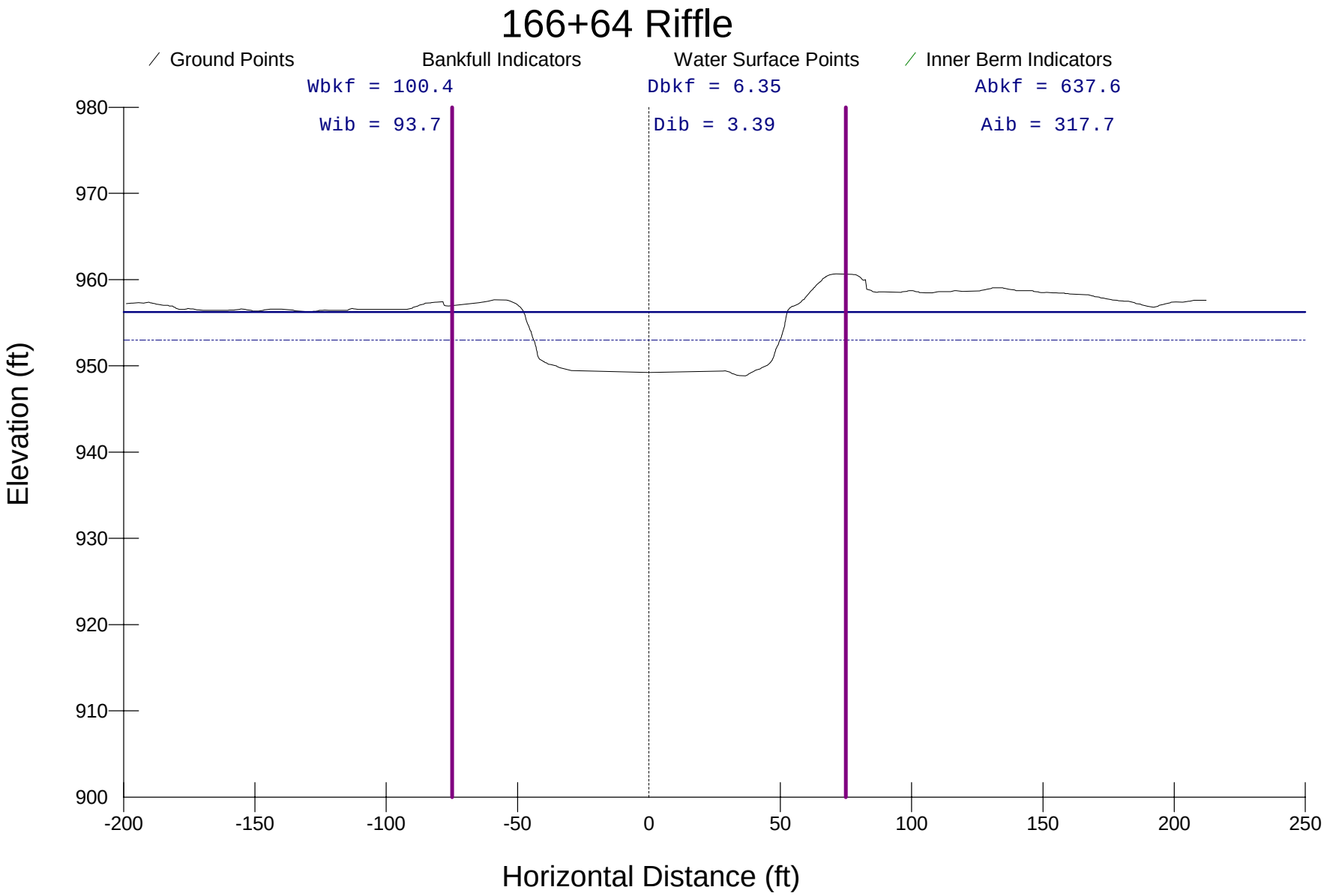
	Channel	Left	Right
Floodprone Elevation (ft)	967.29	967.29	967.29
Bankfull Elevation (ft)	956.56	956.56	956.56
Floodprone Width (ft)	1200	-----	-----
Bankfull Width (ft)	73.9	37.06	36.84
Entrenchment Ratio	16.24	-----	-----
Mean Depth (ft)	8.22	8.54	7.9
Maximum Depth (ft)	10.73	10.73	9.95
Width/Depth Ratio	8.99	4.34	4.66
Bankfull Area (sq ft)	607.56	316.58	290.99
Wetted Perimeter (ft)	80.53	50.49	49.94

Hydraulic Radius (ft)	7.54	6.27	5.83
Begin BKF Station	11.96	11.96	49.02
End BKF Station	85.86	49.02	85.86

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


166+64 Riffle
Ground Points
Bankfull Indicators
Water Surface Points
Inner Berm Indicators
Wbkf = 100.4
Wib = 93.7
Dbkf = 6.35
Dib = 3.39
Abkf = 637.6
Aib = 317.7
Elevation (ft)
980
970
960
950
940
930
920
910
900
-200
-150
-100
-50
0
50
100
150
200
250
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-4
Cross Section Name: 166+64 Riffle
Survey Date: 11/19/2025

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
-198.99	0	957.24	
-197.09	0	957.26	
-196.54	0	957.28	
-194.31	0	957.34	
-192.27	0	957.26	
-192.08	0	957.3	
-191.53	0	957.34	
-191.52	0	957.35	
-191.51	0	957.35	
-190.37	0	957.39	
-189.85	0	957.32	
-189.3	0	957.29	
-189.24	0	957.28	
-188.1	0	957.23	
-187.63	0	957.17	
-187.07	0	957.14	
-187.04	0	957.14	
-186.96	0	957.13	
-185.83	0	957.09	
-185.54	0	957.07	
-185.4	0	957.05	
-184.84	0	957.01	
-184.69	0	957	
-183.55	0	957.02	
-183.17	0	957	
-182.62	0	956.95	
-182.42	0	956.94	
-181.28	0	956.93	
-181.06	0	956.88	
-180.95	0	956.85	
-180.39	0	956.78	
-180.15	0	956.69	
-178.81	0	956.55	
-178.72	0	956.55	
-176.74	0	956.56	
-176.57	0	956.57	
-176.49	0	956.58	
-175.93	0	956.61	
-175.82	0	956.62	
-175.6	0	956.65	
-174.47	0	956.62	
-174.33	0	956.61	
-174.26	0	956.6	
-173.71	0	956.62	
-173.58	0	956.61	
-172.04	0	956.5	
-171.48	0	956.5	
-169.81	0	956.44	
-160.34	0	956.45	

-159.79	0	956.48
-158.12	0	956.46
-157.89	0	956.46
-157.56	0	956.49
-155.89	0	956.55
-155.33	0	956.61
-153.66	0	956.56
-153.1	0	956.5
-151.43	0	956.44
-150.88	0	956.37
-149.21	0	956.36
-148.92	0	956.37
-148.65	0	956.38
-146.98	0	956.44
-146.42	0	956.51
-144.75	0	956.56
-144.2	0	956.57
-142.52	0	956.57
-141.97	0	956.57
-139.95	0	956.57
-135.47	0	956.47
-135.29	0	956.45
-134.73	0	956.39
-134.72	0	956.39
-134.7	0	956.39
-130.83	0	956.28
-130.27	0	956.27
-129.02	0	956.26
-128.05	0	956.3
-127.89	0	956.32
-126.75	0	956.33
-126.38	0	956.37
-125.82	0	956.4
-125.61	0	956.42
-124.48	0	956.44
-124.26	0	956.45
-123.59	0	956.47
-121.92	0	956.43
-115.39	0	956.42
-115.29	0	956.42
-114.68	0	956.44
-114.25	0	956.54
-113.05	0	956.64
-113.01	0	956.64
-112.3	0	956.6
-111.98	0	956.6
-110.79	0	956.55
-110.23	0	956.54
-100.76	0	956.56
-99.09	0	956.55
-98.54	0	956.53
-92.41	0	956.54
-92.17	0	956.55
-92.12	0	956.55
-91.85	0	956.58
-90.18	0	956.69
-89.88	0	956.75
-89.63	0	956.81
-87.96	0	956.94
-87.4	0	957.05
-85.73	0	957.16
-85.17	0	957.27
-83.5	0	957.3
-83.15	0	957.32
-82.94	0	957.33
-81.27	0	957.38

-80.91	0	957.39	
-78.49	0	957.45	
-78.29	0	957.29	
-77.93	0	957.01	
-77.92	0	957.01	
-77.38	0	956.97	
-76.26	0	956.96	
-64.57	0	957.34	
-63.46	0	957.37	
-62.9	0	957.41	
-61.23	0	957.47	
-59	0	957.67	
-54.55	0	957.64	
-54.38	0	957.64	
-54.01	0	957.61	
-53.99	0	957.61	
-53.63	0	957.59	
-53.26	0	957.55	
-52.88	0	957.53	
-50.65	0	957.24	
-50.64	0	957.24	
-50.27	0	957.14	
-49.9	0	957.04	
-49.54	0	956.95	
-49.15	0	956.86	
-48.98	0	956.82	
-48.42	0	956.61	
-48.03	0	956.43	
-47.87	0	956.35	
-47.65	0	956.23	bkf
-47.39	0	956.04	
-47.31	0	955.98	
-47.28	0	955.95	
-46.91	0	955.53	
-46.75	0	955.39	
-46.19	0	954.92	
-45.78	0	954.59	
-45.64	0	954.47	
-45.08	0	954.09	
-45.04	0	954.05	
-44.95	0	954	
-44.66	0	953.73	
-44.52	0	953.57	
-44.29	0	953.32	
-44.12	0	953.2	
-43.97	0	953.07	
-43.92	0	953.03	
-43.81	0	952.97	
-43.41	0	952.69	
-43.17	0	952.39	
-43.02	0	952.18	
-42.85	0	951.95	
-42.8	0	951.83	
-42.68	0	951.64	
-42.42	0	951.24	
-42.3	0	951.09	
-42.05	0	950.95	
-41.93	0	950.9	
-41.74	0	950.82	
-41.54	0	950.77	
-41.18	0	950.7	lew
-40.63	0	950.6	
-40.18	0	950.51	
-40.07	0	950.48	
-39.81	0	950.43	
-39.51	0	950.39	

-38.96	0	950.33	
-38.68	0	950.28	
-38.4	0	950.22	
-38.13	0	950.2	
-37.84	0	950.18	
-37.29	0	950.15	
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-34.95	0	949.95	
-33.94	0	949.78	
-29.49	0	949.47	
0	0	949.26	
28.2	0	949.41	
28.98	0	949.42	
30.09	0	949.36	
30.65	0	949.3	
30.82	0	949.27	
31.76	0	949.11	
32.31	0	949.05	
32.32	0	949.05	
33.44	0	948.92	
34.54	0	948.87	
34.56	0	948.87	
36.77	0	948.86	
37.33	0	948.93	
37.55	0	948.97	
37.92	0	949.05	
38.67	0	949.16	
39.04	0	949.24	
39.56	0	949.31	
40.67	0	949.49	
42.34	0	949.64	
42.4	0	949.65	
42.78	0	949.77	
42.9	0	949.79	
43.15	0	949.82	
44.01	0	949.94	
44.65	0	950.02	
45.12	0	950.09	
45.39	0	950.15	
45.68	0	950.23	
45.77	0	950.25	
45.94	0	950.31	
46.14	0	950.37	
46.24	0	950.4	
46.51	0	950.5	
46.79	0	950.61	
46.89	0	950.66	rew
47.08	0	950.8	
47.26	0	950.92	
47.35	0	950.97	
47.63	0	951.21	
48.01	0	951.54	
48.21	0	951.75	
48.38	0	951.94	
48.47	0	952.02	
49.02	0	952.38	
49.13	0	952.46	
49.35	0	952.58	
49.58	0	952.73	
49.8	0	952.9	
49.88	0	952.97	ib
50.14	0	953.14	
50.48	0	953.43	
50.62	0	953.56	
50.69	0	953.61	
51	0	953.92	

51.25	0	954.17	
51.37	0	954.31	
51.62	0	954.63	
51.75	0	954.86	
51.81	0	954.98	
51.98	0	955.3	
52.12	0	955.56	
52.36	0	955.94	
52.49	0	956.07	
52.76	0	956.3	bkf
52.87	0	956.38	
52.92	0	956.42	
53.48	0	956.66	
53.61	0	956.72	
53.89	0	956.78	
54.59	0	956.89	
54.73	0	956.91	
55.15	0	956.96	
56.82	0	957.16	
57.35	0	957.3	
57.72	0	957.38	
57.93	0	957.43	
58.1	0	957.49	
58.44	0	957.62	
58.49	0	957.63	
59.04	0	957.71	
59.22	0	957.76	
59.57	0	957.91	
59.6	0	957.92	
60.71	0	958.32	
60.72	0	958.32	
61.27	0	958.51	
61.46	0	958.6	
61.81	0	958.72	
61.83	0	958.72	
61.83	0	958.73	
62.21	0	958.84	
62.39	0	958.89	
62.58	0	958.96	
62.94	0	959.07	
62.96	0	959.08	
63.7	0	959.36	
64.06	0	959.47	
64.08	0	959.48	
64.12	0	959.49	
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64.82	0	959.65	
65.09	0	959.73	
65.17	0	959.75	
65.25	0	959.76	
65.57	0	959.83	
65.73	0	959.87	
66.28	0	960.1	
66.69	0	960.2	
66.84	0	960.23	
67.4	0	960.33	
67.44	0	960.34	
68.66	0	960.53	
69.07	0	960.57	
69.31	0	960.58	
70.18	0	960.64	
71.29	0	960.68	
77.42	0	960.6	
77.9	0	960.59	
77.98	0	960.59	
78.53	0	960.58	

79.09	0	960.55
79.77	0	960.44
80.14	0	960.36
80.52	0	960.24
80.89	0	960.12
81.16	0	960.02
81.27	0	959.99
81.32	0	959.98
81.47	0	959.97
81.64	0	959.96
81.87	0	959.96
82.01	0	959.97
82.43	0	959.99
82.56	0	959.74
82.76	0	959.37
82.99	0	958.91
84.66	0	958.75
85.22	0	958.61
86.89	0	958.55
87.44	0	958.56
89.67	0	958.58
95.93	0	958.55
96.35	0	958.59
96.91	0	958.61
97.07	0	958.63
98.2	0	958.66
98.58	0	958.7
99.14	0	958.72
99.2	0	958.72
99.34	0	958.73
100.47	0	958.71
100.81	0	958.67
101.36	0	958.65
101.61	0	958.61
102.75	0	958.56
103.03	0	958.52
103.59	0	958.5
103.69	0	958.49
105.26	0	958.45
105.82	0	958.46
106.15	0	958.46
107.29	0	958.45
108.05	0	958.48
108.17	0	958.49
108.43	0	958.51
109.72	0	958.59
110.27	0	958.6
111.91	0	958.61
111.94	0	958.61
112.5	0	958.6
114.17	0	958.61
114.73	0	958.6
114.9	0	958.61
116.39	0	958.72
116.95	0	958.71
119.18	0	958.66
119.74	0	958.64
125.86	0	958.69
126.42	0	958.76
128.09	0	958.84
128.65	0	958.91
130.32	0	958.98
130.87	0	959.05
134.77	0	959.06
135.08	0	959.03
135.33	0	959.01

137	0	958.92
137.56	0	958.85
139.23	0	958.79
139.78	0	958.72
145.92	0	958.74
146.29	0	958.67
146.47	0	958.65
147.02	0	958.61
147.03	0	958.61
147.05	0	958.61
148.19	0	958.57
148.69	0	958.55
149.33	0	958.52
150.46	0	958.51
151.48	0	958.54
151.52	0	958.54
153.87	0	958.45
155.01	0	958.46
156.14	0	958.43
157.28	0	958.44
158.24	0	958.42
158.42	0	958.41
159.55	0	958.39
159.83	0	958.37
160.39	0	958.33
160.69	0	958.31
166.46	0	958.26
166.51	0	958.26
167.07	0	958.26
167.21	0	958.24
168.64	0	958.14
168.74	0	958.12
169.3	0	958.11
169.78	0	958.04
170.91	0	957.98
170.97	0	957.98
171.52	0	957.95
172.05	0	957.89
173.18	0	957.86
173.19	0	957.86
173.75	0	957.83
174.31	0	957.77
175.98	0	957.71
176.53	0	957.65
178.2	0	957.61
178.76	0	957.56
180.43	0	957.51
180.99	0	957.48
182.66	0	957.49
184.89	0	957.33
185.44	0	957.25
187.11	0	957.17
187.67	0	957.08
189.9	0	956.92
191.57	0	956.84
192.13	0	956.8
193.8	0	956.92
194.35	0	957.01
196.02	0	957.11
196.58	0	957.21
198.25	0	957.31
198.32	0	957.32
198.6	0	957.34
198.81	0	957.38
200.5	0	957.41
200.84	0	957.41

203.26	0	957.39
203.82	0	957.4
205.49	0	957.5
206.05	0	957.5
207.57	0	957.59
207.72	0	957.59
208.27	0	957.59
212.17	0	957.58

Cross Sectional Geometry

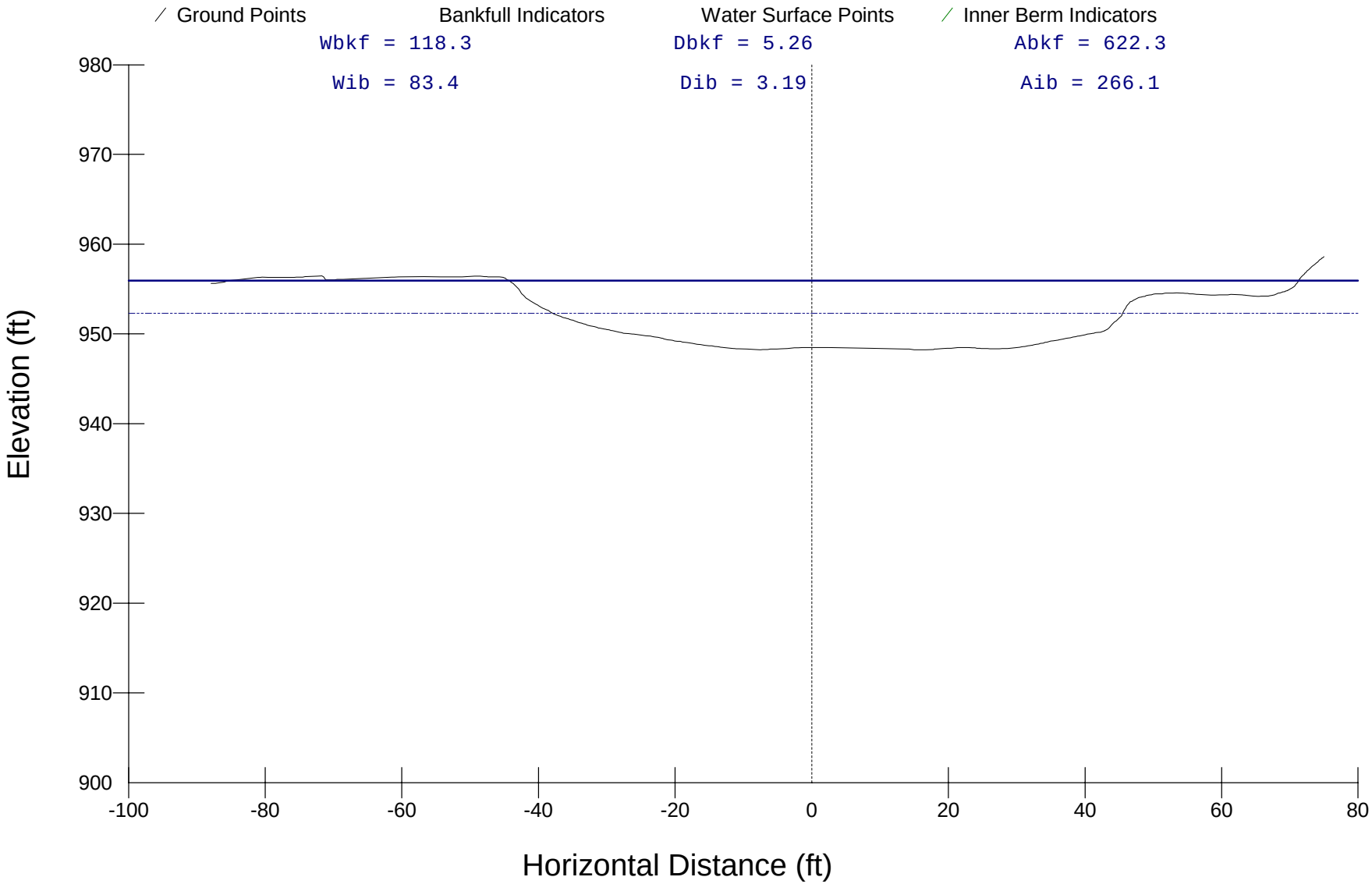
	Channel	Left	Right
Floodprone Elevation (ft)	963.66	963.66	963.66
Bankfull Elevation (ft)	956.26	956.26	956.26
Floodprone Width (ft)	1340	-----	-----
Bankfull Width (ft)	100.42	50.35	50.06
Entrenchment Ratio	13.34	-----	-----
Mean Depth (ft)	6.35	6.24	6.46
Maximum Depth (ft)	7.4	7	7.4
Width/Depth Ratio	15.81	8.07	7.75
Bankfull Area (sq ft)	637.56	313.98	323.58
Wetted Perimeter (ft)	105.33	59.65	59.65
Hydraulic Radius (ft)	6.05	5.26	5.42
Begin BKF Station	-47.7	-47.7	2.65
End BKF Station	52.71	2.65	52.71

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

170+74 Riffle



RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-4
Cross Section Name: 170+74 Riffle
Survey Date: 11/19/2025

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
-87.94	0	955.63	
-87.92	0	955.63	
-87.91	0	955.63	
-87.29	0	955.64	
-87.11	0	955.68	
-86.04	0	955.78	
-85.43	0	955.91	
-84.17	0	956.04	
-82.3	0	956.17	
-81.06	0	956.29	
-80.78	0	956.29	
-80.44	0	956.31	
-79.56	0	956.3	
-79.19	0	956.3	
-77.32	0	956.3	
-77.04	0	956.3	
-76.08	0	956.29	
-75.77	0	956.3	
-75.45	0	956.31	
-74.52	0	956.34	
-74.34	0	956.37	
-74.21	0	956.39	
-72.34	0	956.45	
-71.72	0	956.47	
-71.48	0	956.38	
-71.17	0	956.07	
-71.13	0	956.03	
-71.1	0	956.02	
-70.77	0	956.02	
-70.41	0	956.02	
-70.05	0	956.03	
-69.85	0	956.04	
-69.49	0	956.06	
-69.23	0	956.07	
-68.98	0	956.07	
-68.6	0	956.09	
-65.49	0	956.17	
-65.41	0	956.17	
-62.19	0	956.29	
-61.48	0	956.33	
-61.12	0	956.34	
-60.51	0	956.36	
-56.77	0	956.41	
-54.33	0	956.38	
-54.28	0	956.38	
-52.9	0	956.36	
-51.17	0	956.38	
-49.36	0	956.43	
-48.97	0	956.43	

-48.61	0	956.42	
-48.52	0	956.42	
-47.9	0	956.4	
-47.54	0	956.39	
-47.43	0	956.38	
-46.81	0	956.36	
-46.47	0	956.38	
-46.19	0	956.38	
-46	0	956.37	
-45.75	0	956.35	
-45.39	0	956.31	
-45.16	0	956.29	
-45.04	0	956.27	
-44.94	0	956.24	
-44.68	0	956.09	
-44.32	0	955.92	bkf
-44.32	0	955.92	
-44.32	0	955.92	
-44.3	0	955.91	
-43.96	0	955.75	
-43.7	0	955.6	
-43.61	0	955.54	
-43.49	0	955.46	
-43.25	0	955.28	
-43.07	0	955.14	
-42.89	0	954.98	
-42.65	0	954.69	
-42.53	0	954.57	
-42.45	0	954.47	
-42.18	0	954.27	
-41.83	0	954.02	
-41.82	0	954.02	
-41.81	0	954.01	
-41.46	0	953.81	
-41.21	0	953.67	
-40.39	0	953.32	
-40.13	0	953.2	
-39.96	0	953.12	
-39.68	0	953	
-39.34	0	952.86	
-39.32	0	952.85	
-39.29	0	952.84	
-38.96	0	952.74	
-38.71	0	952.66	
-38.6	0	952.61	
-38.45	0	952.54	
-38.25	0	952.44	
-38.09	0	952.38	
-37.89	0	952.31	ib
-37.61	0	952.19	
-37.53	0	952.16	
-37.47	0	952.14	
-37.17	0	952.06	
-36.77	0	951.97	
-36.46	0	951.87	
-36.22	0	951.8	
-36.1	0	951.78	
-35.94	0	951.75	
-35.74	0	951.71	
-35.6	0	951.68	
-35.39	0	951.62	
-35.1	0	951.55	
-35.03	0	951.54	
-34.98	0	951.52	
-34.67	0	951.43	
-34.36	0	951.35	

-34.31	0	951.34	
-34.26	0	951.33	
-33.96	0	951.26	
-33.73	0	951.22	
-33.6	0	951.18	
-33.42	0	951.14	
-33.24	0	951.09	
-33.11	0	951.06	
-32.88	0	951	
-32.49	0	950.91	
-31.87	0	950.81	
-31.45	0	950.72	
-31.24	0	950.68	
-31.1	0	950.66	
-30.38	0	950.57	lew
-30.06	0	950.51	
-30.03	0	950.5	
-30	0	950.5	
-29.67	0	950.44	
-29.37	0	950.39	
-29.31	0	950.39	
-29.22	0	950.37	
-28.75	0	950.31	
-28.6	0	950.28	
-28.13	0	950.18	
-27.88	0	950.14	
-27.55	0	950.09	
-27.52	0	950.08	
-27.51	0	950.08	
-26.81	0	950.03	
-26.26	0	949.98	
-26.09	0	949.97	
-25.02	0	949.88	
-24.31	0	949.8	
-23.59	0	949.74	
-23.35	0	949.72	
-23.23	0	949.71	
-23.15	0	949.7	
-22.88	0	949.66	
-22.52	0	949.6	
-22.51	0	949.6	
-21.9	0	949.51	
-21.81	0	949.49	
-21.68	0	949.47	
-21.09	0	949.37	
-20.66	0	949.33	
-20.38	0	949.28	
-20.03	0	949.23	
-20	0	949.23	
-19.66	0	949.18	
-19.41	0	949.17	
-19.3	0	949.16	
-19.16	0	949.15	
-18.95	0	949.12	
-18.23	0	949.03	
-17.54	0	948.95	
-17.52	0	948.95	
-17.48	0	948.95	
-16.8	0	948.86	
-16.3	0	948.8	
-15.73	0	948.74	
-15.05	0	948.68	
-14.96	0	948.68	
-14.66	0	948.65	
-14.3	0	948.62	
-14.13	0	948.6	

-13.94	0	948.58
-13.59	0	948.55
-13.29	0	948.53
-13.23	0	948.53
-13.18	0	948.52
-12.87	0	948.49
-11.44	0	948.37
-11.32	0	948.36
-11.08	0	948.35
-10.69	0	948.33
-9.45	0	948.29
-8.25	0	948.26
-7.58	0	948.25
-7.51	0	948.25
-7.15	0	948.27
-6.96	0	948.28
-6.79	0	948.28
-6.44	0	948.28
-6.08	0	948.29
-5.74	0	948.3
-5.09	0	948.32
-4.47	0	948.35
-3.58	0	948.39
-2.51	0	948.44
-1.98	0	948.46
-1.35	0	948.49
-1.08	0	948.5
1.81	0	948.49
2.5	0	948.48
8.61	0	948.43
13.59	0	948.32
14.21	0	948.29
14.29	0	948.29
15.01	0	948.25
15.46	0	948.23
16.71	0	948.23
17.87	0	948.28
17.95	0	948.29
18.22	0	948.31
19.2	0	948.38
19.82	0	948.41
20.37	0	948.43
21.44	0	948.47
21.69	0	948.47
22.31	0	948.48
22.93	0	948.47
23.56	0	948.45
23.94	0	948.44
24.18	0	948.42
24.46	0	948.41
24.66	0	948.4
24.8	0	948.39
25.3	0	948.38
25.37	0	948.38
25.73	0	948.36
26.05	0	948.35
26.14	0	948.34
26.44	0	948.35
26.67	0	948.34
27.29	0	948.35
27.52	0	948.35
27.87	0	948.36
28.54	0	948.37
28.59	0	948.37
28.66	0	948.38
30.02	0	948.48

30.37	0	948.52	
30.41	0	948.52	
30.73	0	948.56	
31.03	0	948.59	
31.17	0	948.61	
31.65	0	948.66	
32.01	0	948.71	
32.16	0	948.74	
32.27	0	948.75	
32.52	0	948.79	
32.85	0	948.85	
32.9	0	948.86	
33.23	0	948.9	
33.52	0	948.94	
33.69	0	948.97	
33.95	0	949.01	
34.14	0	949.05	
34.31	0	949.07	
34.53	0	949.1	
35.02	0	949.2	
35.37	0	949.24	
35.38	0	949.24	
36.09	0	949.33	
36.21	0	949.35	
36.81	0	949.44	
37.25	0	949.51	
37.52	0	949.54	
37.88	0	949.59	
37.88	0	949.59	
38.24	0	949.64	
38.5	0	949.69	
38.6	0	949.7	
38.95	0	949.74	
39.12	0	949.77	
39.31	0	949.8	
40.02	0	949.92	
40.37	0	949.98	
40.4	0	949.99	
40.74	0	950.02	
40.99	0	950.06	
41.1	0	950.07	
41.24	0	950.1	
41.45	0	950.13	
41.61	0	950.15	
42.08	0	950.2	
42.24	0	950.21	
42.53	0	950.28	
42.86	0	950.35	
42.88	0	950.36	
42.92	0	950.37	
43.24	0	950.51	rew
43.48	0	950.66	
43.6	0	950.73	
43.76	0	950.89	
43.96	0	951.06	
44.1	0	951.16	
44.31	0	951.3	
44.59	0	951.47	
44.73	0	951.56	
45.03	0	951.79	
45.35	0	952.02	
45.39	0	952.06	
45.43	0	952.12	
45.74	0	952.61	
45.97	0	952.92	
46.1	0	953.08	

46.27	0	953.29
46.46	0	953.44
46.6	0	953.55
46.82	0	953.64
47.17	0	953.77
47.22	0	953.79
47.84	0	954.04
47.89	0	954.05
47.95	0	954.06
48.24	0	954.12
48.46	0	954.15
48.79	0	954.2
48.96	0	954.26
49.32	0	954.34
49.63	0	954.38
49.71	0	954.38
49.94	0	954.42
50.03	0	954.44
50.33	0	954.47
50.75	0	954.47
50.95	0	954.48
51.31	0	954.49
51.58	0	954.51
51.82	0	954.53
52.82	0	954.56
52.89	0	954.56
53.45	0	954.57
54.07	0	954.56
54.32	0	954.54
54.66	0	954.52
54.68	0	954.51
55.04	0	954.51
55.31	0	954.49
55.75	0	954.47
56.34	0	954.42
56.56	0	954.4
57.8	0	954.35
58.43	0	954.33
59.05	0	954.34
59.69	0	954.36
60.92	0	954.38
61.37	0	954.39
63.05	0	954.35
63.26	0	954.34
63.41	0	954.33
63.61	0	954.31
63.97	0	954.27
64.65	0	954.22
64.69	0	954.21
65.28	0	954.2
65.4	0	954.2
65.57	0	954.2
65.76	0	954.21
65.9	0	954.21
66.83	0	954.23
67.14	0	954.25
67.19	0	954.26
67.24	0	954.26
67.54	0	954.33
67.77	0	954.38
67.9	0	954.42
68.08	0	954.48
68.26	0	954.53
68.39	0	954.56
68.62	0	954.6
68.92	0	954.67

68.97	0	954.68	
69.01	0	954.68	
69.28	0	954.74	
69.33	0	954.75	
69.64	0	954.84	
69.69	0	954.86	
69.76	0	954.89	
70.05	0	955.02	
70.26	0	955.1	
70.4	0	955.17	
70.6	0	955.27	
70.76	0	955.4	
70.88	0	955.54	
71	0	955.62	
71.12	0	955.79	
71.3	0	955.95	bkf
71.44	0	956.13	
71.48	0	956.16	
71.5	0	956.18	
71.69	0	956.35	
71.83	0	956.48	
72.13	0	956.7	
72.19	0	956.75	
72.28	0	956.81	
72.55	0	957	
72.75	0	957.15	
72.91	0	957.27	
73.12	0	957.42	
73.26	0	957.54	
73.37	0	957.6	
73.62	0	957.75	
73.95	0	957.95	
73.98	0	957.96	
73.99	0	957.97	
74.11	0	958.07	
74.33	0	958.26	
74.62	0	958.41	
74.69	0	958.43	
74.79	0	958.48	
75	0	958.62	

Cross Sectional Geometry

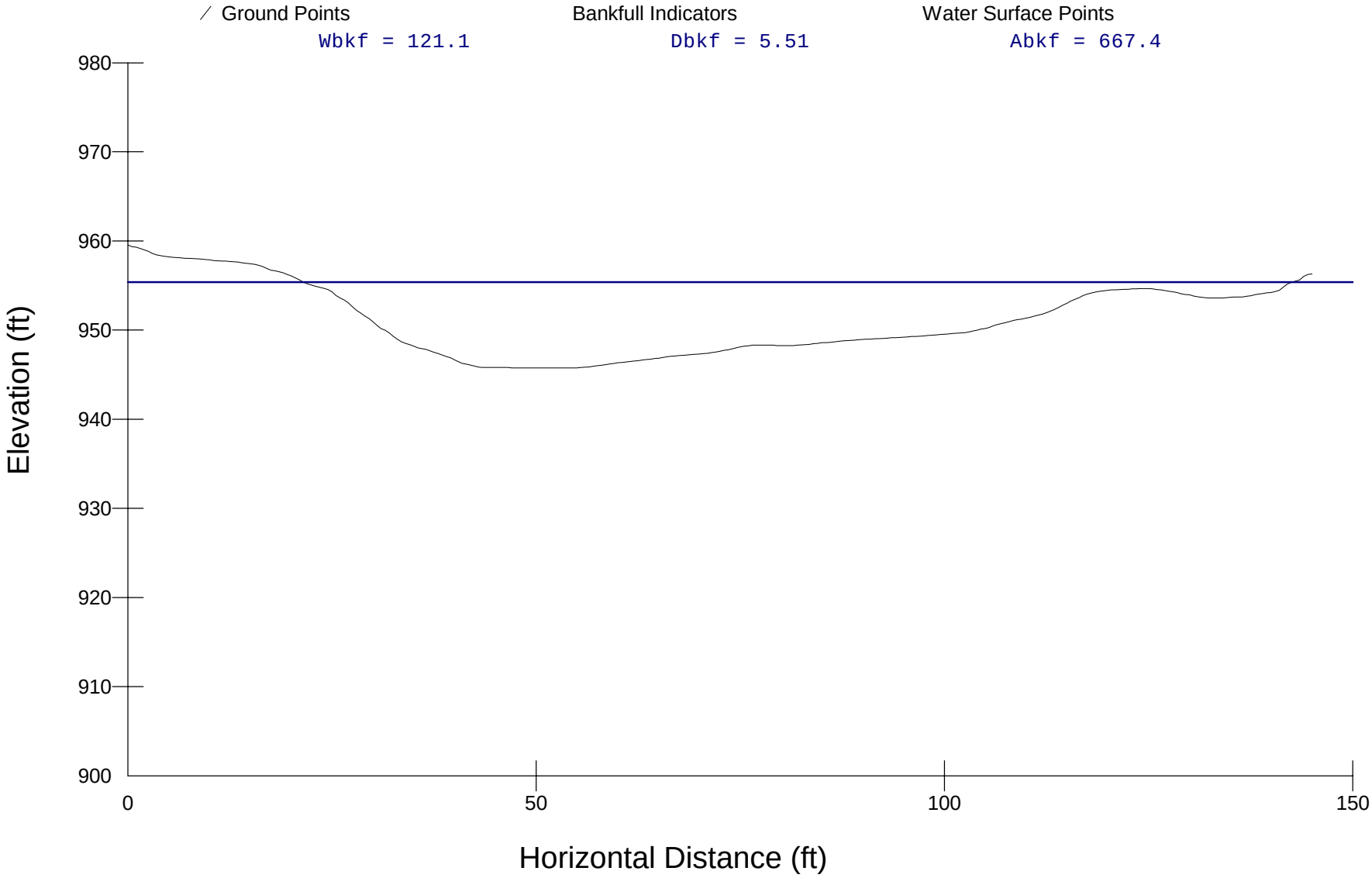
	Channel	Left	Right
Floodprone Elevation (ft)	963.63	963.63	963.63
Bankfull Elevation (ft)	955.93	955.93	955.93
Floodprone Width (ft)	1200	-----	-----
Bankfull Width (ft)	118.32	101.55	57.67
Entrenchment Ratio	10.14	-----	-----
Mean Depth (ft)	5.26	5.95	4.53
Maximum Depth (ft)	7.7	7.68	7.7
Width/Depth Ratio	22.49	17.06	12.73
Bankfull Area (sq ft)	622.26	361.09	261.17
Wetted Perimeter (ft)	122.08	70	67.31
Hydraulic Radius (ft)	5.1	5.16	3.88
Begin BKF Station	-87.94	-87.94	13.61
End BKF Station	71.28	13.61	71.28

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

73+10 Pool


Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 121.1
Dbkf = 5.51
Abkf = 667.4
980
970
960
950
940
930
920
910
900
Elevation (ft)
0
50
100
150
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-4
Cross Section Name: 173+10 Pool
Survey Date: 01/25/2026

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	959.57	
0.5	0	959.39	
1	0	959.3	
1.5	0	959.16	
2	0	959.02	
2.5	0	958.84	
3	0	958.61	
3.5	0	958.44	
4	0	958.36	
4.5	0	958.28	
5	0	958.21	
5.5	0	958.17	
6	0	958.13	
6.5	0	958.1	
7	0	958.08	
7.5	0	958.06	
8	0	958.03	
8.5	0	958	
9	0	957.96	
9.5	0	957.92	
10	0	957.88	
10.5	0	957.83	
11	0	957.78	
11.5	0	957.75	
12	0	957.73	
12.5	0	957.71	
13	0	957.67	
13.5	0	957.62	
14	0	957.56	
14.5	0	957.5	
15	0	957.44	
15.5	0	957.37	
16	0	957.27	
16.5	0	957.12	
17	0	956.91	
17.5	0	956.73	
18	0	956.64	
18.5	0	956.53	
19	0	956.42	
19.5	0	956.26	
20	0	956.06	
20.5	0	955.87	
21	0	955.64	
21.5	0	955.4	BKF
22	0	955.21	
22.5	0	955.04	
23	0	954.9	
23.5	0	954.8	
24	0	954.69	

24.5	0	954.53	
25	0	954.27	
25.5	0	953.9	
26	0	953.62	
26.5	0	953.4	
27	0	953.07	
27.5	0	952.61	
28	0	952.24	
28.5	0	951.9	
29	0	951.61	
29.49	0	951.32	
29.99	0	950.96	
30.49	0	950.55	WS
30.99	0	950.21	
31.49	0	949.97	
31.99	0	949.68	
32.49	0	949.32	
32.99	0	948.98	
33.49	0	948.71	
33.99	0	948.51	
34.49	0	948.37	
34.99	0	948.2	
35.49	0	948.03	
35.99	0	947.95	
36.49	0	947.83	
36.99	0	947.67	
37.49	0	947.52	
37.99	0	947.37	
38.49	0	947.21	
38.99	0	947.05	
39.49	0	946.88	
39.99	0	946.67	
40.49	0	946.44	
40.99	0	946.29	
41.49	0	946.17	
41.99	0	946.06	
42.49	0	945.93	
42.99	0	945.83	
43.49	0	945.81	
43.99	0	945.79	
44.49	0	945.79	
44.99	0	945.79	
45.49	0	945.79	
45.99	0	945.79	
46.49	0	945.79	
46.99	0	945.78	
47.49	0	945.78	
47.99	0	945.78	
48.49	0	945.78	
48.99	0	945.78	
49.49	0	945.78	
49.99	0	945.78	
50.49	0	945.78	
50.99	0	945.78	
51.49	0	945.78	
51.99	0	945.77	
52.49	0	945.77	
52.99	0	945.77	
53.49	0	945.77	
53.99	0	945.77	
54.49	0	945.77	
54.99	0	945.77	
55.49	0	945.79	
55.99	0	945.83	
56.49	0	945.88	
56.99	0	945.94	

57.49	0	946.02
57.99	0	946.07
58.49	0	946.13
58.99	0	946.19
59.49	0	946.27
59.99	0	946.33
60.49	0	946.38
60.99	0	946.43
61.49	0	946.48
61.99	0	946.53
62.49	0	946.58
62.99	0	946.64
63.49	0	946.71
63.99	0	946.75
64.49	0	946.8
64.99	0	946.86
65.49	0	946.94
65.99	0	947
66.49	0	947.07
66.99	0	947.12
67.49	0	947.16
67.99	0	947.19
68.49	0	947.22
68.99	0	947.27
69.49	0	947.29
69.99	0	947.32
70.49	0	947.35
70.99	0	947.4
71.49	0	947.46
71.99	0	947.54
72.49	0	947.63
72.99	0	947.74
73.49	0	947.8
73.99	0	947.89
74.49	0	948.01
74.99	0	948.12
75.49	0	948.2
75.99	0	948.25
76.49	0	948.29
76.99	0	948.3
77.49	0	948.31
77.99	0	948.3
78.49	0	948.29
78.99	0	948.29
79.49	0	948.28
79.99	0	948.28
80.49	0	948.28
80.99	0	948.28
81.49	0	948.28
81.99	0	948.29
82.49	0	948.33
82.99	0	948.37
83.49	0	948.43
83.99	0	948.49
84.49	0	948.53
84.99	0	948.59
85.49	0	948.61
85.99	0	948.63
86.49	0	948.67
86.99	0	948.73
87.49	0	948.77
87.98	0	948.81
88.48	0	948.85
88.98	0	948.89
89.48	0	948.92
89.98	0	948.95

90.48	0	948.98
90.98	0	949
91.48	0	949.02
91.98	0	949.04
92.48	0	949.07
92.98	0	949.1
93.48	0	949.13
93.98	0	949.15
94.48	0	949.18
94.98	0	949.21
95.48	0	949.25
95.98	0	949.27
96.48	0	949.29
96.98	0	949.33
97.48	0	949.37
97.98	0	949.4
98.48	0	949.42
98.98	0	949.46
99.48	0	949.49
99.98	0	949.53
100.48	0	949.56
100.98	0	949.6
101.48	0	949.64
101.98	0	949.68
102.48	0	949.73
102.98	0	949.81
103.48	0	949.9
103.98	0	949.99
104.48	0	950.12
104.98	0	950.2
105.48	0	950.29
105.98	0	950.48
106.48	0	950.61
106.98	0	950.72
107.48	0	950.83
107.98	0	950.97
108.48	0	951.09
108.98	0	951.18
109.48	0	951.26
109.98	0	951.35
110.48	0	951.43
110.98	0	951.56
111.48	0	951.67
111.98	0	951.8
112.48	0	951.97
112.98	0	952.13
113.48	0	952.34
113.98	0	952.56
114.48	0	952.8
114.98	0	953.04
115.48	0	953.27
115.98	0	953.45
116.48	0	953.63
116.98	0	953.9
117.48	0	954.04
117.98	0	954.15
118.48	0	954.26
118.98	0	954.35
119.48	0	954.42
119.98	0	954.47
120.48	0	954.5
120.98	0	954.52
121.48	0	954.55
121.98	0	954.57
122.48	0	954.59
122.98	0	954.61

123.48	0	954.63
123.98	0	954.64
124.48	0	954.65
124.98	0	954.65
125.48	0	954.61
125.98	0	954.55
126.48	0	954.51
126.98	0	954.45
127.48	0	954.37
127.98	0	954.3
128.48	0	954.23
128.98	0	954.07
129.48	0	954.01
129.98	0	953.96
130.48	0	953.83
130.98	0	953.74
131.48	0	953.67
131.98	0	953.63
132.48	0	953.6
132.98	0	953.6
133.48	0	953.61
133.98	0	953.62
134.48	0	953.64
134.98	0	953.66
135.48	0	953.7
135.98	0	953.73
136.48	0	953.73
136.98	0	953.77
137.48	0	953.86
137.98	0	953.97
138.48	0	954.05
138.98	0	954.11
139.48	0	954.17
139.98	0	954.22
140.48	0	954.33
140.98	0	954.47
141.48	0	954.79
141.98	0	955.17
142.48	0	955.36
142.98	0	955.5
143.48	0	955.64
143.98	0	956.04
144.48	0	956.24
144.98	0	956.29

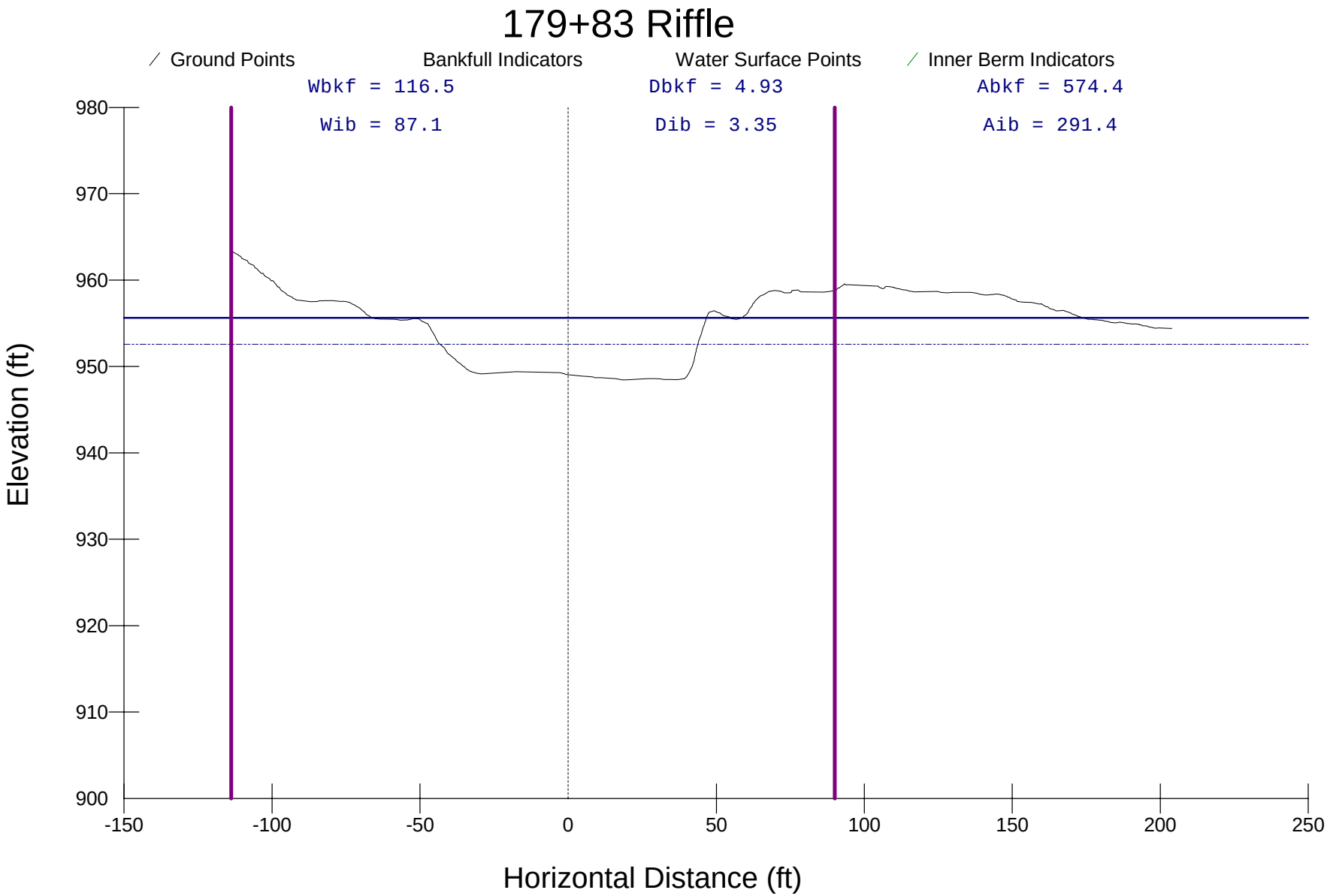
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	965.03	965.03	965.03
Bankfull Elevation (ft)	955.4	955.4	955.4
Floodprone Width (ft)	1100	-----	-----
Bankfull Width (ft)	121.12	60.56	60.56
Entrenchment Ratio	9.08	-----	-----
Mean Depth (ft)	5.51	7.43	3.59
Maximum Depth (ft)	9.63	9.63	7.1
Width/Depth Ratio	21.98	8.15	16.87
Bankfull Area (sq ft)	667.4	449.75	217.65
Wetted Perimeter (ft)	124.84	70.17	68.88
Hydraulic Radius (ft)	5.35	6.41	3.16
Begin BKF Station	21.5	21.5	82.06
End BKF Station	142.62	82.06	142.62

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


179+83 Riffle
Ground Points
Bankfull Indicators
Water Surface Points
Inner Berm Indicators
Wbkf = 116.5
Dbkf = 4.93
Abkf = 574.4
Wib = 87.1
Dib = 3.35
Aib = 291.4
Elevation (ft)
980
970
960
950
940
930
920
910
900
-150
-100
-50
0
50
100
150
200
250
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-4
Cross Section Name: 179+83 Riffle
Survey Date: 11/19/2025

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
-113.82	0	963.5	
-113.28	0	963.26	
-111.44	0	962.95	
-111.21	0	962.85	
-111.12	0	962.81	
-110.58	0	962.74	
-110.45	0	962.67	
-110.13	0	962.51	
-108.41	0	962.23	
-107.87	0	961.96	
-106.19	0	961.69	
-105.85	0	961.47	
-105.71	0	961.4	
-105.17	0	961.35	
-105.08	0	961.3	
-104.88	0	961.18	
-103.55	0	960.78	
-103	0	960.78	
-102.79	0	960.66	
-102.61	0	960.55	
-102.46	0	960.47	
-100.84	0	960.18	
-100.77	0	960.14	
-100.49	0	960.02	
-100.3	0	959.93	
-99.76	0	959.96	
-99.72	0	959.94	
-98.32	0	959.35	
-98.19	0	959.26	
-98.14	0	959.22	
-97.6	0	959.18	
-97.06	0	958.83	
-95.43	0	958.5	
-94.89	0	958.28	
-93.08	0	957.99	
-92.83	0	957.9	
-92.73	0	957.86	
-92.19	0	957.82	
-92.06	0	957.79	
-91.77	0	957.71	
-90.02	0	957.63	
-89.48	0	957.58	
-87.32	0	957.51	
-86.78	0	957.5	
-85.16	0	957.52	
-84.62	0	957.53	
-84.07	0	957.59	
-82.45	0	957.61	
-81.91	0	957.62	

-81.37	0	957.6	
-81.28	0	957.61	
-79.96	0	957.62	
-76.5	0	957.54	
-76.36	0	957.54	
-75.98	0	957.55	
-75.96	0	957.55	
-74.83	0	957.49	
-73.8	0	957.4	
-73.68	0	957.38	
-73.26	0	957.29	
-72.72	0	957.2	
-72.18	0	957.14	
-72.15	0	957.14	
-71.39	0	956.99	
-70.62	0	956.81	
-70.24	0	956.71	
-70.01	0	956.66	
-69.09	0	956.41	
-68.93	0	956.36	
-68.71	0	956.27	
-68.55	0	956.2	
-68.39	0	956.13	
-68.16	0	956.05	
-67.85	0	955.96	
-67.17	0	955.84	
-66.85	0	955.77	
-66.79	0	955.76	
-66.23	0	955.65	
-66.03	0	955.63	bkf
-65.64	0	955.59	
-65.26	0	955.55	
-65.15	0	955.54	
-64.88	0	955.53	
-64.6	0	955.51	
-64.11	0	955.51	
-64.06	0	955.5	
-58.65	0	955.45	
-56.49	0	955.33	
-56.45	0	955.33	
-55.41	0	955.37	
-54.33	0	955.4	
-52.16	0	955.58	
-50.54	0	955.53	
-50.33	0	955.49	
-50.14	0	955.45	
-50	0	955.41	
-49.94	0	955.39	
-49.8	0	955.35	
-49.56	0	955.29	
-49.46	0	955.27	
-48.92	0	955.18	
-48.79	0	955.17	
-48.41	0	955.1	
-48.38	0	955.1	
-47.84	0	955	
-47.65	0	954.98	
-47.38	0	954.93	
-47.3	0	954.92	
-47.26	0	954.9	
-46.88	0	954.67	
-46.76	0	954.58	
-46.22	0	954.21	
-45.73	0	953.96	
-45.35	0	953.75	
-45.13	0	953.63	

-44.96	0	953.5	
-44.59	0	953.22	
-44.58	0	953.21	
-44.55	0	953.19	
-44.2	0	952.98	
-43.82	0	952.78	
-43.51	0	952.64	
-43.43	0	952.61	ib
-43.24	0	952.55	
-42.97	0	952.47	
-42.67	0	952.4	
-42.43	0	952.35	
-42.28	0	952.31	
-41.9	0	952.2	
-41.89	0	952.2	
-41.35	0	951.88	
-41.14	0	951.76	
-40.81	0	951.58	
-40.75	0	951.56	
-40.37	0	951.44	
-39.73	0	951.27	
-39.6	0	951.23	
-39.22	0	951.13	
-39.18	0	951.12	
-38.84	0	951.03	
-38.07	0	950.8	
-38	0	950.77	
-37.56	0	950.61	
-37.31	0	950.54	
-37.26	0	950.53	
-37.02	0	950.45	
-36.69	0	950.38	
-36.48	0	950.33	
-35.94	0	950.18	
-35.77	0	950.12	
-35.42	0	950.04	
-35.4	0	950.03	
-35.39	0	950.03	
-35.37	0	950.03	
-34.86	0	949.9	
-34.32	0	949.7	
-34.24	0	949.68	
-33.48	0	949.55	
-33.09	0	949.47	
-32.71	0	949.42	
-32.69	0	949.41	
-32.33	0	949.36	
-32.15	0	949.34	
-31.56	0	949.3	
-31.44	0	949.29	
-31.07	0	949.26	
-30.8	0	949.23	
-30.53	0	949.2	
-30.03	0	949.17	
-29.45	0	949.14	
-28.91	0	949.14	
-17.55	0	949.41	
-3.23	0	949.28	
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-1.87	0	949.2	
-1.69	0	949.19	
-1.32	0	949.18	
-1.31	0	949.18	
-0.93	0	949.12	
-0.54	0	949.08	
-0.24	0	949.05	

0	0	949.04	
0.3	0	949.03	
5.17	0	948.9	
6.73	0	948.85	
7.33	0	948.8	
7.5	0	948.8	
8.41	0	948.76	
8.95	0	948.72	
9.49	0	948.69	
10.56	0	948.69	
11.11	0	948.69	
15.98	0	948.59	
17.45	0	948.51	
18.15	0	948.45	
18.22	0	948.45	
18.6	0	948.44	
18.69	0	948.44	
19.77	0	948.44	
26.8	0	948.59	
28.42	0	948.61	
28.94	0	948.61	
29.32	0	948.61	
29.5	0	948.61	
31.13	0	948.57	
31.24	0	948.56	
32	0	948.53	
33.83	0	948.5	
34.3	0	948.51	
34.37	0	948.51	
34.91	0	948.49	
37.08	0	948.48	
39.24	0	948.6	
39.28	0	948.61	
39.38	0	948.63	
39.66	0	948.7	
39.78	0	948.73	
40.05	0	948.84	
40.06	0	948.85	
40.32	0	948.98	
40.43	0	949.04	
40.69	0	949.21	
40.81	0	949.27	
40.86	0	949.31	
40.98	0	949.39	
41.19	0	949.53	
41.4	0	949.66	
41.58	0	949.77	
41.9	0	950.01	
41.94	0	950.04	
41.96	0	950.06	
42	0	950.1	
42.34	0	950.49	
42.48	0	950.68	
42.73	0	951.07	
42.82	0	951.23	
43.02	0	951.56	
43.11	0	951.69	
43.31	0	951.96	
43.49	0	952.18	
43.57	0	952.3	
43.74	0	952.53	ib
43.87	0	952.71	
44.11	0	952.97	
44.26	0	953.11	
44.62	0	953.47	
44.65	0	953.5	

44.66	0	953.51
45.02	0	953.84
45.19	0	954
45.73	0	954.63
45.79	0	954.69
45.94	0	954.81
46.17	0	955.04
46.27	0	955.12
46.5	0	955.4
46.56	0	955.46
46.81	0	955.73
46.94	0	955.86
47.32	0	956.14
47.35	0	956.16
47.42	0	956.18
47.7	0	956.28
47.89	0	956.32
48.43	0	956.38
48.56	0	956.38
48.97	0	956.42
49.24	0	956.42
49.27	0	956.42
49.51	0	956.42
49.62	0	956.4
50	0	956.32
50.38	0	956.28
50.6	0	956.26
51.14	0	956.2
51.18	0	956.2
51.53	0	956.12
51.68	0	956.09
51.92	0	956.01
52.03	0	955.98
52.22	0	955.92
52.3	0	955.91
52.49	0	955.89
54.38	0	955.74
54.92	0	955.56
55.12	0	955.55
55.36	0	955.54
55.46	0	955.52
56.51	0	955.45
56.55	0	955.45
57.09	0	955.46
57.28	0	955.47
57.63	0	955.51
57.74	0	955.53
58.04	0	955.58
58.17	0	955.59
58.43	0	955.63
58.71	0	955.67
59.19	0	955.79
59.25	0	955.81
59.79	0	955.93
60.33	0	956.08
60.34	0	956.08
60.36	0	956.09
60.72	0	956.29
61.11	0	956.55
61.23	0	956.62
61.41	0	956.74
61.49	0	956.77
61.67	0	956.84
61.95	0	956.94
62.15	0	957.07
62.26	0	957.15

62.5	0	957.3
62.64	0	957.36
63.04	0	957.53
63.4	0	957.69
63.58	0	957.76
64.12	0	957.94
64.17	0	957.96
64.3	0	958
64.55	0	958.08
64.66	0	958.11
65.2	0	958.2
65.32	0	958.21
65.7	0	958.28
65.74	0	958.28
66.28	0	958.36
66.82	0	958.45
67.36	0	958.61
67.62	0	958.65
67.9	0	958.69
68	0	958.69
68.38	0	958.71
68.44	0	958.71
68.99	0	958.77
69.53	0	958.78
71.15	0	958.75
71.36	0	958.74
71.45	0	958.74
71.69	0	958.72
72.21	0	958.65
72.28	0	958.64
72.59	0	958.58
72.77	0	958.56
72.98	0	958.54
73.2	0	958.54
73.31	0	958.54
74.93	0	958.53
75.04	0	958.56
75.27	0	958.59
75.48	0	958.69
75.66	0	958.79
75.96	0	958.8
76.02	0	958.81
77.64	0	958.86
78.18	0	958.72
78.72	0	958.64
78.72	0	958.64
78.72	0	958.64
85.75	0	958.61
86.29	0	958.6
88.46	0	958.68
90.62	0	958.85
91.16	0	959.1
91.7	0	959.13
91.84	0	959.19
93.15	0	959.5
93.27	0	959.54
93.32	0	959.55
93.86	0	959.45
94.04	0	959.46
94.37	0	959.5
94.41	0	959.5
103.99	0	959.31
104.68	0	959.31
104.76	0	959.28
104.95	0	959.2
106.26	0	959.02

106.29	0	959.02
106.84	0	959.1
107.06	0	959.17
107.39	0	959.26
109.01	0	959.23
109.09	0	959.22
109.36	0	959.18
109.55	0	959.16
110.09	0	959.15
110.2	0	959.13
111.51	0	959.03
111.71	0	959
112.25	0	958.99
112.79	0	958.91
114.42	0	958.84
114.96	0	958.76
117.01	0	958.65
117.12	0	958.65
124.62	0	958.68
124.69	0	958.68
125.23	0	958.65
125.77	0	958.57
127.94	0	958.55
130.1	0	958.57
130.64	0	958.57
135.39	0	958.57
135.51	0	958.57
136.05	0	958.56
138.21	0	958.45
138.75	0	958.4
140.92	0	958.29
141.46	0	958.29
141.52	0	958.28
143.08	0	958.32
143.62	0	958.33
144.16	0	958.4
145.79	0	958.37
146.33	0	958.3
146.87	0	958.27
146.88	0	958.26
146.92	0	958.26
148.23	0	958.1
148.49	0	958.03
149.03	0	958
149.54	0	957.85
151.19	0	957.7
151.48	0	957.62
151.74	0	957.54
153.9	0	957.46
154.44	0	957.46
156.6	0	957.4
159.31	0	957.25
159.85	0	957.26
159.9	0	957.24
161.47	0	956.91
162.01	0	956.91
162.55	0	956.73
164.17	0	956.56
164.72	0	956.44
165.26	0	956.45
167.42	0	956.49
167.56	0	956.45
169.58	0	956.22
170.12	0	956.07
171.84	0	955.9
172.29	0	955.77

172.83	0	955.79
173.15	0	955.7
174.99	0	955.51
175.22	0	955.49
175.53	0	955.47
177.16	0	955.44
177.7	0	955.42
178.24	0	955.42
179.86	0	955.33
180.4	0	955.33
180.94	0	955.27
182.56	0	955.19
183.1	0	955.11
184.95	0	955.06
186.26	0	955.12
187.97	0	955.06
188.51	0	955
190.2	0	954.95
190.68	0	954.92
191.22	0	954.95
191.51	0	954.94
192.83	0	954.86
192.84	0	954.85
193.38	0	954.84
193.6	0	954.81
193.77	0	954.77
193.92	0	954.74
195.54	0	954.71
196.08	0	954.6
196.63	0	954.58
196.75	0	954.56
198.2	0	954.43
198.25	0	954.43
198.79	0	954.43
199.33	0	954.46
203.31	0	954.41
203.93	0	954.39

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	962.82	962.82	962.82
Bankfull Elevation (ft)	955.63	955.63	955.63
Floodprone Width (ft)	720	-----	-----
Bankfull Width (ft)	116.47	64.5	59.96
Entrenchment Ratio	6.18	-----	-----
Mean Depth (ft)	4.93	4.03	6.06
Maximum Depth (ft)	7.19	6.49	7.19
Width/Depth Ratio	23.62	16.01	9.89
Bankfull Area (sq ft)	574.45	259.78	314.67
Wetted Perimeter (ft)	120.8	72.22	61.47
Hydraulic Radius (ft)	4.76	3.6	5.12
Begin BKF Station	-66.03	-66.03	-1.53
End BKF Station	58.43	-1.53	58.43

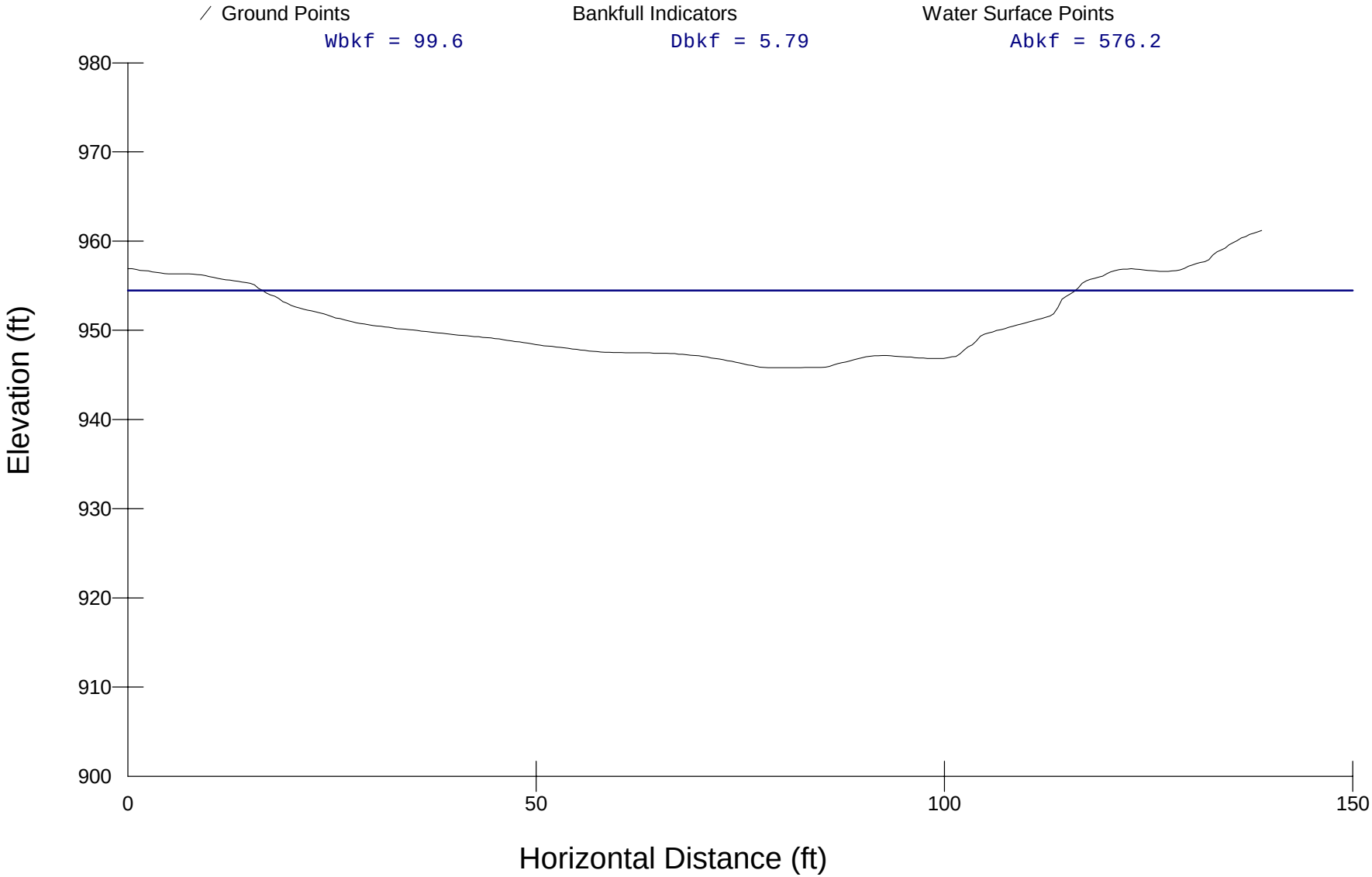
Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0

Shear Stress (lb/sq ft)
Movable Particle (mm)

188+25 Pool


Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 99.6
Dbkf = 5.79
Abkf = 576.2
980
970
960
950
940
930
920
910
900
Elevation (ft)
0
50
100
150
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-4
Cross Section Name: 188+25 Pool
Survey Date: 01/25/2026

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	956.92	
0.5	0	956.89	
1	0	956.82	
1.5	0	956.74	
2	0	956.69	
2.5	0	956.65	
3	0	956.55	
3.5	0	956.52	
4	0	956.44	
4.5	0	956.36	
4.99	0	956.32	
5.49	0	956.32	
5.99	0	956.32	
6.49	0	956.31	
6.99	0	956.33	
7.49	0	956.32	
7.99	0	956.28	
8.49	0	956.27	
8.99	0	956.23	
9.49	0	956.15	
9.99	0	956.02	
10.49	0	955.91	
10.99	0	955.82	
11.49	0	955.76	
11.99	0	955.69	
12.49	0	955.63	
12.99	0	955.56	
13.49	0	955.49	
13.98	0	955.43	
14.48	0	955.35	
14.98	0	955.26	
15.48	0	955.09	
15.98	0	954.74	
16.48	0	954.49	BKF
16.98	0	954.2	
17.48	0	953.98	
17.98	0	953.81	
18.48	0	953.57	
18.98	0	953.21	
19.48	0	953.05	
19.98	0	952.81	
20.48	0	952.63	
20.98	0	952.5	
21.48	0	952.38	
21.98	0	952.27	
22.48	0	952.2	
22.98	0	952.09	
23.47	0	951.97	
23.97	0	951.88	

24.47	0	951.73	
24.97	0	951.52	
25.47	0	951.4	
25.97	0	951.3	
26.47	0	951.19	
26.97	0	951.07	
27.47	0	950.94	
27.97	0	950.86	
28.47	0	950.77	
28.97	0	950.69	
29.47	0	950.62	
29.97	0	950.57	
30.47	0	950.5	
30.97	0	950.44	
31.47	0	950.38	
31.97	0	950.33	
32.47	0	950.26	
32.96	0	950.21	
33.46	0	950.16	
33.96	0	950.13	WS
34.46	0	950.09	
34.96	0	950.04	
35.46	0	949.96	
35.96	0	949.91	
36.46	0	949.87	
36.96	0	949.83	
37.46	0	949.77	
37.96	0	949.72	
38.46	0	949.67	
38.96	0	949.61	
39.46	0	949.56	
39.96	0	949.52	
40.46	0	949.47	
40.96	0	949.43	
41.46	0	949.39	
41.95	0	949.34	
42.45	0	949.3	
42.95	0	949.27	
43.45	0	949.23	
43.95	0	949.19	
44.45	0	949.14	
44.95	0	949.08	
45.45	0	949.02	
45.95	0	948.95	
46.45	0	948.87	
46.95	0	948.81	
47.45	0	948.74	
47.95	0	948.69	
48.45	0	948.64	
48.95	0	948.57	
49.45	0	948.5	
49.95	0	948.43	
50.45	0	948.33	
50.95	0	948.28	
51.44	0	948.23	
51.94	0	948.18	
52.44	0	948.14	
52.94	0	948.09	
53.44	0	948.04	
53.94	0	947.98	
54.44	0	947.91	
54.94	0	947.86	
55.44	0	947.8	
55.94	0	947.76	
56.44	0	947.7	
56.94	0	947.65	

57.44	0	947.6
57.94	0	947.57
58.44	0	947.55
58.94	0	947.53
59.44	0	947.51
59.94	0	947.5
60.44	0	947.49
60.93	0	947.48
61.43	0	947.47
61.93	0	947.47
62.43	0	947.46
62.93	0	947.46
63.43	0	947.46
63.93	0	947.46
64.43	0	947.45
64.93	0	947.45
65.43	0	947.44
65.93	0	947.42
66.43	0	947.41
66.93	0	947.38
67.43	0	947.34
67.93	0	947.31
68.43	0	947.27
68.93	0	947.23
69.43	0	947.17
69.92	0	947.13
70.42	0	947.08
70.92	0	947
71.42	0	946.9
71.92	0	946.84
72.42	0	946.79
72.92	0	946.7
73.42	0	946.61
73.92	0	946.52
74.42	0	946.42
74.92	0	946.34
75.42	0	946.24
75.92	0	946.12
76.42	0	946.04
76.92	0	945.96
77.42	0	945.89
77.92	0	945.84
78.42	0	945.81
78.92	0	945.8
79.41	0	945.8
79.91	0	945.8
80.41	0	945.8
80.91	0	945.81
81.41	0	945.81
81.91	0	945.81
82.41	0	945.81
82.91	0	945.82
83.41	0	945.82
83.91	0	945.82
84.41	0	945.82
84.91	0	945.83
85.41	0	945.88
85.91	0	945.96
86.41	0	946.12
86.91	0	946.27
87.41	0	946.38
87.91	0	946.47
88.4	0	946.57
88.9	0	946.71
89.4	0	946.81
89.9	0	946.91

90.4	0	947.03
90.9	0	947.12
91.4	0	947.15
91.9	0	947.16
92.4	0	947.17
92.9	0	947.17
93.4	0	947.15
93.9	0	947.12
94.4	0	947.07
94.9	0	947.04
95.4	0	947.01
95.9	0	946.98
96.4	0	946.93
96.9	0	946.9
97.4	0	946.88
97.89	0	946.87
98.39	0	946.85
98.89	0	946.85
99.39	0	946.85
99.89	0	946.87
100.39	0	946.93
100.89	0	947.02
101.39	0	947.08
101.89	0	947.35
102.39	0	947.76
102.89	0	948.16
103.39	0	948.37
103.89	0	948.78
104.39	0	949.35
104.89	0	949.59
105.39	0	949.71
105.89	0	949.83
106.39	0	949.96
106.89	0	950.08
107.38	0	950.21
107.88	0	950.33
108.38	0	950.45
108.88	0	950.58
109.38	0	950.7
109.88	0	950.82
110.38	0	950.95
110.88	0	951.07
111.38	0	951.2
111.88	0	951.32
112.38	0	951.45
112.88	0	951.61
113.38	0	951.86
113.88	0	952.55
114.38	0	953.51
114.88	0	953.79
115.38	0	954.07
115.88	0	954.35
116.37	0	954.75
116.87	0	955.27
117.37	0	955.57
117.87	0	955.7
118.37	0	955.82
118.87	0	955.95
119.37	0	956.08
119.87	0	956.37
120.37	0	956.56
120.87	0	956.7
121.37	0	956.81
121.87	0	956.86
122.37	0	956.87
122.87	0	956.9

123.37	0	956.87
123.87	0	956.83
124.37	0	956.77
124.87	0	956.71
125.37	0	956.68
125.86	0	956.64
126.36	0	956.61
126.86	0	956.6
127.36	0	956.61
127.86	0	956.65
128.36	0	956.69
128.86	0	956.78
129.36	0	956.93
129.86	0	957.19
130.36	0	957.35
130.86	0	957.47
131.36	0	957.6
131.86	0	957.72
132.36	0	957.93
132.86	0	958.43
133.36	0	958.79
133.86	0	959
134.36	0	959.22
134.85	0	959.61
135.35	0	959.85
135.85	0	960.05
136.35	0	960.34
136.85	0	960.51
137.35	0	960.74
137.85	0	960.91
138.35	0	961.04
138.85	0	961.19

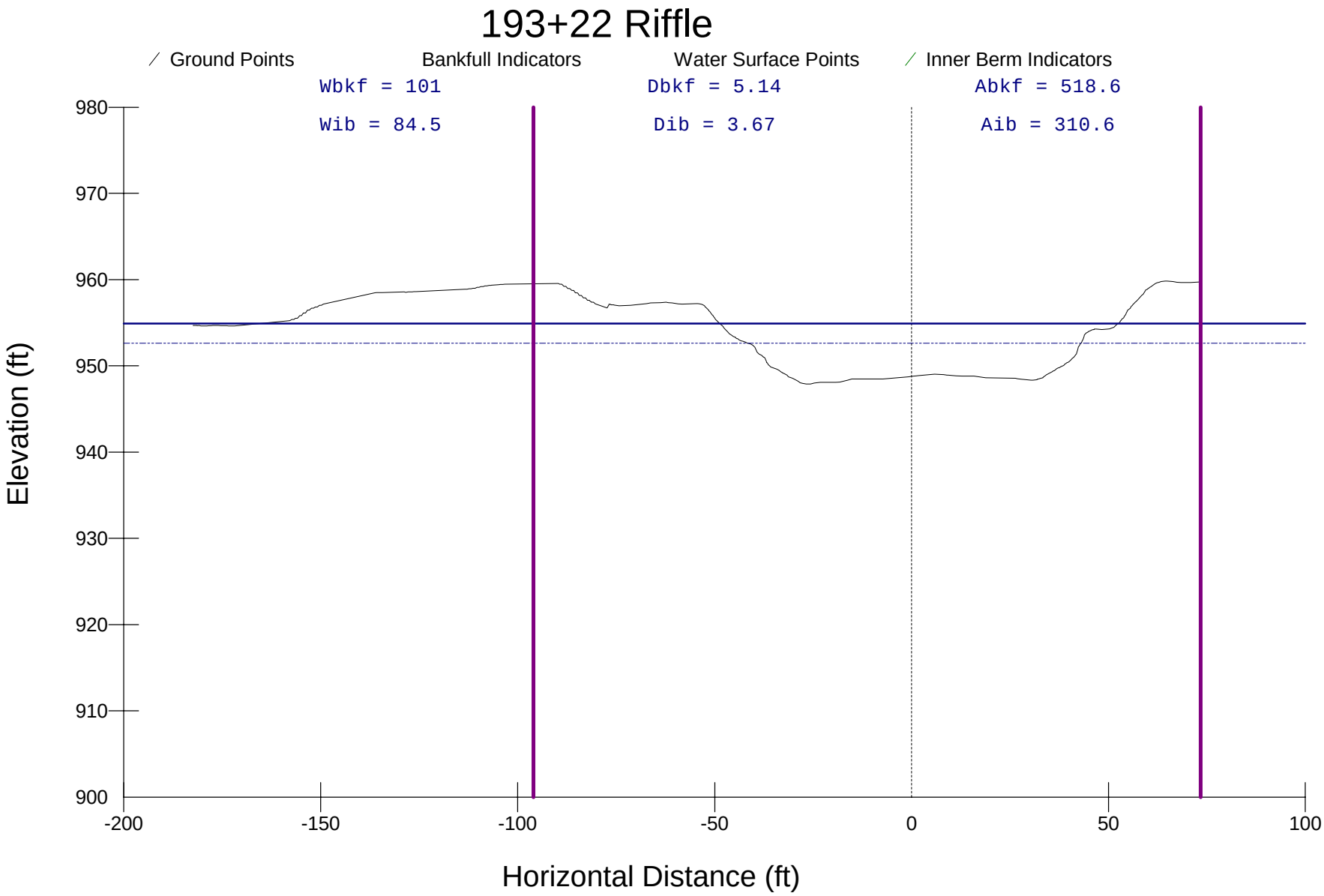
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	963.18	963.18	963.18
Bankfull Elevation (ft)	954.49	954.49	954.49
Floodprone Width (ft)	620	-----	-----
Bankfull Width (ft)	99.57	49.79	49.78
Entrenchment Ratio	6.23	-----	-----
Mean Depth (ft)	5.79	4.85	6.72
Maximum Depth (ft)	8.69	7.08	8.69
Width/Depth Ratio	17.2	10.26	7.41
Bankfull Area (sq ft)	576.18	241.67	334.51
Wetted Perimeter (ft)	103.09	57.72	59.53
Hydraulic Radius (ft)	5.59	4.19	5.62
Begin BKF Station	16.48	16.48	66.27
End BKF Station	116.05	66.27	116.05

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


193+22 Riffle
Ground Points
Bankfull Indicators
Water Surface Points
Inner Berm Indicators
Wbkf = 101
Wib = 84.5
Dbkf = 5.14
Dib = 3.67
Abkf = 518.6
Aib = 310.6
980
970
960
950
940
930
920
910
900
Elevation (ft)
-200
-150
-100
-50
0
50
100
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-5
Cross Section Name: 193+22 Riffle
Survey Date: 11/19/2025

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
-182.39	0	954.68	
-182.37	0	954.68	
-181.87	0	954.69	
-181.83	0	954.69	
-181.43	0	954.68	
-181.37	0	954.67	
-180.87	0	954.68	
-180.37	0	954.62	
-179.87	0	954.62	
-179.73	0	954.62	
-179.52	0	954.63	
-179.37	0	954.62	
-178.87	0	954.63	
-178.37	0	954.65	
-177.87	0	954.65	
-177.37	0	954.68	
-176.87	0	954.68	
-176.64	0	954.69	
-176.59	0	954.69	
-176.37	0	954.69	
-175.87	0	954.69	
-175.37	0	954.67	
-174.87	0	954.67	
-174.37	0	954.65	
-173.86	0	954.65	
-173.36	0	954.63	
-172.86	0	954.63	
-171.84	0	954.61	
-157.85	0	955.24	
-157.35	0	955.4	
-156.85	0	955.4	
-156.7	0	955.43	
-156.5	0	955.49	
-156.35	0	955.53	
-155.85	0	955.52	
-155.66	0	955.64	
-155.54	0	955.71	
-155.35	0	955.82	
-154.85	0	955.82	
-154.35	0	956.14	
-153.85	0	956.13	
-153.35	0	956.47	
-152.84	0	956.46	
-152.66	0	956.54	
-152.52	0	956.61	
-152.34	0	956.68	
-151.84	0	956.68	
-151.34	0	956.84	
-150.84	0	956.84	

-150.34	0	957
-149.84	0	957
-149.34	0	957.16
-136.33	0	958.48
-135.83	0	958.49
-135.33	0	958.49
-134.83	0	958.5
-134.33	0	958.51
-128.82	0	958.56
-128.32	0	958.55
-127.82	0	958.56
-127.32	0	958.58
-126.82	0	958.59
-126.77	0	958.59
-126.35	0	958.61
-126.32	0	958.61
-125.81	0	958.61
-113.35	0	958.89
-112.81	0	958.89
-112.31	0	958.95
-111.81	0	958.95
-111.31	0	959.03
-110.8	0	959.03
-110.3	0	959.11
-109.8	0	959.11
-109.3	0	959.19
-108.8	0	959.19
-108.3	0	959.27
-107.8	0	959.26
-107.3	0	959.34
-106.8	0	959.34
-106.63	0	959.36
-106.46	0	959.39
-104.71	0	959.42
-104.37	0	959.45
-104.3	0	959.45
-103.8	0	959.46
-103.76	0	959.46
-103.32	0	959.47
-89.78	0	959.55
-89.71	0	959.54
-89.37	0	959.49
-89.28	0	959.47
-88.78	0	959.47
-88.28	0	959.23
-87.78	0	959.23
-87.28	0	958.99
-86.78	0	958.99
-86.28	0	958.76
-85.78	0	958.76
-85.54	0	958.61
-85.53	0	958.61
-85.28	0	958.47
-84.78	0	958.47
-84.58	0	958.35
-84.48	0	958.29
-84.28	0	958.17
-83.78	0	958.18
-83.28	0	957.88
-82.78	0	957.88
-82.28	0	957.59
-81.78	0	957.59
-81.7	0	957.56
-81.34	0	957.4
-81.28	0	957.37
-80.78	0	957.37

-80.28	0	957.21	
-77.27	0	956.74	
-77.15	0	956.84	
-76.9	0	957.04	
-76.77	0	957.15	
-76.63	0	957.14	
-76.42	0	957.11	
-76.27	0	957.1	
-76.11	0	957.09	
-75.95	0	957.1	
-75.77	0	957.09	
-75.58	0	957.08	
-75.47	0	957.07	
-74.27	0	956.98	
-71.27	0	957.01	
-67.26	0	957.24	
-66.26	0	957.31	
-63.76	0	957.34	
-62.26	0	957.38	
-61.76	0	957.33	
-60.76	0	957.3	
-59.26	0	957.19	
-58.25	0	957.15	
-54.75	0	957.22	
-54.25	0	957.23	
-53.75	0	957.21	
-53.25	0	957.13	
-52.75	0	957.01	
-52.55	0	956.93	
-52.45	0	956.88	
-52.25	0	956.8	
-52.03	0	956.68	
-51.97	0	956.65	
-51.75	0	956.53	
-51.51	0	956.42	
-51.49	0	956.41	
-51.25	0	956.29	
-50.75	0	956.03	
-50.53	0	955.9	
-50.46	0	955.87	
-50.25	0	955.74	
-50.05	0	955.61	
-49.94	0	955.53	
-49.75	0	955.4	
-49.57	0	955.31	
-49.41	0	955.22	
-49.25	0	955.13	
-49.09	0	955.08	
-48.89	0	955	
-48.75	0	954.95	
-48.61	0	954.89	bkf
-48.37	0	954.78	
-48.25	0	954.73	
-48.13	0	954.68	
-47.84	0	954.53	
-47.74	0	954.48	
-47.24	0	954.23	
-47.18	0	954.19	
-46.8	0	954.02	
-46.7	0	953.96	
-46.27	0	953.74	
-46.24	0	953.72	
-46.22	0	953.71	
-45.75	0	953.56	
-45.74	0	953.55	
-45.26	0	953.44	

-45.24	0	953.43	
-44.74	0	953.3	
-44.7	0	953.29	
-44.3	0	953.18	
-44.18	0	953.16	
-43.82	0	953.06	
-43.74	0	953.04	
-43.24	0	952.92	
-42.74	0	952.85	
-42.24	0	952.76	
-42.09	0	952.73	
-41.9	0	952.7	
-41.74	0	952.67	
-41.56	0	952.64	ib
-41.42	0	952.62	
-40.74	0	952.52	
-40.24	0	952.37	
-39.99	0	952.26	
-39.98	0	952.26	
-39.74	0	952.14	
-39.5	0	951.9	
-39.47	0	951.86	
-39.24	0	951.61	
-39.02	0	951.51	
-38.95	0	951.49	
-38.74	0	951.4	
-38.06	0	951.2	
-37.9	0	951.15	
-37.74	0	951.1	
-37.59	0	951.04	
-37.38	0	950.98	
-37.23	0	950.93	
-37.11	0	950.79	
-36.85	0	950.52	
-36.73	0	950.39	
-36.63	0	950.33	
-36.33	0	950.13	
-36.23	0	950.08	
-35.73	0	949.88	rew
-34.23	0	949.62	
-34.23	0	949.62	
-33.75	0	949.5	
-33.71	0	949.49	
-33.27	0	949.34	
-33.19	0	949.31	
-32.79	0	949.22	
-32.73	0	949.2	
-32.66	0	949.19	
-32.31	0	949.1	
-32.23	0	949.08	
-32.14	0	949.05	
-31.83	0	949	
-31.73	0	948.97	
-31.62	0	948.92	
-31.35	0	948.79	
-31.23	0	948.75	
-31.09	0	948.72	
-30.87	0	948.68	
-30.57	0	948.62	
-30.39	0	948.59	
-30.23	0	948.56	
-29.23	0	948.29	
-28.73	0	948.18	
-28.23	0	948.05	
-28	0	948.02	
-27.95	0	948.01	

-27.73	0	947.98	
-26.72	0	947.9	
-26.22	0	947.9	
-26.08	0	947.9	
-25.72	0	947.91	
-25.6	0	947.92	
-25.34	0	947.95	
-24.72	0	948	
-23.22	0	948.08	
-21.22	0	948.1	
-20.22	0	948.08	
-19.22	0	948.1	
-18.22	0	948.14	
-16.21	0	948.33	
-15.21	0	948.47	
-14.71	0	948.49	
-14.21	0	948.5	
-12.21	0	948.47	
-7.21	0	948.48	
-0.7	0	948.74	
0	0	948.78	
1.3	0	948.84	
1.8	0	948.87	
5.81	0	949.02	
8.31	0	948.98	
8.45	0	948.97	
8.68	0	948.95	
8.93	0	948.93	
9.21	0	948.93	
11.31	0	948.84	
12.81	0	948.81	
14.82	0	948.83	
15.32	0	948.82	
15.82	0	948.8	
18.82	0	948.63	
26.33	0	948.55	
26.83	0	948.53	
27.83	0	948.45	
30.33	0	948.35	
30.83	0	948.35	
31.33	0	948.38	
31.83	0	948.43	
31.94	0	948.44	
32.23	0	948.49	
32.83	0	948.56	
33.33	0	948.64	
33.38	0	948.65	
33.8	0	948.82	
33.83	0	948.83	
34.33	0	949	
34.34	0	949	
35.33	0	949.25	
35.84	0	949.36	
35.9	0	949.38	
36.26	0	949.48	
36.42	0	949.54	
36.74	0	949.65	
36.84	0	949.68	
37.34	0	949.78	
37.47	0	949.81	
37.7	0	949.86	rew
37.84	0	949.89	
37.99	0	949.92	
38.18	0	949.96	
38.34	0	949.99	
38.51	0	950.06	

38.65	0	950.1	
38.84	0	950.18	
39.04	0	950.24	
39.13	0	950.27	
39.34	0	950.33	
39.61	0	950.4	
39.84	0	950.46	
40.34	0	950.65	
40.84	0	950.89	
41.05	0	950.97	
41.13	0	951	
41.34	0	951.08	
41.53	0	951.2	
41.65	0	951.27	
41.84	0	951.38	
42.01	0	951.64	
42.18	0	951.93	
42.34	0	952.18	
42.49	0	952.29	
42.7	0	952.46	
42.84	0	952.56	
42.97	0	952.64	ib
43.22	0	952.82	
43.34	0	952.9	
43.45	0	953.04	
43.75	0	953.42	
43.84	0	953.55	
43.93	0	953.6	
44.27	0	953.78	
44.34	0	953.82	
44.41	0	953.84	
44.79	0	953.94	
44.84	0	953.95	
45.34	0	954.08	
45.84	0	954.19	
45.85	0	954.19	
46.33	0	954.23	
46.35	0	954.24	
46.85	0	954.24	
48.35	0	954.23	
49.85	0	954.26	
50.35	0	954.31	
50.55	0	954.35	
50.64	0	954.36	
51.08	0	954.43	
51.12	0	954.44	
51.35	0	954.48	
51.85	0	954.68	
52.35	0	954.9	bkf
52.56	0	954.96	
52.85	0	955.05	
53.04	0	955.19	
53.17	0	955.27	
53.35	0	955.4	
53.52	0	955.47	
53.69	0	955.52	
53.85	0	955.59	
54	0	955.7	
54.22	0	955.87	
54.35	0	955.97	
54.48	0	956.08	
54.74	0	956.34	
54.85	0	956.44	
55.35	0	956.61	
55.44	0	956.66	
55.79	0	956.89	

55.85	0	956.93
55.92	0	956.98
56.31	0	957.17
56.35	0	957.2
56.4	0	957.22
56.83	0	957.4
56.86	0	957.41
56.88	0	957.42
57.36	0	957.62
57.36	0	957.62
57.83	0	957.88
57.86	0	957.89
58.36	0	958.15
58.4	0	958.17
58.79	0	958.33
58.86	0	958.35
58.93	0	958.4
59.27	0	958.7
59.36	0	958.76
59.45	0	958.79
59.75	0	958.88
59.86	0	958.92
59.97	0	958.95
60.23	0	959.03
60.36	0	959.07
60.5	0	959.11
60.71	0	959.17
61.86	0	959.53
62.36	0	959.63
62.86	0	959.71
63.36	0	959.76
63.86	0	959.82
64.36	0	959.84
64.86	0	959.83
66.36	0	959.79
67.37	0	959.71
68.37	0	959.67
70.87	0	959.67
72.87	0	959.75
73.37	0	959.72

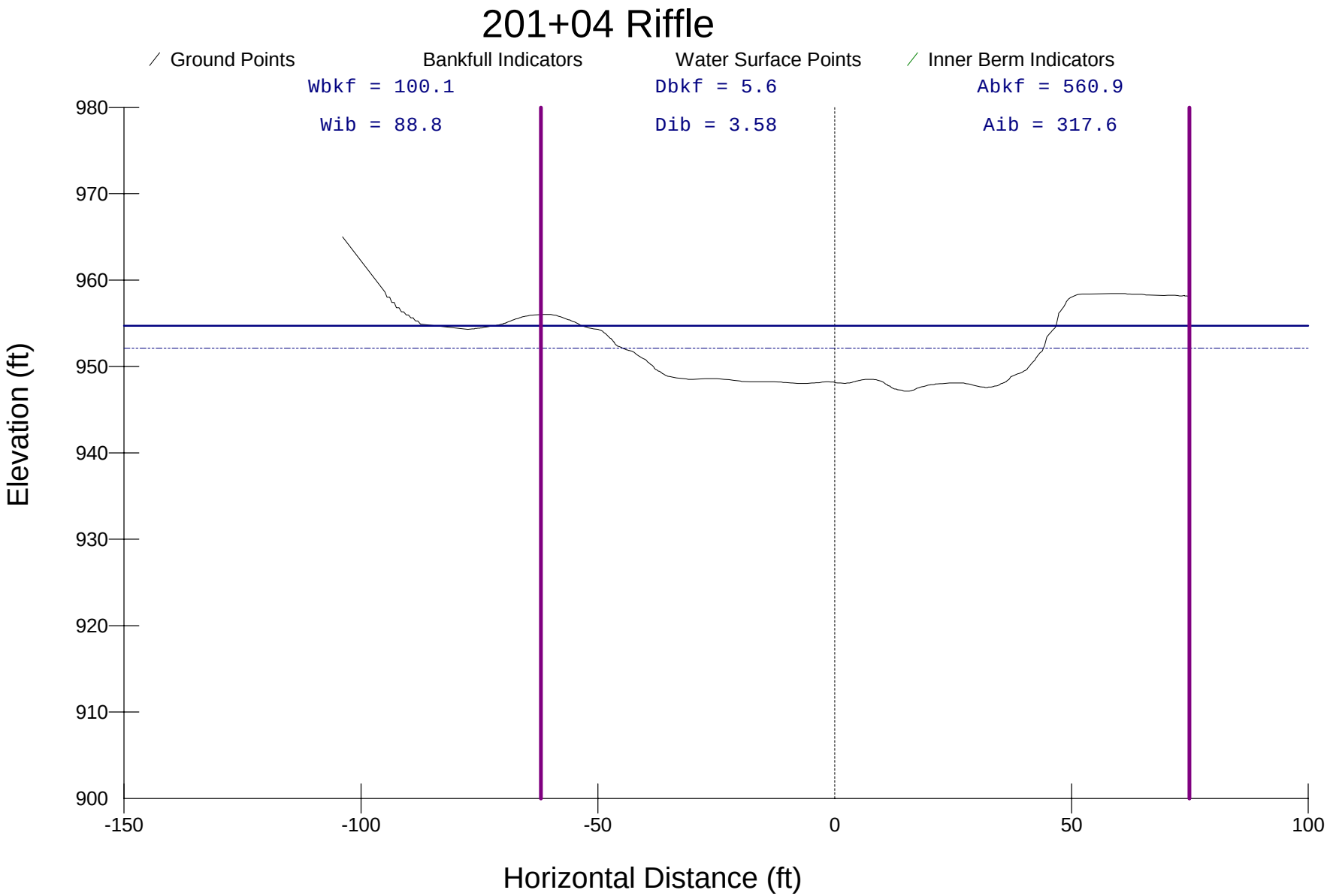
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	961.9	961.9	961.9
Bankfull Elevation (ft)	954.9	954.9	954.9
Floodprone Width (ft)	590	-----	-----
Bankfull Width (ft)	100.98	50.49	50.49
Entrenchment Ratio	5.84	-----	-----
Mean Depth (ft)	5.14	5.36	4.91
Maximum Depth (ft)	7	7	6.55
Width/Depth Ratio	19.65	9.42	10.28
Bankfull Area (sq ft)	518.58	270.71	247.88
Wetted Perimeter (ft)	104.19	58	58.24
Hydraulic Radius (ft)	4.98	4.67	4.26
Begin BKF Station	-48.63	-48.63	1.86
End BKF Station	52.35	1.86	52.35

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


201+04 Riffle
Ground Points
Bankfull Indicators
Water Surface Points
Inner Berm Indicators
Wbkf = 100.1
Wib = 88.8
Dbkf = 5.6
Dib = 3.58
Abkf = 560.9
Aib = 317.6
980
970
960
950
940
930
920
910
900
Elevation (ft)
-150
-100
-50
0
50
100
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-5
Cross Section Name: 201+04 Riffle
Survey Date: 11/19/2025

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
-103.91	0	965	
-94.95	0	958.65	
-94.45	0	958.04	
-93.95	0	958.03	
-93.45	0	957.42	
-92.95	0	957.42	
-92.45	0	956.81	
-91.95	0	956.81	
-91.74	0	956.61	
-91.66	0	956.54	
-91.45	0	956.33	
-90.95	0	956.33	
-90.45	0	955.98	
-89.95	0	955.98	
-89.45	0	955.63	
-88.95	0	955.63	
-88.82	0	955.54	
-88.55	0	955.35	
-88.44	0	955.27	
-87.94	0	955.27	
-87.44	0	954.9	
-77.44	0	954.31	
-77.43	0	954.31	
-76.93	0	954.32	
-76.88	0	954.32	
-76.5	0	954.35	
-76.43	0	954.35	
-76.02	0	954.38	
-75.92	0	954.39	
-75.55	0	954.41	
-75.28	0	954.43	
-75.07	0	954.44	
-74.92	0	954.45	
-74.75	0	954.46	
-74.6	0	954.47	
-74.42	0	954.48	
-73.92	0	954.53	
-73.42	0	954.6	
-72.92	0	954.63	
-72.7	0	954.65	
-72.63	0	954.66	
-72.42	0	954.69	
-71.76	0	954.73	
-71.57	0	954.74	
-71.42	0	954.75	
-71.28	0	954.77	
-71.04	0	954.8	
-70.92	0	954.82	
-70.81	0	954.83	

-70.51	0	954.88	
-69.91	0	954.96	
-69.86	0	954.97	
-69.45	0	955.03	
-69.41	0	955.03	
-69.39	0	955.04	
-68.92	0	955.15	
-68.91	0	955.15	
-68.91	0	955.15	
-68.41	0	955.28	
-67.91	0	955.39	
-67.85	0	955.4	
-67.49	0	955.47	
-67.41	0	955.48	
-66.91	0	955.56	
-66.41	0	955.66	
-66.26	0	955.69	
-66.07	0	955.72	
-65.91	0	955.75	
-65.73	0	955.77	
-65.59	0	955.79	
-65.2	0	955.83	
-65.12	0	955.83	
-64.91	0	955.85	
-64.67	0	955.87	
-64.65	0	955.88	
-64.17	0	955.91	
-64.14	0	955.91	
-63.91	0	955.93	
-63.4	0	955.96	
-61.4	0	956.03	
-60.4	0	956.03	
-59.9	0	956.02	
-59.4	0	955.98	
-59.36	0	955.97	
-58.96	0	955.93	
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-56.89	0	955.55	
-56.18	0	955.43	
-56.11	0	955.42	
-55.89	0	955.38	
-55.65	0	955.31	
-55.64	0	955.31	
-55.39	0	955.24	
-55.16	0	955.21	
-55.12	0	955.2	
-54.89	0	955.17	
-54.69	0	955.11	
-54.58	0	955.08	
-54.39	0	955.03	
-54.22	0	954.97	
-54.05	0	954.92	
-53.89	0	954.86	
-53.74	0	954.82	
-53.52	0	954.77	
-53.39	0	954.74	bkf
-52.89	0	954.63	
-52.39	0	954.56	
-52.32	0	954.55	
-51.93	0	954.49	
-51.89	0	954.48	

-51.39	0	954.41	
-50.9	0	954.35	
-50.88	0	954.35	
-49.95	0	954.29	
-49.88	0	954.28	
-49.81	0	954.27	
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-49.28	0	954.18	
-49	0	954.07	
-48.88	0	954.03	
-48.75	0	953.97	
-48.53	0	953.87	
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-48.21	0	953.72	
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-47.88	0	953.53	
-47.68	0	953.44	
-47.58	0	953.39	
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-47.15	0	953.19	
-47.11	0	953.17	
-46.88	0	953.07	
-46.63	0	952.85	
-46.62	0	952.85	
-46.38	0	952.63	
-46.16	0	952.52	
-46.09	0	952.49	
-45.88	0	952.38	
-45.68	0	952.35	
-45.56	0	952.33	
-45.38	0	952.3	
-44.87	0	952.15	
-44.26	0	952.02	ib
-43.97	0	951.95	
-43.87	0	951.93	
-43.79	0	951.92	
-43.44	0	951.87	
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-42.91	0	951.79	
-42.87	0	951.78	
-42.37	0	951.63	
-42.37	0	951.63	
-41.89	0	951.42	
-41.87	0	951.41	
-41.85	0	951.41	
-41.42	0	951.26	
-40.87	0	951.07	
-40.37	0	950.92	
-40.25	0	950.88	
-40	0	950.82	
-39.87	0	950.77	
-39.72	0	950.69	
-39.52	0	950.57	
-39.37	0	950.49	
-39.19	0	950.42	
-39.05	0	950.35	
-38.87	0	950.28	
-38.66	0	950.18	
-38.57	0	950.14	
-38.36	0	950.04	
-38.13	0	949.87	lew
-38.1	0	949.84	
-37.86	0	949.67	
-37.63	0	949.61	
-37.6	0	949.6	

-37.36	0	949.53
-37.15	0	949.48
-37.07	0	949.45
-36.86	0	949.41
-36.68	0	949.33
-36.54	0	949.27
-36.36	0	949.19
-36.2	0	949.14
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-35.26	0	948.89
-34.95	0	948.86
-34.78	0	948.84
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-31.85	0	948.59
-31.35	0	948.55
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-30.35	0	948.52
-29.85	0	948.52
-27.35	0	948.6
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-25.84	0	948.61
-24.84	0	948.58
-24.34	0	948.57
-23.34	0	948.51
-22.34	0	948.47
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-20.84	0	948.36
-20.34	0	948.33
-19.84	0	948.29
-19.61	0	948.28
-19.33	0	948.27
-17.83	0	948.23
-12.82	0	948.23
-11.82	0	948.2
-11.32	0	948.18
-10.82	0	948.17
-10.32	0	948.16
-9.19	0	948.1
-8.94	0	948.09
-7.82	0	948.05
-6.31	0	948.04
-5.81	0	948.05
-4.81	0	948.1
-4.31	0	948.1
-3.97	0	948.12
-3.31	0	948.14
-2.55	0	948.18
-2.31	0	948.2
-1.81	0	948.22
-1.31	0	948.22
-0.8	0	948.21
-0.3	0	948.19
-0.18	0	948.18
0	0	948.15
0.09	0	948.14
0.7	0	948.08
0.77	0	948.08
1.15	0	948.07
1.2	0	948.07
2.19	0	948.06

2.7	0	948.07
2.74	0	948.07
3.14	0	948.09
3.2	0	948.1
3.27	0	948.11
3.61	0	948.17
3.8	0	948.2
4.09	0	948.23
4.33	0	948.26
4.56	0	948.3
4.7	0	948.32
4.86	0	948.34
5.04	0	948.36
5.2	0	948.38
5.71	0	948.45
6.21	0	948.5
6.46	0	948.52
6.46	0	948.52
6.71	0	948.54
7.21	0	948.54
7.41	0	948.54
7.52	0	948.54
7.71	0	948.54
8.21	0	948.51
8.35	0	948.5
8.58	0	948.48
8.71	0	948.47
8.83	0	948.45
9.11	0	948.41
9.21	0	948.4
9.71	0	948.31
9.78	0	948.29
10.17	0	948.2
10.21	0	948.19
10.25	0	948.18
10.7	0	947.98
10.71	0	947.98
10.72	0	947.98
11.21	0	947.82
11.23	0	947.81
11.67	0	947.71
11.72	0	947.69
11.76	0	947.68
12.15	0	947.51
12.22	0	947.49
12.29	0	947.47
12.62	0	947.41
12.72	0	947.39
12.83	0	947.38
13.09	0	947.35
13.22	0	947.34
13.72	0	947.29
14.22	0	947.24
14.42	0	947.21
14.52	0	947.19
14.72	0	947.16
14.95	0	947.15
14.99	0	947.15
15.22	0	947.14
15.46	0	947.15
15.48	0	947.15
15.72	0	947.16
15.94	0	947.18
16.22	0	947.21
16.41	0	947.25
16.54	0	947.27

16.72	0	947.3
16.89	0	947.34
17.07	0	947.4
17.22	0	947.44
17.36	0	947.46
17.6	0	947.51
17.72	0	947.53
17.83	0	947.55
18.13	0	947.61
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18.66	0	947.68
18.73	0	947.69
19.23	0	947.77
19.73	0	947.84
19.73	0	947.84
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20.23	0	947.89
20.73	0	947.92
20.79	0	947.92
21.15	0	947.95
21.23	0	947.96
21.32	0	947.96
21.63	0	947.97
22.23	0	948
22.73	0	948.02
24.23	0	948.09
25.24	0	948.1
25.89	0	948.09
26.09	0	948.1
26.37	0	948.1
26.84	0	948.1
27.24	0	948.09
27.74	0	948.02
28.24	0	947.98
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28.74	0	947.94
28.74	0	947.94
28.75	0	947.94
29.21	0	947.85
29.24	0	947.85
30.75	0	947.66
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31.4	0	947.6
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32.75	0	947.61
33	0	947.63
33	0	947.63
33.25	0	947.66
33.48	0	947.68
33.53	0	947.69
33.75	0	947.72
34.25	0	947.76
34.42	0	947.8
34.59	0	947.84
34.75	0	947.88
34.9	0	947.93
35.12	0	948
35.25	0	948.04
35.37	0	948.06
35.65	0	948.11
35.75	0	948.13

35.85	0	948.15	
36.18	0	948.26	
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36.32	0	948.31	
36.71	0	948.48	
36.75	0	948.5	
37.26	0	948.86	
37.27	0	948.86	
38.76	0	949.17	
38.83	0	949.19	
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39.36	0	949.3	
39.64	0	949.36	
39.76	0	949.39	
40.11	0	949.49	
40.26	0	949.53	
40.43	0	949.61	
40.59	0	949.69	
40.76	0	949.78	rew
41.76	0	950.43	
42.01	0	950.59	
42.02	0	950.6	
42.26	0	950.77	
42.48	0	950.95	
42.55	0	951.01	
42.76	0	951.19	
42.96	0	951.32	
43.08	0	951.4	
43.27	0	951.52	
43.77	0	951.78	
43.9	0	951.94	
44.14	0	952.22	ib
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44.67	0	953.21	
44.77	0	953.42	
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45.73	0	954.02	
45.8	0	954.07	
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46.75	0	954.71	bkf
46.77	0	954.73	
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49.45	0	957.85	
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51.28	0	958.31
51.78	0	958.35
52.28	0	958.38
53.28	0	958.41
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60.79	0	958.44
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61.79	0	958.41
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64.8	0	958.35
64.84	0	958.35
65.24	0	958.33
65.3	0	958.32
65.37	0	958.32
65.71	0	958.3
65.8	0	958.29
66.18	0	958.29
66.3	0	958.29
67.8	0	958.24
69.31	0	958.23
69.5	0	958.23
69.62	0	958.23
70.31	0	958.25
70.45	0	958.24
70.81	0	958.24
71.87	0	958.24
72.27	0	958.22
72.31	0	958.22
72.35	0	958.22
72.8	0	958.16
73.29	0	958.17
73.31	0	958.18
73.33	0	958.18
73.77	0	958.2
73.81	0	958.2
73.87	0	958.19
74.24	0	958.17
74.31	0	958.17
74.4	0	958.17
74.72	0	958.15
74.82	0	958.14
74.93	0	958.14

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	962.32	962.32	962.32
Bankfull Elevation (ft)	954.73	954.73	954.73
Floodprone Width (ft)	450	-----	-----
Bankfull Width (ft)	100.11	25	75.11
Entrenchment Ratio	4.49	-----	-----
Mean Depth (ft)	5.6	3.59	6.27
Maximum Depth (ft)	7.59	6.21	7.59
Width/Depth Ratio	17.88	6.96	11.98
Bankfull Area (sq ft)	560.86	89.75	471.11
Wetted Perimeter (ft)	103.96	32.35	83.93

Hydraulic Radius (ft)	5.39	2.77	5.61
Begin BKF Station	-53.34	-53.34	-28.34
End BKF Station	46.77	-28.34	46.77

Entrainment Calculations

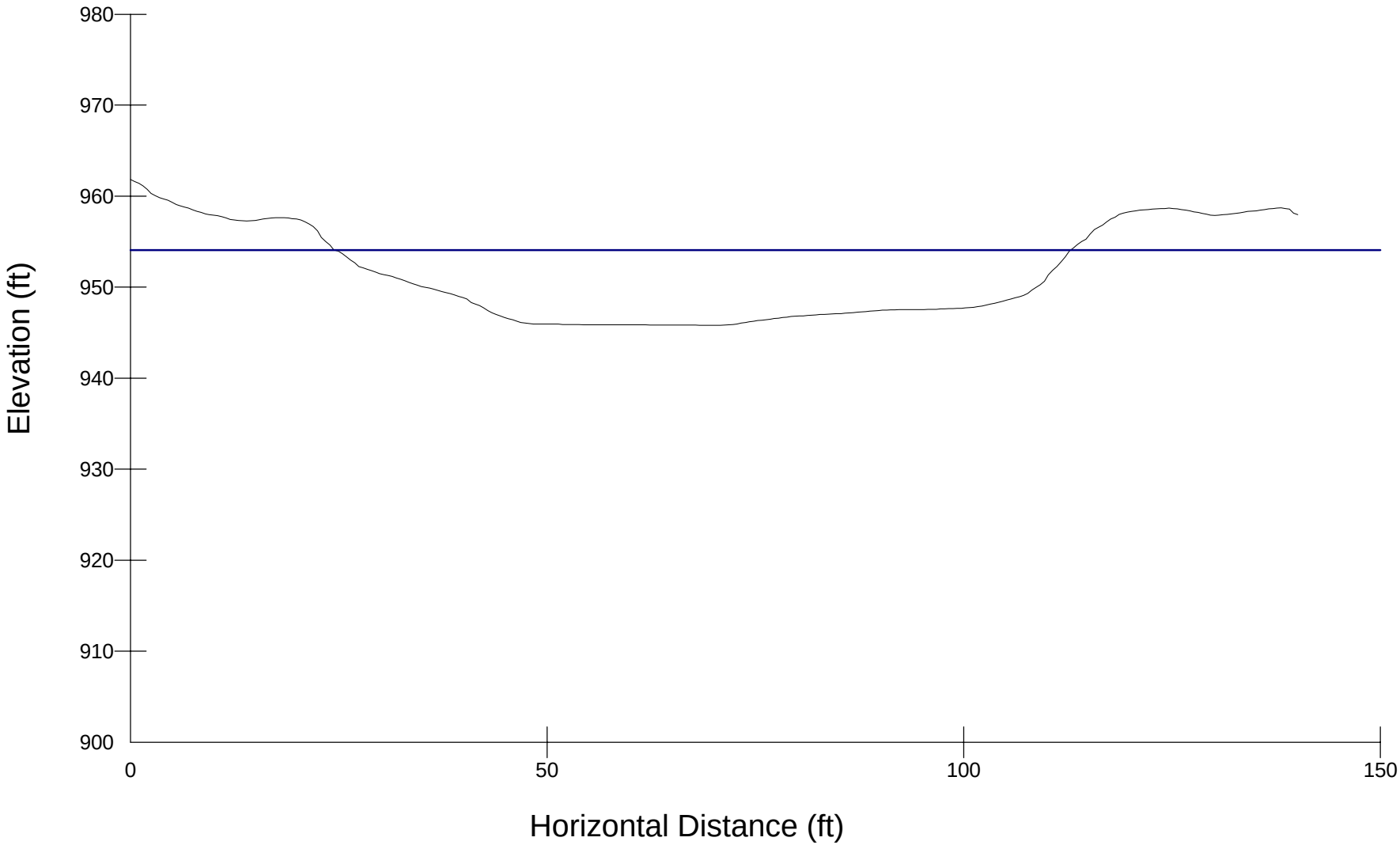
Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

205+60 Pool

Ground Points | Bankfull Indicators | Water Surface Points

Wbkf = 88.4 | Dbkf = 6.25 | Abkf = 552.8



RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-5
Cross Section Name: 205+60 Pool
Survey Date: 01/25/2026

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	961.83	
0.5	0	961.61	
1	0	961.41	
1.5	0	961.16	
1.99	0	960.74	
2.49	0	960.32	
2.99	0	960.05	
3.49	0	959.86	
3.99	0	959.71	
4.49	0	959.56	
4.99	0	959.34	
5.48	0	959.1	
5.98	0	958.95	
6.48	0	958.81	
6.98	0	958.67	
7.48	0	958.51	
7.98	0	958.33	
8.47	0	958.22	
8.97	0	958.08	
9.47	0	957.97	
9.97	0	957.91	
10.47	0	957.84	
10.97	0	957.73	
11.47	0	957.59	
11.96	0	957.46	
12.46	0	957.39	
12.96	0	957.34	
13.46	0	957.29	
13.96	0	957.26	
14.46	0	957.29	
14.96	0	957.35	
15.45	0	957.42	
15.95	0	957.5	
16.45	0	957.57	
16.95	0	957.61	
17.45	0	957.63	
17.95	0	957.65	
18.44	0	957.65	
18.94	0	957.61	
19.44	0	957.54	
19.94	0	957.47	
20.44	0	957.38	
20.94	0	957.19	
21.44	0	956.93	
21.93	0	956.67	
22.43	0	956.18	
22.93	0	955.45	
23.43	0	955.01	
23.93	0	954.62	

24.43	0	954.07	BKF
24.93	0	953.98	
25.42	0	953.66	
25.92	0	953.33	
26.42	0	953	
26.92	0	952.68	
27.42	0	952.27	
27.92	0	952.13	
28.42	0	951.97	
28.91	0	951.83	
29.41	0	951.65	
29.91	0	951.5	
30.41	0	951.39	
30.91	0	951.28	
31.41	0	951.18	
31.9	0	951.04	
32.4	0	950.87	
32.9	0	950.69	
33.4	0	950.56	
33.9	0	950.39	
34.4	0	950.24	
34.9	0	950.09	
35.39	0	949.99	
35.89	0	949.9	
36.39	0	949.78	
36.89	0	949.66	
37.39	0	949.5	
37.89	0	949.4	
38.39	0	949.29	
38.88	0	949.15	WS
39.38	0	949.01	
39.88	0	948.87	
40.38	0	948.71	
40.88	0	948.3	
41.38	0	948.15	
41.87	0	947.96	
42.37	0	947.72	
42.87	0	947.43	
43.37	0	947.2	
43.87	0	946.98	
44.37	0	946.85	
44.87	0	946.67	
45.36	0	946.52	
45.86	0	946.41	
46.36	0	946.29	
46.86	0	946.13	
47.36	0	946.05	
47.86	0	946	
48.36	0	945.96	
48.85	0	945.95	
49.35	0	945.95	
49.85	0	945.95	
50.35	0	945.94	
50.85	0	945.94	
51.35	0	945.93	
51.85	0	945.92	
52.34	0	945.92	
52.84	0	945.92	
53.34	0	945.91	
53.84	0	945.9	
54.34	0	945.89	
54.84	0	945.89	
55.33	0	945.89	
55.83	0	945.88	
56.33	0	945.88	
56.83	0	945.88	

57.33	0	945.88
57.83	0	945.87
58.33	0	945.87
58.82	0	945.87
59.32	0	945.87
59.82	0	945.87
60.32	0	945.86
60.82	0	945.86
61.32	0	945.86
61.82	0	945.86
62.31	0	945.85
62.81	0	945.85
63.31	0	945.85
63.81	0	945.85
64.31	0	945.84
64.81	0	945.84
65.3	0	945.84
65.8	0	945.84
66.3	0	945.83
66.8	0	945.83
67.3	0	945.83
67.8	0	945.82
68.3	0	945.81
68.79	0	945.81
69.29	0	945.81
69.79	0	945.79
70.29	0	945.79
70.79	0	945.79
71.29	0	945.82
71.79	0	945.86
72.28	0	945.91
72.78	0	945.96
73.28	0	946.04
73.78	0	946.13
74.28	0	946.21
74.78	0	946.27
75.28	0	946.34
75.77	0	946.38
76.27	0	946.43
76.77	0	946.49
77.27	0	946.55
77.77	0	946.61
78.27	0	946.67
78.76	0	946.72
79.26	0	946.77
79.76	0	946.81
80.26	0	946.84
80.76	0	946.87
81.26	0	946.89
81.76	0	946.92
82.25	0	946.96
82.75	0	946.98
83.25	0	947
83.75	0	947.03
84.25	0	947.06
84.75	0	947.09
85.25	0	947.12
85.74	0	947.15
86.24	0	947.19
86.74	0	947.23
87.24	0	947.27
87.74	0	947.3
88.24	0	947.34
88.74	0	947.37
89.23	0	947.41
89.73	0	947.44

90.23	0	947.46
90.73	0	947.48
91.23	0	947.5
91.73	0	947.51
92.22	0	947.53
92.72	0	947.54
93.22	0	947.55
93.72	0	947.55
94.22	0	947.55
94.72	0	947.56
95.22	0	947.56
95.71	0	947.57
96.21	0	947.58
96.71	0	947.59
97.21	0	947.6
97.71	0	947.62
98.21	0	947.64
98.71	0	947.66
99.2	0	947.68
99.7	0	947.7
100.2	0	947.73
100.7	0	947.76
101.2	0	947.81
101.7	0	947.87
102.19	0	947.94
102.69	0	948.04
103.19	0	948.15
103.69	0	948.25
104.19	0	948.34
104.69	0	948.44
105.19	0	948.6
105.68	0	948.72
106.18	0	948.84
106.68	0	948.97
107.18	0	949.11
107.68	0	949.32
108.18	0	949.67
108.68	0	949.98
109.17	0	950.28
109.67	0	950.66
110.17	0	951.34
110.67	0	951.88
111.17	0	952.25
111.67	0	952.78
112.17	0	953.32
112.66	0	953.95
113.16	0	954.34
113.66	0	954.69
114.16	0	955.01
114.66	0	955.29
115.16	0	955.82
115.65	0	956.32
116.15	0	956.59
116.65	0	956.84
117.15	0	957.17
117.65	0	957.47
118.15	0	957.72
118.65	0	957.98
119.14	0	958.13
119.64	0	958.26
120.14	0	958.34
120.64	0	958.39
121.14	0	958.45
121.64	0	958.49
122.14	0	958.54
122.63	0	958.58

123.13	0	958.61
123.63	0	958.64
124.13	0	958.66
124.63	0	958.67
125.13	0	958.65
125.62	0	958.61
126.12	0	958.55
126.62	0	958.48
127.12	0	958.39
127.62	0	958.29
128.12	0	958.2
128.62	0	958.1
129.11	0	958.04
129.61	0	957.93
130.11	0	957.88
130.61	0	957.92
131.11	0	957.96
131.61	0	958.01
132.11	0	958.07
132.6	0	958.12
133.1	0	958.18
133.6	0	958.26
134.1	0	958.32
134.6	0	958.37
135.1	0	958.41
135.6	0	958.48
136.09	0	958.54
136.59	0	958.6
137.09	0	958.66
137.59	0	958.7
138.09	0	958.71
138.59	0	958.66
139.08	0	958.57
139.58	0	958.15
140.08	0	957.97

Cross Sectional Geometry

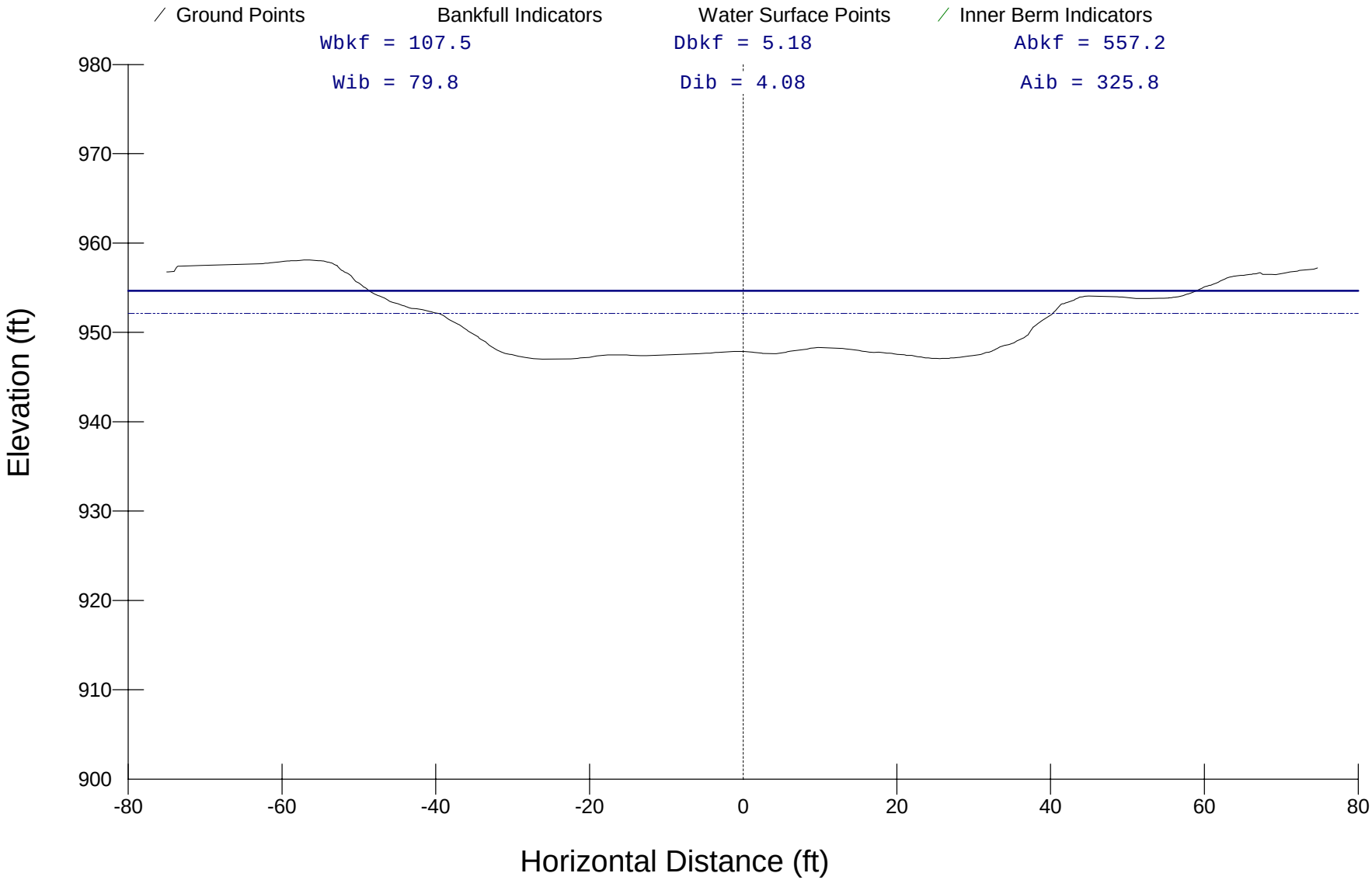
	Channel	Left	Right
Floodprone Elevation (ft)	962.35	962.35	962.35
Bankfull Elevation (ft)	954.07	954.07	954.07
Floodprone Width (ft)	500	-----	-----
Bankfull Width (ft)	88.38	44.19	44.19
Entrenchment Ratio	5.66	-----	-----
Mean Depth (ft)	6.25	6.14	6.36
Maximum Depth (ft)	8.28	8.26	8.28
Width/Depth Ratio	14.14	7.19	6.95
Bankfull Area (sq ft)	552.75	271.54	281.21
Wetted Perimeter (ft)	92.2	54.05	54.66
Hydraulic Radius (ft)	6	5.02	5.14
Begin BKF Station	24.43	24.43	68.62
End BKF Station	112.81	68.62	112.81

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

222+11 Riffle



RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-5
Cross Section Name: 222+11 Riffle
Survey Date: 11/19/2025

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
-75	0	956.77	
-74.8	0	956.76	
-74.03	0	956.84	
-73.92	0	956.96	
-73.67	0	957.31	
-73.5	0	957.4	
-73.31	0	957.41	
-70.46	0	957.49	
-62.48	0	957.7	
-62.17	0	957.73	
-61.95	0	957.74	
-61.81	0	957.76	
-61.45	0	957.81	
-61.34	0	957.82	
-60.73	0	957.84	
-60.37	0	957.87	
-59.65	0	957.97	
-59.29	0	958	
-58.97	0	958.01	
-58.91	0	958.02	
-58.57	0	958.04	
-58.3	0	958.04	
-58.09	0	958.05	
-57.7	0	958.08	
-57.14	0	958.11	
-57.09	0	958.11	
-56.78	0	958.11	
-56.42	0	958.1	
-55.26	0	958.04	
-54.98	0	958.02	
-54.66	0	957.99	
-54.57	0	957.98	
-54.05	0	957.86	
-53.9	0	957.84	
-53.69	0	957.81	
-53.54	0	957.77	
-53.44	0	957.74	
-53.18	0	957.6	
-52.89	0	957.49	
-52.83	0	957.47	
-52.82	0	957.46	
-52.81	0	957.45	
-52.46	0	957.12	
-52.23	0	956.96	
-52.11	0	956.89	
-51.93	0	956.81	
-51.75	0	956.74	
-51.62	0	956.7	
-51.39	0	956.59	

-51.05	0	956.35	
-51.01	0	956.32	
-50.67	0	955.97	
-50.4	0	955.71	
-50.31	0	955.66	
-50.17	0	955.59	
-49.95	0	955.48	
-49.79	0	955.38	
-49.59	0	955.27	
-49.29	0	955.07	
-49.23	0	955.04	
-49.19	0	955.01	
-48.95	0	954.87	
-48.87	0	954.83	
-48.58	0	954.61	bkf
-48.41	0	954.51	
-48.15	0	954.39	
-47.97	0	954.3	
-47.43	0	954.12	
-47.36	0	954.1	
-46.76	0	953.9	
-46.71	0	953.88	
-46.35	0	953.68	
-46.15	0	953.56	
-46	0	953.5	
-45.77	0	953.41	
-45.54	0	953.34	
-44.93	0	953.2	
-44.32	0	953.02	
-44.2	0	952.99	
-44.02	0	952.95	
-43.84	0	952.89	
-43.72	0	952.84	
-43.48	0	952.77	
-43.14	0	952.7	
-43.11	0	952.69	
-42.5	0	952.67	
-41.68	0	952.56	
-40.68	0	952.34	
-40.6	0	952.32	
-40.5	0	952.29	
-40.24	0	952.22	
-40.07	0	952.18	
-39.62	0	952.12	
-39.53	0	952.1	
-39.46	0	952.09	ib
-39.17	0	951.96	
-38.86	0	951.82	
-38.81	0	951.79	
-38.45	0	951.52	
-38.25	0	951.41	
-37.03	0	950.9	
-36.98	0	950.87	
-36.65	0	950.71	
-36.42	0	950.57	
-35.93	0	950.25	
-35.82	0	950.19	
-35.57	0	950.06	
-34.6	0	949.57	
-34.49	0	949.49	
-34.4	0	949.4	lew
-34.14	0	949.25	
-33.99	0	949.17	
-33.46	0	948.93	
-33.42	0	948.88	
-33.21	0	948.72	

-33.06	0	948.6
-32.7	0	948.36
-32.58	0	948.3
-32.34	0	948.19
-31.98	0	948.01
-31.7	0	947.89
-31.62	0	947.87
-31.56	0	947.85
-30.95	0	947.66
-30.35	0	947.56
-30.18	0	947.53
-29.13	0	947.34
-29.1	0	947.33
-28.38	0	947.2
-27.31	0	947.06
-26.7	0	947.02
-26.09	0	947
-22.45	0	947.04
-21.56	0	947.1
-21.2	0	947.14
-20.62	0	947.17
-20.01	0	947.21
-19.4	0	947.31
-19.04	0	947.35
-17.6	0	947.47
-15.15	0	947.48
-14.54	0	947.45
-14.37	0	947.43
-13.29	0	947.38
-12.57	0	947.38
-5.74	0	947.61
-4.82	0	947.68
-4.3	0	947.7
-3.6	0	947.76
-3.23	0	947.77
-1.17	0	947.88
-1.07	0	947.88
-0.04	0	947.88
0	0	947.88
0.04	0	947.87
1.26	0	947.78
1.45	0	947.77
1.81	0	947.74
2.47	0	947.67
2.52	0	947.66
3.96	0	947.62
4.3	0	947.63
5.4	0	947.76
5.51	0	947.77
5.76	0	947.83
6.12	0	947.89
6.12	0	947.89
7.2	0	948
7.94	0	948.09
8.27	0	948.14
8.63	0	948.21
8.75	0	948.23
9.16	0	948.27
9.71	0	948.3
12.95	0	948.18
13.41	0	948.15
14.02	0	948.09
15.1	0	947.97
15.46	0	947.91
15.79	0	947.88
15.84	0	947.87

16.45	0	947.8
16.54	0	947.8
16.9	0	947.77
17.06	0	947.77
17.55	0	947.78
17.62	0	947.78
17.67	0	947.78
18.28	0	947.73
18.7	0	947.7
19.06	0	947.67
19.42	0	947.64
19.49	0	947.63
20.1	0	947.56
20.13	0	947.56
20.19	0	947.55
20.71	0	947.51
20.85	0	947.49
21.07	0	947.46
21.21	0	947.44
21.31	0	947.43
21.57	0	947.44
21.92	0	947.44
21.93	0	947.44
21.95	0	947.44
22.65	0	947.3
23.01	0	947.26
23.14	0	947.24
23.37	0	947.21
23.7	0	947.15
23.73	0	947.15
23.75	0	947.15
24.09	0	947.14
24.58	0	947.12
24.96	0	947.11
25.17	0	947.1
25.57	0	947.08
25.89	0	947.09
26.78	0	947.12
26.96	0	947.14
27.32	0	947.16
27.39	0	947.16
27.68	0	947.18
28.04	0	947.22
28.1	0	947.23
28.76	0	947.28
28.98	0	947.31
29.48	0	947.37
29.82	0	947.39
30.74	0	947.51
30.92	0	947.54
31.04	0	947.57
31.28	0	947.65
31.62	0	947.75
31.64	0	947.75
32	0	947.81
32.25	0	947.86
32.35	0	947.9
32.5	0	947.96
32.71	0	948.04
32.86	0	948.11
33.07	0	948.21
33.38	0	948.37
33.43	0	948.41
33.47	0	948.43
33.67	0	948.46
33.79	0	948.47

34.08	0	948.55	
34.15	0	948.57	
34.26	0	948.6	
34.51	0	948.64	
34.69	0	948.67	
34.87	0	948.74	
35.23	0	948.86	
35.29	0	948.89	
35.59	0	949.04	
35.64	0	949.05	
35.9	0	949.15	
36.31	0	949.33	
36.51	0	949.41	rew
36.9	0	949.63	
37.03	0	949.72	
37.12	0	949.81	
37.39	0	950.19	
37.61	0	950.44	
37.72	0	950.58	
37.75	0	950.6	
38.11	0	950.83	
38.33	0	950.99	
38.94	0	951.36	
39.18	0	951.5	
40.16	0	952.01	
40.26	0	952.11	ib
40.42	0	952.25	
40.62	0	952.44	
40.76	0	952.58	
40.98	0	952.79	
41.29	0	953.11	
41.34	0	953.14	
41.37	0	953.16	
41.54	0	953.19	
41.7	0	953.22	
41.98	0	953.3	
42.06	0	953.32	
43.05	0	953.64	
43.14	0	953.68	
43.19	0	953.71	
43.5	0	953.84	
43.8	0	953.95	
43.86	0	953.97	
43.93	0	953.98	
44.22	0	954.02	
44.41	0	954.04	
44.93	0	954.07	
48.53	0	954.02	
48.66	0	954.01	
48.89	0	953.98	
49.25	0	953.96	
49.27	0	953.96	
51.1	0	953.8	
52.12	0	953.77	
52.84	0	953.78	
54.13	0	953.81	
54.28	0	953.81	
54.49	0	953.81	
54.74	0	953.82	
55.36	0	953.87	
55.37	0	953.88	
55.72	0	953.9	
55.96	0	953.92	
56.08	0	953.94	
56.57	0	954.01	
57.13	0	954.1	

57.17	0	954.12	
57.51	0	954.22	
57.78	0	954.29	
57.87	0	954.3	
58.23	0	954.42	
58.39	0	954.48	
58.95	0	954.67	bkf
59.31	0	954.81	
59.6	0	954.9	
59.67	0	954.93	
59.76	0	954.97	
60.03	0	955.08	
60.21	0	955.16	
60.39	0	955.21	
60.64	0	955.27	
60.75	0	955.28	
60.82	0	955.29	
61.11	0	955.37	
61.43	0	955.48	
61.47	0	955.49	
61.52	0	955.52	
61.83	0	955.65	
62.04	0	955.75	
62.54	0	955.94	
62.64	0	955.98	
62.9	0	956.07	
63.25	0	956.18	
63.26	0	956.19	
63.28	0	956.19	
63.62	0	956.25	
63.86	0	956.28	
63.98	0	956.29	
64.16	0	956.31	
64.7	0	956.39	
65.04	0	956.41	
65.07	0	956.41	
65.42	0	956.45	
65.68	0	956.48	
65.92	0	956.5	
66.14	0	956.51	
66.29	0	956.53	
66.5	0	956.55	
66.8	0	956.59	
66.86	0	956.6	
66.9	0	956.61	
67.12	0	956.65	
67.22	0	956.69	
67.51	0	956.56	
67.58	0	956.5	
68.56	0	956.52	
68.65	0	956.52	
68.72	0	956.52	
69.33	0	956.48	
69.44	0	956.51	
70.54	0	956.64	
71.15	0	956.78	
72.08	0	956.88	
72.37	0	956.95	
74.19	0	957.1	
74.72	0	957.24	

Cross Sectional Geometry

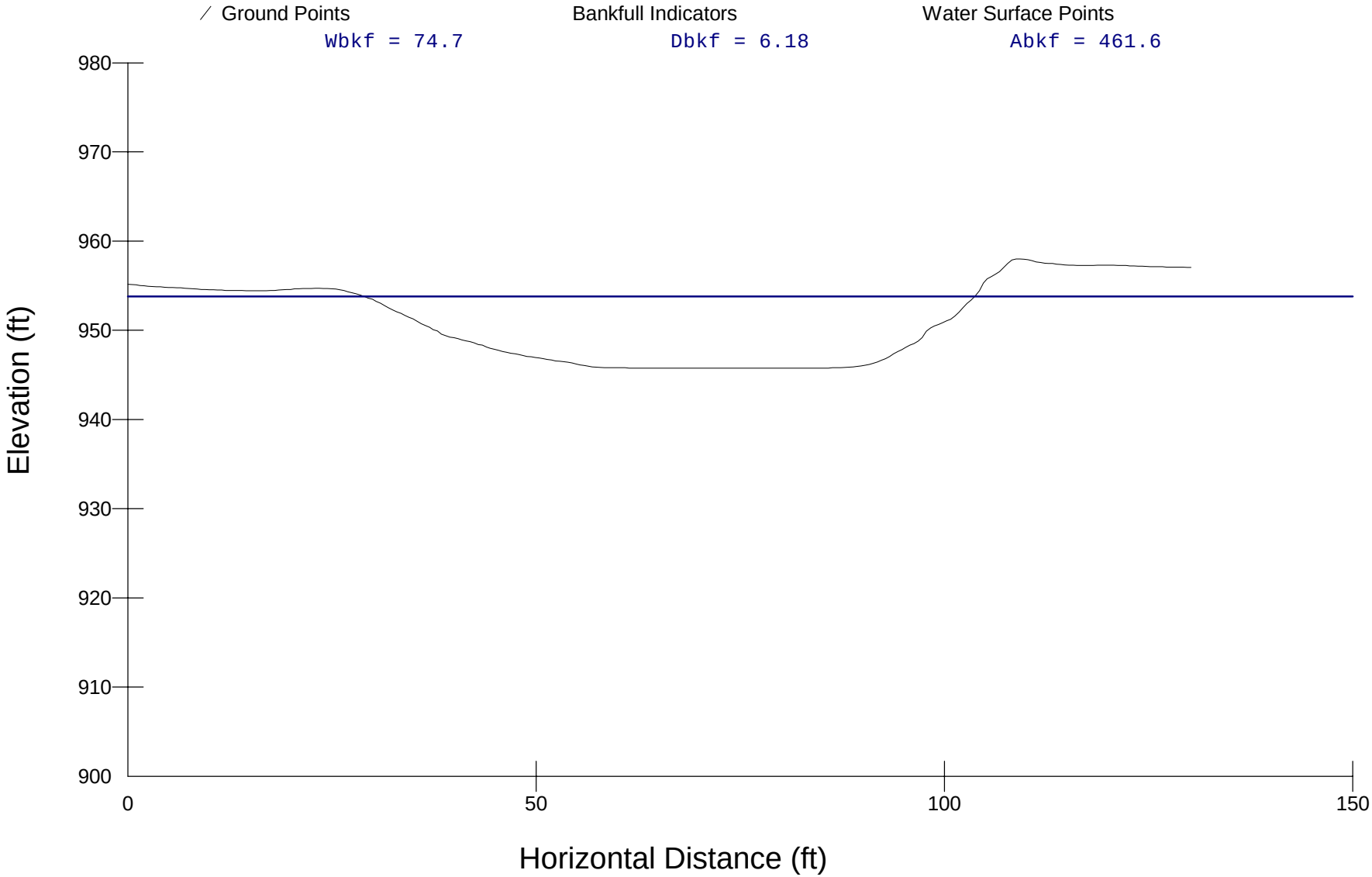
	Channel	Left	Right
Floodprone Elevation (ft)	962.28	962.28	962.28
Bankfull Elevation (ft)	954.64	954.64	954.64
Floodprone Width (ft)	680	-----	-----
Bankfull Width (ft)	107.48	56.14	51.34
Entrenchment Ratio	6.33	-----	-----
Mean Depth (ft)	5.18	5.89	4.42
Maximum Depth (ft)	7.64	7.64	7.56
Width/Depth Ratio	20.75	9.54	11.62
Bankfull Area (sq ft)	557.22	330.38	226.83
Wetted Perimeter (ft)	111.24	64.43	60.01
Hydraulic Radius (ft)	5.01	5.13	3.78
Begin BKF Station	-48.62	-48.62	7.52
End BKF Station	58.86	7.52	58.86

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

224+00 Pool


Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 74.7
Dbkf = 6.18
Abkf = 461.6
980
970
960
950
940
930
920
910
900
Elevation (ft)
0
50
100
150
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-5
Cross Section Name: 224+00 Pool
Survey Date: 01/25/2026

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	955.16	
0.5	0	955.13	
1	0	955.08	
1.5	0	955.03	
2	0	954.99	
2.49	0	954.95	
2.99	0	954.91	
3.49	0	954.88	
3.99	0	954.86	
4.49	0	954.83	
4.99	0	954.81	
5.49	0	954.79	
5.99	0	954.77	
6.48	0	954.75	
6.98	0	954.72	
7.48	0	954.69	
7.98	0	954.66	
8.48	0	954.63	
8.98	0	954.59	
9.48	0	954.57	
9.98	0	954.56	
10.48	0	954.54	
10.97	0	954.52	
11.47	0	954.5	
11.97	0	954.47	
12.47	0	954.47	
12.97	0	954.47	
13.47	0	954.46	
13.97	0	954.46	
14.47	0	954.45	
14.97	0	954.44	
15.46	0	954.44	
15.96	0	954.43	
16.46	0	954.43	
16.96	0	954.44	
17.46	0	954.46	
17.96	0	954.48	
18.46	0	954.52	
18.96	0	954.54	
19.45	0	954.57	
19.95	0	954.6	
20.45	0	954.64	
20.95	0	954.67	
21.45	0	954.69	
21.95	0	954.7	
22.45	0	954.71	
22.95	0	954.73	
23.45	0	954.72	
23.94	0	954.7	

24.44	0	954.68	
24.94	0	954.64	
25.44	0	954.61	
25.94	0	954.54	
26.44	0	954.46	
26.94	0	954.34	
27.44	0	954.21	
27.93	0	954.1	
28.43	0	953.97	
28.93	0	953.78	BKF
29.43	0	953.62	
29.93	0	953.48	
30.43	0	953.25	
30.93	0	953.05	
31.43	0	952.77	
31.93	0	952.52	
32.42	0	952.28	
32.92	0	952.07	
33.42	0	951.89	
33.92	0	951.68	
34.42	0	951.47	
34.92	0	951.29	
35.42	0	951.03	
35.92	0	950.72	
36.41	0	950.54	
36.91	0	950.35	
37.41	0	950.1	
37.91	0	949.93	
38.41	0	949.59	
38.91	0	949.38	
39.41	0	949.26	WS
39.91	0	949.18	
40.41	0	949.06	
40.9	0	948.93	
41.4	0	948.83	
41.9	0	948.73	
42.4	0	948.61	
42.9	0	948.43	
43.4	0	948.33	
43.9	0	948.11	
44.4	0	947.98	
44.9	0	947.88	
45.39	0	947.76	
45.89	0	947.62	
46.39	0	947.53	
46.89	0	947.44	
47.39	0	947.37	
47.89	0	947.28	
48.39	0	947.18	
48.89	0	947.07	
49.38	0	947.02	
49.88	0	946.97	
50.38	0	946.89	
50.88	0	946.81	
51.38	0	946.75	
51.88	0	946.67	
52.38	0	946.57	
52.88	0	946.51	
53.38	0	946.49	
53.87	0	946.4	
54.37	0	946.33	
54.87	0	946.23	
55.37	0	946.14	
55.87	0	946.07	
56.37	0	945.99	
56.87	0	945.9	

57.37	0	945.86
57.86	0	945.83
58.36	0	945.81
58.86	0	945.79
59.36	0	945.79
59.86	0	945.79
60.36	0	945.79
60.86	0	945.79
61.36	0	945.78
61.86	0	945.78
62.35	0	945.78
62.85	0	945.78
63.35	0	945.78
63.85	0	945.78
64.35	0	945.78
64.85	0	945.78
65.35	0	945.78
65.85	0	945.78
66.34	0	945.78
66.84	0	945.78
67.34	0	945.78
67.84	0	945.78
68.34	0	945.78
68.84	0	945.78
69.34	0	945.77
69.84	0	945.77
70.34	0	945.77
70.83	0	945.77
71.33	0	945.77
71.83	0	945.77
72.33	0	945.77
72.83	0	945.77
73.33	0	945.77
73.83	0	945.77
74.33	0	945.77
74.83	0	945.77
75.32	0	945.77
75.82	0	945.77
76.32	0	945.77
76.82	0	945.76
77.32	0	945.76
77.82	0	945.76
78.32	0	945.76
78.82	0	945.76
79.31	0	945.77
79.81	0	945.78
80.31	0	945.78
80.81	0	945.78
81.31	0	945.78
81.81	0	945.78
82.31	0	945.77
82.81	0	945.77
83.31	0	945.77
83.8	0	945.77
84.3	0	945.78
84.8	0	945.78
85.3	0	945.78
85.8	0	945.78
86.3	0	945.79
86.8	0	945.8
87.3	0	945.81
87.79	0	945.83
88.29	0	945.86
88.79	0	945.9
89.29	0	945.95
89.79	0	946.01

90.29	0	946.08
90.79	0	946.18
91.29	0	946.31
91.79	0	946.46
92.28	0	946.64
92.78	0	946.83
93.28	0	947.08
93.78	0	947.36
94.28	0	947.61
94.78	0	947.85
95.28	0	948.09
95.78	0	948.34
96.27	0	948.53
96.77	0	948.79
97.27	0	949.17
97.77	0	949.89
98.27	0	950.28
98.77	0	950.48
99.27	0	950.67
99.77	0	950.86
100.27	0	951.05
100.76	0	951.25
101.26	0	951.61
101.76	0	952.06
102.26	0	952.5
102.76	0	953.02
103.26	0	953.4
103.76	0	953.86
104.26	0	954.44
104.76	0	955.3
105.25	0	955.78
105.75	0	956.04
106.25	0	956.3
106.75	0	956.59
107.25	0	957.06
107.75	0	957.5
108.25	0	957.88
108.75	0	957.98
109.24	0	957.99
109.74	0	957.96
110.24	0	957.92
110.74	0	957.81
111.24	0	957.68
111.74	0	957.59
112.24	0	957.54
112.74	0	957.5
113.24	0	957.47
113.73	0	957.43
114.23	0	957.39
114.73	0	957.36
115.23	0	957.32
115.73	0	957.29
116.23	0	957.26
116.73	0	957.27
117.23	0	957.27
117.72	0	957.28
118.22	0	957.28
118.72	0	957.29
119.22	0	957.29
119.72	0	957.29
120.22	0	957.29
120.72	0	957.29
121.22	0	957.28
121.72	0	957.28
122.21	0	957.27
122.71	0	957.25

123.21	0	957.23
123.71	0	957.2
124.21	0	957.18
124.71	0	957.15
125.21	0	957.14
125.71	0	957.13
126.21	0	957.12
126.7	0	957.11
127.2	0	957.1
127.7	0	957.1
128.2	0	957.09
128.7	0	957.09
129.2	0	957.08
129.7	0	957.06
130.2	0	957.05

Cross Sectional Geometry

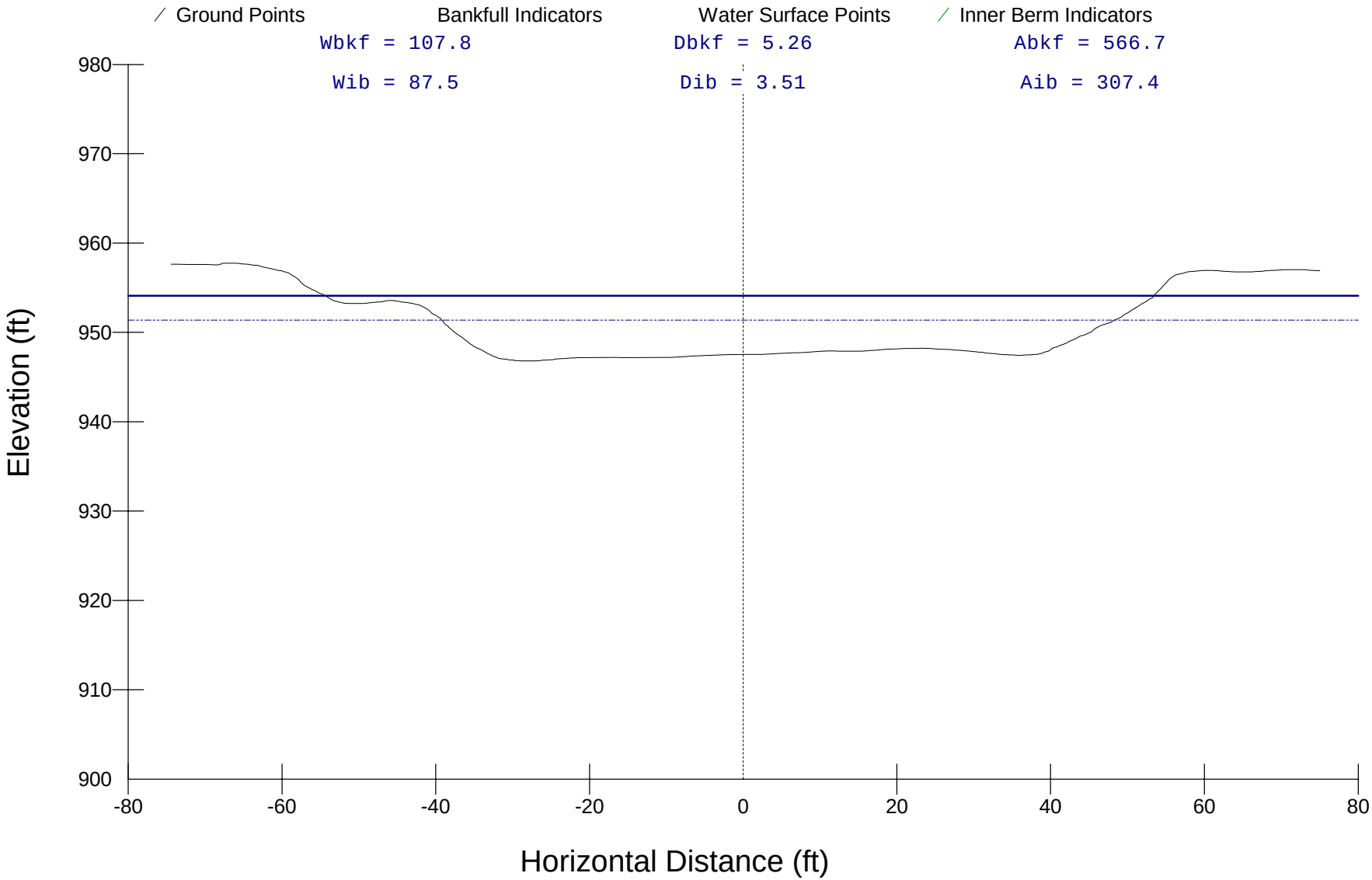
	Channel	Left	Right
Floodprone Elevation (ft)	961.8	961.8	961.8
Bankfull Elevation (ft)	953.78	953.78	953.78
Floodprone Width (ft)	130.2	-----	-----
Bankfull Width (ft)	74.74	37.37	37.37
Entrenchment Ratio	1.74	-----	-----
Mean Depth (ft)	6.18	5.63	6.73
Maximum Depth (ft)	8.02	8	8.02
Width/Depth Ratio	12.09	6.64	5.55
Bankfull Area (sq ft)	461.6	210.22	251.38
Wetted Perimeter (ft)	78.45	46.71	47.73
Hydraulic Radius (ft)	5.88	4.5	5.27
Begin BKF Station	28.93	28.93	66.3
End BKF Station	103.67	66.3	103.67

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

227+54 Riffle



RIVERMORPH CROSS SECTION SUMMARY

River Name: Housatonic New
Reach Name: 2025 LiDAR Reach 5A-5
Cross Section Name: 227+54 Riffle
Survey Date: 11/19/2025

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
-74.41	0	957.64	
-73.84	0	957.64	
-73.79	0	957.64	
-72.15	0	957.58	
-71.58	0	957.58	
-69.89	0	957.58	
-68.31	0	957.57	
-68.23	0	957.58	
-68.19	0	957.58	
-68.06	0	957.62	
-67.86	0	957.68	
-67.63	0	957.75	
-67.06	0	957.75	
-66.38	0	957.74	
-66.16	0	957.74	
-65.93	0	957.73	
-65.37	0	957.69	
-65.27	0	957.68	
-65.08	0	957.67	
-64.53	0	957.62	
-64.24	0	957.59	
-64.16	0	957.59	
-63.79	0	957.54	
-63.67	0	957.53	
-63.42	0	957.51	
-63.11	0	957.48	
-63.05	0	957.47	
-62.93	0	957.44	
-62.68	0	957.38	
-62.54	0	957.34	
-62.31	0	957.3	
-62.11	0	957.27	
-61.98	0	957.25	
-61.94	0	957.24	
-61.86	0	957.22	
-61.57	0	957.15	
-61.41	0	957.11	
-61.2	0	957.08	
-60.85	0	957.03	
-60.83	0	957.02	
-60.78	0	957.01	
-60.46	0	956.95	
-60.28	0	956.92	
-60.09	0	956.89	
-59.73	0	956.8	
-59.72	0	956.8	
-59.72	0	956.8	
-59.35	0	956.72	
-59.16	0	956.66	

-58.98	0	956.58	
-58.63	0	956.39	
-58.61	0	956.38	
-58.59	0	956.37	
-58.54	0	956.34	
-58.23	0	956.17	
-58.03	0	956.03	
-57.86	0	955.91	
-57.56	0	955.62	
-57.49	0	955.56	
-57.46	0	955.51	
-57.35	0	955.45	
-57.12	0	955.3	
-56.75	0	955.09	
-56.48	0	954.97	
-56.38	0	954.93	
-56.33	0	954.91	
-55.77	0	954.7	
-55.64	0	954.64	
-55.41	0	954.51	
-55.27	0	954.45	
-55.2	0	954.42	
-54.97	0	954.35	
-54.9	0	954.33	
-54.64	0	954.24	
-54.53	0	954.19	bkf
-54.33	0	954.09	
-54.16	0	954	
-54.07	0	953.95	
-53.79	0	953.8	
-53.78	0	953.79	
-53.51	0	953.66	
-53.42	0	953.63	
-53.26	0	953.57	
-53.05	0	953.51	
-52.94	0	953.48	
-52.68	0	953.43	
-52.38	0	953.37	
-52.31	0	953.36	
-51.94	0	953.29	
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-51.25	0	953.24	
-50.12	0	953.23	
-49.35	0	953.25	
-48.99	0	953.26	
-48.98	0	953.26	
-48.96	0	953.27	
-48.61	0	953.31	
-48.42	0	953.33	
-48.24	0	953.34	
-47.88	0	953.38	
-47.87	0	953.38	
-47.86	0	953.38	
-47.83	0	953.38	
-47.5	0	953.41	
-47.29	0	953.44	
-46.81	0	953.47	
-46.76	0	953.48	
-46.39	0	953.52	
-46.16	0	953.55	
-46.02	0	953.56	
-45.65	0	953.56	
-45.6	0	953.56	
-45.45	0	953.55	
-45.28	0	953.53	
-45.03	0	953.49	

-44.91	0	953.48	
-44.66	0	953.46	
-44.53	0	953.44	
-44.16	0	953.4	
-43.79	0	953.34	
-43.58	0	953.31	
-42.78	0	953.19	
-42.68	0	953.17	
-42.31	0	953.1	
-42.21	0	953.08	
-41.94	0	952.99	
-41.65	0	952.88	
-41.57	0	952.85	
-41.43	0	952.77	
-41.2	0	952.66	
-41.08	0	952.59	
-40.83	0	952.43	
-40.69	0	952.31	
-40.52	0	952.17	
-40.46	0	952.15	
-40.36	0	952.08	
-40.09	0	951.96	
-39.95	0	951.89	
-39.72	0	951.77	
-39.5	0	951.64	
-39.39	0	951.57	
-39.35	0	951.54	
-39.28	0	951.46	ib
-38.98	0	951.16	
-38.82	0	950.97	
-38.61	0	950.82	
-38.31	0	950.61	
-38.26	0	950.57	
-38.24	0	950.56	
-37.69	0	950.13	
-37.5	0	950	
-37.13	0	949.75	
-37.13	0	949.75	
-36.56	0	949.43	
-36.39	0	949.31	lew
-36.06	0	949.11	
-36.02	0	949.08	
-36	0	949.07	
-35.93	0	949.02	
-35.65	0	948.82	
-35.43	0	948.65	
-35.28	0	948.58	
-34.98	0	948.43	
-34.91	0	948.39	
-34.87	0	948.37	
-34.74	0	948.32	
-34.54	0	948.23	
-34.3	0	948.15	
-34.17	0	948.07	
-33.91	0	947.96	
-33.8	0	947.91	
-33.74	0	947.89	
-33.43	0	947.73	
-33.17	0	947.61	
-33.06	0	947.57	
-32.83	0	947.46	
-32.69	0	947.39	
-32.61	0	947.35	
-32.36	0	947.29	
-32.32	0	947.28	
-32.04	0	947.18	

-31.76	0	947.11
-31.58	0	947.07
-31.48	0	947.05
-31.21	0	947.02
-30.91	0	946.98
-30.83	0	946.98
-30.46	0	946.93
-30.35	0	946.92
-29.79	0	946.88
-29.72	0	946.87
-29.35	0	946.84
-28.98	0	946.83
-28.09	0	946.82
-27.13	0	946.83
-26.96	0	946.83
-26.4	0	946.86
-26.39	0	946.86
-26.02	0	946.89
-25.83	0	946.89
-25.31	0	946.93
-25.28	0	946.93
-25.27	0	946.94
-24.7	0	946.97
-24.54	0	946.99
-24.14	0	947.03
-23.8	0	947.06
-23.57	0	947.07
-23.43	0	947.07
-23.01	0	947.09
-22.32	0	947.13
-21.95	0	947.16
-21.88	0	947.16
-21.58	0	947.17
-21.21	0	947.18
-20.84	0	947.19
-16.39	0	947.2
-16.02	0	947.19
-9.45	0	947.23
-7.76	0	947.29
-7.19	0	947.32
-6.4	0	947.35
-6.06	0	947.36
-5.96	0	947.37
-5.5	0	947.39
-2.11	0	947.49
0	0	947.53
1.84	0	947.54
2.41	0	947.55
4.67	0	947.65
6.93	0	947.72
7.3	0	947.73
7.49	0	947.74
8.06	0	947.77
10.17	0	947.89
10.32	0	947.9
10.64	0	947.92
10.88	0	947.93
11.01	0	947.93
11.45	0	947.94
11.75	0	947.93
12.49	0	947.92
12.58	0	947.91
13.23	0	947.9
14.27	0	947.89
15.4	0	947.92
15.45	0	947.92

15.82	0	947.94
15.96	0	947.94
16.53	0	947.97
16.56	0	947.97
16.93	0	947.99
17.09	0	948
17.3	0	948.02
17.66	0	948.04
18.22	0	948.07
18.79	0	948.11
19.89	0	948.15
19.92	0	948.15
20.92	0	948.18
21.37	0	948.19
21.99	0	948.21
22.18	0	948.21
23.31	0	948.22
24.34	0	948.19
24.44	0	948.19
25	0	948.15
25.57	0	948.13
26.7	0	948.08
26.93	0	948.07
27.3	0	948.04
28.41	0	947.99
29.52	0	947.91
29.52	0	947.91
29.52	0	947.91
30.08	0	947.84
30.26	0	947.83
30.59	0	947.8
30.63	0	947.8
30.65	0	947.8
30.71	0	947.79
31	0	947.78
31.21	0	947.76
31.37	0	947.74
31.74	0	947.7
31.78	0	947.7
32.74	0	947.62
33.22	0	947.57
33.47	0	947.55
33.59	0	947.54
33.82	0	947.52
33.96	0	947.51
34.33	0	947.49
34.6	0	947.47
34.89	0	947.47
35.07	0	947.46
35.73	0	947.45
35.97	0	947.45
36.86	0	947.46
37.29	0	947.48
37.43	0	947.49
37.66	0	947.51
37.99	0	947.54
38.04	0	947.55
38.12	0	947.55
38.41	0	947.58
38.56	0	947.61
38.78	0	947.66
39.04	0	947.74
39.15	0	947.76
39.19	0	947.78
39.52	0	947.86
39.69	0	947.9

39.89	0	948	
40.23	0	948.25	
40.25	0	948.26	
40.26	0	948.26	
40.27	0	948.26	
40.63	0	948.33	
40.82	0	948.39	
41	0	948.45	
41.34	0	948.58	
41.37	0	948.58	
41.38	0	948.59	
41.42	0	948.61	
41.74	0	948.71	
41.95	0	948.79	
42.11	0	948.86	
42.42	0	948.99	
42.48	0	949.02	
42.51	0	949.03	
42.85	0	949.15	
43.08	0	949.24	
43.22	0	949.3	rew
43.49	0	949.44	
43.64	0	949.5	
43.8	0	949.56	
43.96	0	949.6	
44.21	0	949.7	
44.33	0	949.73	
44.57	0	949.81	
44.7	0	949.84	
44.77	0	949.87	
44.99	0	949.94	
45.07	0	949.96	
45.33	0	950.1	
45.64	0	950.32	
45.81	0	950.42	
45.9	0	950.47	
46.46	0	950.73	
46.55	0	950.77	
46.72	0	950.83	
46.92	0	950.89	
47.03	0	950.92	
47.29	0	950.98	
47.59	0	951.06	
47.66	0	951.08	
47.79	0	951.13	
48.16	0	951.3	ib
48.4	0	951.41	
48.57	0	951.48	
48.72	0	951.55	
48.87	0	951.6	
49.14	0	951.71	
49.29	0	951.78	
49.51	0	951.92	
49.85	0	952.12	
49.88	0	952.14	
49.94	0	952.17	
50.25	0	952.35	
50.42	0	952.44	
50.62	0	952.55	
50.95	0	952.7	
50.98	0	952.72	
50.99	0	952.73	
51.02	0	952.74	
51.36	0	952.93	
51.55	0	953.03	
51.74	0	953.13	

52.09	0	953.3	
52.11	0	953.31	
52.14	0	953.32	
52.48	0	953.51	
52.68	0	953.62	
52.85	0	953.71	
53.17	0	953.86	
53.22	0	953.9	
53.24	0	953.91	
53.33	0	954	bkf
53.59	0	954.28	
53.81	0	954.45	
53.96	0	954.61	
54.24	0	954.82	
54.33	0	954.91	
54.37	0	954.94	
54.52	0	955.09	
54.7	0	955.28	
54.94	0	955.49	
55.07	0	955.61	
55.32	0	955.84	
55.44	0	955.95	
55.5	0	956.01	
55.71	0	956.13	
55.81	0	956.19	
56.07	0	956.35	
56.18	0	956.41	
56.39	0	956.47	
56.55	0	956.5	
56.92	0	956.57	
57.2	0	956.63	
57.47	0	956.69	
57.66	0	956.72	
57.76	0	956.75	
58.4	0	956.83	
58.54	0	956.84	
58.89	0	956.88	
59.46	0	956.92	
59.88	0	956.93	
60.02	0	956.93	
60.58	0	956.94	
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61.36	0	956.92	
61.71	0	956.9	
61.73	0	956.9	
62.28	0	956.86	
63.95	0	956.77	
63.97	0	956.77	
64.69	0	956.75	
65.67	0	956.76	
65.81	0	956.76	
66.07	0	956.77	
66.18	0	956.78	
66.8	0	956.83	
66.92	0	956.83	
67.14	0	956.84	
67.29	0	956.85	
67.66	0	956.87	
68.03	0	956.89	
68.22	0	956.91	
68.4	0	956.92	
68.49	0	956.93	
69.06	0	956.95	
69.14	0	956.96	
69.29	0	956.97	
69.51	0	956.99	

69.62	0	956.99
70.19	0	957.01
70.25	0	957.01
71.32	0	957.03
73.01	0	957.01
73.58	0	956.99
73.58	0	956.99
73.95	0	956.96
74.14	0	956.94
74.7	0	956.92
75	0	956.91

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	961.38	961.38	961.38
Bankfull Elevation (ft)	954.1	954.1	954.1
Floodprone Width (ft)	1500	-----	-----
Bankfull Width (ft)	107.77	53.97	53.8
Entrenchment Ratio	13.92	-----	-----
Mean Depth (ft)	5.26	5	5.52
Maximum Depth (ft)	7.28	7.28	6.65
Width/Depth Ratio	20.49	10.79	9.75
Bankfull Area (sq ft)	566.73	269.92	296.81
Wetted Perimeter (ft)	111.27	62.51	61.91
Hydraulic Radius (ft)	5.09	4.32	4.79
Begin BKF Station	-54.35	-54.35	-0.38
End BKF Station	53.42	-0.38	53.42

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

Attachment B Particle Data

RIVERMORPH PARTICLE SUMMARY

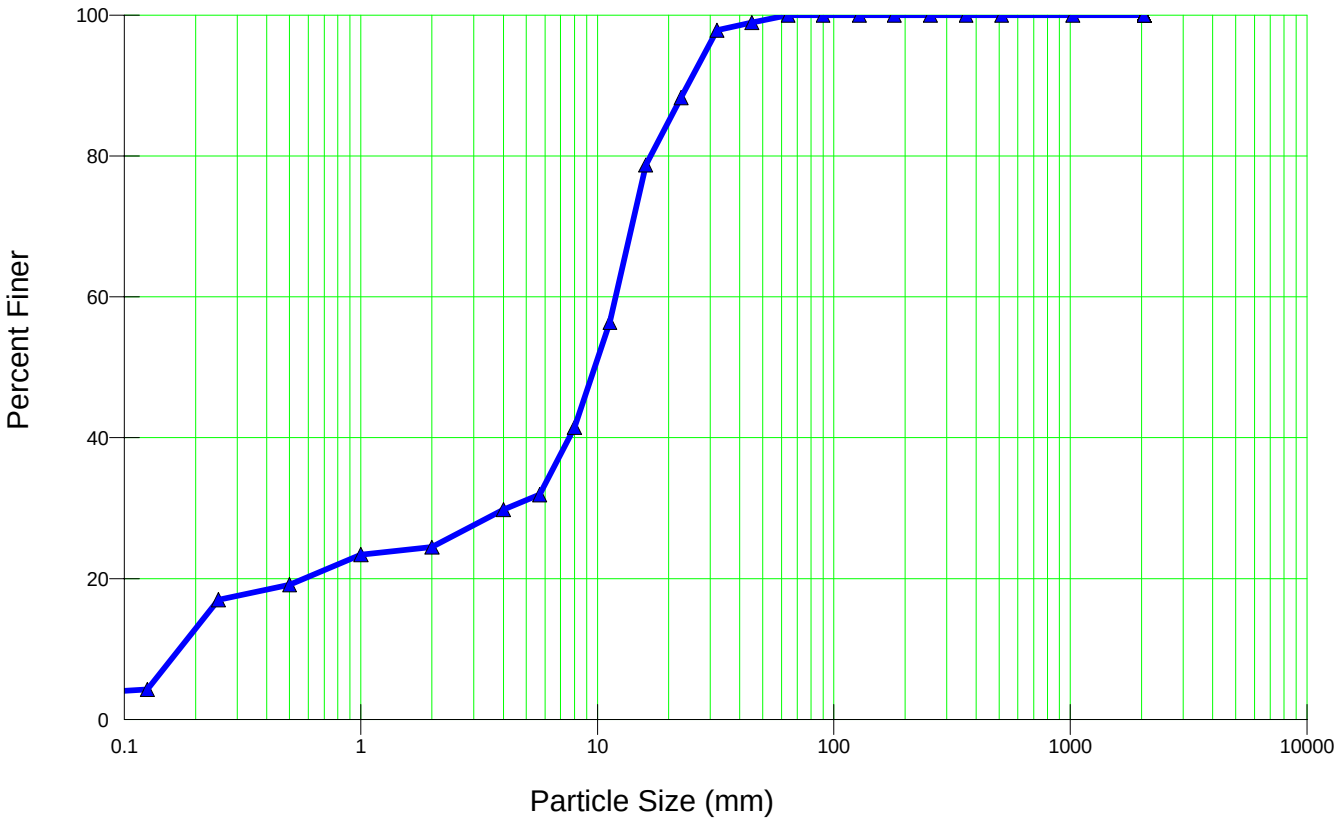
River Name: Housatonic
Reach Name: Reach 5A-1
Sample Name: PC 21+55
Survey Date: 11/11/2024

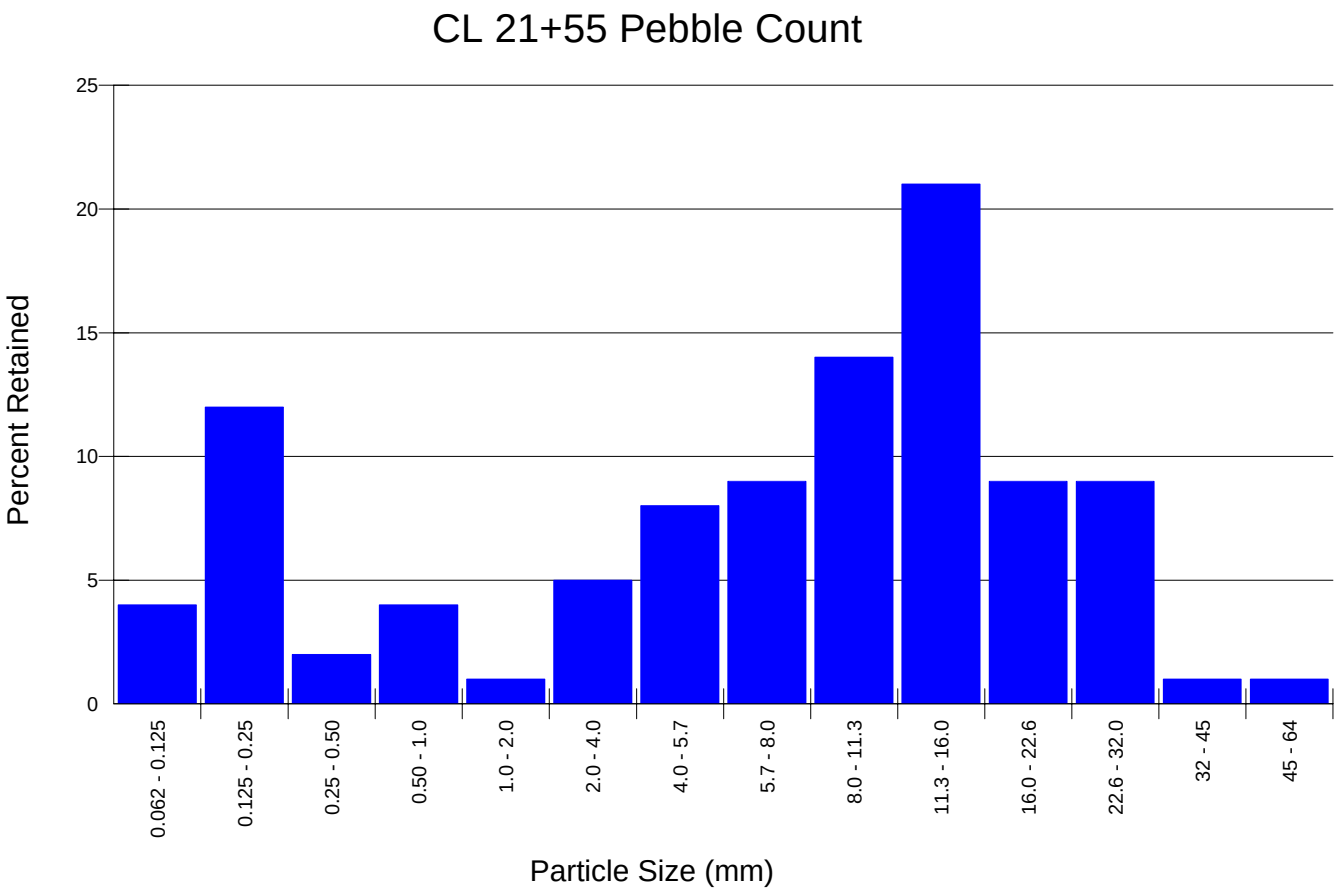
Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	0	0.00	0.00
0.062 - 0.125	4	4.26	4.26
0.125 - 0.25	12	12.77	17.02
0.25 - 0.50	2	2.13	19.15
0.50 - 1.0	4	4.26	23.40
1.0 - 2.0	1	1.06	24.47
2.0 - 4.0	5	5.32	29.79
4.0 - 5.7	2	2.13	31.91
5.7 - 8.0	9	9.57	41.49
8.0 - 11.3	14	14.89	56.38
11.3 - 16.0	21	22.34	78.72
16.0 - 22.6	9	9.57	88.30
22.6 - 32.0	9	9.57	97.87
32 - 45	1	1.06	98.94
45 - 64	1	1.06	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.24
D35 (mm)	6.44
D50 (mm)	9.89
D84 (mm)	19.64
D95 (mm)	29.18
D100 (mm)	64
Silt/Clay (%)	0
Sand (%)	24.47
Gravel (%)	75.53
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 94.

21+55


Percent Finer
100
80
60
40
20
0
0.1
1
10
100
1000
10000
Particle Size (mm)


CL 21+55 Pebble Count
Percent Retained
25
20
15
10
5
0
0.062 - 0.125
0.125 - 0.25
0.25 - 0.50
0.50 - 1.0
1.0 - 2.0
2.0 - 4.0
4.0 - 5.7
5.7 - 8.0
8.0 - 11.3
11.3 - 16.0
16.0 - 22.6
22.6 - 32.0
32 - 45
45 - 64
Particle Size (mm)

RIVERMORPH PARTICLE SUMMARY

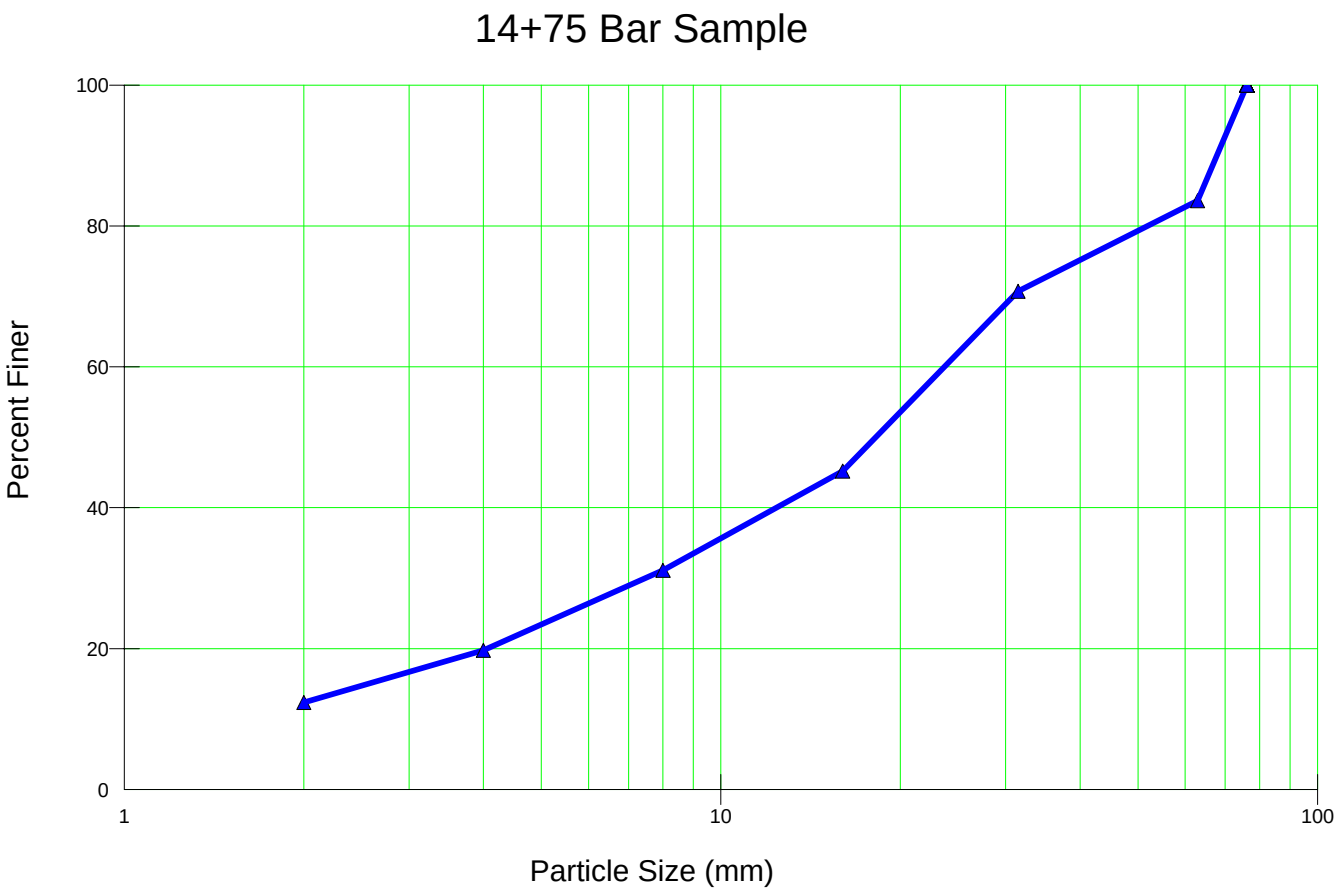
River Name: Housatonic New
Reach Name: 2023 LiDAR Reach 5A-1
Sample Name: CL 14+75 Bar Sample
Survey Date: 04/18/2025

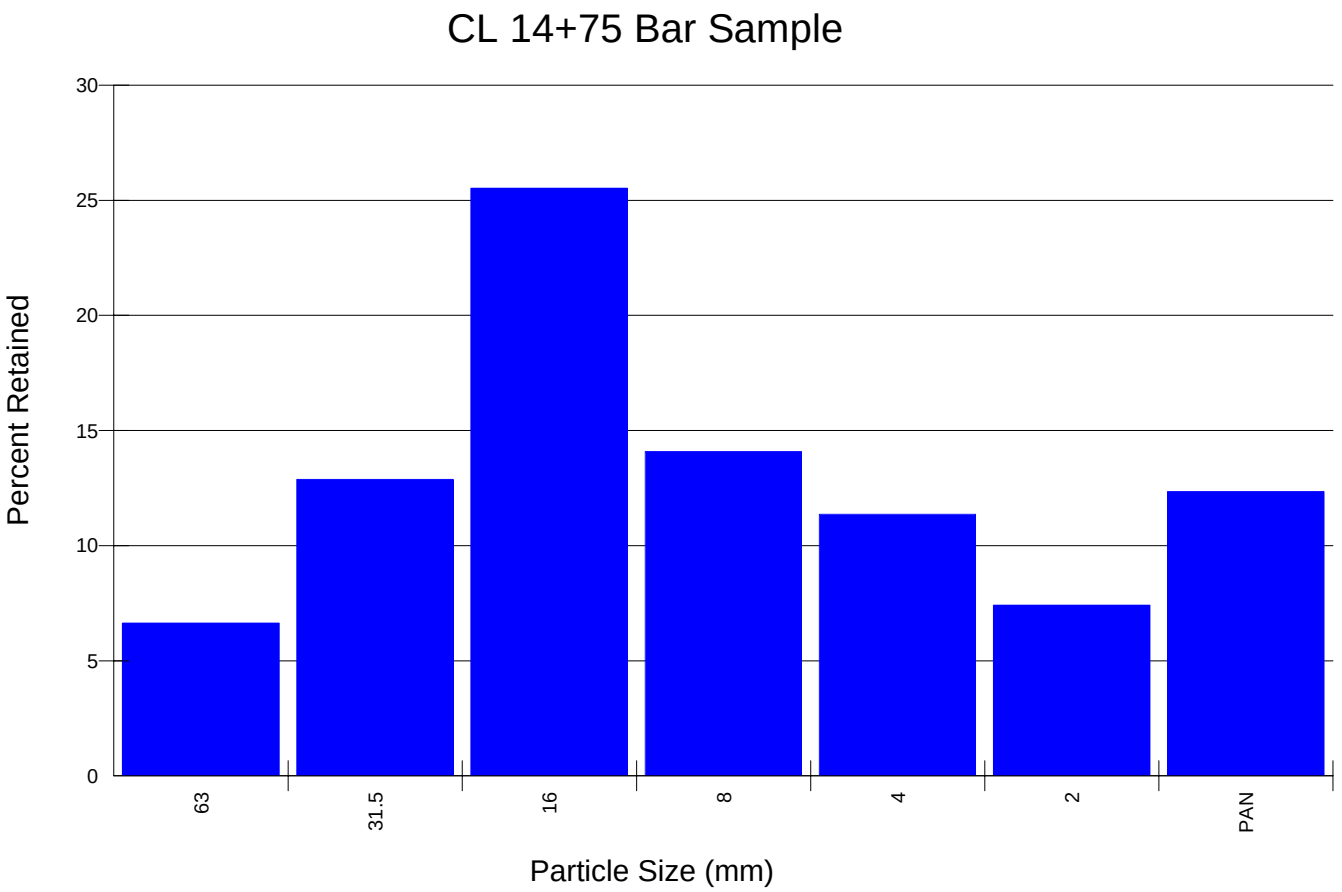
SIEVE (mm)	NET WT
63	2.46
31.5	4.775
16	9.465
8	5.225
4	4.215
2	2.75
PAN	4.575
D16 (mm)	2.99
D35 (mm)	10.2
D50 (mm)	18.91
D84 (mm)	63.32
D95 (mm)	72.17
D100 (mm)	76.2
Silt/Clay (%)	0
Sand (%)	12.34
Gravel (%)	72.63
Cobble (%)	15.04
Boulder (%)	0
Bedrock (%)	0

Total Weight = 37.0850.

Largest Surface Particles:

	Size(mm)	Weight
Particle 1:	76.2	2.44
Particle 2:	69.85	1.18


14+75 Bar Sample
Percent Finer
100
80
60
40
20
0
1
10
100
Particle Size (mm)


CL 14+75 Bar Sample
Percent Retained
30
25
20
15
10
5
0
63
31.5
16
8
4
2
PAN
Particle Size (mm)

RIVERMORPH PARTICLE SUMMARY

River Name: Housatonic New
Reach Name: 2023 LiDAR Reach 5A-1
Sample Name: CL 40+63 Pavement
Survey Date: 04/18/2025

SIEVE (mm)	NET WT
16	0.655
8	0.835
4	0.385
2	0.125
PAN	0.27

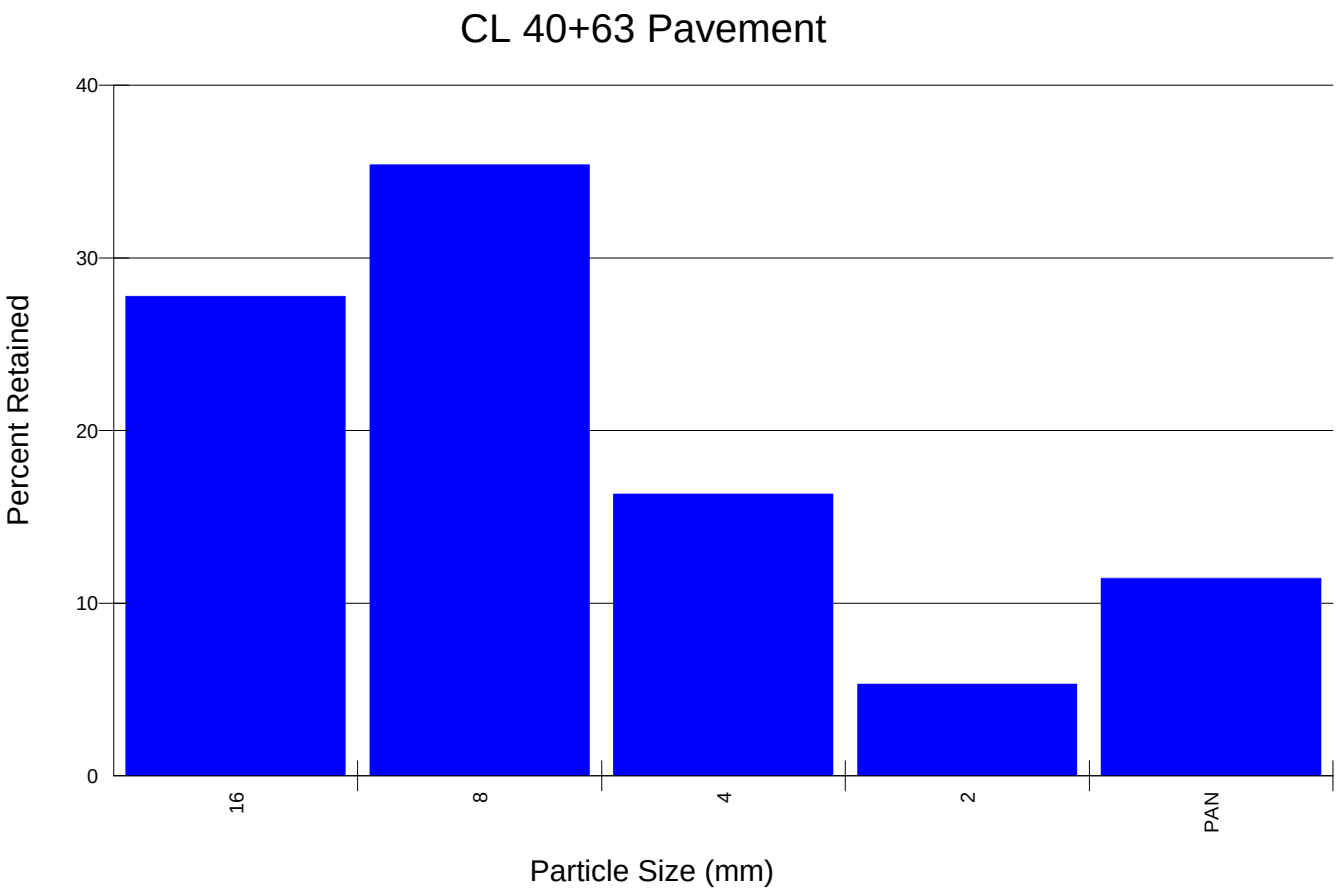
D16 (mm)	3.72
D35 (mm)	8.44
D50 (mm)	11.83
D84 (mm)	18.13
D95 (mm)	19.64
D100 (mm)	27.94
Silt/Clay (%)	0
Sand (%)	11.44
Gravel (%)	88.56
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Weight = 2.3600.

Largest Surface Particles:

	Size(mm)	Weight
Particle 1:	20.32	0.05
Particle 2:	27.94	0.04

CL 40+63 Pavement
Percent Finer
100
80
60
40
20
0
1
10
100
Particle Size (mm)


CL 40+63 Pavement
Percent Retained
40
30
20
10
0
16
8
4
2
PAN
Particle Size (mm)

RIVERMORPH PARTICLE SUMMARY

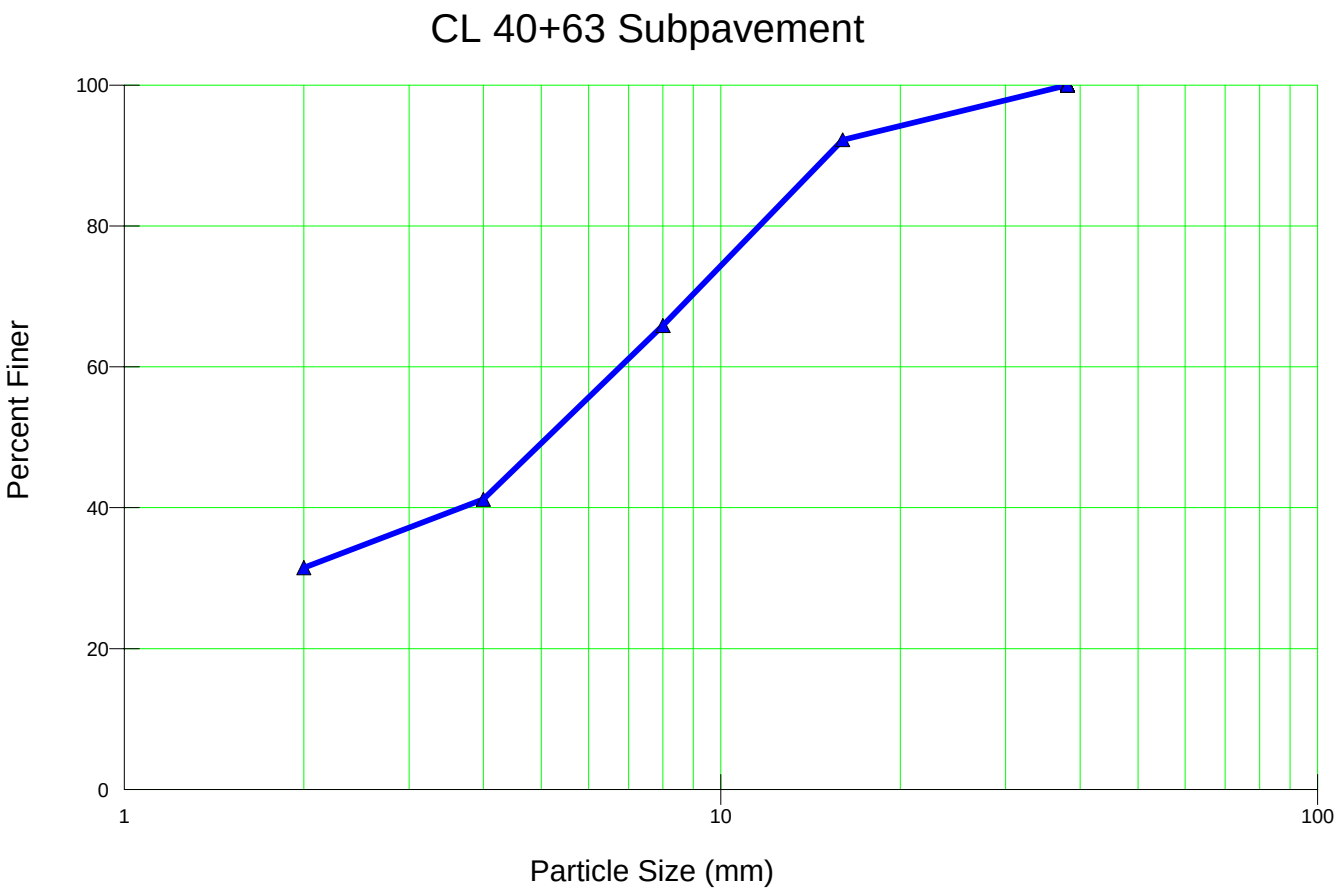
River Name: Housatonic New
Reach Name: 2023 LiDAR Reach 5A-1
Sample Name: CL 40+63 Subpavement
Survey Date: 04/18/2025

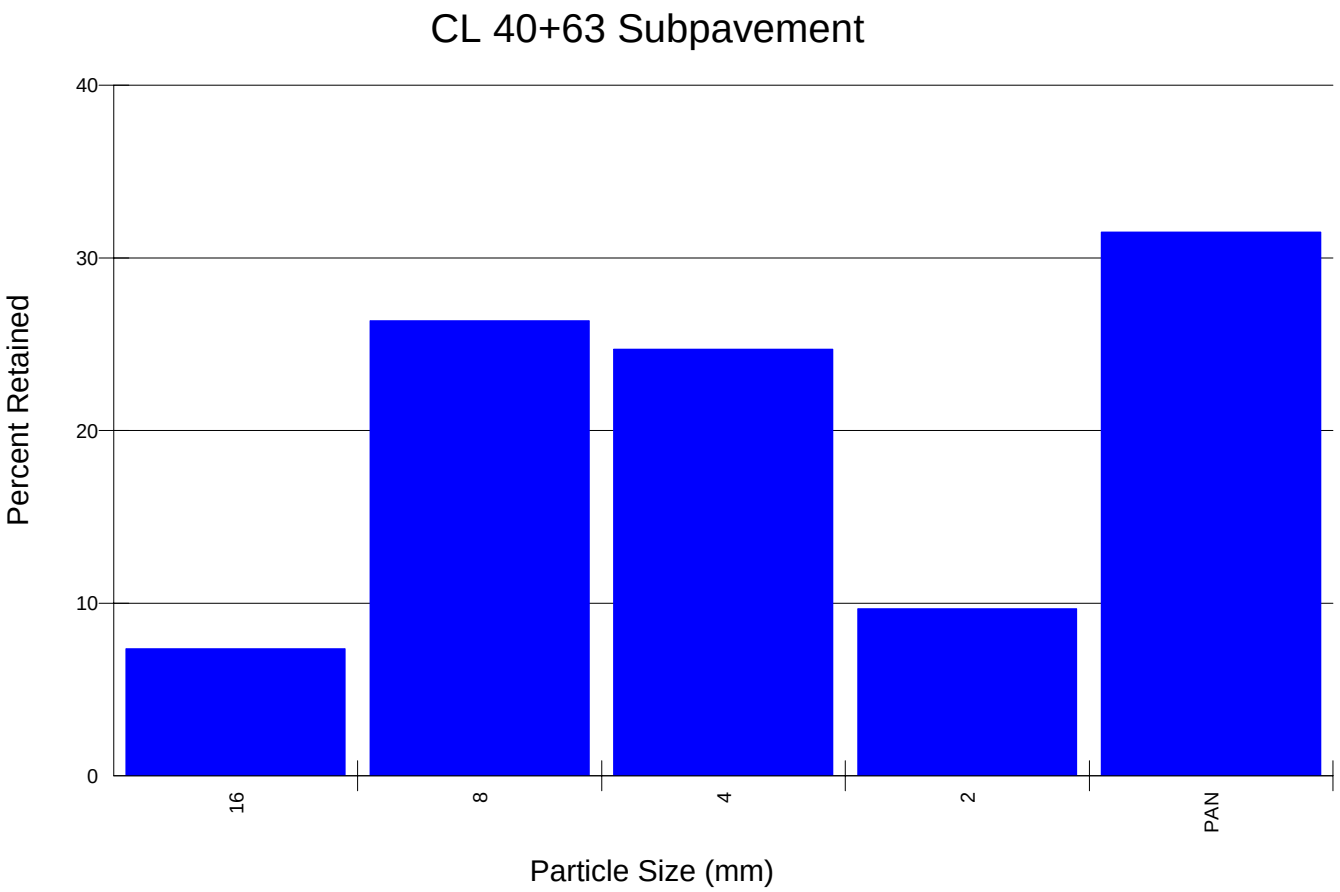
SIEVE (mm)	NET WT
16	2
8	7.17
4	6.715
2	2.635
PAN	8.565
D16 (mm)	0
D35 (mm)	2.72
D50 (mm)	5.43
D84 (mm)	13.5
D95 (mm)	23.86
D100 (mm)	38.1
Silt/Clay (%)	0
Sand (%)	31.49
Gravel (%)	68.51
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Weight = 27.1950.

Largest Surface Particles:

	Size(mm)	Weight
Particle 1:	38.1	0.07
Particle 2:	38.1	0.04


CL 40+63 Subpavement
Percent Finer
100
80
60
40
20
0
1
10
100
Particle Size (mm)


CL 40+63 Subpavement
Percent Retained
40
30
20
10
0
16
8
4
2
PAN
Particle Size (mm)

RIVERMORPH PARTICLE SUMMARY

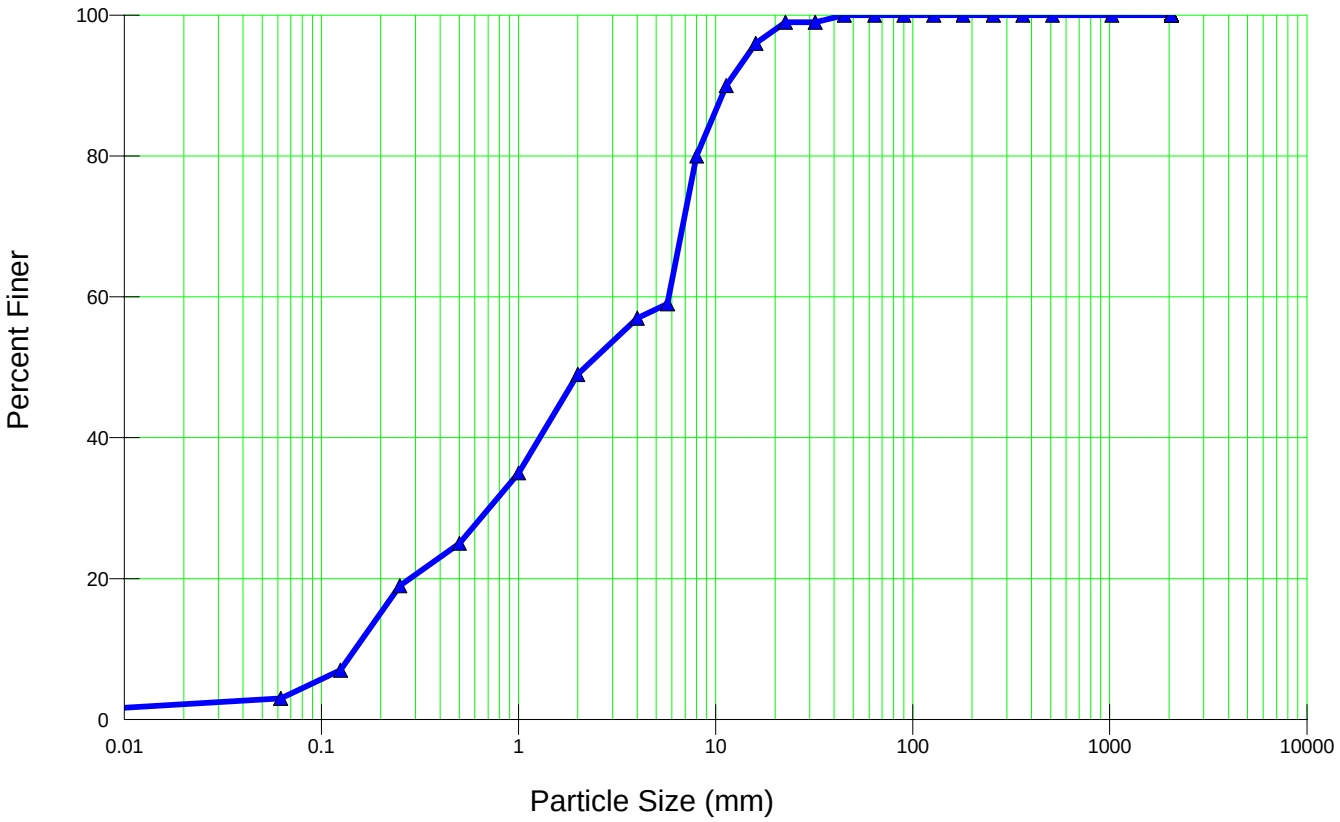
River Name: Housatonic New
Reach Name: 2023 LiDAR Reach 5A-2
Sample Name: CL 71+67 Pebble Count
Survey Date: 11/11/2024

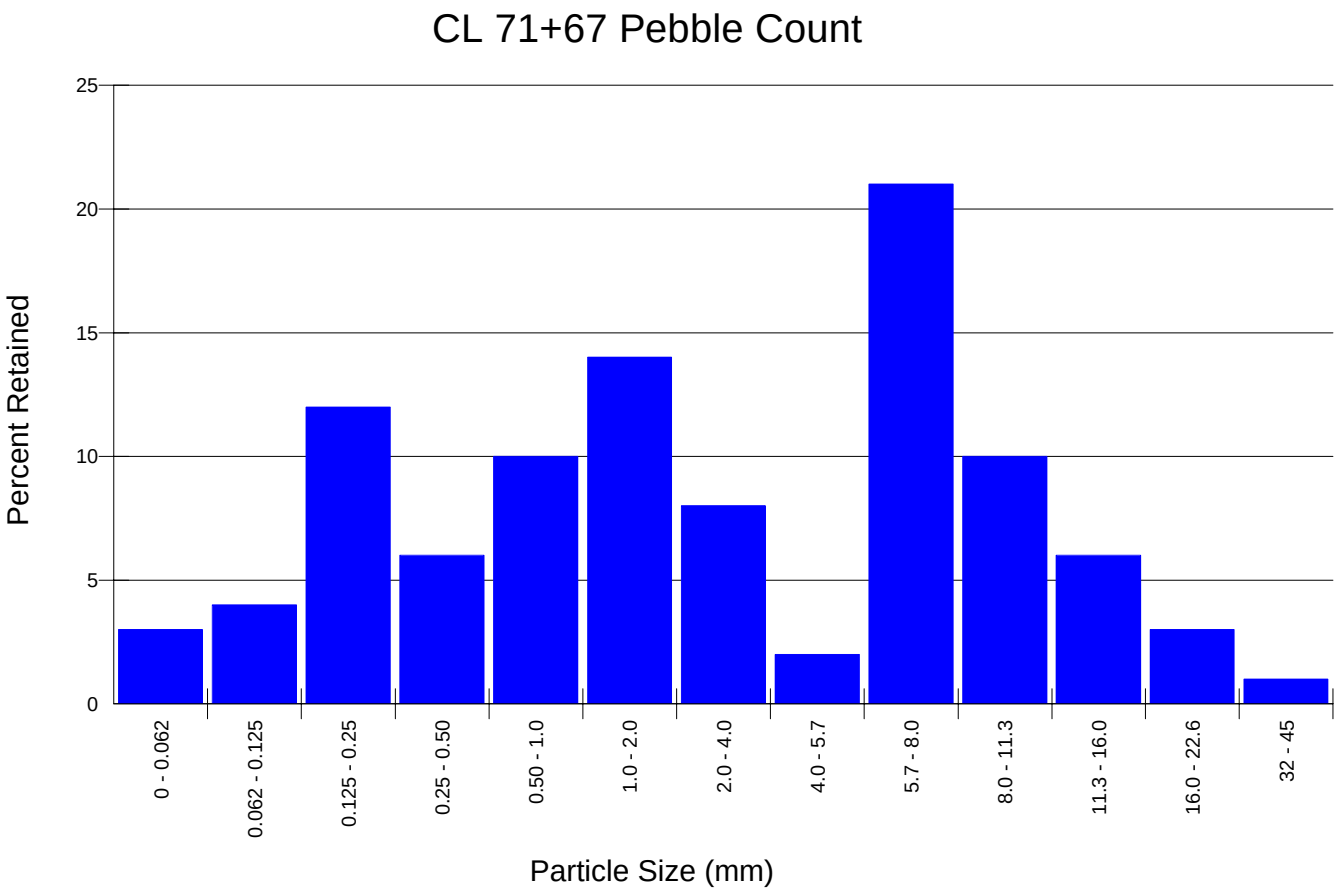
Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	3	3.00	3.00
0.062 - 0.125	4	4.00	7.00
0.125 - 0.25	12	12.00	19.00
0.25 - 0.50	6	6.00	25.00
0.50 - 1.0	10	10.00	35.00
1.0 - 2.0	14	14.00	49.00
2.0 - 4.0	8	8.00	57.00
4.0 - 5.7	2	2.00	59.00
5.7 - 8.0	21	21.00	80.00
8.0 - 11.3	10	10.00	90.00
11.3 - 16.0	6	6.00	96.00
16.0 - 22.6	3	3.00	99.00
22.6 - 32.0	0	0.00	99.00
32 - 45	1	1.00	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.22
D35 (mm)	1
D50 (mm)	2.25
D84 (mm)	9.32
D95 (mm)	15.22
D100 (mm)	45
Silt/Clay (%)	3
Sand (%)	46
Gravel (%)	51
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

PC 71+67


Percent Finer
100
80
60
40
20
0
0.01
0.1
1
10
100
1000
10000
Particle Size (mm)


CL 71+67 Pebble Count
Percent Retained
25
20
15
10
5
0
0 - 0.062
0.062 - 0.125
0.125 - 0.25
0.25 - 0.50
0.50 - 1.0
1.0 - 2.0
2.0 - 4.0
4.0 - 5.7
5.7 - 8.0
8.0 - 11.3
11.3 - 16.0
16.0 - 22.6
32 - 45
Particle Size (mm)

RIVERMORPH PARTICLE SUMMARY

River Name: Housatonic
Reach Name: 2025 LiDAR Reach 5A-2
Sample Name: CL 71+67 Pavement
Survey Date: 04/18/2025

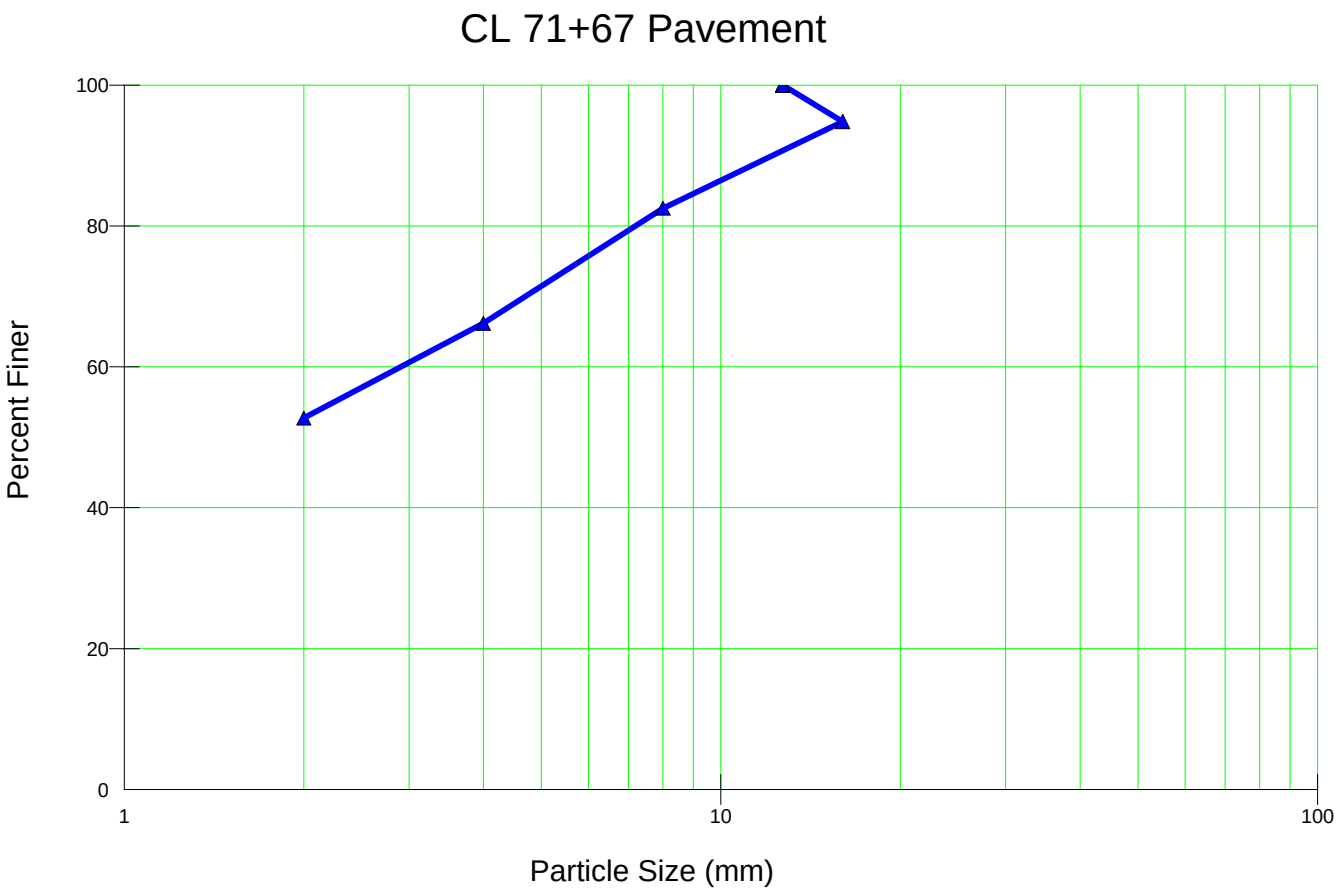
SIEVE (mm)	NET WT
16	0.03
8	0.215
4	0.285
2	0.235
PAN	0.92

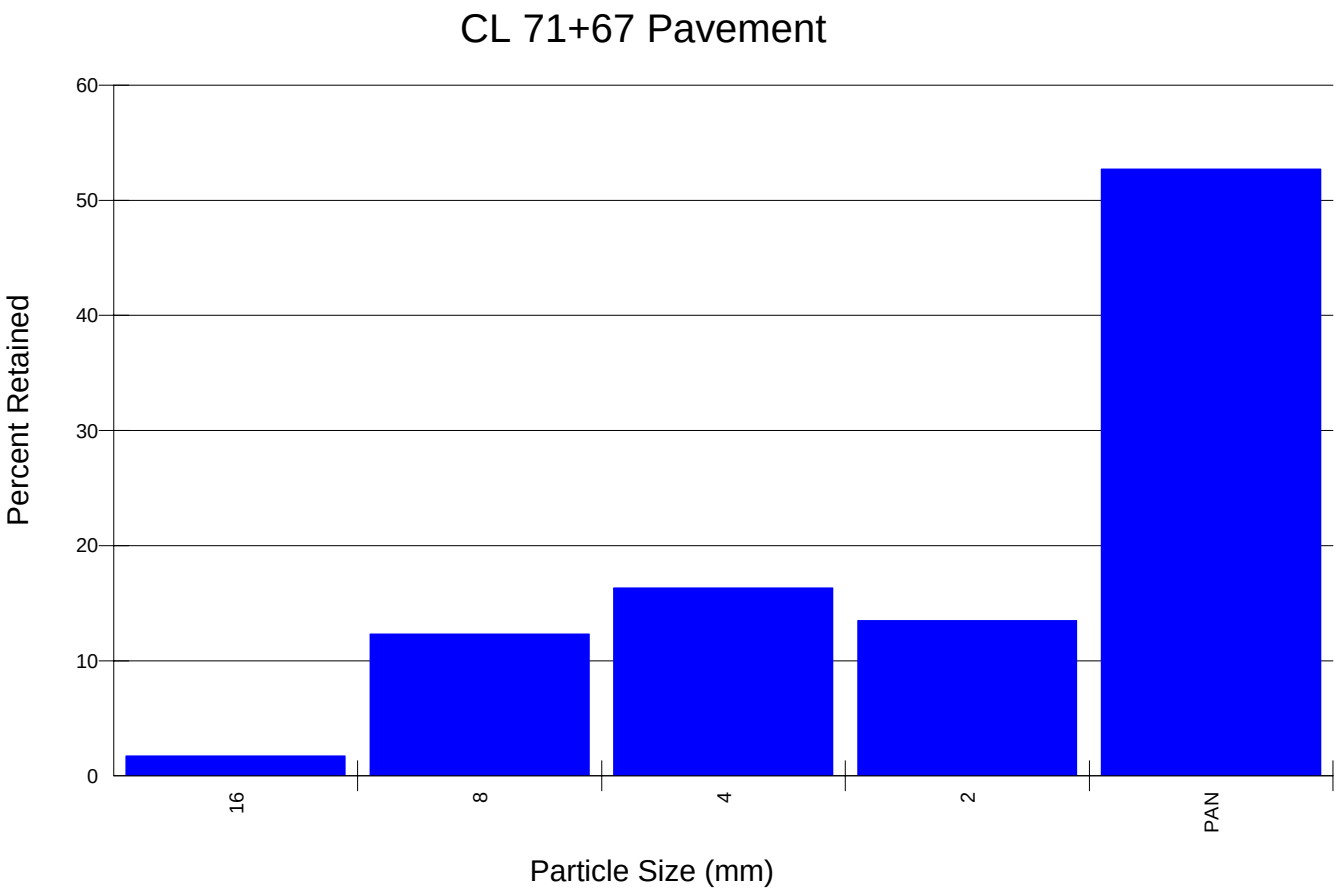
D16 (mm)	0
D35 (mm)	0
D50 (mm)	0
D84 (mm)	8.96
D95 (mm)	15.9
D100 (mm)	12.7
Silt/Clay (%)	0
Sand (%)	52.72
Gravel (%)	47.28
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Weight = 1.7450.

Largest Surface Particles:

	Size(mm)	Weight
Particle 1:	12.7	0.01
Particle 2:	7.62	0.05


CL 71+67 Pavement
Percent Finer
100
80
60
40
20
0
1
10
100
Particle Size (mm)


CL 71+67 Pavement
Percent Retained
60
50
40
30
20
10
0
16
8
4
2
PAN
Particle Size (mm)

RIVERMORPH PARTICLE SUMMARY

River Name: Housatonic
Reach Name: 2025 LiDAR Reach 5A-2
Sample Name: CL 71+67 Subpavement
Survey Date: 04/18/2025

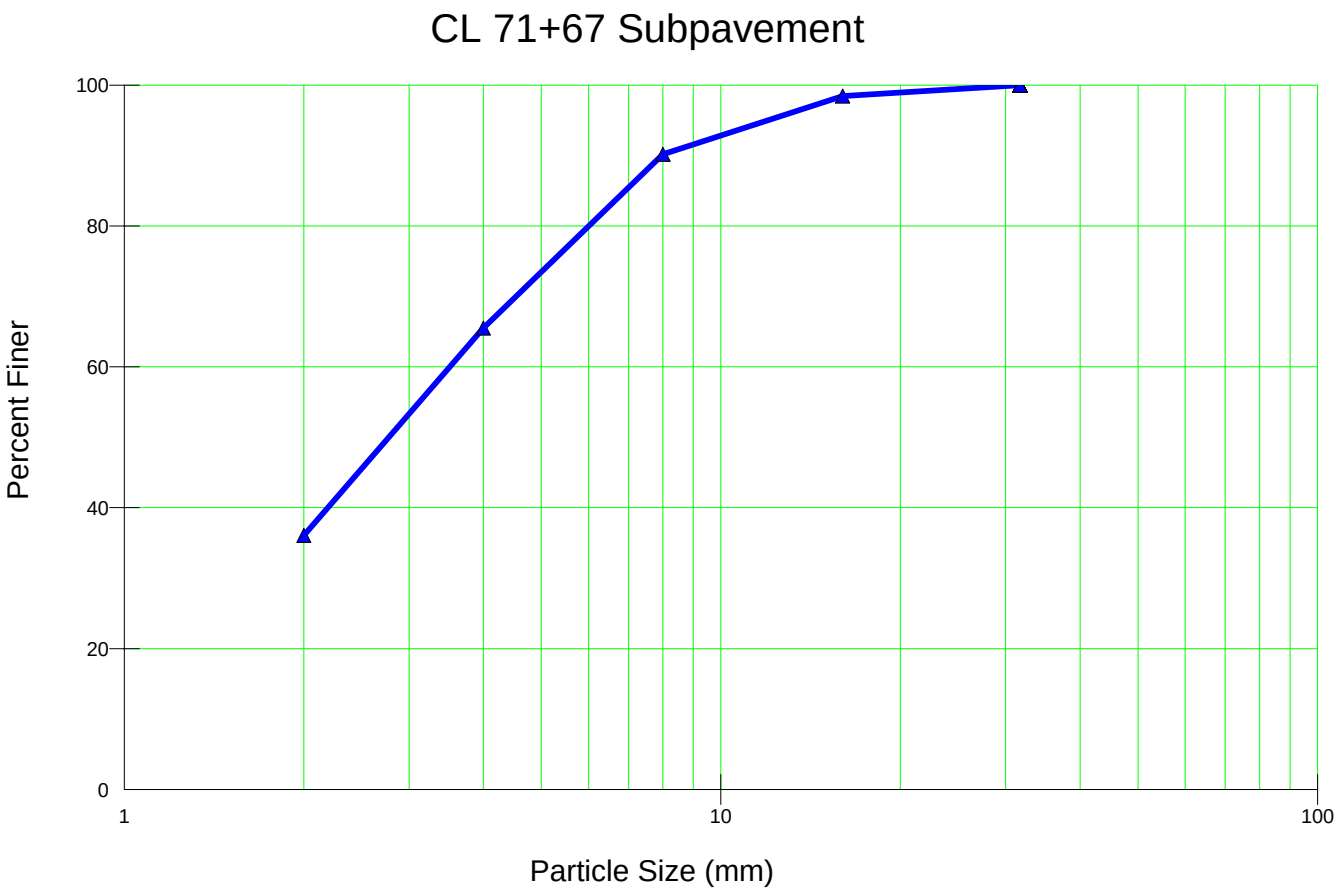
SIEVE (mm)	NET WT
16	0.375
8	2.37
4	7.06
2	8.44
PAN	10.335

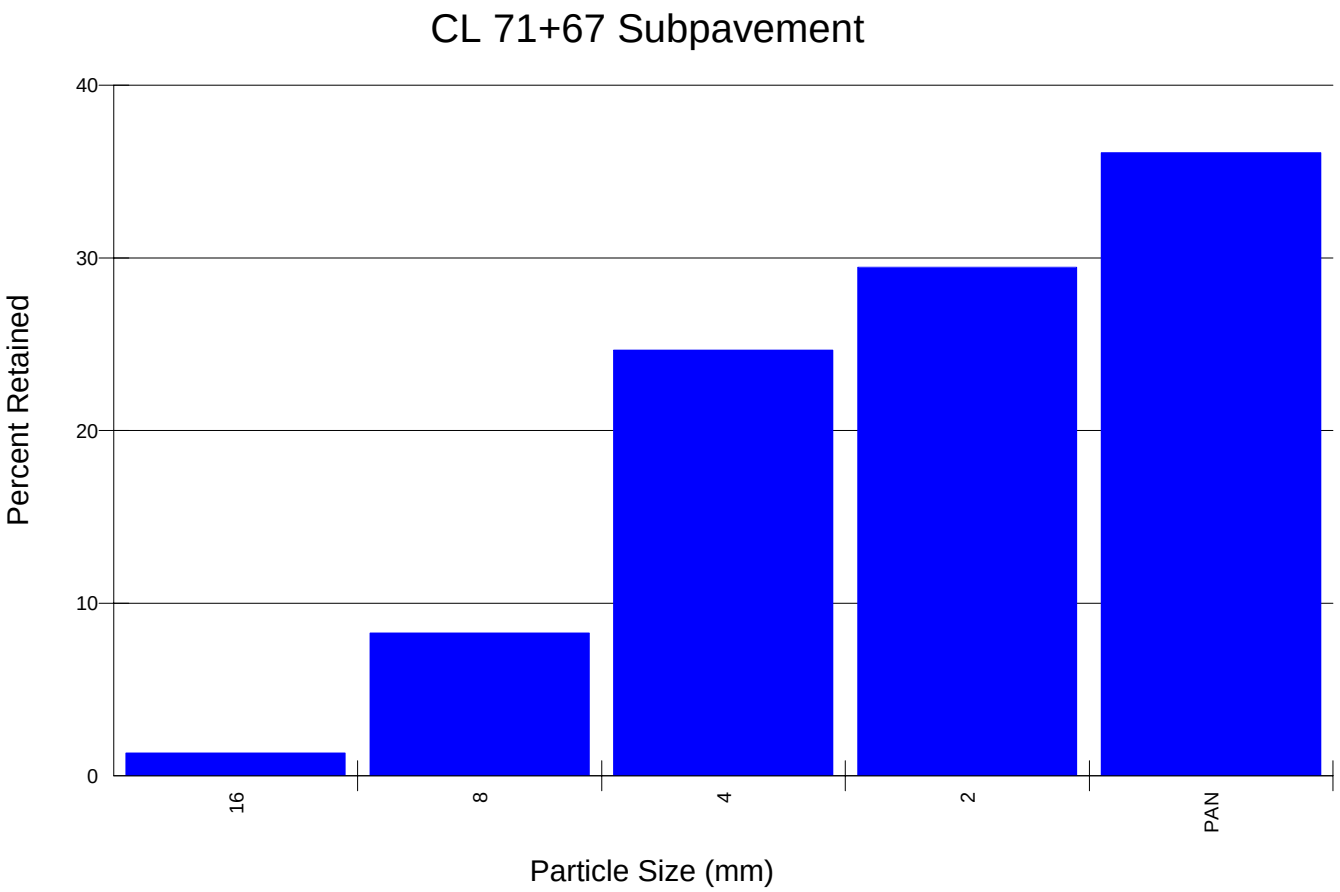
D16 (mm)	0
D35 (mm)	0
D50 (mm)	2.95
D84 (mm)	7
D95 (mm)	12.67
D100 (mm)	31.75
Silt/Clay (%)	0
Sand (%)	36.07
Gravel (%)	63.93
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Weight = 28.6500.

Largest Surface Particles:

	Size(mm)	Weight
Particle 1:	31.75	0.03
Particle 2:	25.4	0.04


CL 71+67 Subpavement
Percent Finer
100
80
60
40
20
0
1
10
100
Particle Size (mm)


CL 71+67 Subpavement
Percent Retained
40
30
20
10
0
16
8
4
2
PAN
Particle Size (mm)

RIVERMORPH PARTICLE SUMMARY

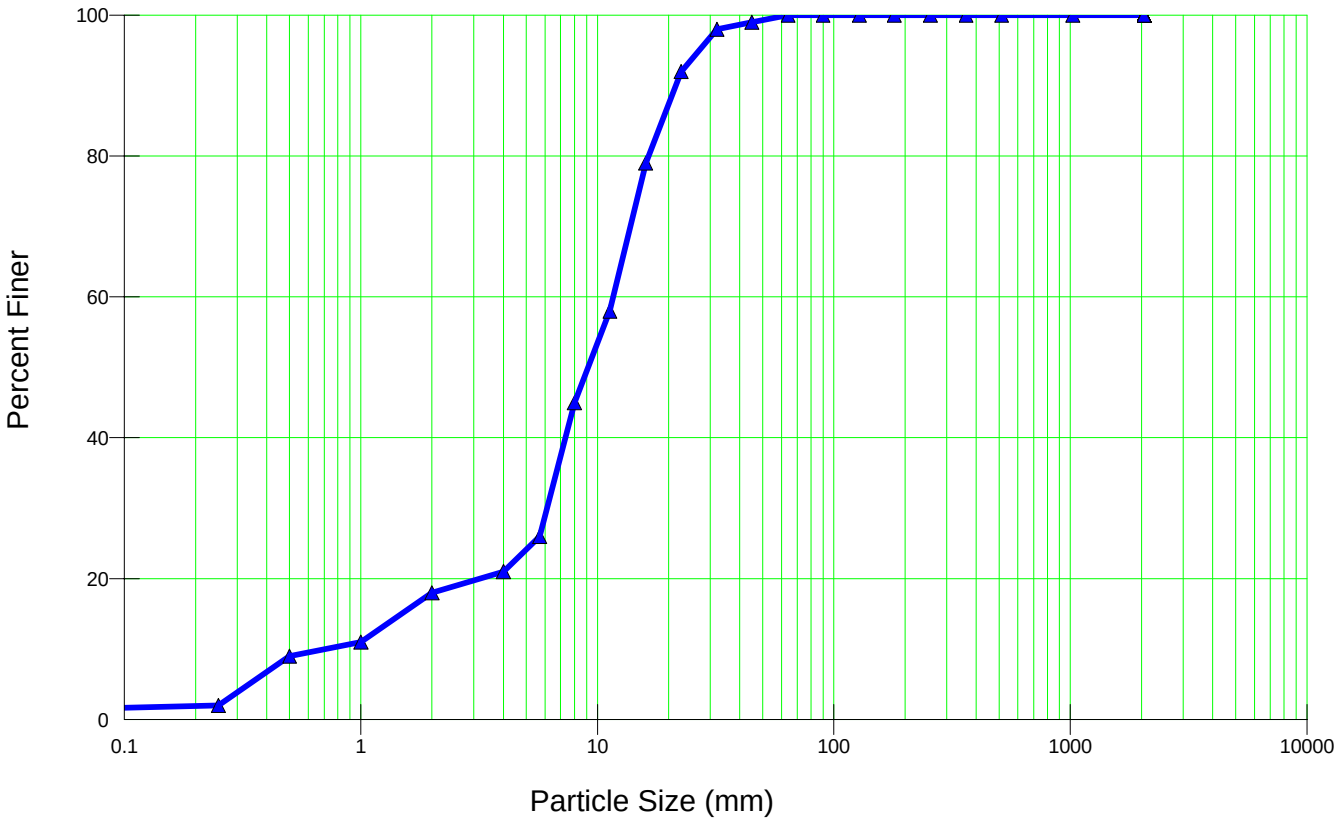
River Name: Housatonic
Reach Name: 2023 LiDAR Reach 5A-3
Sample Name: CL 129+56 Pebble Count
Survey Date: 11/11/2024

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	0	0.00	0.00
0.062 - 0.125	0	0.00	0.00
0.125 - 0.25	2	2.00	2.00
0.25 - 0.50	7	7.00	9.00
0.50 - 1.0	2	2.00	11.00
1.0 - 2.0	7	7.00	18.00
2.0 - 4.0	3	3.00	21.00
4.0 - 5.7	5	5.00	26.00
5.7 - 8.0	19	19.00	45.00
8.0 - 11.3	13	13.00	58.00
11.3 - 16.0	21	21.00	79.00
16.0 - 22.6	13	13.00	92.00
22.6 - 32.0	6	6.00	98.00
32 - 45	1	1.00	99.00
45 - 64	1	1.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

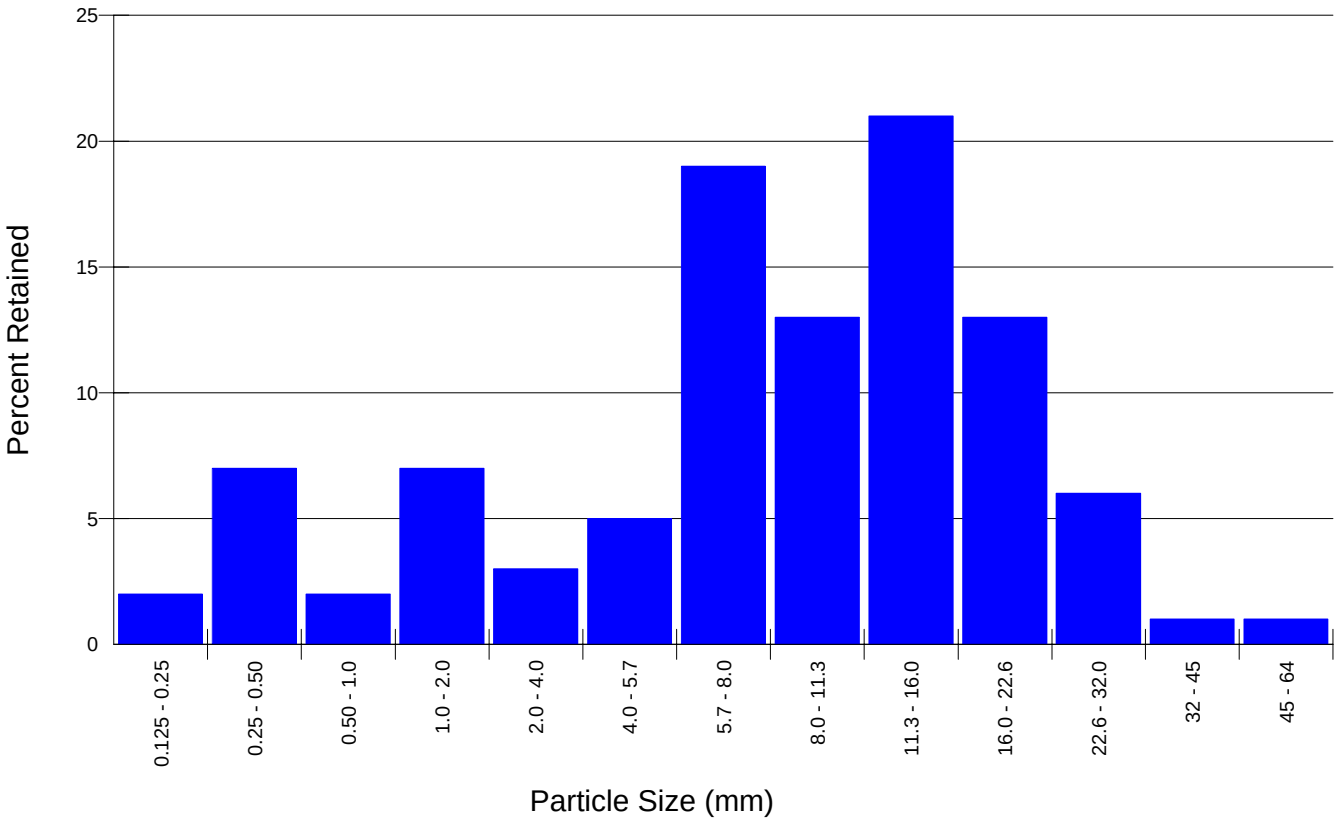
D16 (mm)	1.71
D35 (mm)	6.79
D50 (mm)	9.27
D84 (mm)	18.54
D95 (mm)	27.3
D100 (mm)	64
Silt/Clay (%)	0
Sand (%)	18
Gravel (%)	82
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

PC 129+56


Percent Finer
100
80
60
40
20
0
0.1
1
10
100
1000
10000
Particle Size (mm)

CL 129+56 Pebble Count



RIVERMORPH PARTICLE SUMMARY

River Name: Housatonic
Reach Name: 2025 LiDAR Reach 5A-3
Sample Name: CL 138+00 Bar Sample
Survey Date: 04/18/2025

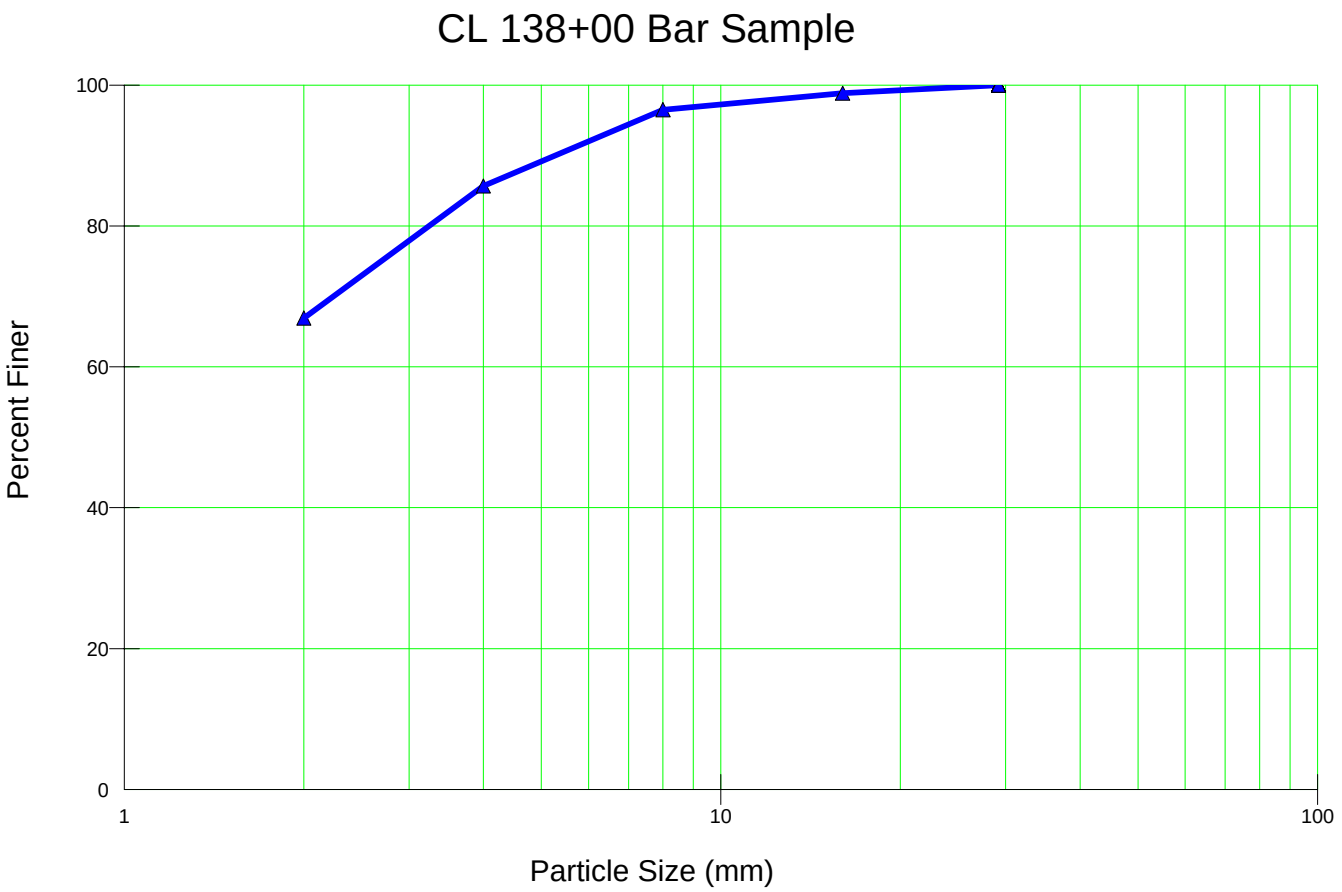
SIEVE (mm)	NET WT
16	0.125
8	0.485
4	2.24
2	3.875
PAN	13.845

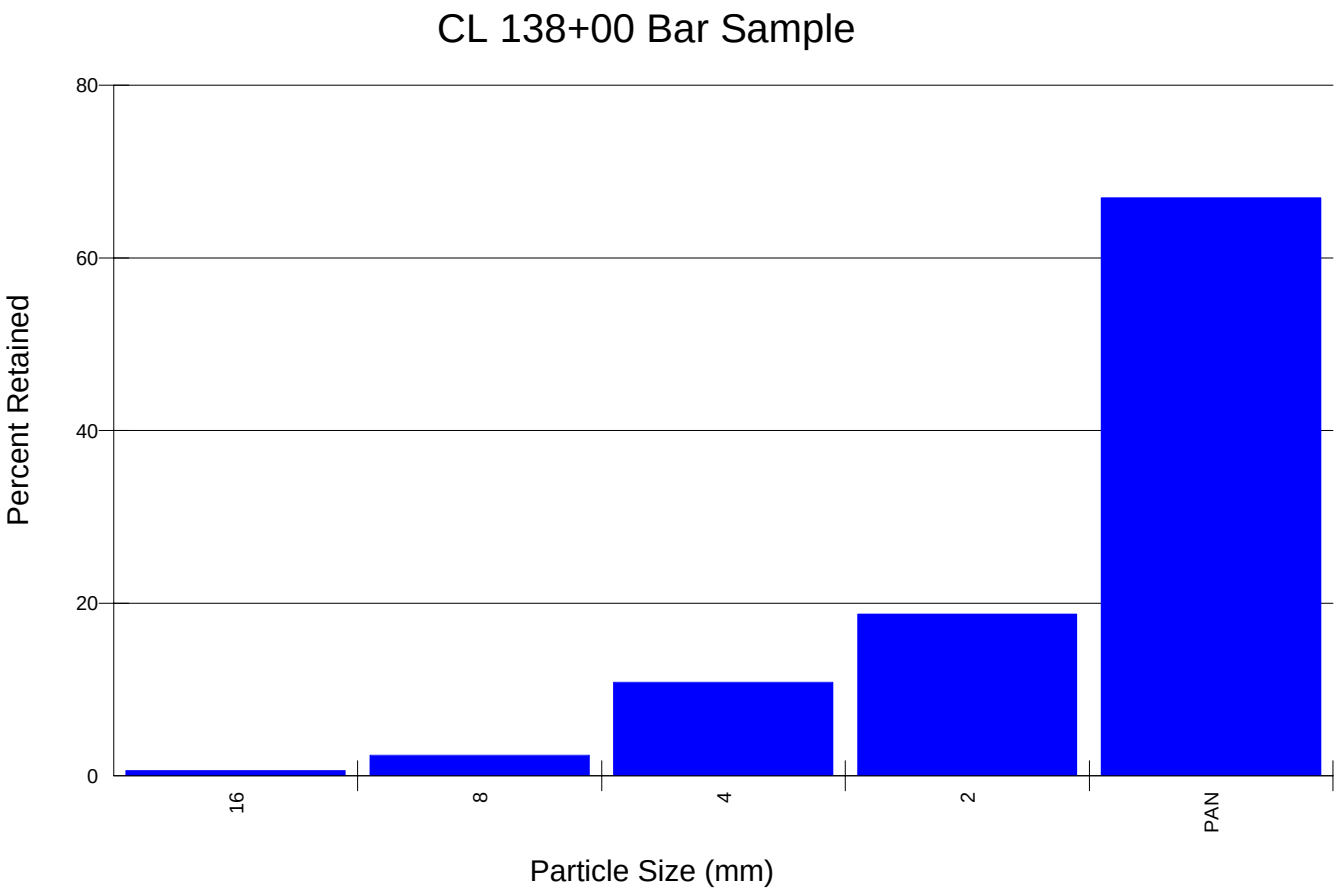
D16 (mm)	0
D35 (mm)	0
D50 (mm)	0
D84 (mm)	3.82
D95 (mm)	7.44
D100 (mm)	29.21
Silt/Clay (%)	0
Sand (%)	66.95
Gravel (%)	33.05
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Weight = 20.6800.

Largest Surface Particles:

	Size(mm)	Weight
Particle 1:	29.21	0.01
Particle 2:	25.4	0.1


CL 138+00 Bar Sample
Percent Finer
100
80
60
40
20
0
1
10
100
Particle Size (mm)


CL 138+00 Bar Sample
Percent Retained
80
60
40
20
0
16
8
4
2
PAN
Particle Size (mm)

RIVERMORPH PARTICLE SUMMARY

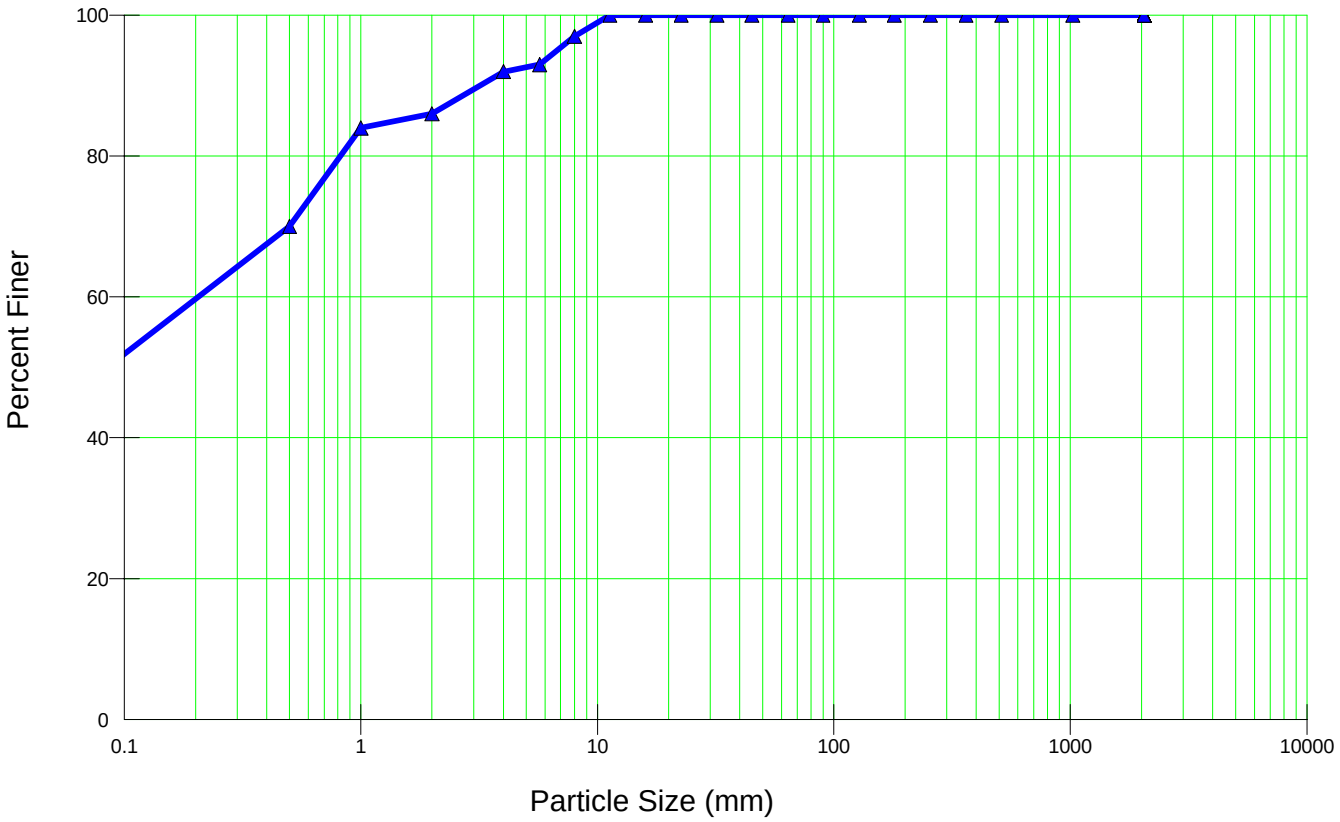
River Name: Housatonic
Reach Name: 2023 LiDAR Reach 5A-4
Sample Name: CL 160+00 Pebble Count
Survey Date: 11/11/2024

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	0	0.00	0.00
0.062 - 0.125	0	0.00	0.00
0.125 - 0.25	0	0.00	0.00
0.25 - 0.50	70	70.00	70.00
0.50 - 1.0	14	14.00	84.00
1.0 - 2.0	2	2.00	86.00
2.0 - 4.0	6	6.00	92.00
4.0 - 5.7	1	1.00	93.00
5.7 - 8.0	4	4.00	97.00
8.0 - 11.3	3	3.00	100.00
11.3 - 16.0	0	0.00	100.00
16.0 - 22.6	0	0.00	100.00
22.6 - 32.0	0	0.00	100.00
32 - 45	0	0.00	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

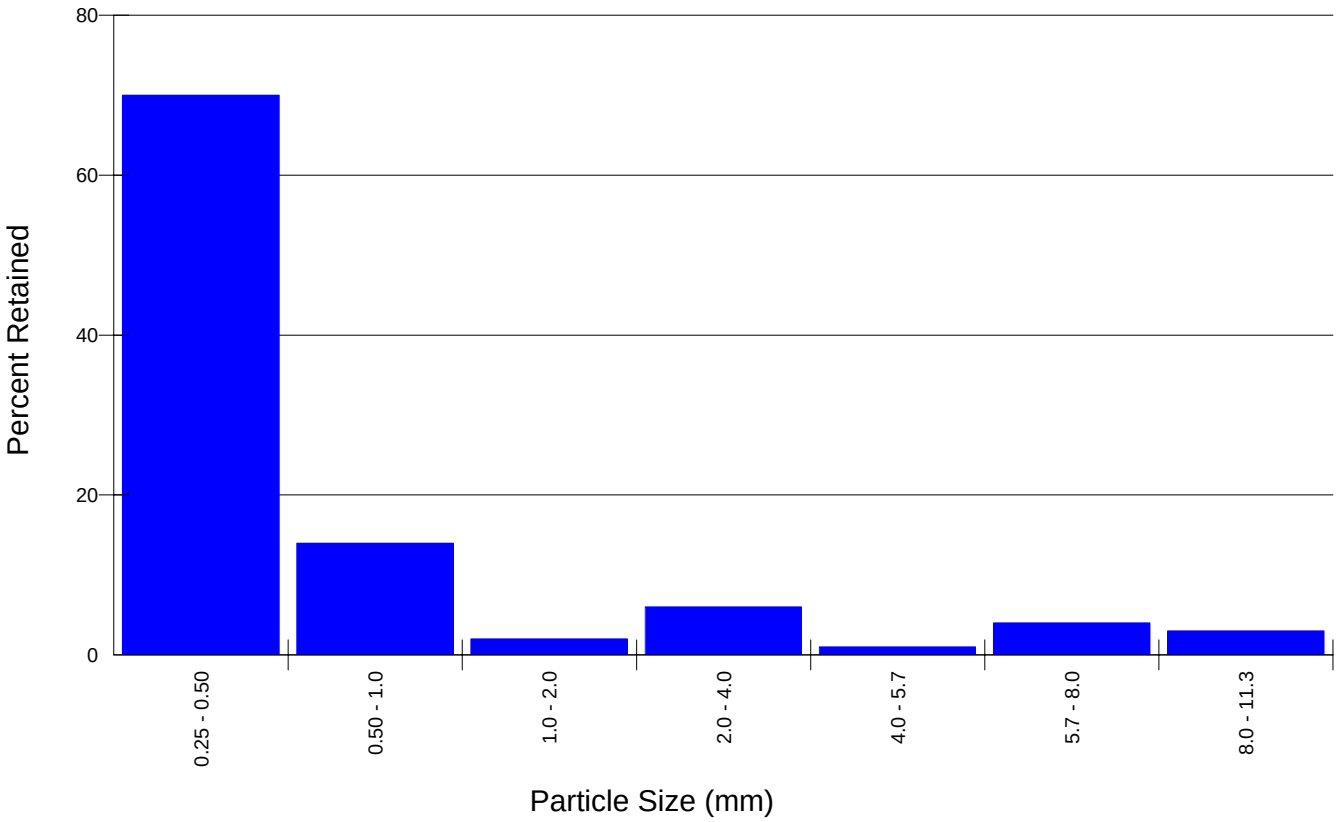
D16 (mm)	0.31
D35 (mm)	0.38
D50 (mm)	0.43
D84 (mm)	1
D95 (mm)	6.85
D100 (mm)	11.3
Silt/Clay (%)	0
Sand (%)	86
Gravel (%)	14
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

PC 160+00


100
80
60
40
20
0
Percent Finer
0.1
1
10
100
1000
10000
Particle Size (mm)

CL 160+00 Pebble Count



RIVERMORPH PARTICLE SUMMARY

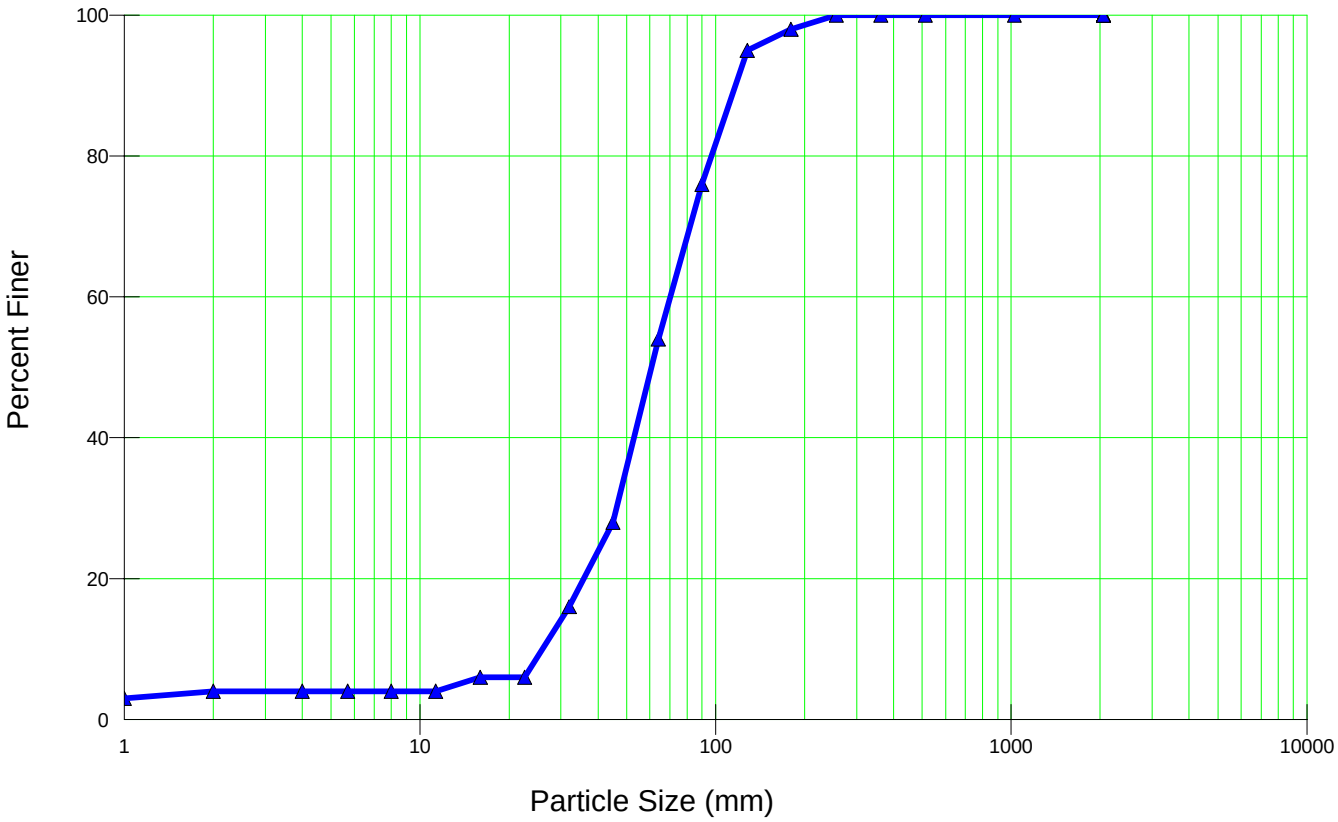
River Name: Housatonic
Reach Name: 2023 LiDAR Reach 5A-4
Sample Name: CL 170+44 Pebble Count
Survey Date: 11/11/2024

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	0	0.00	0.00
0.062 - 0.125	0	0.00	0.00
0.125 - 0.25	0	0.00	0.00
0.25 - 0.50	0	0.00	0.00
0.50 - 1.0	3	3.00	3.00
1.0 - 2.0	1	1.00	4.00
2.0 - 4.0	0	0.00	4.00
4.0 - 5.7	0	0.00	4.00
5.7 - 8.0	0	0.00	4.00
8.0 - 11.3	0	0.00	4.00
11.3 - 16.0	2	2.00	6.00
16.0 - 22.6	0	0.00	6.00
22.6 - 32.0	10	10.00	16.00
32 - 45	12	12.00	28.00
45 - 64	26	26.00	54.00
64 - 90	22	22.00	76.00
90 - 128	19	19.00	95.00
128 - 180	3	3.00	98.00
180 - 256	2	2.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

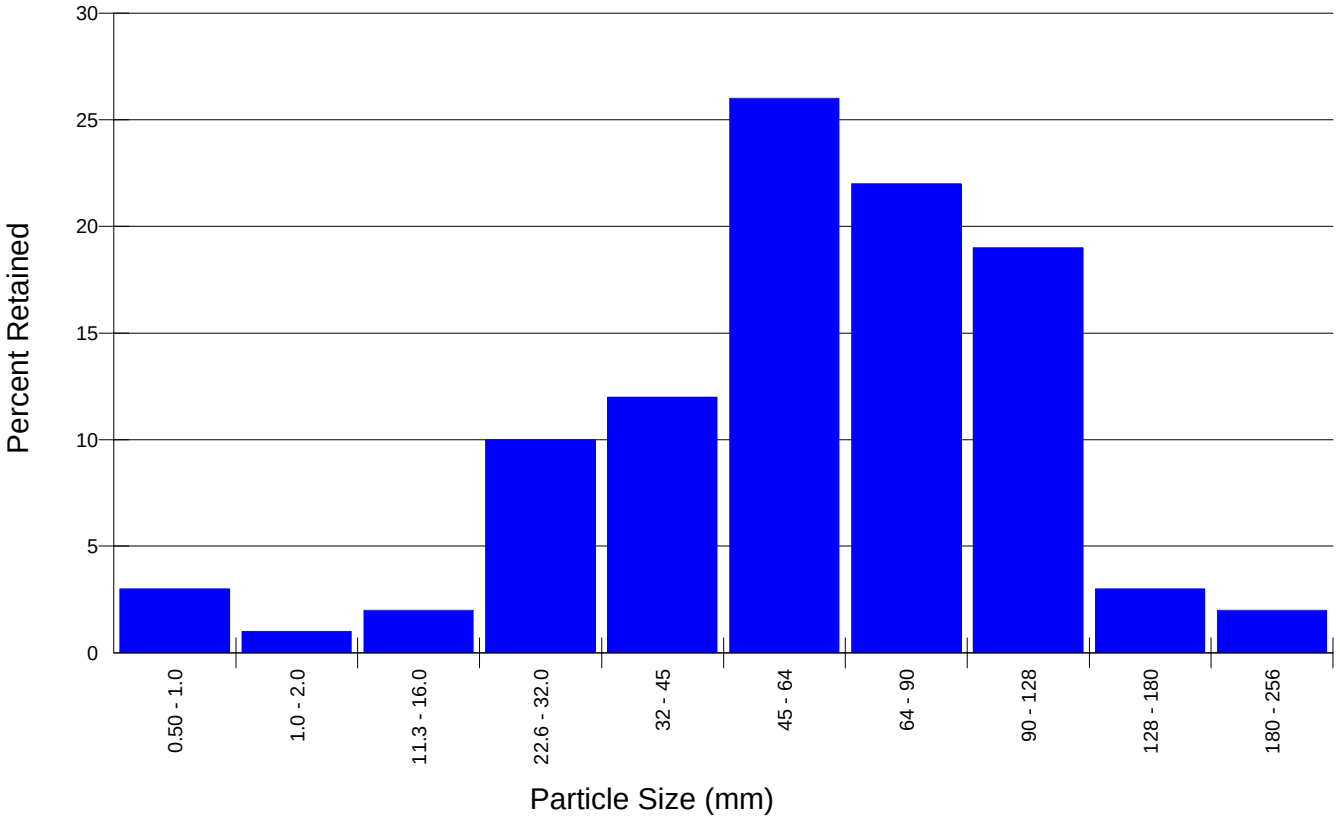
D16 (mm)	32
D35 (mm)	50.12
D50 (mm)	61.08
D84 (mm)	106
D95 (mm)	128
D100 (mm)	256
Silt/Clay (%)	0
Sand (%)	4
Gravel (%)	50
Cobble (%)	46
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

PC 170+44


Percent Finer
100
80
60
40
20
0
1
10
100
1000
10000
Particle Size (mm)

CL 170+44 Pebble Count



RIVERMORPH PARTICLE SUMMARY

River Name: Housatonic
Reach Name: 2023 LiDAR Reach 5A-5
Sample Name: CL 196+40 Pebble Count sand
Survey Date: 11/11/2024

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	0	0.00	0.00
0.062 - 0.125	0	0.00	0.00
0.125 - 0.25	0	0.00	0.00
0.25 - 0.50	0	0.00	0.00
0.50 - 1.0	100	100.00	100.00
1.0 - 2.0	0	0.00	100.00
2.0 - 4.0	0	0.00	100.00
4.0 - 5.7	0	0.00	100.00
5.7 - 8.0	0	0.00	100.00
8.0 - 11.3	0	0.00	100.00
11.3 - 16.0	0	0.00	100.00
16.0 - 22.6	0	0.00	100.00
22.6 - 32.0	0	0.00	100.00
32 - 45	0	0.00	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.58
D35 (mm)	0.68
D50 (mm)	0.75
D84 (mm)	0.92
D95 (mm)	0.97
D100 (mm)	1
Silt/Clay (%)	0
Sand (%)	100
Gravel (%)	0
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

Attachment C Rosgen Level II and III Forms

Worksheet 2-2. Computations of bankfull mean velocity and bankfull discharge using various methods.

Bankfull VELOCITY & DISCHARGE Estimates

Stream:	**Housatonic River Reach 5A-1**			Location:	**Pittsfield MA**
Date:	**1/19/2026**	Stream Type:	**C4**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**			HUC:	__ _ _ _ _ _ _ _ _ **01** _ _ **10** _ _ **00** _ _ **05**

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional Area	**587**	**A_{bkf}** (ft^2)	Bankfull Riffle Mean Depth	**6.31**	**d_{bkf}** (ft)
Bankfull Riffle Width	**93**	**W_{bkf}** (ft)	Wetted Perimeter ≈ (2 * d_{bkf}) + W_{bkf}	**105.62**	**W_p** (ft)
D_{84} Particle Size at Riffle	**19.64**	**D_{84}** (mm)	D_{84} Particle Size in Feet D_{84} (mm) / 304.8	**0.06**	**D_{84}** (ft)
Bankfull Slope	**0.0006**	**S_{bkf}** (ft / ft)	Hydraulic Radius A_{bkf} / W_p	**5.56**	**R** (ft)
Gravitational Acceleration	**32.2**	**g** (ft / sec^2)	Relative Roughness R (ft) / D_{84} (ft)	**86.25**	**R / D_{84}** (ft / ft)
Drainage Area	**131**	**DA** (mi^2)	Shear Velocity $u^* = (gRS)^{½}$	**0.328**	**u*** (ft / sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $\bar{u} = [\ 2.83 + 5.66 * Log\ \{ R / D_{84} \}\ ]\ u^*$	**4.52**	ft / sec	**2651.73**	cfs
2. Roughness Coefficient: a) Manning's *n* from Friction Factor/Relative Roughness (Figs. 2-29, 2-30) $\bar{u} = 1.49 R^{2/3} S^{1/2} / n$ $n =$ **0.023**	**4.98**	ft / sec	**2922.52**	cfs
2. Roughness Coefficient: b) Manning's *n* from Stream Type (Fig. 2-31) $\bar{u} = 1.49 R^{2/3} S^{1/2} / n$ $n =$ **0.02**	**5.73**	ft / sec	**3360.89**	cfs
2. Roughness Coefficient: c) Manning's *n* from Jarrett (USGS): $\bar{u} = 1.49 R^{2/3} S^{1/2} / n$ $n = 0.39 S^{0.38} R^{-0.16}$ **Note:** This equation is applicable to **steep, step/pool, high boundary roughness, cobble- and boulder-dominated stream systems**; i.e., for Stream Types A1, A2, A3, B1, B2, B3, C2 & E3 $n =$		ft / sec		cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)		ft / sec		cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)		ft / sec		cfs
4. Continuity Equations: a) USGS Gage Data $\bar{u} = Q / A$ **Return Period for Bankfull Q** $Q =$ **1.5** **year**	**5.00**	ft / sec	**2935.0**	cfs
4. Continuity Equations: b) Regional Curves $\bar{u} = Q / A$	**5.26**	ft / sec	**3087.6**	cfs

Protrusion Height Options for the D_{84} Term in the Relative Roughness Relation (R/D_{84}) – Estimation Method 1

Option 1. For **sand-bed** channels: Measure 100 **"protrusion heights"** of sand dunes from the downstream side of feature to the top of feature. Substitute the D_{84} sand dune protrusion height in ft for the D_{84} term in method 1.

Option 2. For **boulder-dominated** channels: Measure 100 **"protrusion heights"** of boulders on the sides from the bed elevation to the top of the rock on that side. Substitute the D_{84} boulder protrusion height in ft for the D_{84} term in method 1.

Option 3. For **bedrock-dominated** channels: Measure 100 **"protrusion heights"** of rock separations, steps, joints or uplifted surfaces above channel bed elevation. Substitute the D_{84} bedrock protrusion height in ft for the D_{84} term in method 1.

Option 4. For **log-influenced** channels: Measure "**protrustion heights**" proportionate to channel width of log diameters or the height of the log on upstream side if embedded. Substitute the D_{84} protrusion height in ft for the D_{84} term in method 1.

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Worksheet 2-3. Field form for *Level II* stream classification.

Stream:	**Housatonic River Reach 5A-1**				
Basin:		Drainage Area:	acres	**131**	mi^2
Location:	**Pittsfield MA**				
Twp.&Rge:		Sec.&Qtr.:			
Cross-Section Monuments (Lat./Long.):				Date:	**1/19/2026**
Observers:	**RGJ**			Landscape Type:	**U-AL-FD**

Bankfull Width (W_{bkf}) The surface width of the stream at bankfull stage elevation, in a riffle section.	**93.0**	ft
Bankfull Mean Depth (d_{bkf}) Mean depth of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A_{bkf} / W_{bkf}$).	**6.31**	ft
Bankfull Cross-Sectional Area (A_{bkf}) Area of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**587.0**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) *Bankfull Width* divided by *Bankfull Mean Depth*, in a riffle section.	**14.7**	ft/ft
Bankfull Maximum Depth (d_{max}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	**8.38**	ft
Flood-Prone Area Width (W_{fpa}) Width of the channel at an elevation that is twice the *Bankfull Maximum Depth*, measured perpendicular to the fall line of the valley in a riffle section.	**1200.00**	ft
Entrenchment Ratio (ER) The *Flood-Prone Area Width* divided by *Bankfull Width* (W_{fpa} / W_{bkf}), in a riffle section.	**12.90**	ft/ft
Channel Materials (Particle Size Index D_{50}) The D_{50} particle size index represents the median or dominant diameter of channel materials, as sampled proportionately from the channel surface between the bankfull stage and Thalweg elevations.	**10**	mm
Average Water Surface Slope (S) The elevation difference of water surface measurements over the stream length between two similar bed features (e.g., start of riffle to start of last riffle) for several riffle–pool or step–pool sequences, representing channel gradient.	**0.0006**	ft/ft
Channel Sinuosity (k) An index of channel pattern determined from stream length divided by valley length (SL / VL), or from valley slope divided by average water surface slope (S_{val} / S).	**1.29**	ft/ft

Stream Type **C4** **See Classification Key (Figure 2-35)**

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Worksheet 2-4a. Morphological relations, including dimensionless ratios of river reach sites.

Stream: **Housatonic River Reach 5A-1** Location: **Pittsfield MA**

Observers: **RGJ** Date: **1/19/2026** Landscape Type: **U-AL-FD** Stream Type: **C4**

River Reach Dimension Summary Data…..1

Riffle Dimensions*, **, *

Riffle Dimensions*, **, ***	Mean	Min.	Max.		Riffle Dimensions & Dimensionless Ratios****	Mean	Min.	Max.
Riffle Width (W_{bkf})	**99.6**	**93.0**	**118.7**	ft	Riffle Cross-Sectional Area (A_{bkf}) (ft^2)	**587.8**	**580.0**	**611.0**
Riffle Mean Depth (d_{bkf})	**5.95**	**4.90**	**6.50**	ft	Riffle Width/Depth Ratio (W_{bkf} / d_{bkf})	**17.0**	**14.2**	**24.3**
Riffle Maximum Depth (d_{max})	**8.21**	**7.70**	**8.60**	ft	Riffle Max Depth to Riffle Mean Depth (d_{max} / d_{bkf})	**1.4**	**1.3**	**1.6**
Width of Flood-Prone Area (W_{fpa})	**825**	**310**	**1200**	ft	Entrenchment Ratio (W_{fpa} / W_{bkf})	**8.4**	**3.3**	**12.9**
Riffle Inner Berm Width (W_{ib})				ft	Riffle Inner Berm Width to Riffle Width (W_{ib} / W_{bkf})			
Riffle Inner Berm Depth (d_{ib})				ft	Riffle Inner Berm Depth to Mean Depth (d_{ib} / d_{bkf})			
Riffle Inner Berm Area (A_{ib})				ft^2	Riffle Inner Berm Area to Riffle Area (A_{ib} / A_{bkf})			
Riffle Inner Berm W/d Ratio (W_{ib} / d_{ib})								

Pool Dimensions*, **, *

Pool Dimensions*, **, ***	Mean	Min.	Max.		Pool Dimensions & Dimensionless Ratios****	Mean	Min.	Max.
Pool Width (W_{bkfp})	**94.0**	**83.1**	**101.4**	ft	Pool Width to Riffle Width (W_{bkfp} / W_{bkf})	**1.05**		
Pool Mean Depth (d_{bkfp})	**6.37**	**6.10**	**6.30**	ft	Pool Mean Depth to Riffle Mean Depth (d_{bkfp} / d_{bkf})	**1.06**		
Pool Cross-Sectional Area (A_{bkfp})	**599.9**	**558.0**	**622.8**	ft	Pool Area to Riffle Area (A_{bkfp} / A_{bkf})	**1.02**		
Pool Maximum Depth (d_{maxp})	**11.50**	**10.80**	**12.40**	ft	Pool Max Depth to Riffle Mean Depth (d_{maxp} / d_{bkf})	**1.93**		
Pool Inner Berm Width (W_{ibp})				ft	Pool Inner Berm Width to Pool Width (W_{ibp} / W_{bkfp})			
Pool Inner Berm Depth (d_{ibp})				ft	Pool Inner Berm Depth to Pool Depth (d_{ibp} / d_{bkfp})			
Pool Inner Berm Area (A_{ibp})				ft^2	Pool Inner Berm Area to Pool Area (A_{ibp} / A_{bkfp})			
Point Bar Slope (S_{pb})				ft/ft	Pool Inner Berm Width/Depth Ratio (W_{ibp} / d_{ibp})			

Run Dimensions*

Run Dimensions*	Mean	Min.	Max.		Run Dimensionless Ratios****	Mean	Min.	Max.
Run Width (W_{bkfr})				ft	Run Width to Riffle Width (W_{bkfr} / W_{bkf})			
Run Mean Depth (d_{bkfr})				ft	Run Mean Depth to Riffle Mean Depth (d_{bkfr} / d_{bkf})			
Run Cross-Sectional Area (A_{bkfr})				ft	Run Area to Riffle Area (A_{bkfr} / A_{bkf})			
Run Maximum Depth (d_{maxr})				ft	Run Max Depth to Riffle Mean Depth (d_{maxr} / d_{bkf})			
Run Width/Depth Ratio (W_{bkfr} / d_{bkfr})				ft				

Glide Dimensions*

Glide Dimensions*	Mean	Min.	Max.		Glide Dimensions & Dimensionless Ratios****	Mean	Min.	Max.
Glide Width (W_{bkfg})				ft	Glide Width to Riffle Width (W_{bkfg} / W_{bkf})			
Glide Mean Depth (d_{bkfg})				ft	Glide Mean Depth to Riffle Mean Depth (d_{bkfg} / d_{bkf})			
Glide Cross-Sectional Area (A_{bkfg})				ft	Glide Area to Riffle Area (A_{bkfg} / A_{bkf})			
Glide Maximum Depth (d_{maxg})				ft	Glide Max Depth to Riffle Mean Depth (d_{maxg} / d_{bkf})			
Glide Width/Depth Ratio (W_{bkfg} / d_{bkfg})				ft/ft	Glide Inner Berm Width/Depth Ratio (W_{ibg} / d_{ibg})			
Glide Inner Berm Width (W_{ibg})				ft	Glide Inner Berm Width to Glide Width (W_{ibg}/W_{bkfg})			
Glide Inner Berm Depth (d_{ibg})				ft	Glide Inner Berm Depth to Glide Depth (d_{ibg} / d_{bkfg})			
Glide Inner Berm Area (A_{ibg})				ft^2	Glide Inner Berm Area to Glide Area (A_{ibg} / A_{bkfg})			

Step Dimensions**

Step Dimensions**	Mean	Min.	Max.		Step Dimensionless Ratios****	Mean	Min.	Max.
Step Width (W_{bkfs})				ft	Step Width to Riffle Width (W_{bkfs} / W_{bkf})			
Step Mean Depth (d_{bkfs})				ft	Step Mean Depth to Riffle Mean Depth (d_{bkfs} / d_{bkf})			
Step Cross-Sectional Area (A_{bkfs})				ft	Step Area to Riffle Area (A_{bkfs} / A_{bkf})			
Step Maximum Depth (d_{maxs})				ft	Step Max Depth to Riffle Mean Depth (d_{maxs} / d_{bkf})			
Step Width/Depth Ratio (W_{bkfs} / d_{bkfs})				ft/ft				

*Riffle–Pool system (i.e., C, E, F stream types) bed features include riffles, runs, pools, and glides.

**Step–Pool system (i.e., A, B, G stream types) bed features include riffles, rapids, chutes, pools, and steps (note: include rapids and chutes in riffle category).

***Convergence-Divergence system (i.e., D stream types) bed features include riffles and pools; cross-sections taken at riffles for classification purposes.

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Worksheet 2-4b. Morphological relations, including dimensionless ratios of river reach sites.

Stream: **Housatonic River Reach 5A-1** Location: **Pittsfield MA**

Observers: **RGJ** Date: **1/19/2026** Landscape Type: **U-AL-FD** Stream Type: **C4**

River Reach Summary Data…..2

Hydraulics

Streamflow: Estimated Mean Velocity at Bankfull Stage ($\bar{u}_{bkf}$)	**5.3**	ft/sec	Estimation Method	**Regional Curve**	
Streamflow: Estimated Discharge at Bankfull Stage (Q_{bkf})	**3087.0**	cfs	Drainage Area	**131.0**	mi^2

Channel Pattern

Geometry	Mean	Min.	Max.		Dimensionless Geometry Ratios	Mean	Min.	Max.
Linear Wavelength (λ)	**719.0**	**560.0**	**984.0**	ft	Linear Wavelength to Riffle Width (λ / W_{bkf})	**7.22**	**5.62**	**9.88**
Stream Meander Length (L_m)	**924.0**	**598.0**	**1461.0**	ft	Stream Meander Length Ratio (L_m / W_{bkf})	**9.28**	**6.00**	**14.67**
Radius of Curvature (R_c)	**237.0**	**90.0**	**531.0**	ft	Radius of Curvature to Riffle Width (R_c / W_{bkf})	**2.38**	**0.90**	**5.33**
Belt Width (W_{blt})	**193.0**	**61.0**	**360.0**	ft	Meander Width Ratio (W_{blt} / W_{bkf})	**1.94**	**0.61**	**3.61**
Arc Length (L_a)	**175.7**	**38.0**	**624.6**	ft	Arc Length to Riffle Width (L_a / W_{bkf})	**1.76**	**0.38**	**6.27**
Riffle Length (L_r)				ft	Riffle Length to Riffle Width (L_r / W_{bkf})			
Individual Pool Length (L_p)				ft	Individual Pool Length to Riffle Width (L_p / W_{bkf})			
Pool-to-Pool Spacing (P_s)				ft	Pool-to-Pool Spacing to Riffle Width (P_s / W_{bkf})			

Channel Profile

Valley Slope (S_{val})	**0.0008**	ft/ft	Average Water Surface Slope (S)	**0.0006**	ft/ft	Sinuosity (S_{val} / S)		**1.33**
Stream Length (SL)	**5800.0**	ft	Valley Length (VL)	**4617.0**	ft	Sinuosity (SL / VL)		**1.26**
Low Bank Height (LBH)	start **7.90** ft end **8.99** ft		Bankfull Max Depth (d_{max})	start **7.90** ft end **8.01** ft		Bank-Height Ratio (BHR) (LBH / d_{max})	start **1.0** end **1.1**	

Facet Slopes	Mean	Min.	Max.		Dimensionless Facet Slope Ratios	Mean	Min.	Max.
Riffle Slope (S_{rif})				ft/ft	Riffle Slope to Average Water Surface Slope (S_{rif} / S)			
Run Slope (S_{run})				ft/ft	Run Slope to Average Water Surface Slope (S_{run} / S)			
Pool Slope (S_p)				ft/ft	Pool Slope to Average Water Surface Slope (S_p / S)			
Glide Slope (S_g)				ft/ft	Glide Slope to Average Water Surface Slope (S_g / S)			
Step Slope (S_s)				ft/ft	Step Slope to Average Water Surface Slope (S_s / S)			

Max Depths[a]	Mean	Min.	Max.		Dimensionless Depth Ratios	Mean	Min.	Max.
Max Riffle Depth (d_{max})				ft	Max Riffle Depth to Mean Riffle Depth (d_{max} / d_{bkf})			
Max Run Depth (d_{maxr})				ft	Max Run Depth to Mean Riffle Depth (d_{maxr} / d_{bkf})			
Max Pool Depth (d_{maxp})				ft	Max Pool Depth to Mean Riffle Depth (d_{maxp} / d_{bkf})			
Max Glide Depth (d_{maxg})				ft	Max Glide Depth to Mean Riffle Depth (d_{maxg} / d_{bkf})			
Max Step Depth (d_{maxs})				ft	Max Step Depth to Mean Riffle Depth (d_{maxs} / d_{bkf})			

Channel Materials

	Reach[b]	Riffle[c]	Bar		Reach[b]	Riffle[c]	Bar	Protrusion Height[d]	
% Silt/Clay		**0**	**0**	D_{16}		**0.24**	**2.99**		mm
% Sand		**25**	**12**	D_{35}		**6.44**	**10.20**		mm
% Gravel		**75**	**73**	D_{50}		**9.89**	**18.91**		mm
% Cobble		**0**	**15**	D_{84}		**19.64**	**63.32**		mm
% Boulder		**0**	**0**	D_{95}		**29.18**	**72.17**		mm
% Bedrock		**0**	**0**	D_{100}		**64**	**76.20**		mm

[a] *Mean* , *Min* ., and *Max* . depths are measured from Thalweg to bankfull at mid-point of feature for riffles, runs, and steps, the deepest part of pools, and at the tail-out of glides.

[b] Composite sample of riffles and pools within the designated reach. [c] Active bed of a riffle. [d] Height of roughness feature above bed.

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Worksheet 3-2. Flow regime variables that influence channel characteristics, sediment regime, and biological interpretations.

Flow Regime

Stream:	**Housatonic River Reach 5A-1**	Stream Type:	**C4**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

List ALL COMBINATIONS that APPLY…….☞								
	P	**2**						

General Category

E	***Ephemeral stream channel:*** Flows only in response to precipitation.
S	***Subterranean stream channel:*** Flows parallel to and near the surface for various seasons – a sub-surface flow that follows the stream bed.
I	***Intermittent stream channel:*** Surface water flows discontinuously along its length. Often associated with sporadic or seasonal flows and also with Karst (limestone) geology where losing/gaining reaches create flows that disappear then reappear farther downstream.
P	***Perennial stream channels:*** Surface water persists yearlong.

Specific Category

1	Seasonal variation in streamflow dominated primarily by snowmelt runoff.
2	Seasonal variation in streamflow dominated primarily by stormflow runoff.
3	Uniform stage and associated streamflow due to spring-fed condition, backwater, etc.
4	Streamflow regulated by glacial melt.
5	Ice flows/ice torrents from ice dam breaches.
6	Alternating flow/backwater due to tidal influence.
7	Regulated streamflow due to diversions, dam release, dewatering, etc.
8	Altered due to development, such as urban streams, cut-over watersheds, or vegetation conversions (forested to grassland) that change flow response to precipitation events.
9	Rain-on-snow generated runoff.

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Worksheet 3-3. Stream order and stream size categories for stratification by stream type.

Stream Size and Order			
Stream:	**Housatonic River Reach 5A-1**		
Location:	**Pittsfield MA**		
Observers:	**RGJ**	Stream Type:	**C4**
Landscape Type:	**U-AL-FD**	Date:	**1/19/2026**

Stream Size Category and Order ☞	**S-8(4)**

Category	STREAM SIZE: Bankfull Width		Check (✓) Appropriate Category
	meters	feet	
S-1	0.305	<1	☐
S-2	0.3 – 1.5	1 – 5	☐
S-3	1.5 – 4.6	5 – 15	☐
S-4	4.6 – 9.0	15 – 30	☐
S-5	9.0 – 15.0	30 – 50	☐
S-6	15.0 – 22.8	50 – 75	☐
S-7	22.8 – 30.5	75 – 100	☐
S-8	30.5 – 46.0	100 – 150	☑
S-9	46 – 76	150 – 250	☐
S-10	76 – 107	250 – 350	☐
S-11	107 – 150	350 – 500	☐
S-12	150 – 305	500 – 1000	☐
S-13	>305	>1000	☐

Stream Order

Add categories in parenthesis for specific stream order of reach. For example, a third-order stream with a bankfull width of 6.1 meters (20 feet) would be indexed as: S-4(3).

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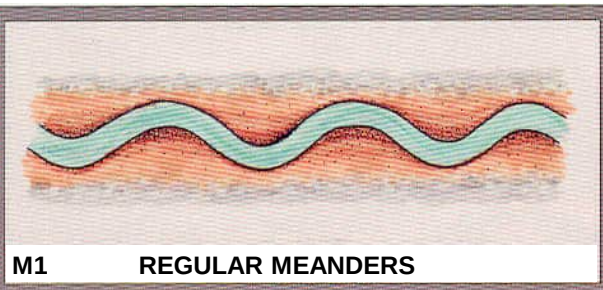
Worksheet 3-4. Meander pattern relations used for interpretations for river stability.

Meander Patterns

Stream:	**Housatonic River Reach 5A-1**	Stream Type:	**C4**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

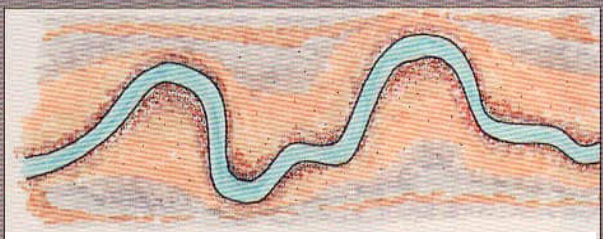
List ALL CATEGORIES that APPLY ☞	M3				

Various Meander Pattern Variables modified from Galay et al. (1973)

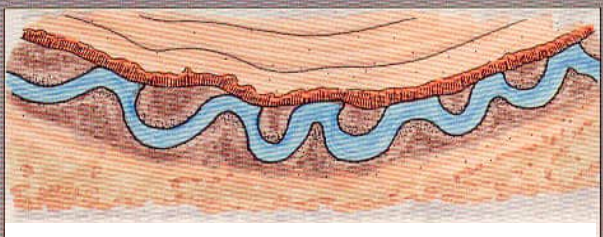


M1 REGULAR MEANDERS

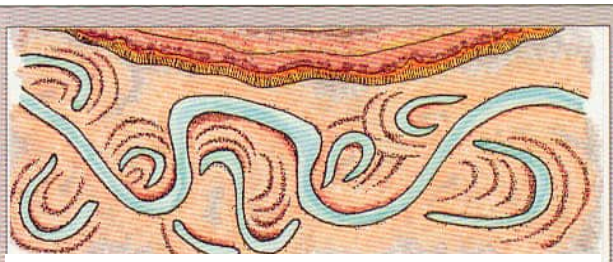
M2 TORTUOUS MEANDERS



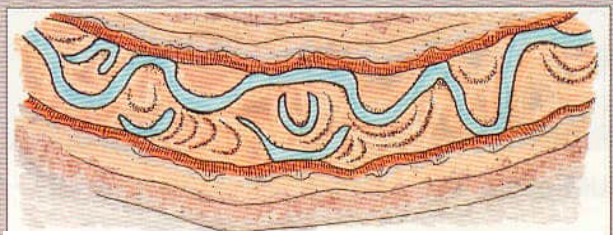
M3 IRREGULAR MEANDERS



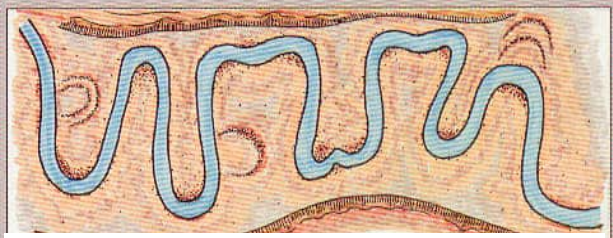
M4 TRUNCATED MEANDERS



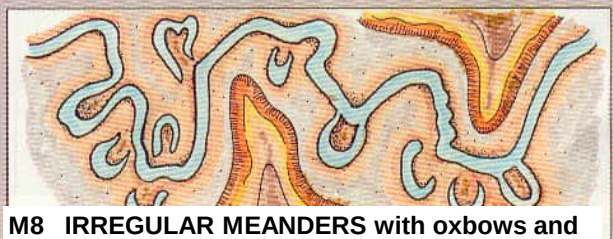
M5 UNCONFINED MEANDER SCROLLS



M6 CONFINED MEANDER SCROLLS



M7 DISTORTED MEANDER LOOPS



M8 IRREGULAR MEANDERS with oxbows and oxbow cutoffs

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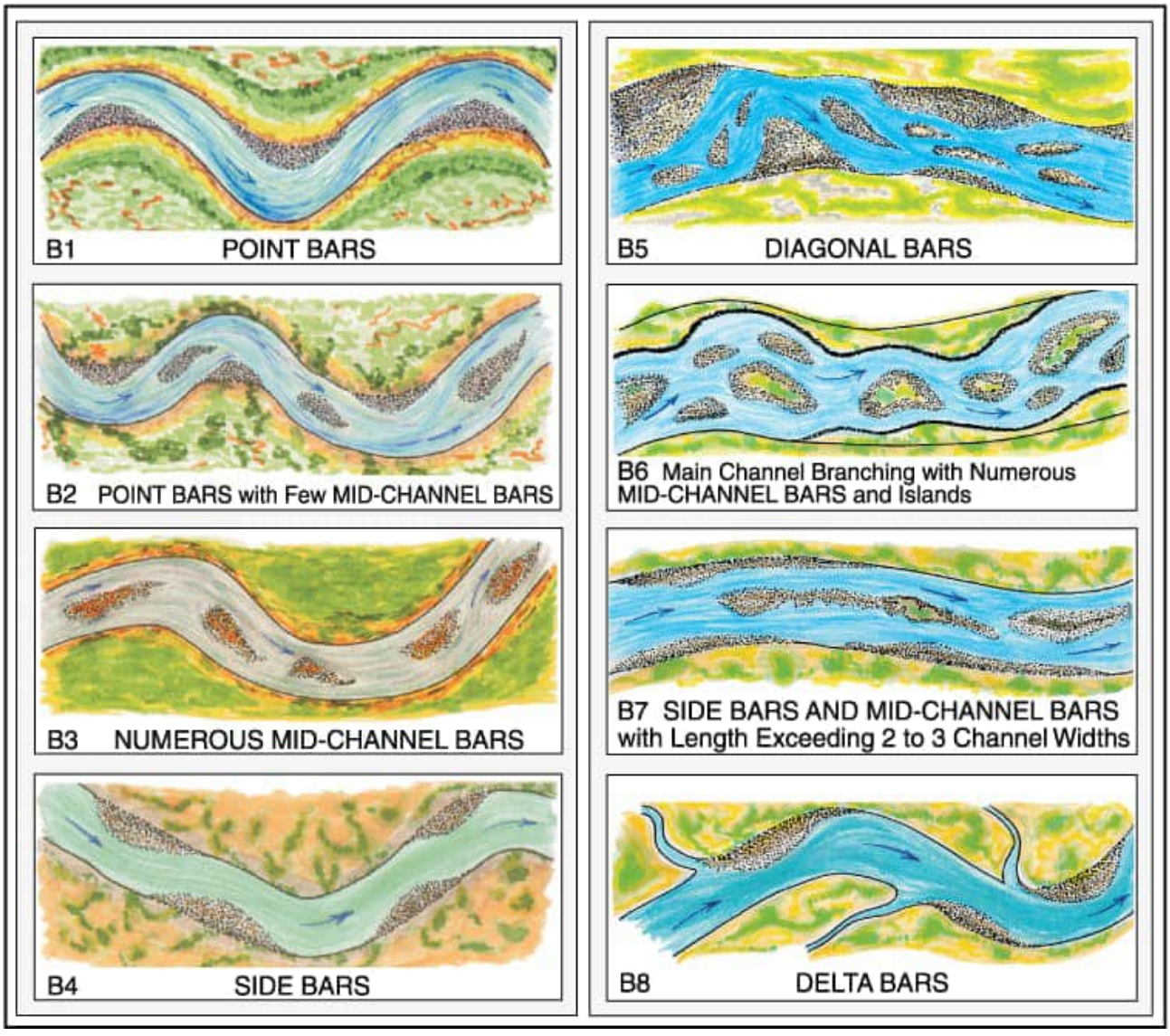
Worksheet 3-5. Depositional patterns used for stabiilty assessments.

Depositional Patterns

Stream:	**Housatonic River Reach 5A-1**	Stream Type:	**C4**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

List ALL CATEGORIES that APPLY ☞	B1	B4			

Various Depositional Features modified from Galay et al. (1973)



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Worksheet 3-6. Various categories of in-channel debris, dams, and channel blockages used to evaluate channel stability.

Channel Blockages			
Stream:	**Housatonic River Reach 5A-1**	Stream Type:	**C4**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

Description/Extent		Materials that upon placement into the active channel or flood-prone area may cause adjustments in channel dimensions or conditions due to influences on the existing flow regime.	Check (✓) all that apply
D1	None	Minor amounts of small, floatable material.	☐
D2	Infrequent	Debris consists of small, easily moved, floatable material, e.g., leaves, needles, small limbs, and twigs.	☐
D3	Moderate	Increasing frequency of small- to medium-sized material, such as large limbs, branches, and small logs, that when accumulated affect 10% or less of the active channel cross-sectional area.	☑
D4	Numerous	Significant build-up of medium- to large-sized materials, e.g., large limbs, branches, small logs, or portions of trees, occupying 10–30% of the active channel cross-sectional area.	☑
D5	Extensive	Debris "dams" of predominantly larger materials, e.g., branches, logs, and trees, occupying 30–50% of the active channel cross-sectional area, often extending across the width of the active channel.	☐
D6	Dominating	Large, somewhat continuous, debris "dams," extensive in nature and occupying over 50% of the active channel cross-sectional area. Such accumulations may divert water into the flood-prone areas and form fish migration barriers, even when flows are at less than bankfull.	☐
D7	Beaver Dams: Few	An infrequent number of dams spaced such that normal streamflow and expected channel conditions exist in the reaches between dams.	☐
D8	Beaver Dams: Frequent	Frequency of dams is such that backwater conditions exist for channel reaches between structures where streamflow velocities are reduced and channel dimensions or conditions are influenced.	☐
D9	Beaver Dams: Abandoned	Numerous abandoned dams, many of which have filled with sediment or breached, initiating a series of channel adjustments, such as streambank erosion, lateral migration, avulsion, aggradation, or degradation.	☐
D10	Human Influences	Structures, facilities, or materials related to land uses or development located within the flood-prone area, such as diversions or low-head dams, controlled by-pass channels, velocity control structures, and various transportation encroachments that have an influence on the existing flow regime, such that significant channel adjustments occur.	☐

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Worksheet 3-7. Relationship of Bank-Height Ratio (BHR) ranges to corresponding stream stability ratings.

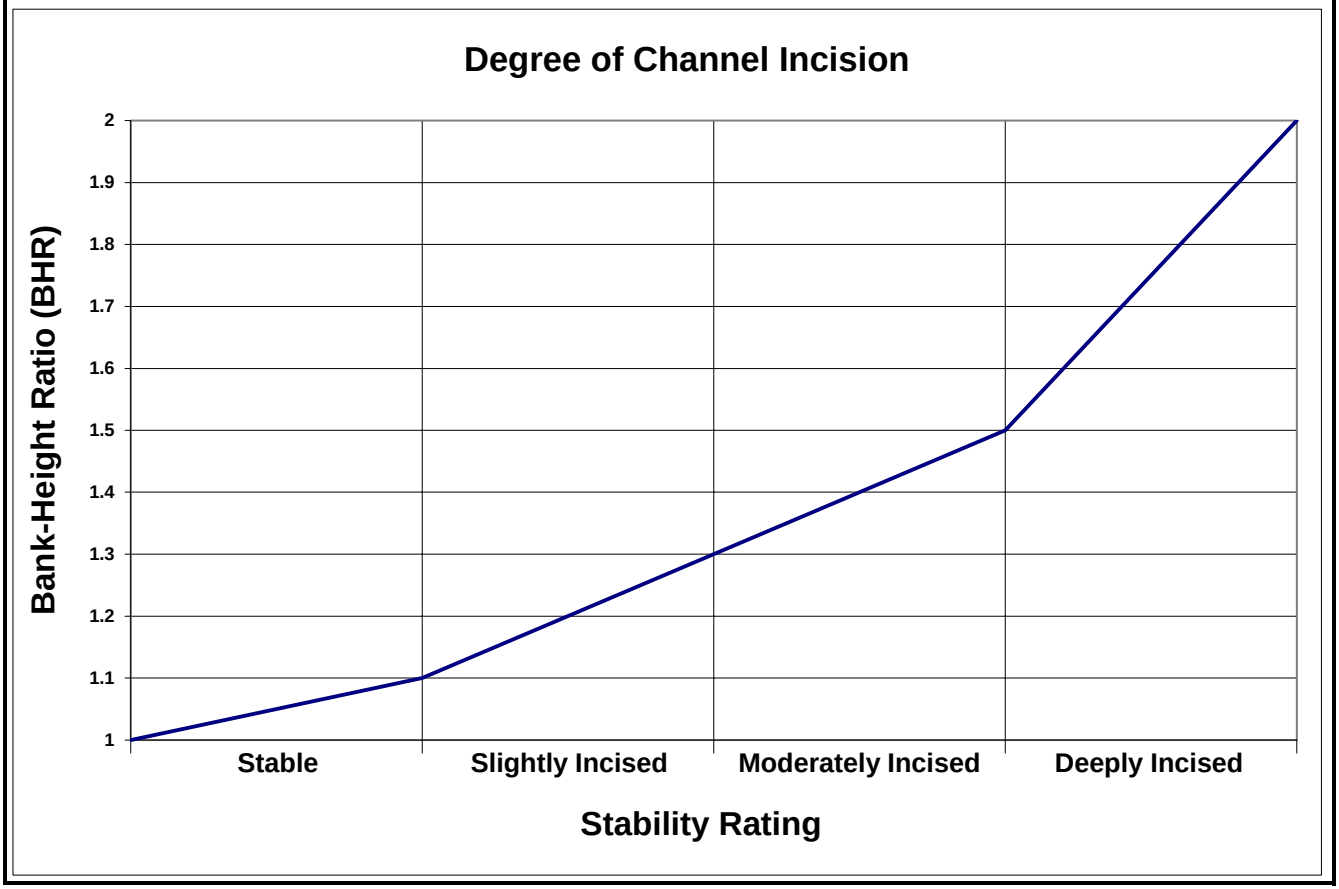
Degree of Channel Incision

Stream:	**Housatonic River Reach 5A-1**	Stream Type:	**C4**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

Low Bank Height:	**8.38**
Bankfull Max Depth:	**8.38**

Bank-Height Ratio (BHR):	**1.00**

Degree of Channel Incision Stability Rating ☞ **Stable**



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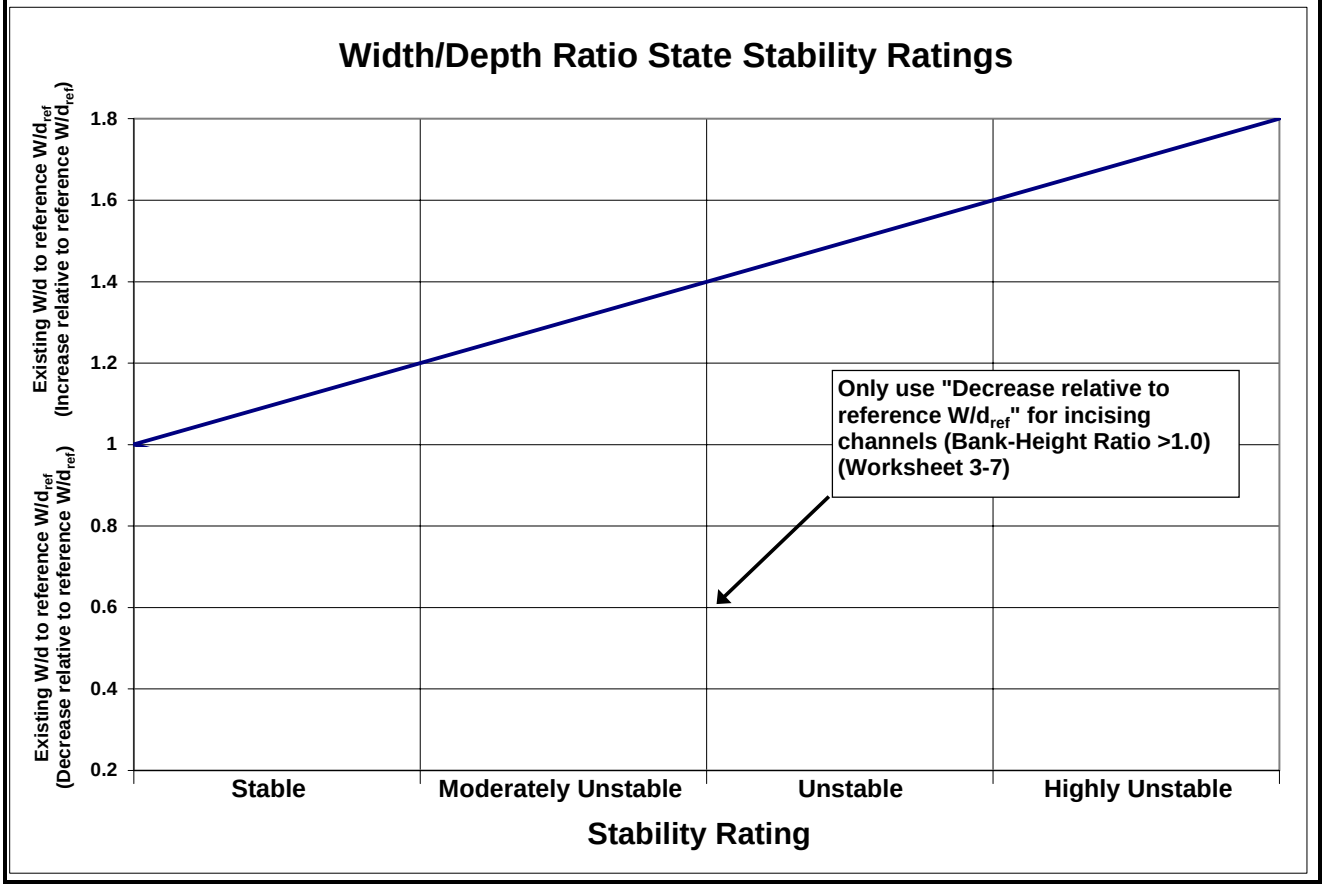
Worksheet 3-8. Stability ratings based on departure of width/depth ratio from reference condition.

Width/Depth Ratio State

Stream:	**Housatonic River Reach 5A-1**	Stream Type:	**C4**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

Existing Width/Depth Ratio (W/d):	**14.7**	Existing W/d to Reference W/d_{ref} :	**1.05**
Reference Width/Depth Ratio (W/d_{ref}):	**14**		

Width/Depth Ratio State Stability Rating ☞ **Stable**



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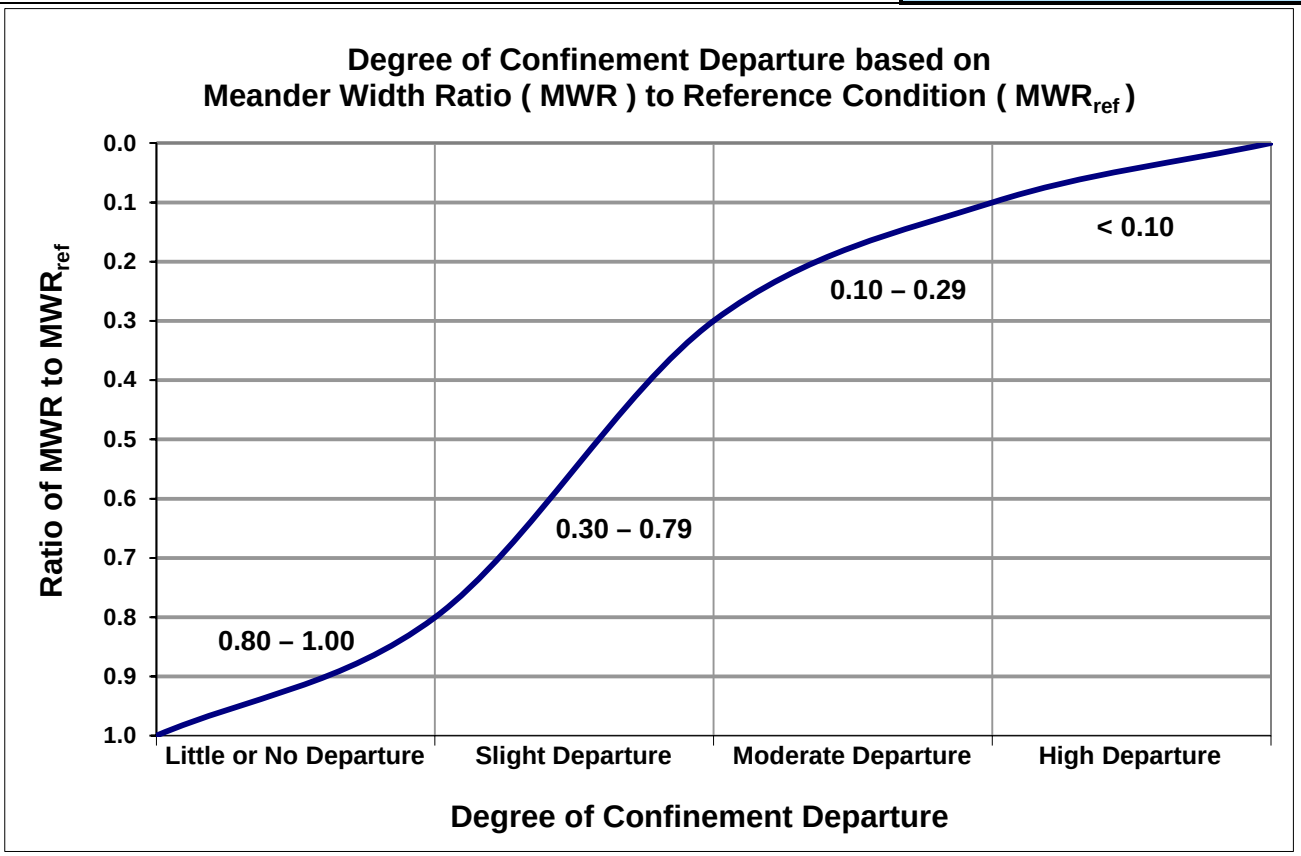
Worksheet 3-9. Degree of confinement departure based on Meander Width Ratio (MWR) divided by reference condition Meander Width Ratio (MWR_{ref}).

Degree of Confinement

Stream:	**Housatonic River Reach 5A-1**	Stream Type:	**C4**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

Existing Meander Width Ratio (MWR):	**1.69**	Ratio of MWR to MWR_{ref} :	**0.34**
Reference Meander Width Ratio (MWR_{ref}):	**5**		

Degree of Confinement Stability Rating ☞ **Slight**



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Worksheet 3-10. Pfankuch (1975) channel stability rating procedure, as modified by Rosgen (1996, 2006b).

Stream: Housatonic River Reach 5A-1 **Location:** Pittsfield MA **Landscape Type:** U-AL-FD **Observers:** RGJ **Date:** 1/19/2026

Loca-tion	Key	Category	Excellent		Good		Fair		Poor	
			Description	Rating	Description	Rating	Description	Rating	Description	Rating
Upper banks	1	Landform slope	Bank slope gradient <30%.	2	Bank slope gradient 30–40%.	4	Bank slope gradient 40–60%.	6	Bank slope gradient > 60%.	8
	2	Mass erosion	No evidence of past or future mass erosion.	3	Infrequent. Mostly healed over. Low future potential.	6	Frequent or large, causing sediment nearly yearlong.	9	Frequent or large, causing sediment nearly yearlong OR imminent danger of same.	12
	3	Debris jam potential	Essentially absent from immediate channel area.	2	Present, but mostly small twigs and limbs.	4	Moderate to heavy amounts, mostly larger sizes.	6	Moderate to heavy amounts, predominantly larger sizes.	8
	4	Vegetative bank protection	> 90% plant density. Vigor and variety suggest a deep, dense, soil-binding root mass.	3	70–90% density. Fewer species or less vigor suggest less dense or deep root mass.	6	50–70% density. Lower vigor and fewer species from a shallow, discontinuous root mass.	9	<50% density plus fewer species and less vigor indicating poor, discontinuous, and shallow root mass.	12
Lower banks	5	Channel capacity	Bank heights sufficient to contain the bankfull stage. Width/depth ratio departure from reference width/depth ratio = 1.0. Bank-Height Ratio (BHR) = 1.0.	1	Bankfull stage is contained within banks. Width/depth ratio departure from reference width/depth ratio = 1.0–1.2. Bank-Height Ratio (BHR) = 1.0–1.1.	2	Bankfull stage is not contained. Width/depth ratio departure from reference width/depth ratio = 1.2–1.4. Bank-Height Ratio (BHR) = 1.1–1.3.	3	Bankfull stage is not contained; over-bank flows are common with flows less than bankfull. Width/depth ratio departure from reference width/depth ratio > 1.4. Bank-Height Ratio (BHR) > 1.3.	4
	6	Bank rock content	> 65% with large angular boulders. 12"+ common.	2	40–65%. Mostly boulders and small cobbles 6–12".	4	20–40%. Most in the 3–6" diameter class.	6	<20% rock fragments of gravel sizes, 1–3" or less.	8
	7	Obstructions to flow	Rocks and logs firmly imbedded. Flow pattern w/o cutting or deposition. Stable bed.	2	Some present causing erosive cross currents and minor pool filling. Obstructions fewer and less firm.	4	Moderately frequent, unstable obstructions move with high flows causing bank cutting and pool filling.	6	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	8
	8	Cutting	Little or none. Infrequent raw banks <6".	4	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12".	6	Significant. Cuts 12–24" high. Root mat overhangs and sloughing evident.	12	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
	9	Deposition	Little or no enlargement of channel or point bars.	4	Some new bar increase, mostly from coarse gravel.	8	Moderate depostion of new gravel and coarse sand on old and some new bars.	12	Extensive deposit of predominantly fine particles. Accelerated bar development.	16
Bottom	10	Rock angularity	Sharp edges and corners. Plane surfaces rough.	1	Rounded corners and edges. Surfaces smooth and flat.	2	Corners and edges well-rounded in two dimensions.	3	Well-rounded in all dimensions, surfaces smooth.	4
	11	Brightness	Surfaces dull, dark, or stained. Generally not bright.	1	Mostly dull, but may have <35% bright surfaces.	2	Mixture dull and bright, i.e., 35–65% mixture range.	3	Predominantly bright, > 65%, exposed or scoured surfaces.	4
	12	Consolidation of particles	Assorted sizes tightly packed or overlapping.	2	Moderately packed with some overlapping.	4	Mostly loose assortment with no apparent overlap.	6	No packing evident. Loose assortment, easily moved.	8
	13	Bottom size distribution	No size change evident. Stable material 80–100%.	4	Distribution shift light. Stable material 50–80%.	8	Moderate change in sizes. Stable materials 20–50%.	12	Marked distribution change. Stable materials 0–20%.	16
	14	Scouring and deposition	<5% of bottom affected by scour or deposition.	6	5–30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12	30–50% affected. Deposits and scour at obstructions, constrictions, and bends. Some filling of pools.	18	More than 50% of the bottom in a state of flux or change nearly yearlong.	24
	15	Aquatic vegetation	Abundant growth moss-like, dark green perennial. In swift water too.	1	Common. Algae forms in low velocity and pool areas. Moss here too.	2	Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick.	3	Perennial types scarce or absent. Yellow-green, short-term bloom may be present.	4
			Excellent Total =		**Good Total =**	**42**	**Fair Total =**	**33**	**Poor Total =**	**20**

Stream type	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6	D3	D4	D5	D6
Good (Stable)	38-43	38-43	54-90	60-95	60-95	50-80	38-45	38-45	40-60	40-64	48-68	40-60	38-50	38-50	60-85	70-90	70-90	60-85	85-107	85-107	85-107	67-98
Fair (Mod. unstable)	44-47	44-47	91-129	96-132	96-142	81-110	46-58	46-58	61-78	65-84	69-88	61-78	51-61	51-61	86-105	91-110	91-110	86-105	108-132	108-132	108-132	99-125
Poor (Unstable)	48+	48+	130+	133+	143+	111+	59+	59+	79+	85+	89+	79+	62+	62+	106+	111+	111+	106+	133+	133+	133+	126+

Stream type	DA3	DA4	DA5	DA6	E3	E4	E5	E6	F1	F2	F3	F4	F5	F6	G1	G2	G3	G4	G5	G6
Good (Stable)	40-63	40-63	40-63	40-63	40-63	50-75	50-75	40-63	60-85	60-85	85-110	85-110	90-115	80-95	40-60	40-60	85-107	85-107	90-112	85-107
Fair (Mod. unstable)	64-86	64-86	64-86	64-86	64-86	76-96	76-96	64-86	86-105	86-105	111-125	111-125	116-130	96-110	61-78	61-78	108-120	108-120	113-125	108-120
Poor (Unstable)	87+	87+	87+	87+	87+	97+	97+	87+	106+	106+	126+	126+	131+	111+	79+	79+	121+	121+	126+	121+

Grand Total =	**95**
Existing Stream Type =	**C4**
***Potential Stream Type =**	**C4**
Modified channel stability rating =	**Fair**

***Rating is adjusted to *potential* stream type, not existing stream type**

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Worksheet 3-14. Sediment competence calculation form to assess bed stability.

Sediment Competence using Dimensional and Dimensionless Shear Stress Methods

Stream:	**Housatonic River Reach 5A-1**		Stream Type: **C4**		
Location:	**Pittsfield MA**		Landscape Type: **U-AL-FD**		
Observers:	**RGJ**		Date: **1/19/2026**		

Enter Required Information for Existing Condition

9.9	D_{50}	Median particle size of riffle bed material (mm)			
18.9	$\hat{D}_{50}$	Median particle size of bar or sub-pavement sample (mm)			
0.25	D_{max}	Largest particle from bar sample (ft)	**76**	**(mm)**	304.8 mm/ft
0.0006	S	Existing average water surface slope (ft/ft)			
6.30	d	Existing bankfull mean depth (ft)			
1.65	γ_s-γ/γ	Immersed specific gravity of sediment			

Select the Appropriate Equation and Calculate Critical Dimensionless Shear Stress

0.52	$D_{50}/\hat{D}_{50}$	Range: 3 – 7	Use EQUATION 1:	$\tau^* = 0.0834\,(\,D_{50}/\hat{D}_{50})^{-0.872}$
7.68	D_{max}/D_{50}	Range: 1.3 – 3.0	Use EQUATION 2:	$\tau^* = 0.0384\,(D_{max}/D_{50})^{-0.887}$
N/A	τ^*	Bankfull Dimensionless Shear Stress	EQUATION USED:	**N/A**

Calculate Bankfull Mean Depth Required for Entrainment of Largest Particle in Bar Sample

N/A	**d**	Required bankfull mean depth (ft) $d = \frac{\tau^*(\gamma_s - 1)D_{max}}{S}$	(use D_{max} in ft)

Calculate Average Water Surface Slope Required for Entrainment of Largest Particle in Bar Sample

N/A	**S**	Required average water surface slope (ft/ft) $S = \frac{\tau^*(\gamma_s - 1)D_{max}}{d}$	(use D_{max} in ft)

Check: ☐ Stable ☐ Aggrading ☐ Degrading

Sediment Competence Using Dimensional Shear Stress

Shields	CO	
0.236		Bankfull shear stress $\tau = \gamma dS$ (lbs/ft^2) (substitute hydraulic radius, R, with mean depth, d) γ = 62.43, d = existing depth, S = existing slope
17	**53**	Predicted largest moveable particle size (mm) at bankfull shear stress τ **(Figure 3-11)**
0.976	**0.390**	Predicted shear stress required to initiate movement of measured D_{max} (mm) **(Figure 3-11)**
26.06	**10.41**	Predicted mean depth required to initiate movement of measured D_{max} (mm) $d = \frac{\tau}{\gamma S}$ τ = predicted shear stress, γ = 62.43, S = existing slope
0.0025	**0.0010**	Predicted slope required to initiate movement of measured D_{max} (mm) $S = \frac{\tau}{\gamma d}$ τ = predicted shear stress, γ = 62.43, d = existing depth

Check: ☐ Stable ☐ Aggrading ☑ Degrading

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Worksheet 3-15. Stability ratings for stream type stage shifts.

Stream Succession Stage Shifts			
Stream:	**Housatonic River Reach 5A-1**	Stream Type:	**C4**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

Stream Type Stage Shifts (Figure 3-14)	**Stability Rating (Check ✓ Appropriate Rating)**
Stream Type at Potential, (C→E), (F_b→B), (F→B_c), (F→C), (G→B), (D→C)	☐ Stable
(E→C), (B→High W/d B), (C→High W/d C)	☑ Moderately Unstable
(G_c→F), (G→F_b), (F→D), (C→F)	☐ Unstable
(C→D), (A→G), (B→G), (D→G), (C→G), (E→G), (E→A)	☐ Highly Unstable

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Worksheet 3-16. Lateral stability prediction summary.

Lateral Stability Prediction					
Stream:	**Housatonic River Reach 5A-1**		Stream Type: **C4**		
Location:	**Pittsfield MA**		Landscape Type: **U-AL-FD**		
Observers:	**RGJ**		Date: **1/19/2026**		
Lateral stability criteria (choose one stability category for each criterion 1–5)	**Lateral Stability Categories**				**Selected Points (from each row)**
	Stable	***Moderately Unstable***	***Unstable***	***Highly Unstable***	
1 W/d Ratio State (Worksheet 3-8)	< 1.2	1.2 – 1.4	1.4 – 1.6	> 1.6	**2**
	(2)	**(4)**	**(6)**	**(8)**	
2 Depositional Patterns (Worksheet 3-5)	B1, B2	B4, B8	B3	B5, B6, B7	**2**
	(1)	**(2)**	**(3)**	**(4)**	
3 Meander Patterns (Worksheet 3-4)	M1, M3, M4		M2, M5, M6, M7, M8		**1**
	(1)		**(3)**		
4 Streambank Erosion: Unit Rate (Worksheet 3-13)	< 0.006	0.006 – 0.04	0.041 – 0.07	> 0.07	**6**
	(2)	**(4)**	**(6)**	**(8)**	
5 Degree of Confinement (MWR / MWR_{ref}) (Worksheet 3-9)	> 0.8	0.3 – 0.79	0.1 – 0.29	< 0.1	**2**
	(1)	**(2)**	**(3)**	**(4)**	
				Total Points	**13**
	Lateral Stability Category Point Range				
Overall Lateral Stability Category (use total points and check ✓ stability rating)	***Stable*** **< 10** ☐	***Moderately Unstable*** **10 – 12** ☐	***Unstable*** **13 – 21** ☑	***Highly Unstable*** **> 21** ☐	

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Worksheet 3-17. Vertical stability prediction for excess deposition and aggradation.

Vertical Stability Prediction for Excess Deposition and Aggradation					
Stream: **Housatonic River Reach 5A-1**			Stream Type: **C4**		
Location: **Pittsfield MA**			Landscape Type: **U-AL-FD**		
Observers: **RGJ**			Date: **1/19/2026**		
Vertical Stability Criteria (choose one stability category for each criterion 1–6)	**Vertical Stability Categories for Excess Deposition / Aggradation**				**Selected Points (from each row)**
	No Deposition	***Moderate Deposition***	***Excess Deposition***	***Aggradation***	
1 Sediment Competence (Worksheet 3-14)	Sufficient depth and slope to transport largest size available	Trend toward insufficient depth or slope-slightly incompetent	Cannot move D_{35} of bed material and/or D_{100} of bar material	Cannot move D_{16} of bed material and/or D_{100} of bar or sub-pavement size	**2**
	(2)	**(4)**	**(6)**	**(8)**	
2 Sediment Capacity (POWERSED)	Sufficient capacity to transport annual load	Trend toward insufficient sediment capacity	Reduction up to 25% of annual sediment yield of bedload or suspended sand	Reduction over 25% of annual sediment yield for bedload or suspended sand	**2**
	(2)	**(4)**	**(6)**	**(8)**	
3 W/d Ratio State (Worksheet 3-8)	< 1.2	1.2 – 1.4	1.4 – 1.6	> 1.6	**2**
	(2)	**(4)**	**(6)**	**(8)**	
4 Stream Succession Stage Shifts (Worksheet 3-15)	Current stream type at potential or does not indicate deposition/ aggradation	(E→C)	(B→High W/d B), (C→High W/d C), (C→F), (G_c→F), (G→F_b)	(C→D), (F→D)	**4**
	(2)	**(4)**	**(6)**	**(8)**	
5 Depositional Patterns (Worksheet 3-5)	B1	B2, B4	B3, B5	B6, B7, B8	**2**
	(1)	**(2)**	**(3)**	**(4)**	
6 Debris / Blockages (Worksheet 3-6)	D1, D2, D3	D4, D7	D5, D8	D6, D9, D10	**2**
	(1)	**(2)**	**(3)**	**(4)**	
				Total Points	**14**
	Vertical Stability Category Point Range for Excess Deposition and Aggradation				
Vertical Stability for Excess Deposition / Aggradation (use total points and check ✓ stability rating)	***No Deposition*** **< 15** ☑	***Moderate Deposition*** **15 – 20** ☐	***Excess Deposition*** **21 – 30** ☐	***Aggradation*** **> 30** ☐	

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Worksheet 3-18. Vertical stability prediction for channel incision and degradation.

Vertical Stability Prediction for Channel Incision and Degradation					
Stream: **Housatonic River Reach 5A-1**			Stream Type: **C4**		
Location: **Pittsfield MA**			Landscape Type: **U-AL-FD**		
Observers: **RGJ**			Date: **1/19/2026**		
Vertical Stability Criteria (choose one stability category for each criterion 1–5)	**Vertical Stability Categories for Channel Incision / Degradation**				**Selected Points (from each row)**
	Not Incised	***Slightly Incised***	***Moderately Incised***	***Degradation***	
1 Sediment Competence (Worksheet 3-14)	Does not indicate excess competence	Trend to move larger sizes than D_{100} of bar or D_{84} of bed	D_{100} of bed moved	Particles much larger than D_{100} of bed moved	**4**
	(2)	**(4)**	**(6)**	**(8)**	
2 Sediment Capacity (POWERSED)	Does not indicate excess capacity	Slight excess energy: up to 10% increase above reference	Excess energy sufficient to increase load up to 50% of annual load	Excess energy transporting more than 50% of annual load	**4**
	(2)	**(4)**	**(6)**	**(8)**	
3 Degree of Channel Incision (BHR) (Worksheet 3-7)	1.00 – 1.10	1.11 – 1.30	1.31 – 1.50	> 1.50	**2**
	(2)	**(4)**	**(6)**	**(8)**	
4 Stream Succession States (Worksheets 3-15 and 3-7)	Does not indicate incision or degradation	If BHR > 1.1 and stream type has W/d between 5–10	If BHR > 1.1 and stream type has W/d less than 5	(B→G), (C→G), (E→G), (D→G), (A→G), (E→A)	**2**
	(2)	**(4)**	**(6)**	**(8)**	
5 Confinement (MWR / MWR_{ref}) (Worksheet 3-9)	0.80 – 1.00	0.30 – 0.79	0.10 – 0.29	< 0.10	**2**
	(1)	**(2)**	**(3)**	**(4)**	
				Total Points	**14**
	Vertical Stability Category Point Range for Channel Incision and Degradation				
Vertical Stability for Channel Incision/ Degradation (use total points and check ✓ stability rating)	***Not Incised*** **< 12** ☐	***Slightly Incised*** **12 – 18** ☑	***Moderately Incised*** **19 – 27** ☐	***Degradation*** **> 27** ☐	

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Worksheet 3-19. Channel enlargement prediction summary.

Channel Enlargement Prediction					
Stream: **Housatonic River Reach 5A-1**			Stream Type: **C4**		
Location: **Pittsfield MA**			Landscape Type: **U-AL-FD**		
Observers: **RGJ**			Date: **1/19/2026**		
Channel Enlargement Prediction Criteria (choose one stability category for each criterion 1–4)	**Channel Enlargement Prediction Categories**				**Selected Points (from each row)**
	No Increase	***Slight Increase***	***Moderate Increase***	***Extensive***	
1 Stream Succession Stage Shifts (Worksheet 3-15)	Stream Type at Potential, (C→E), (F_b→B), (G→B), (F→B_c), (F→C), (D→C)	(B→High W/d B), (C→High W/d C), (E→C)	(G→F), (F→D)	(C→D), (A→G), (B→G), (D→G), (C→G), (E→G), (E→A), (C→F)	**4**
	(2)	**(4)**	**(6)**	**(8)**	
2 Lateral Stability (Worksheet 3-16)	*Stable*	*Moderately Unstable*	*Unstable*	*Highly Unstable*	**6**
	(2)	**(4)**	**(6)**	**(8)**	
3 Vertical Stability Excess Deposition and Aggradation (Worksheet 3-17)	*No Deposition*	*Moderate Deposition*	*Excess Deposition*	*Aggradation*	**2**
	(2)	**(4)**	**(6)**	**(8)**	
4 Vertical Stability Channel Incision and Degradation (Worksheet 3-18)	*Not Incised*	*Slightly Incised*	*Moderately Incised*	*Degradation*	**4**
	(2)	**(4)**	**(6)**	**(8)**	
				Total Points	**16**
	Category Point Range				
Channel Enlargement Prediction (use total points and check ✓ stability rating)	***No Increase*** **< 11** ☐	***Slight Increase*** **11 – 16** ☑	***Moderate Increase*** **17 – 24** ☐	***Extensive*** **> 24** ☐	

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Worksheet 3-20. Overall sediment supply rating determined from individual stability rating categories.

Overall Sediment Supply Prediction			
Stream: **Housatonic River Reach 5A-1**		Stream Type: **C4**	
Location: **Pittsfield MA**		Landscape Type: **U-AL-FD**	
Observers: **RGJ**		Date: **1/19/2026**	
Overall Sediment Supply Prediction Criteria (choose corresponding points for each criterion 1–5)	**Stability Rating**	**Points**	**Selected Points**
1 Lateral Stability (Worksheet 3-16)	***Stable***	**1**	**3**
	Mod. Unstable	**2**	
	Unstable	**3**	
	Highly Unstable	**4**	
2 Vertical Stability Excess Deposition or Aggradation (Worksheet 3-17)	***No Deposition***	**1**	**1**
	Mod. Deposition	**2**	
	Excess Deposition	**3**	
	Aggradation	**4**	
3 Vertical Stability Channel Incision or Degradation (Worksheet 3-18)	***Not Incised***	**1**	**2**
	Slightly Incised	**2**	
	Mod. Incised	**3**	
	Degradation	**4**	
4 Channel Enlargement Prediction (Worksheet 3-19)	***No Increase***	**1**	**2**
	Slight Increase	**2**	
	Mod. Increase	**3**	
	Extensive	**4**	
5 Pfankuch Channel Stability (Worksheet 3-10)	***Good: Stable***	**1**	**2**
	Fair: Mod. Unstable	**2**	
	Poor: Unstable	**4**	
		Total Points	**10**

	Category Point Range			
Overall Sediment Supply Rating (use total points and check ✓ stability rating)	***Low*** **< 6** ☐	***Moderate*** **6 – 10** ☑	***High*** **11 – 15** ☐	***Very High*** **> 15** ☐

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Worksheet 3-21. Summary of stability condition categories.

Summary of Stability Conditions

Stream:	**Housatonic River Reach 5A-1**					Location: **Pittsfield MA**					
Observers:	**RGJ**			Date: **1/19/2026**		Stream Type: **C4**			Landscape Type: **U-AL-FD**		
Channel Dimension	Bankfull Mean Depth (ft): **6.31**		Bankfull Width (ft): **93**		Cross-Sectional Area (ft^2): **587**		Width/Depth Ratio: **14.7**		Entrenchment Ratio: **12.9**		
Channel Pattern	Mean:	λ/W_{bkf}: **6.31**	L_m/W_{bkf}: **8.11**		R_c/W_{bkf}: **2.08**		MWR: **1.69**		Sinuosity: **1.26**		
	Range:	**4.9-8.6**	**5.3-12.8**		**0.79-4.66**		**0.54-3.16**				
Streamflow	Bankfull Mean Velocity ($\bar{u}_{bkf}$) (ft/sec): **5.3**		Bankfull Discharge (Q_{bkf}): **3088**		Estimation Method: **Regional Curve**				Drainage Area (mi^2): **131**		
River Profile & Bed Features	Check: ☑ Riffle/Pool ☐ Step/Pool ☐ Plane Bed ☐ Convergence/Divergence ☐ Dunes/Antidunes/Smooth Bed										
	Bankfull Max Depth (ft):	Riffle: **8.21**	Pool: **11.5**	Depth Ratio (max to mean):	Riffle: **1.6**	Pool: **1.8**	Pool-to-Pool Spacing:	Ratio:	Slope — Valley: **0.0004**	Water Surface: **0.0006**	
Level III Stream Stability Indices	Riparian Vegetation	Current Composition/Density:		Potential Composition/Density:			Remarks: Condition, Vigor & Usage of Existing Reach:				
	Flow Regime: **P2**	Stream Size & Order: **s-8(4)**		Meander Patterns: **M3**			Depositional Patterns: **B1, B4**		Debris/Channel Blockages: **D3, D4**		
	Degree of Incision (Bank-Height Ratio): **1**		Degree of Incision Stability Rating: **Stable**				Modified Pfankuch Stability Rating (Numeric & Adjective Rating): **95 - Fair**				
	W/d Ratio State (W/d) / (W/d_{ref}): **1.05**		W/d Ratio State Stability Rating: **Stable**		Degree of Confinement (MWR / MWR_{ref}): **0.34**		MWR / MWR_{ref} Stability Rating: **Slight**				
Bank Erosion Summary	Length of Reach Studied (ft): **11578**	Annual Streambank Erosion Rate: **559** (tons/yr)	**0.05** (tons/yr/ft)	Curve Used: **Housatonic**	Remarks:						
Sediment Capacity (POWERSED)	☑ *Sufficient Capacity* ☐ *Insufficient Capacity* ☐ *Excess Capacity*						Remarks:				
Entrainment/ Competence	Largest Particle from Bar Sample (mm): **38.1**	$\tau =$	$\tau^* =$	Existing Depth: **6.31**	Required Depth: **10.4**	Existing Slope: **0.0006**	Required Slope: **0.001**				
Stream Succession	**E** → **C** → → → →	Existing Stream State (Type): **C**	Potential Stream State (Type): **C**								
Lateral Stability	☐ *Stable*	☑ *Mod. Unstable*	☐ *Unstable*	☐ *Highly Unstable*	Remarks:						
Vertical Stability (Aggradation)	☑ *No Deposition*	☐ *Mod. Deposition*	☐ *Ex. Deposition*	☐ *Aggradation*	Remarks:						
Vertical Stability (Degradation)	☐ *Not Incised*	☑ *Slightly Incised*	☐ *Mod. Incised*	☐ *Degradation*	Remarks:						
Channel Enlargement	☐ *No Increase*	☑ *Slight Increase*	☐ *Mod. Increase*	☐ *Extensive*	Remarks:						
Sediment Supply (Channel Source)	☐ *Low*	☑ *Moderate*	☐ *High*	☐ *Very High*	Remarks:						

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Worksheet 2-2. Computations of bankfull mean velocity and bankfull discharge using various methods.

Bankfull VELOCITY & DISCHARGE Estimates

Stream:	**Housatonic River Reach 5A-2**			Location:	**Pittsfield MA**
Date:	**1/19/2026**	Stream Type:	**C4**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**			HUC:	_ _ _ _ _ _ _ _ _ _ _ _

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional Area	**584**	**A_{bkf}** (ft^2)	Bankfull Riffle Mean Depth	**6.60**	**d_{bkf}** (ft)
Bankfull Riffle Width	**88.5**	**W_{bkf}** (ft)	Wetted Perimeter ≈ (2 * d_{bkf}) + W_{bkf}	**101.70**	**W_p** (ft)
D_{84} Particle Size at Riffle	**15.22**	**D_{84}** (mm)	D_{84} Particle Size in Feet D_{84} (mm) / 304.8	**0.05**	**D_{84}** (ft)
Bankfull Slope	**0.0002**	**S_{bkf}** (ft / ft)	Hydraulic Radius A_{bkf} / W_p	**5.74**	**R** (ft)
Gravitational Acceleration	**32.2**	**g** (ft / sec^2)	Relative Roughness R (ft) / D_{84} (ft)	**115.00**	**R / D_{84}** (ft / ft)
Drainage Area	**134**	**DA** (mi^2)	Shear Velocity $u^* = (gRS)^{½}$	**0.19231**	**u*** (ft / sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $\bar{u} = [\ 2.83 + 5.66 * Log\ \{ R / D_{84} \}\ ]\ u^*$	**2.79**	ft / sec	**1627.73**	cfs
2. Roughness Coefficient: a) Manning's *n* from Friction Factor/Relative Roughness (Figs. 2-29, 2-30) $\bar{u} = 1.49 R^{2/3} S^{1/2} / n$ $n =$ **0.023**	**2.94**	ft / sec	**1715.75**	cfs
2. Roughness Coefficient: b) Manning's *n* from Stream Type (Fig. 2-31) $\bar{u} = 1.49 R^{2/3} S^{1/2} / n$ $n =$ **0.02**	**3.38**	ft / sec	**1973.11**	cfs
2. Roughness Coefficient: c) Manning's *n* from Jarrett (USGS): $\bar{u} = 1.49 R^{2/3} S^{1/2} / n$ $n = 0.39 S^{0.38} R^{-0.16}$ **Note:** This equation is applicable to **steep, step/pool, high boundary roughness, cobble- and boulder-dominated stream systems**; i.e., for Stream Types A1, A2, A3, B1, B2, B3, C2 & E3 $n =$		ft / sec		cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)		ft / sec		cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)		ft / sec		cfs
4. Continuity Equations: a) USGS Gage Data $\bar{u} = Q / A$ **Return Period for Bankfull Q** $Q =$ **1.5** **year**	**3.00**	ft / sec	**1752.0**	cfs
4. Continuity Equations: b) Regional Curves $\bar{u} = Q / A$	**5.26**	ft / sec	**3071.8**	cfs

Protrusion Height Options for the D_{84} Term in the Relative Roughness Relation (R/D_{84}) – Estimation Method 1

Option 1.	For **sand-bed** channels: Measure 100 **"protrusion heights"** of sand dunes from the downstream side of feature to the top of feature. Substitute the D_{84} sand dune protrusion height in ft for the D_{84} term in method 1.
Option 2.	For **boulder-dominated** channels: Measure 100 **"protrusion heights"** of boulders on the sides from the bed elevation to the top of the rock on that side. Substitute the D_{84} boulder protrusion height in ft for the D_{84} term in method 1.
Option 3.	For **bedrock-dominated** channels: Measure 100 **"protrusion heights"** of rock separations, steps, joints or uplifted surfaces above channel bed elevation. Substitute the D_{84} bedrock protrusion height in ft for the D_{84} term in method 1.
Option 4.	For **log-influenced** channels: Measure "**protrustion heights**" proportionate to channel width of log diameters or the height of the log on upstream side if embedded. Substitute the D_{84} protrusion height in ft for the D_{84} term in method 1.

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Worksheet 2-3. Field form for *Level II* stream classification.

Stream:	**Housatonic River Reach 5A-2**				
Basin:	**Housatonic**	Drainage Area:	acres	**134**	mi^2
Location:	**Pittsfield MA**				
Twp.&Rge:		Sec.&Qtr.:			
Cross-Section Monuments (Lat./Long.):				Date:	**1/19/2026**
Observers:	**RGJ**			Landscape Type:	**U-AL-FD**

Bankfull Width (W_{bkf}) The surface width of the stream at bankfull stage elevation, in a riffle section.	**88.5**	ft
Bankfull Mean Depth (d_{bkf}) Mean depth of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A_{bkf} / W_{bkf}$).	**6.60**	ft
Bankfull Cross-Sectional Area (A_{bkf}) Area of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**584.0**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) *Bankfull Width* divided by *Bankfull Mean Depth*, in a riffle section.	**13.4**	ft/ft
Bankfull Maximum Depth (d_{max}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	**7.70**	ft
Flood-Prone Area Width (W_{fpa}) Width of the channel at an elevation that is twice the *Bankfull Maximum Depth*, measured perpendicular to the fall line of the valley in a riffle section.	**610.00**	ft
Entrenchment Ratio (ER) The *Flood-Prone Area Width* divided by *Bankfull Width* (W_{fpa} / W_{bkf}), in a riffle section.	**6.90**	ft/ft
Channel Materials (Particle Size Index D_{50}) The D_{50} particle size index represents the median or dominant diameter of channel materials, as sampled proportionately from the channel surface between the bankfull stage and Thalweg elevations.	**9**	mm
Average Water Surface Slope (S) The elevation difference of water surface measurements over the stream length between two similar bed features (e.g., start of riffle to start of last riffle) for several riffle–pool or step–pool sequences, representing channel gradient.	**0.0002**	ft/ft
Channel Sinuosity (k) An index of channel pattern determined from stream length divided by valley length (SL / VL), or from valley slope divided by average water surface slope (S_{val} / S).	**1.02**	ft/ft

Stream Type **C4** **See Classification Key (Figure 2-35)**

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Worksheet 2-4a. Morphological relations, including dimensionless ratios of river reach sites.

Stream: **Housatonic River Reach 5A-2** Location: **Pittsfield MA**

Observers: **RGJ** Date: **1/19/2026** Landscape Type: **U-AL-FD** Stream Type: **C4**

River Reach Dimension Summary Data…..1

Riffle Dimensions*, **, *

Riffle Dimensions*, **, ***	Mean	Min.	Max.		Riffle Dimensions & Dimensionless Ratios****	Mean	Min.	Max.
Riffle Width (W_{bkf})	**90.2**	**88.5**	**91.7**	ft	Riffle Cross-Sectional Area (A_{bkf}) (ft^2)	**589**	**582**	**600**
Riffle Mean Depth (d_{bkf})	**6.5**	**6.3**	**6.6**	ft	Riffle Width/Depth Ratio (W_{bkf} / d_{bkf})	**13.8**	**13.4**	**14.5**
Riffle Maximum Depth (d_{max})	**8.1**	**7.7**	**8.7**	ft	Riffle Max Depth to Riffle Mean Depth (d_{max} / d_{bkf})	**1.2**	**1.2**	**1.3**
Width of Flood-Prone Area (W_{fpa})	**763**	**110**	**1570**	ft	Entrenchment Ratio (W_{fpa} / W_{bkf})	**8.4**	**1.2**	**17.1**
Riffle Inner Berm Width (W_{ib})				ft	Riffle Inner Berm Width to Riffle Width (W_{ib} / W_{bkf})			
Riffle Inner Berm Depth (d_{ib})				ft	Riffle Inner Berm Depth to Mean Depth (d_{ib} / d_{bkf})			
Riffle Inner Berm Area (A_{ib})				ft^2	Riffle Inner Berm Area to Riffle Area (A_{ib} / A_{bkf})			
Riffle Inner Berm W/d Ratio (W_{ib} / d_{ib})								

Pool Dimensions*, **, *

Pool Dimensions*, **, ***	Mean	Min.	Max.		Pool Dimensions & Dimensionless Ratios****	Mean	Min.	Max.
Pool Width (W_{bkfp})	**90.9**	**87.3**	**94.6**	ft	Pool Width to Riffle Width (W_{bkfp} / W_{bkf})	**1.00**		
Pool Mean Depth (d_{bkfp})	**6.43**	**6.20**	**6.65**	ft	Pool Mean Depth to Riffle Mean Depth (d_{bkfp} / d_{bkf})	**0.98**		
Pool Cross-Sectional Area (A_{bkfp})	**585.0**	**542.0**	**628.0**	ft	Pool Area to Riffle Area (A_{bkfp} / A_{bkf})	**0.99**		
Pool Maximum Depth (d_{maxp})	**9.78**	**9.81**	**9.75**	ft	Pool Max Depth to Riffle Mean Depth (d_{maxp} / d_{bkf})	**1.50**		
Pool Inner Berm Width (W_{ibp})				ft	Pool Inner Berm Width to Pool Width (W_{ibp} / W_{bkfp})			
Pool Inner Berm Depth (d_{ibp})				ft	Pool Inner Berm Depth to Pool Depth (d_{ibp} / d_{bkfp})			
Pool Inner Berm Area (A_{ibp})				ft^2	Pool Inner Berm Area to Pool Area (A_{ibp} / A_{bkfp})			
Point Bar Slope (S_{pb})				ft/ft	Pool Inner Berm Width/Depth Ratio (W_{ibp} / d_{ibp})			

Run Dimensions*

Run Dimensions*	Mean	Min.	Max.		Run Dimensionless Ratios****	Mean	Min.	Max.
Run Width (W_{bkfr})				ft	Run Width to Riffle Width (W_{bkfr} / W_{bkf})			
Run Mean Depth (d_{bkfr})				ft	Run Mean Depth to Riffle Mean Depth (d_{bkfr} / d_{bkf})			
Run Cross-Sectional Area (A_{bkfr})				ft	Run Area to Riffle Area (A_{bkfr} / A_{bkf})			
Run Maximum Depth (d_{maxr})				ft	Run Max Depth to Riffle Mean Depth (d_{maxr} / d_{bkf})			
Run Width/Depth Ratio (W_{bkfr} / d_{bkfr})				ft				

Glide Dimensions*

Glide Dimensions*	Mean	Min.	Max.		Glide Dimensions & Dimensionless Ratios****	Mean	Min.	Max.
Glide Width (W_{bkfg})				ft	Glide Width to Riffle Width (W_{bkfg} / W_{bkf})			
Glide Mean Depth (d_{bkfg})				ft	Glide Mean Depth to Riffle Mean Depth (d_{bkfg} / d_{bkf})			
Glide Cross-Sectional Area (A_{bkfg})				ft	Glide Area to Riffle Area (A_{bkfg} / A_{bkf})			
Glide Maximum Depth (d_{maxg})				ft	Glide Max Depth to Riffle Mean Depth (d_{maxg} / d_{bkf})			
Glide Width/Depth Ratio (W_{bkfg} / d_{bkfg})				ft/ft	Glide Inner Berm Width/Depth Ratio (W_{ibg} / d_{ibg})			
Glide Inner Berm Width (W_{ibg})				ft	Glide Inner Berm Width to Glide Width (W_{ibg}/W_{bkfg})			
Glide Inner Berm Depth (d_{ibg})				ft	Glide Inner Berm Depth to Glide Depth (d_{ibg} / d_{bkfg})			
Glide Inner Berm Area (A_{ibg})				ft^2	Glide Inner Berm Area to Glide Area (A_{ibg} / A_{bkfg})			

Step Dimensions**

Step Dimensions**	Mean	Min.	Max.		Step Dimensionless Ratios****	Mean	Min.	Max.
Step Width (W_{bkfs})				ft	Step Width to Riffle Width (W_{bkfs} / W_{bkf})			
Step Mean Depth (d_{bkfs})				ft	Step Mean Depth to Riffle Mean Depth (d_{bkfs} / d_{bkf})			
Step Cross-Sectional Area (A_{bkfs})				ft	Step Area to Riffle Area (A_{bkfs} / A_{bkf})			
Step Maximum Depth (d_{maxs})				ft	Step Max Depth to Riffle Mean Depth (d_{maxs} / d_{bkf})			
Step Width/Depth Ratio (W_{bkfs} / d_{bkfs})				ft/ft				

*Riffle–Pool system (i.e., C, E, F stream types) bed features include riffles, runs, pools, and glides.

**Step–Pool system (i.e., A, B, G stream types) bed features include riffles, rapids, chutes, pools, and steps (note: include rapids and chutes in riffle category).

***Convergence-Divergence system (i.e., D stream types) bed features include riffles and pools; cross-sections taken at riffles for classification purposes.

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Worksheet 2-4b. Morphological relations, including dimensionless ratios of river reach sites.

Stream: **Housatonic River Reach 5A-2** Location: **Pittsfield MA**

Observers: **RGJ** Date: **1/19/2026** Landscape Type: **U-AL-FD** Stream Type: **C4**

River Reach Summary Data…..2

Hydraulics

Streamflow: Estimated Mean Velocity at Bankfull Stage ($\bar{u}_{bkf}$)	**5.3**	ft/sec	Estimation Method	**Regional Curve**	
Streamflow: Estimated Discharge at Bankfull Stage (Q_{bkf})	**3072.0**	cfs	Drainage Area	**134.0**	mi^2

Channel Pattern

Geometry	Mean	Min.	Max.		Dimensionless Geometry Ratios	Mean	Min.	Max.
Linear Wavelength (λ)	**653.0**	**384.0**	**922.0**	ft	Linear Wavelength to Riffle Width (λ / W_{bkf})	**7.24**	**4.26**	**10.22**
Stream Meander Length (L_m)	**671.5**	**404.0**	**939.0**	ft	Stream Meander Length Ratio (L_m / W_{bkf})	**7.44**	**4.48**	**10.41**
Radius of Curvature (R_c)	**471.4**	**203.0**	**779.0**	ft	Radius of Curvature to Riffle Width (R_c / W_{bkf})	**5.23**	**2.25**	**8.64**
Belt Width (W_{blt})	**86.0**	**78.0**	**98.0**	ft	Meander Width Ratio (W_{blt} / W_{bkf})	**0.95**	**0.86**	**1.09**
Arc Length (L_a)	**136.2**	**76.6**	**307.1**	ft	Arc Length to Riffle Width (L_a / W_{bkf})	**1.51**	**0.85**	**3.40**
Riffle Length (L_r)				ft	Riffle Length to Riffle Width (L_r / W_{bkf})			
Individual Pool Length (L_p)				ft	Individual Pool Length to Riffle Width (L_p / W_{bkf})			
Pool-to-Pool Spacing (P_s)				ft	Pool-to-Pool Spacing to Riffle Width (P_s / W_{bkf})			

Channel Profile

Valley Slope (S_{val})	**0.0002**	ft/ft	Average Water Surface Slope (S)	**0.0002**	ft/ft	Sinuosity (S_{val} / S)		**0.75**
Stream Length (SL)	**2000.0**	ft	Valley Length (VL)	**1965.0**	ft	Sinuosity (SL / VL)		**1.02**
Low Bank Height (LBH)	start **7.77** ft end **9.78** ft		Bankfull Max Depth (d_{max})	start **6.34** ft end **8.76** ft		Bank-Height Ratio (BHR) (LBH / d_{max})	start **1.2** end **1.1**	

Facet Slopes	Mean	Min.	Max.		Dimensionless Facet Slope Ratios	Mean	Min.	Max.
Riffle Slope (S_{rif})				ft/ft	Riffle Slope to Average Water Surface Slope (S_{rif} / S)			
Run Slope (S_{run})				ft/ft	Run Slope to Average Water Surface Slope (S_{run} / S)			
Pool Slope (S_p)				ft/ft	Pool Slope to Average Water Surface Slope (S_p / S)			
Glide Slope (S_g)				ft/ft	Glide Slope to Average Water Surface Slope (S_g / S)			
Step Slope (S_s)				ft/ft	Step Slope to Average Water Surface Slope (S_s / S)			

Max Depths[a]	Mean	Min.	Max.		Dimensionless Depth Ratios	Mean	Min.	Max.
Max Riffle Depth (d_{max})				ft	Max Riffle Depth to Mean Riffle Depth (d_{max} / d_{bkf})			
Max Run Depth (d_{maxr})				ft	Max Run Depth to Mean Riffle Depth (d_{maxr} / d_{bkf})			
Max Pool Depth (d_{maxp})				ft	Max Pool Depth to Mean Riffle Depth (d_{maxp} / d_{bkf})			
Max Glide Depth (d_{maxg})				ft	Max Glide Depth to Mean Riffle Depth (d_{maxg} / d_{bkf})			
Max Step Depth (d_{maxs})				ft	Max Step Depth to Mean Riffle Depth (d_{maxs} / d_{bkf})			

Channel Materials

	Reach[b]	Riffle[c]	Bar		Reach[b]	Riffle[c]	Bar	Protrusion Height[d]	
% Silt/Clay		**3**		D_{16}		**0.22**			mm
% Sand		**46**		D_{35}		**1.00**			mm
% Gravel		**51**		D_{50}		**2.25**			mm
% Cobble		**0**		D_{84}		**9.32**			mm
% Boulder		**0**		D_{95}		**15.22**			mm
% Bedrock		**0**		D_{100}		**45.00**			mm

[a] *Mean* , *Min* ., and *Max* . depths are measured from Thalweg to bankfull at mid-point of feature for riffles, runs, and steps, the deepest part of pools, and at the tail-out of glides.

[b] Composite sample of riffles and pools within the designated reach. [c] Active bed of a riffle. [d] Height of roughness feature above bed.

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Worksheet 3-2. Flow regime variables that influence channel characteristics, sediment regime, and biological interpretations.

Flow Regime

Stream:	**Housatonic River Reach 5A-2**				Stream Type:	**C4**		
Location:	**Pittsfield MA**				Landscape Type:	**U-AL-FD**		
Observers:	**RGJ**				Date:	**1/19/2026**		
List ALL COMBINATIONS that APPLY……..☞	**P2**							

General Category

E	***Ephemeral stream channel:*** Flows only in response to precipitation.
S	***Subterranean stream channel:*** Flows parallel to and near the surface for various seasons – a sub-surface flow that follows the stream bed.
I	***Intermittent stream channel:*** Surface water flows discontinuously along its length. Often associated with sporadic or seasonal flows and also with Karst (limestone) geology where losing/gaining reaches create flows that disappear then reappear farther downstream.
P	***Perennial stream channels:*** Surface water persists yearlong.

Specific Category

1	Seasonal variation in streamflow dominated primarily by snowmelt runoff.
2	Seasonal variation in streamflow dominated primarily by stormflow runoff.
3	Uniform stage and associated streamflow due to spring-fed condition, backwater, etc.
4	Streamflow regulated by glacial melt.
5	Ice flows/ice torrents from ice dam breaches.
6	Alternating flow/backwater due to tidal influence.
7	Regulated streamflow due to diversions, dam release, dewatering, etc.
8	Altered due to development, such as urban streams, cut-over watersheds, or vegetation conversions (forested to grassland) that change flow response to precipitation events.
9	Rain-on-snow generated runoff.

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Worksheet 3-3. Stream order and stream size categories for stratification by stream type.

Stream Size and Order			
Stream:	**Housatonic River Reach 5A-2**		
Location:	**Pittsfield MA**		
Observers:	**RGJ**	Stream Type:	**C4**
Landscape Type:	**U-AL-FD**	Date:	**1/19/2026**

Stream Size Category and Order ☞	**S-8(4)**

Category	STREAM SIZE: Bankfull Width		Check (✓) Appropriate Category
	meters	feet	
S-1	0.305	<1	☐
S-2	0.3 – 1.5	1 – 5	☐
S-3	1.5 – 4.6	5 – 15	☐
S-4	4.6 – 9.0	15 – 30	☐
S-5	9.0 – 15.0	30 – 50	☐
S-6	15.0 – 22.8	50 – 75	☐
S-7	22.8 – 30.5	75 – 100	☐
S-8	30.5 – 46.0	100 – 150	☑
S-9	46 – 76	150 – 250	☐
S-10	76 – 107	250 – 350	☐
S-11	107 – 150	350 – 500	☐
S-12	150 – 305	500 – 1000	☐
S-13	>305	>1000	☐

Stream Order

Add categories in parenthesis for specific stream order of reach. For example, a third-order stream with a bankfull width of 6.1 meters (20 feet) would be indexed as: S-4(3).

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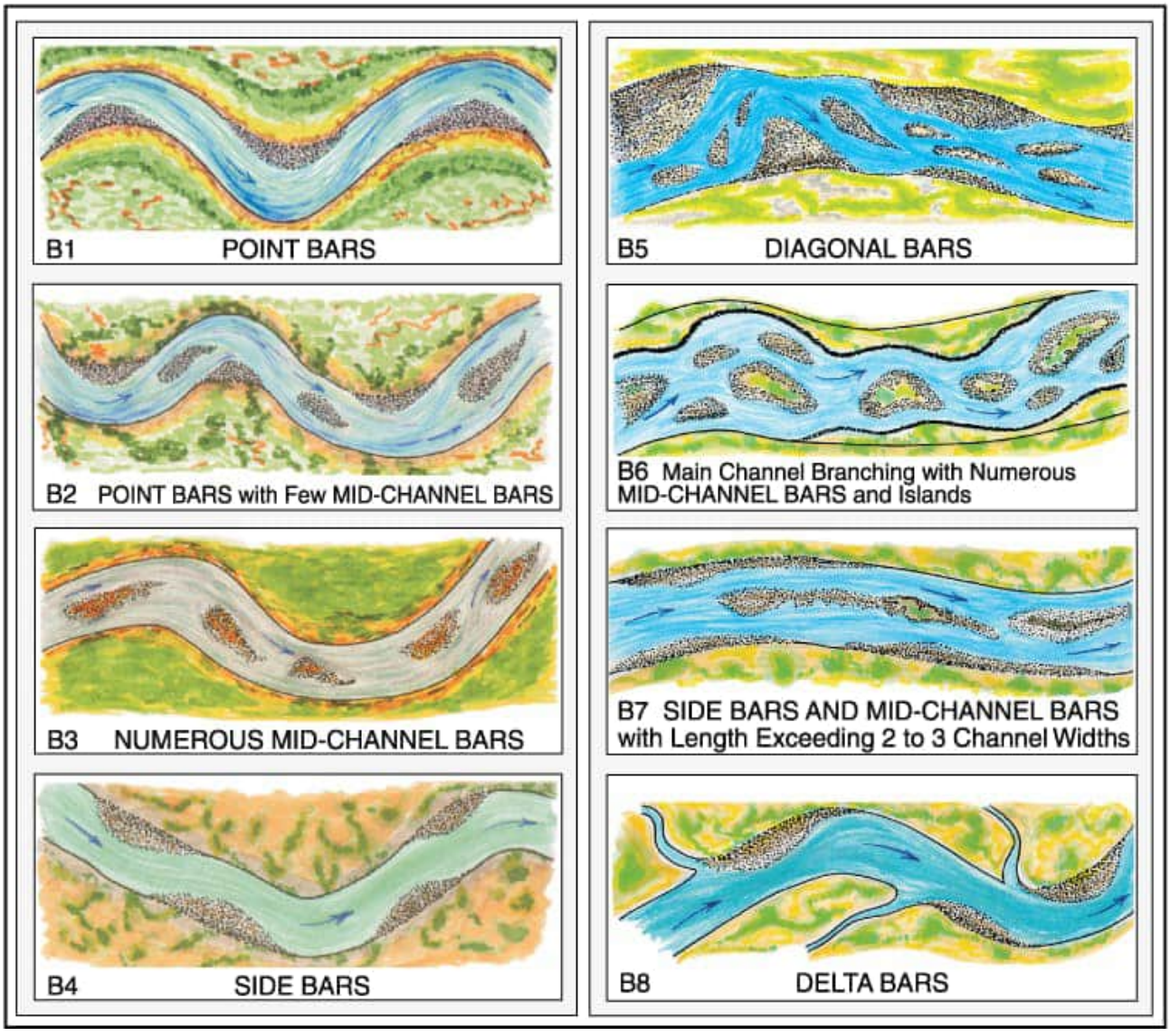
Worksheet 3-5. Depositional patterns used for stabiilty assessments.

Depositional Patterns

Stream:	**Housatonic River Reach 5A-2**	Stream Type:	**C4**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

List ALL CATEGORIES that APPLY ☞	B4				

Various Depositional Features modified from Galay et al. (1973)



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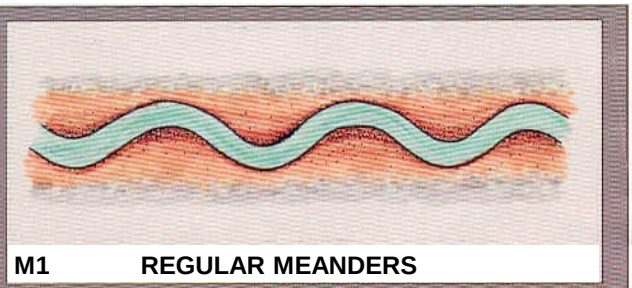
Worksheet 3-4. Meander pattern relations used for interpretations for river stability.

Meander Patterns

Stream:	**Housatonic River Reach 5A-2**	Stream Type:	**C4**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

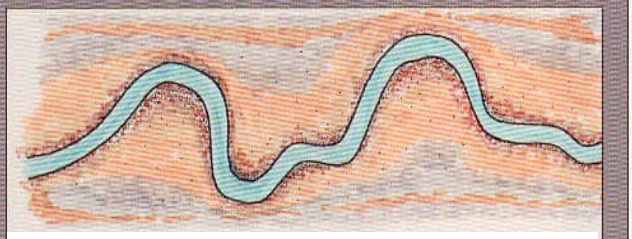
List ALL CATEGORIES that APPLY ☞	M3				

Various Meander Pattern Variables modified from Galay et al. (1973)

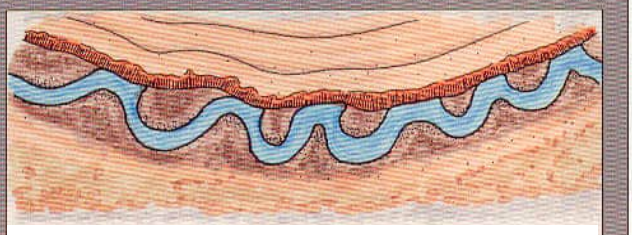


M1 REGULAR MEANDERS

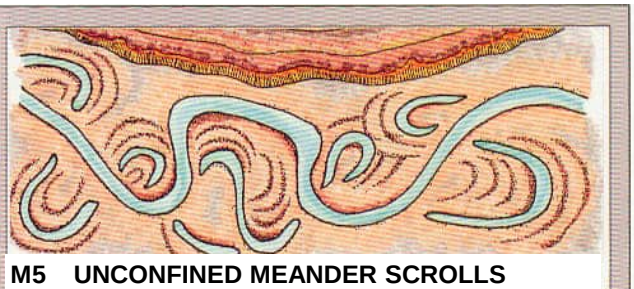
M2 TORTUOUS MEANDERS



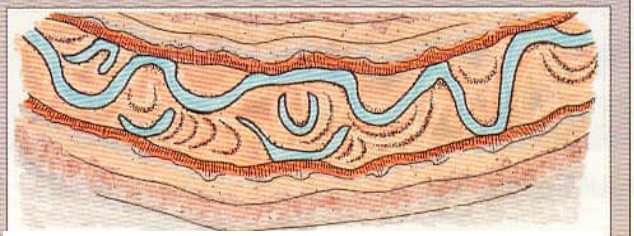
M3 IRREGULAR MEANDERS



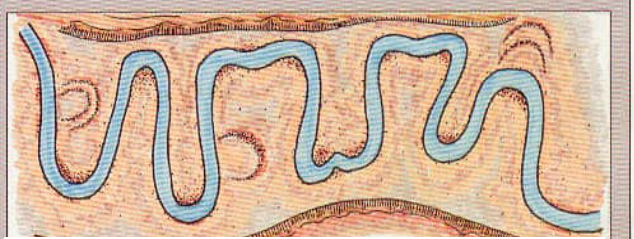
M4 TRUNCATED MEANDERS



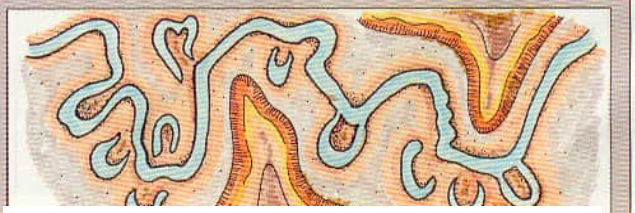
M5 UNCONFINED MEANDER SCROLLS



M6 CONFINED MEANDER SCROLLS



M7 DISTORTED MEANDER LOOPS



M8 IRREGULAR MEANDERS with oxbows and oxbow cutoffs

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Worksheet 3-6. Various categories of in-channel debris, dams, and channel blockages used to evaluate channel stability.

Channel Blockages			
Stream:	**Housatonic River Reach 5A-2**	Stream Type:	**C4**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

Description/Extent		**Materials that upon placement into the active channel or flood-prone area may cause adjustments in channel dimensions or conditions due to influences on the existing flow regime.**	**Check (✓) all that apply**
D1	None	Minor amounts of small, floatable material.	☐
D2	Infrequent	Debris consists of small, easily moved, floatable material, e.g., leaves, needles, small limbs, and twigs.	☑
D3	Moderate	Increasing frequency of small- to medium-sized material, such as large limbs, branches, and small logs, that when accumulated affect 10% or less of the active channel cross-sectional area.	☐
D4	Numerous	Significant build-up of medium- to large-sized materials, e.g., large limbs, branches, small logs, or portions of trees, occupying 10–30% of the active channel cross-sectional area.	☐
D5	Extensive	Debris "dams" of predominantly larger materials, e.g., branches, logs, and trees, occupying 30–50% of the active channel cross-sectional area, often extending across the width of the active channel.	☐
D6	Dominating	Large, somewhat continuous, debris "dams," extensive in nature and occupying over 50% of the active channel cross-sectional area. Such accumulations may divert water into the flood-prone areas and form fish migration barriers, even when flows are at less than bankfull.	☐
D7	Beaver Dams: Few	An infrequent number of dams spaced such that normal streamflow and expected channel conditions exist in the reaches between dams.	☐
D8	Beaver Dams: Frequent	Frequency of dams is such that backwater conditions exist for channel reaches between structures where streamflow velocities are reduced and channel dimensions or conditions are influenced.	☐
D9	Beaver Dams: Abandoned	Numerous abandoned dams, many of which have filled with sediment or breached, initiating a series of channel adjustments, such as streambank erosion, lateral migration, avulsion, aggradation, or degradation.	☐
D10	Human Influences	Structures, facilities, or materials related to land uses or development located within the flood-prone area, such as diversions or low-head dams, controlled by-pass channels, velocity control structures, and various transportation encroachments that have an influence on the existing flow regime, such that significant channel adjustments occur.	☐

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Worksheet 3-7. Relationship of Bank-Height Ratio (BHR) ranges to corresponding stream stability ratings.

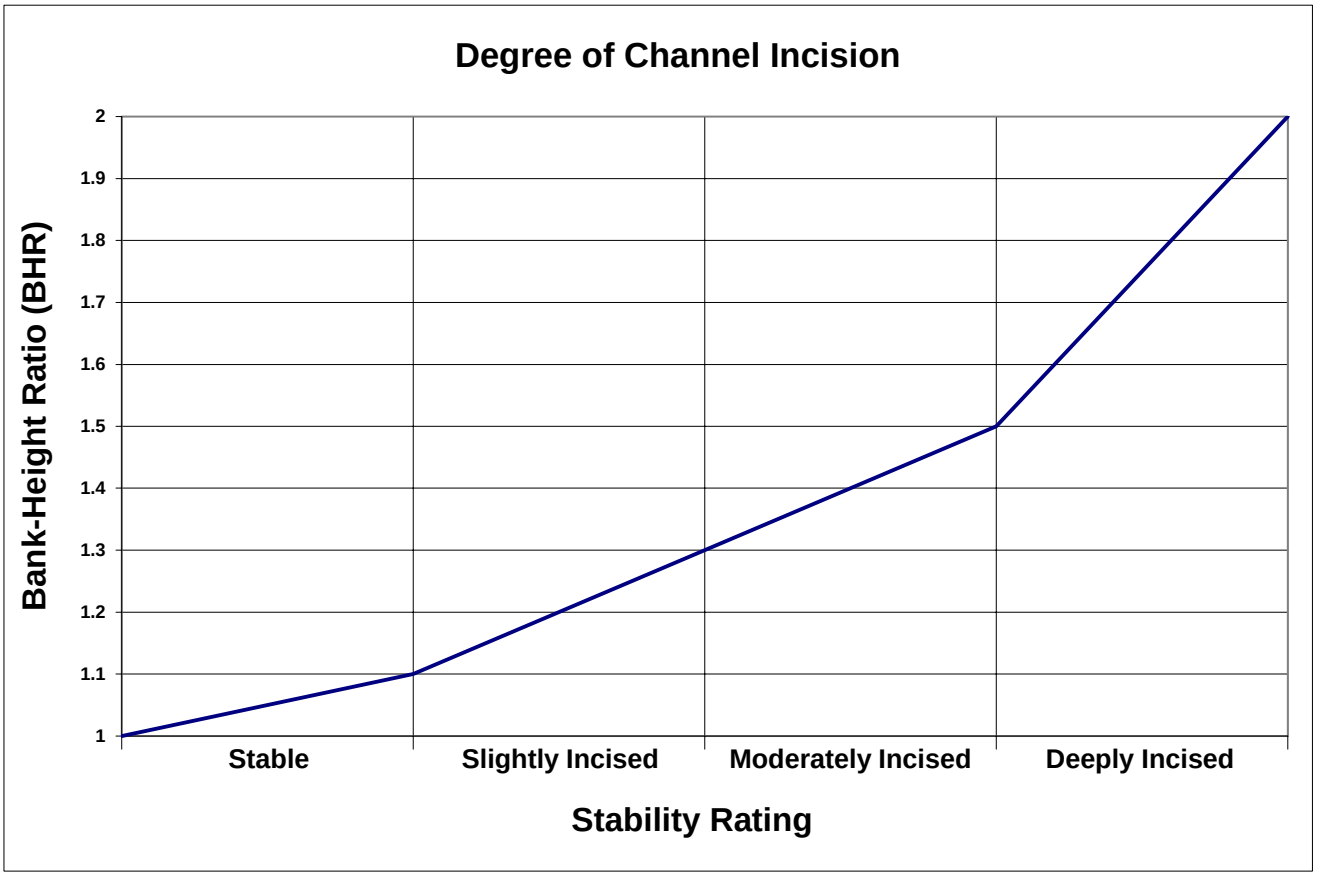
Degree of Channel Incision

Stream:	**Housatonic River Reach 5A-2**	Stream Type:	**C4**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

Low Bank Height:	**9.18**
Bankfull Max Depth:	**7.67**

Bank-Height Ratio (BHR):	**1.20**

Degree of Channel Incision Stability Rating ☞ **Slightly Incised**



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Worksheet 3-8. Stability ratings based on departure of width/depth ratio from reference condition.

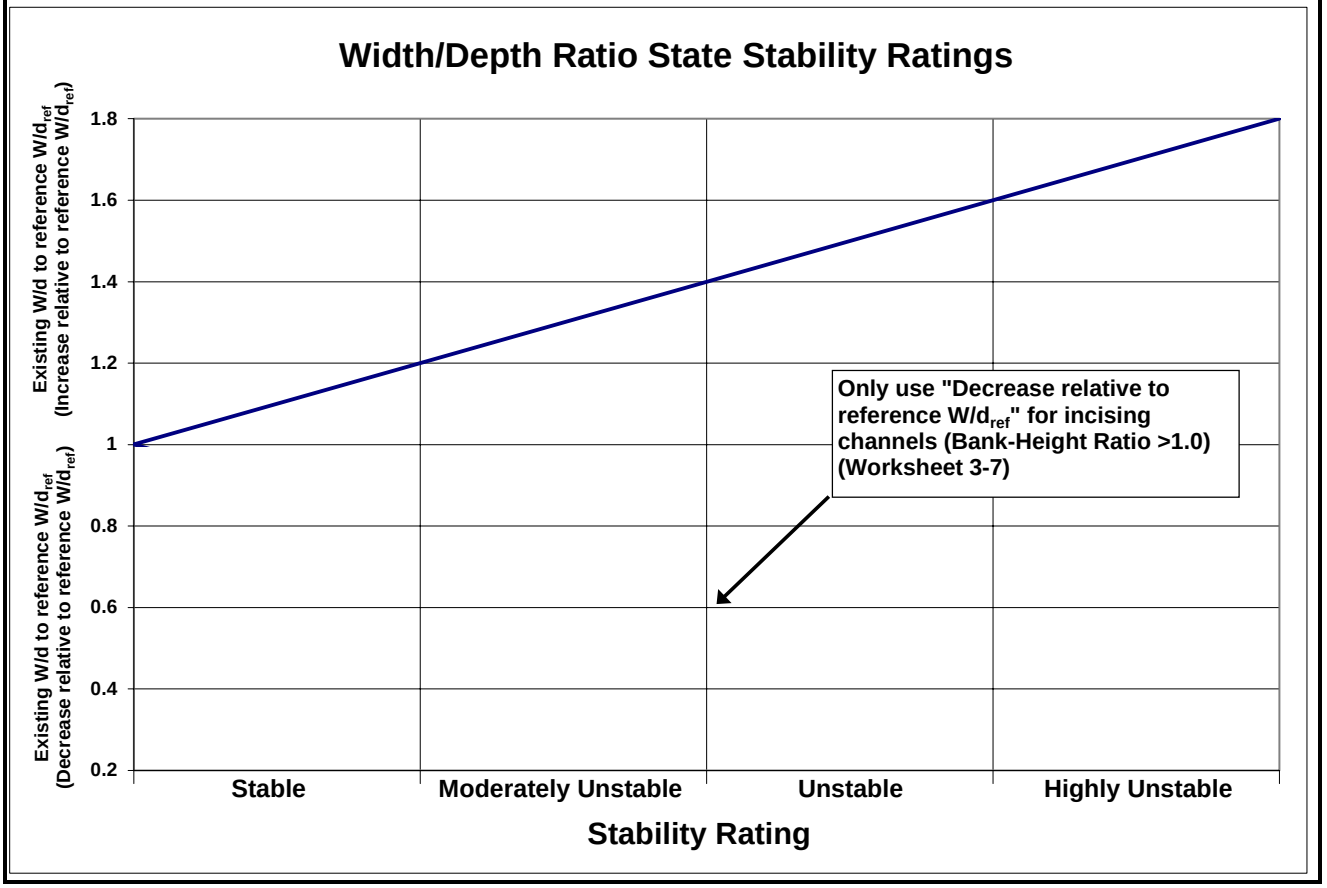
Width/Depth Ratio State

Stream:	**Housatonic River Reach 5A-2**	Stream Type:	**C4**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

Existing Width/Depth Ratio (W/d):	**13.4**
Reference Width/Depth Ratio (W/d_{ref}):	**14**

Existing W/d to Reference W/d_{ref} :	**0.96**

Width/Depth Ratio State Stability Rating ☞ **Stable**



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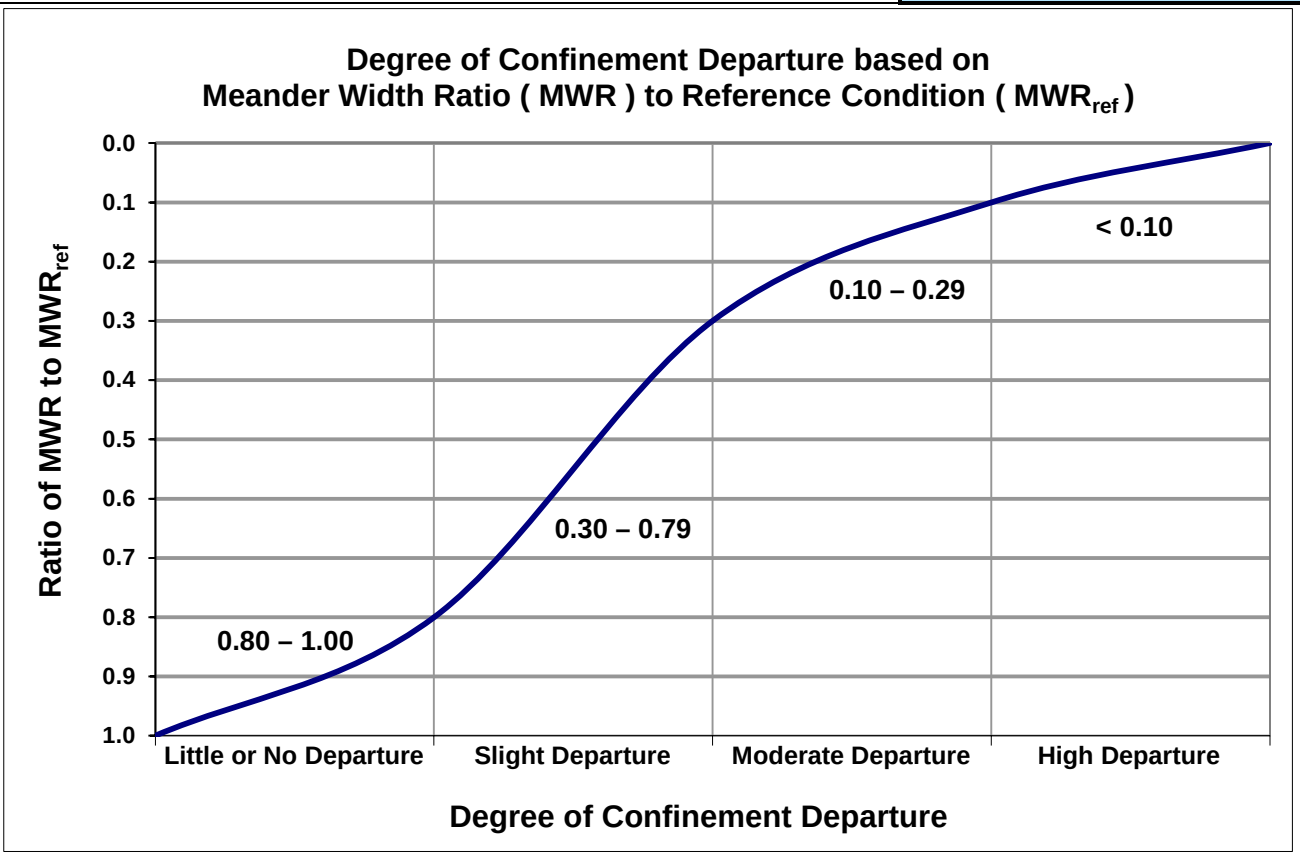
Worksheet 3-9. Degree of confinement departure based on Meander Width Ratio (MWR) divided by reference condition Meander Width Ratio (MWR_{ref}).

Degree of Confinement

Stream:	**Housatonic River Reach 5A-2**	Stream Type:	**C4**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

Existing Meander Width Ratio (MWR):	**0.95**	Ratio of MWR to MWR_{ref} :	**0.19**
Reference Meander Width Ratio (MWR_{ref}):	**5**		

Degree of Confinement Stability Rating ☞ **Moderate Departure**



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Worksheet 3-10. Pfankuch (1975) channel stability rating procedure, as modified by Rosgen (1996, 2006b).

Stream: Housatonic River Reach 5A-2 **Location:** Pittsfield MA **Landscape Type:** U-AL-FD **Observers:** RGJ **Date:** 1/19/2026

Loca-tion	Key	Category	Excellent		Good		Fair		Poor	
			Description	Rating	Description	Rating	Description	Rating	Description	Rating
Upper banks	1	Landform slope	Bank slope gradient <30%.	2	Bank slope gradient 30–40%.	4	Bank slope gradient 40–60%.	6	Bank slope gradient > 60%.	8
	2	Mass erosion	No evidence of past or future mass erosion.	3	Infrequent. Mostly healed over. Low future potential.	6	Frequent or large, causing sediment nearly yearlong.	9	Frequent or large, causing sediment nearly yearlong OR imminent danger of same.	12
	3	Debris jam potential	Essentially absent from immediate channel area.	2	Present, but mostly small twigs and limbs.	4	Moderate to heavy amounts, mostly larger sizes.	6	Moderate to heavy amounts, predominantly larger sizes.	8
	4	Vegetative bank protection	> 90% plant density. Vigor and variety suggest a deep, dense, soil-binding root mass.	3	70–90% density. Fewer species or less vigor suggest less dense or deep root mass.	6	50–70% density. Lower vigor and fewer species from a shallow, discontinuous root mass.	9	<50% density plus fewer species and less vigor indicating poor, discontinuous, and shallow root mass.	12
Lower banks	5	Channel capacity	Bank heights sufficient to contain the bankfull stage. Width/depth ratio departure from reference width/depth ratio = 1.0. Bank-Height Ratio (BHR) = 1.0.	1	Bankfull stage is contained within banks. Width/depth ratio departure from reference width/depth ratio = 1.0–1.2. Bank-Height Ratio (BHR) = 1.0–1.1.	2	Bankfull stage is not contained. Width/depth ratio departure from reference width/depth ratio = 1.2–1.4. Bank-Height Ratio (BHR) = 1.1–1.3.	3	Bankfull stage is not contained; over-bank flows are common with flows less than bankfull. Width/depth ratio departure from reference width/depth ratio > 1.4. Bank-Height Ratio (BHR) > 1.3.	4
	6	Bank rock content	> 65% with large angular boulders. 12"+ common.	2	40–65%. Mostly boulders and small cobbles 6–12".	4	20–40%. Most in the 3–6" diameter class.	6	<20% rock fragments of gravel sizes, 1–3" or less.	8
	7	Obstructions to flow	Rocks and logs firmly imbedded. Flow pattern w/o cutting or deposition. Stable bed.	2	Some present causing erosive cross currents and minor pool filling. Obstructions fewer and less firm.	4	Moderately frequent, unstable obstructions move with high flows causing bank cutting and pool filling.	6	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	8
	8	Cutting	Little or none. Infrequent raw banks <6".	4	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12".	6	Significant. Cuts 12–24" high. Root mat overhangs and sloughing evident.	12	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
	9	Deposition	Little or no enlargement of channel or point bars.	4	Some new bar increase, mostly from coarse gravel.	8	Moderate depostion of new gravel and coarse sand on old and some new bars.	12	Extensive deposit of predominantly fine particles. Accelerated bar development.	16
Bottom	10	Rock angularity	Sharp edges and corners. Plane surfaces rough.	1	Rounded corners and edges. Surfaces smooth and flat.	2	Corners and edges well-rounded in two dimensions.	3	Well-rounded in all dimensions, surfaces smooth.	4
	11	Brightness	Surfaces dull, dark, or stained. Generally not bright.	1	Mostly dull, but may have <35% bright surfaces.	2	Mixture dull and bright, i.e., 35–65% mixture range.	3	Predominantly bright, > 65%, exposed or scoured surfaces.	4
	12	Consolidation of particles	Assorted sizes tightly packed or overlapping.	2	Moderately packed with some overlapping.	4	Mostly loose assortment with no apparent overlap.	6	No packing evident. Loose assortment, easily moved.	8
	13	Bottom size distribution	No size change evident. Stable material 80–100%.	4	Distribution shift light. Stable material 50–80%.	8	Moderate change in sizes. Stable materials 20–50%.	12	Marked distribution change. Stable materials 0–20%.	16
	14	Scouring and deposition	<5% of bottom affected by scour or deposition.	6	5–30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12	30–50% affected. Deposits and scour at obstructions, constrictions, and bends. Some filling of pools.	18	More than 50% of the bottom in a state of flux or change nearly yearlong.	24
	15	Aquatic vegetation	Abundant growth moss-like, dark green perennial. In swift water too.	1	Common. Algae forms in low velocity and pool areas. Moss here too.	2	Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick.	3	Perennial types scarce or absent. Yellow-green, short-term bloom may be present.	4
			Excellent Total =	**4**	**Good Total =**	**30**	**Fair Total =**	**42**	**Poor Total =**	**20**

Stream type	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6	D3	D4	D5	D6
Good (Stable)	38-43	38-43	54-90	60-95	60-95	50-80	38-45	38-45	40-60	40-64	48-68	40-60	38-50	38-50	60-85	70-90	70-90	60-85	85-107	85-107	85-107	67-98
Fair (Mod. unstable)	44-47	44-47	91-129	96-132	96-142	81-110	46-58	46-58	61-78	65-84	69-88	61-78	51-61	51-61	86-105	91-110	91-110	86-105	108-132	108-132	108-132	99-125
Poor (Unstable)	48+	48+	130+	133+	143+	111+	59+	59+	79+	85+	89+	79+	62+	62+	106+	111+	111+	106+	133+	133+	133+	126+

Stream type	DA3	DA4	DA5	DA6	E3	E4	E5	E6	F1	F2	F3	F4	F5	F6	G1	G2	G3	G4	G5	G6
Good (Stable)	40-63	40-63	40-63	40-63	40-63	50-75	50-75	40-63	60-85	60-85	85-110	85-110	90-115	80-95	40-60	40-60	85-107	85-107	90-112	85-107
Fair (Mod. unstable)	64-86	64-86	64-86	64-86	64-86	76-96	76-96	64-86	86-105	86-105	111-125	111-125	116-130	96-110	61-78	61-78	108-120	108-120	113-125	108-120
Poor (Unstable)	87+	87+	87+	87+	87+	97+	97+	87+	106+	106+	126+	126+	131+	111+	79+	79+	121+	121+	126+	121+

Grand Total =	**96**
Existing Stream Type =	**C4**
***Potential Stream Type =**	**C4**
Modified channel stability rating =	**Fair**

***Rating is adjusted to *potential* stream type, not existing stream type**

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Worksheet 3-14. Sediment competence calculation form to assess bed stability.

Sediment Competence using Dimensional and Dimensionless Shear Stress Methods

Stream:	**Housatonic River Reach 5A-2**		Stream Type: **C4**		
Location:	**Pittsfield MA**		Landscape Type: **U-AL-FD**		
Observers:	**RGJ**		Date: **1/19/2026**		

Enter Required Information for Existing Condition

2.3	D_{50}	Median particle size of riffle bed material (mm)			
3.0	$\hat{D}_{50}$	Median particle size of bar or sub-pavement sample (mm)			
0.10	D_{max}	Largest particle from bar sample (ft)	**31.75**	**(mm)**	304.8 mm/ft
0.0002	S	Existing average water surface slope (ft/ft)			
6.60	d	Existing bankfull mean depth (ft)			
1.65	γ_s-γ/γ	Immersed specific gravity of sediment			

Select the Appropriate Equation and Calculate Critical Dimensionless Shear Stress

0.76	$D_{50}/\hat{D}_{50}$	Range: 3 – 7	Use EQUATION 1:	$\tau^* = 0.0834 \left(D_{50}/\hat{D}_{50} \right)^{-0.872}$
14.11	D_{max}/D_{50}	Range: 1.3 – 3.0	Use EQUATION 2:	$\tau^* = 0.0384 \left(D_{max}/D_{50} \right)^{-0.887}$
N/A	τ^*	Bankfull Dimensionless Shear Stress	EQUATION USED:	**N/A**

Calculate Bankfull Mean Depth Required for Entrainment of Largest Particle in Bar Sample

N/A	**d**	Required bankfull mean depth (ft) $d = \frac{\tau^* (\gamma_s - 1) D_{max}}{S}$	(use D_{max} in ft)

Calculate Average Water Surface Slope Required for Entrainment of Largest Particle in Bar Sample

N/A	**S**	Required average water surface slope (ft/ft) $S = \frac{\tau^* (\gamma_s - 1) D_{max}}{d}$	(use D_{max} in ft)

Check: ☐ Stable ☐ Aggrading ☐ Degrading

Sediment Competence Using Dimensional Shear Stress

0.082		Bankfull shear stress $\tau = \gamma d S$ (lbs/ft^2) (substitute hydraulic radius, R, with mean depth, d) γ = 62.43, d = existing depth, S = existing slope
Shields **6**	CO **24**	Predicted largest moveable particle size (mm) at bankfull shear stress τ **(Figure 3-11)**
Shields **0.422**	CO **0.119**	Predicted shear stress required to initiate movement of measured D_{max} (mm) **(Figure 3-11)**
Shields **33.83**	CO **9.53**	Predicted mean depth required to initiate movement of measured D_{max} (mm) $d = \frac{\tau}{\gamma S}$ τ = predicted shear stress, γ = 62.43, S = existing slope
Shields **0.0010**	CO **0.0003**	Predicted slope required to initiate movement of measured D_{max} (mm) $S = \frac{\tau}{\gamma d}$ τ = predicted shear stress, γ = 62.43, d = existing depth

Check: ☐ Stable ☐ Aggrading ☑ Degrading

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Worksheet 3-15. Stability ratings for stream type stage shifts.

Stream Succession Stage Shifts			
Stream:	**Housatonic River Reach 5A-2**	Stream Type:	**C4**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

Stream Type Stage Shifts (Figure 3-14)	**Stability Rating (Check ✓ Appropriate Rating)**
Stream Type at Potential, (C→E), (F_b→B), (F→B_c), (F→C), (G→B), (D→C)	☐ Stable
(E→C), (B→High W/d B), (C→High W/d C)	☑ Moderately Unstable
(G_c→F), (G→F_b), (F→D), (C→F)	☐ Unstable
(C→D), (A→G), (B→G), (D→G), (C→G), (E→G), (E→A)	☐ Highly Unstable

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Worksheet 3-16. Lateral stability prediction summary.

Lateral Stability Prediction					
Stream:	**Housatonic River Reach 5A-2**		Stream Type: **C4**		
Location:	**Pittsfield MA**		Landscape Type: **U-AL-FD**		
Observers:	**RGJ**		Date: **1/19/2026**		
Lateral stability criteria (choose one stability category for each criterion 1–5)	**Lateral Stability Categories**				**Selected Points (from each row)**
	Stable	***Moderately Unstable***	***Unstable***	***Highly Unstable***	
1 W/d Ratio State (Worksheet 3-8)	< 1.2	1.2 – 1.4	1.4 – 1.6	> 1.6	**2**
	(2)	**(4)**	**(6)**	**(8)**	
2 Depositional Patterns (Worksheet 3-5)	B1, B2	B4, B8	B3	B5, B6, B7	**2**
	(1)	**(2)**	**(3)**	**(4)**	
3 Meander Patterns (Worksheet 3-4)	M1, M3, M4		M2, M5, M6, M7, M8		**1**
	(1)		**(3)**		
4 Streambank Erosion: Unit Rate (Worksheet 3-13)	< 0.006	0.006 – 0.04	0.041 – 0.07	> 0.07	**2**
	(2)	**(4)**	**(6)**	**(8)**	
5 Degree of Confinement (MWR / MWR_{ref}) (Worksheet 3-9)	> 0.8	0.3 – 0.79	0.1 – 0.29	< 0.1	**3**
	(1)	**(2)**	**(3)**	**(4)**	
				Total Points	**10**
	Lateral Stability Category Point Range				
Overall Lateral Stability Category (use total points and check ✓ stability rating)	***Stable*** **< 10** ☐	***Moderately Unstable*** **10 – 12** ☑	***Unstable*** **13 – 21** ☐	***Highly Unstable*** **> 21** ☐	

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Worksheet 3-17. Vertical stability prediction for excess deposition and aggradation.

Vertical Stability Prediction for Excess Deposition and Aggradation					
Stream: **Housatonic River Reach 5A-2**			Stream Type: **C4**		
Location: **Pittsfield MA**			Landscape Type: **U-AL-FD**		
Observers: **RGJ**			Date: **1/19/2026**		
Vertical Stability Criteria (choose one stability category for each criterion 1–6)	**Vertical Stability Categories for Excess Deposition / Aggradation**				**Selected Points (from each row)**
	No Deposition	***Moderate Deposition***	***Excess Deposition***	***Aggradation***	
1 Sediment Competence (Worksheet 3-14)	Sufficient depth and slope to transport largest size available	Trend toward insufficient depth or slope-slightly incompetent	Cannot move D_{35} of bed material and/or D_{100} of bar material	Cannot move D_{16} of bed material and/or D_{100} of bar or sub-pavement size	**2**
	(2)	**(4)**	**(6)**	**(8)**	
2 Sediment Capacity (POWERSED)	Sufficient capacity to transport annual load	Trend toward insufficient sediment capacity	Reduction up to 25% of annual sediment yield of bedload or suspended sand	Reduction over 25% of annual sediment yield for bedload or suspended sand	**2**
	(2)	**(4)**	**(6)**	**(8)**	
3 W/d Ratio State (Worksheet 3-8)	< 1.2	1.2 – 1.4	1.4 – 1.6	> 1.6	**2**
	(2)	**(4)**	**(6)**	**(8)**	
4 Stream Succession Stage Shifts (Worksheet 3-15)	Current stream type at potential or does not indicate deposition/ aggradation	(E→C)	(B→High W/d B), (C→High W/d C), (C→F), (G_c→F), (G→F_b)	(C→D), (F→D)	**4**
	(2)	**(4)**	**(6)**	**(8)**	
5 Depositional Patterns (Worksheet 3-5)	B1	B2, B4	B3, B5	B6, B7, B8	**2**
	(1)	**(2)**	**(3)**	**(4)**	
6 Debris / Blockages (Worksheet 3-6)	D1, D2, D3	D4, D7	D5, D8	D6, D9, D10	**1**
	(1)	**(2)**	**(3)**	**(4)**	
				Total Points	**13**
	Vertical Stability Category Point Range for Excess Deposition and Aggradation				
Vertical Stability for Excess Deposition / Aggradation (use total points and check ✓ stability rating)	***No Deposition*** **< 15** ☑	***Moderate Deposition*** **15 – 20** ☐	***Excess Deposition*** **21 – 30** ☐	***Aggradation*** **> 30** ☐	

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Worksheet 3-18. Vertical stability prediction for channel incision and degradation.

Vertical Stability Prediction for Channel Incision and Degradation					
Stream: **Housatonic River Reach 5A-2**			Stream Type: **C4**		
Location: **Pittsfield MA**			Landscape Type: **U-AL-FD**		
Observers: **RGJ**			Date: **1/19/2026**		
Vertical Stability Criteria (choose one stability category for each criterion 1–5)	**Vertical Stability Categories for Channel Incision / Degradation**				**Selected Points (from each row)**
	Not Incised	***Slightly Incised***	***Moderately Incised***	***Degradation***	
1 Sediment Competence (Worksheet 3-14)	Does not indicate excess competence	Trend to move larger sizes than D_{100} of bar or D_{84} of bed	D_{100} of bed moved	Particles much larger than D_{100} of bed moved	**6**
	(2)	**(4)**	**(6)**	**(8)**	
2 Sediment Capacity (POWERSED)	Does not indicate excess capacity	Slight excess energy: up to 10% increase above reference	Excess energy sufficient to increase load up to 50% of annual load	Excess energy transporting more than 50% of annual load	**4**
	(2)	**(4)**	**(6)**	**(8)**	
3 Degree of Channel Incision (BHR) (Worksheet 3-7)	1.00 – 1.10	1.11 – 1.30	1.31 – 1.50	> 1.50	**4**
	(2)	**(4)**	**(6)**	**(8)**	
4 Stream Succession States (Worksheets 3-15 and 3-7)	Does not indicate incision or degradation	If BHR > 1.1 and stream type has W/d between 5–10	If BHR > 1.1 and stream type has W/d less than 5	(B→G), (C→G), (E→G), (D→G), (A→G), (E→A)	**2**
	(2)	**(4)**	**(6)**	**(8)**	
5 Confinement (MWR / MWR_{ref}) (Worksheet 3-9)	0.80 – 1.00	0.30 – 0.79	0.10 – 0.29	< 0.10	**3**
	(1)	**(2)**	**(3)**	**(4)**	
				Total Points	**19**
	Vertical Stability Category Point Range for Channel Incision and Degradation				
Vertical Stability for Channel Incision/ Degradation (use total points and check ✓ stability rating)	***Not Incised*** **< 12** ☐	***Slightly Incised*** **12 – 18** ☐	***Moderately Incised*** **19 – 27** ☑	***Degradation*** **> 27** ☐	

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Worksheet 3-19. Channel enlargement prediction summary.

Channel Enlargement Prediction					
Stream: **Housatonic River Reach 5A-2**			Stream Type: **C4**		
Location: **Pittsfield MA**			Landscape Type: **U-AL-FD**		
Observers: **RGJ**			Date: **1/19/2026**		
Channel Enlargement Prediction Criteria (choose one stability category for each criterion 1–4)	**Channel Enlargement Prediction Categories**				**Selected Points (from each row)**
	No Increase	***Slight Increase***	***Moderate Increase***	***Extensive***	
1 Stream Succession Stage Shifts (Worksheet 3-15)	Stream Type at Potential, (C→E), (F_b→B), (G→B), (F→B_c), (F→C), (D→C)	(B→High W/d B), (C→High W/d C), (E→C)	(G→F), (F→D)	(C→D), (A→G), (B→G), (D→G), (C→G), (E→G), (E→A), (C→F)	**2**
	(2)	**(4)**	**(6)**	**(8)**	
2 Lateral Stability (Worksheet 3-16)	*Stable*	*Moderately Unstable*	*Unstable*	*Highly Unstable*	**4**
	(2)	**(4)**	**(6)**	**(8)**	
3 Vertical Stability Excess Deposition and Aggradation (Worksheet 3-17)	*No Deposition*	*Moderate Deposition*	*Excess Deposition*	*Aggradation*	**2**
	(2)	**(4)**	**(6)**	**(8)**	
4 Vertical Stability Channel Incision and Degradation (Worksheet 3-18)	*Not Incised*	*Slightly Incised*	*Moderately Incised*	*Degradation*	**6**
	(2)	**(4)**	**(6)**	**(8)**	
				Total Points	**14**
	Category Point Range				
Channel Enlargement Prediction (use total points and check ✓ stability rating)	***No Increase*** **< 11** ☐	***Slight Increase*** **11 – 16** ☑	***Moderate Increase*** **17 – 24** ☐	***Extensive*** **> 24** ☐	

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Worksheet 3-20. Overall sediment supply rating determined from individual stability rating categories.

Overall Sediment Supply Prediction			
Stream: **Housatonic River Reach 5A-2**		Stream Type: **C4**	
Location: **Pittsfield MA**		Landscape Type: **U-AL-FD**	
Observers: **RGJ**		Date: **1/19/2026**	
Overall Sediment Supply Prediction Criteria (choose corresponding points for each criterion 1–5)	**Stability Rating**	**Points**	**Selected Points**
1 Lateral Stability (Worksheet 3-16)	***Stable***	**1**	**3**
	Mod. Unstable	**2**	
	Unstable	**3**	
	Highly Unstable	**4**	
2 Vertical Stability Excess Deposition or Aggradation (Worksheet 3-17)	***No Deposition***	**1**	**1**
	Mod. Deposition	**2**	
	Excess Deposition	**3**	
	Aggradation	**4**	
3 Vertical Stability Channel Incision or Degradation (Worksheet 3-18)	***Not Incised***	**1**	**3**
	Slightly Incised	**2**	
	Mod. Incised	**3**	
	Degradation	**4**	
4 Channel Enlargement Prediction (Worksheet 3-19)	***No Increase***	**1**	**2**
	Slight Increase	**2**	
	Mod. Increase	**3**	
	Extensive	**4**	
5 Pfankuch Channel Stability (Worksheet 3-10)	***Good: Stable***	**1**	**2**
	Fair: Mod. Unstable	**2**	
	Poor: Unstable	**4**	
		Total Points	**11**

	Category Point Range			
Overall Sediment Supply Rating (use total points and check ✓ stability rating)	***Low*** **< 6** ☐	***Moderate*** **6 – 10** ☐	***High*** **11 – 15** ☑	***Very High*** **> 15** ☐

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Worksheet 3-21. Summary of stability condition categories.

Summary of Stability Conditions

Stream:	**Housatonic River Reach 5A-2**					Location: **Pittsfield MA**					
Observers:	**RGJ**			Date: **1/19/2026**		Stream Type: **C4**			Landscape Type: **U-AL-FD**		
Channel Dimension	Bankfull Mean Depth (ft): **6.52**		Bankfull Width (ft): **90.5**		Cross-Sectional Area (ft^2): **589**		Width/Depth Ratio: **13.8**		Entrenchment Ratio: **8.4**		
Channel Pattern	Mean:	λ/W_{bkf}: **653**	L_m/W_{bkf}: **671.5**		R_c/W_{bkf}: **471**		MWR: **0.95**		Sinuosity: **1.02**		
	Range:	**384-922**	**404-939**		**203-779**		**0.86-3.4**				
Streamflow	Bankfull Mean Velocity ($\bar{u}_{bkf}$) (ft/sec): **5.3**		Bankfull Discharge (Q_{bkf}): **3072**		Estimation Method: **Regional Curve**				Drainage Area (mi^2): **134**		
River Profile & Bed Features	Check: ☑ Riffle/Pool ☐ Step/Pool ☐ Plane Bed ☐ Convergence/Divergence ☐ Dunes/Antidunes/Smooth Bed										
	Bankfull Max Depth (ft):	Riffle **8.06**	Pool **9.78**	Depth Ratio (max to mean):	Riffle **1.2**	Pool **1.5**	Pool-to-Pool Spacing:	Ratio	Slope Valley: **0.0002**	Water Surface: **0.0002**	
Level III Stream Stability Indices	Riparian Vegetation	Current Composition/Density:		Potential Composition/Density:			Remarks: Condition, Vigor & Usage of Existing Reach:				
	Flow Regime: **P2**	Stream Size & Order: **S-8(4)**		Meander Patterns: **M3**			Depositional Patterns: **B4**		Debris/Channel Blockages: **D2**		
	Degree of Incision (Bank-Height Ratio): **1.2**	Degree of Incision Stability Rating: **Slightly Incised**					Modified Pfankuch Stability Rating (Numeric & Adjective Rating): **96 Fair**				
	W/d Ratio State $(W/d)/(W/d_{ref})$: **0.96**	W/d Ratio State Stability Rating: **Stable**		Degree of Confinement (MWR/MWR_{ref}): **0.19**			MWR/MWR_{ref} Stability Rating: **Moderate Departure**				
Bank Erosion Summary	Length of Reach Studied (ft): **2000**	Annual Streambank Erosion Rate: **117** (tons/yr)	**0.03** (tons/yr/ft)	Curve Used: **Housatonic**	Remarks:						
Sediment Capacity (POWERSED)	☐ *Sufficient Capacity* ☐ *Insufficient Capacity* ☐ *Excess Capacity*						Remarks:				
Entrainment/ Competence	Largest Particle from Bar Sample (mm):	$\tau =$	$\tau^* =$	Existing Depth: **6.5**	Required Depth: **9.53**	Existing Slope: **0.0002**	Required Slope: **0.0003**				
Stream Succession	**E** → **C** → → → →						Existing Stream State (Type): **C4**		Potential Stream State (Type): **C4**		
Lateral Stability	☐ *Stable*	☑ *Mod. Unstable*	☐ *Unstable*	☐ *Highly Unstable*	Remarks:						
Vertical Stability (Aggradation)	☑ *No Deposition*	☐ *Mod. Deposition*	☐ *Ex. Deposition*	☐ *Aggradation*	Remarks:						
Vertical Stability (Degradation)	☐ *Not Incised*	☐ *Slightly Incised*	☑ *Mod. Incised*	☐ *Degradation*	Remarks:						
Channel Enlargement	☐ *No Increase*	☑ *Slight Increase*	☐ *Mod. Increase*	☐ *Extensive*	Remarks:						
Sediment Supply (Channel Source)	☐ *Low*	☐ *Moderate*	☑ *High*	☐ *Very High*	Remarks:						

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Worksheet 2-2. Computations of bankfull mean velocity and bankfull discharge using various methods.

Bankfull VELOCITY & DISCHARGE Estimates

Stream:	**Housatonic River Reach 5A-3**			Location:	**Pittsfield MA**
Date:	**1/19/2026**	Stream Type:	**C4**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**			HUC:	_ _ _ _ _ _ _ _ _ _ _ _

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional Area	**597**	**A_{bkf}** (ft^2)	Bankfull Riffle Mean Depth	**4.36**	**d_{bkf}** (ft)
Bankfull Riffle Width	**137**	**W_{bkf}** (ft)	Wetted Perimeter ≈ (2 * d_{bkf}) + W_{bkf}	**145.72**	**W_p** (ft)
D_{84} Particle Size at Riffle	**18.54**	**D_{84}** (mm)	D_{84} Particle Size in Feet D_{84} (mm) / 304.8	**0.06**	**D_{84}** (ft)
Bankfull Slope	**0.0005**	**S_{bkf}** (ft / ft)	Hydraulic Radius A_{bkf} / W_p	**4.10**	**R** (ft)
Gravitational Acceleration	**32.2**	**g** (ft / sec^2)	Relative Roughness R (ft) / D_{84} (ft)	**67.36**	**R / D_{84}** (ft / ft)
Drainage Area	**143**	**DA** (mi^2)	Shear Velocity $u^* = (gRS)^{½}$	**0.2568**	**u*** (ft / sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $\bar{u} = [\ 2.83 + 5.66 * Log\ \{\ R / D_{84}\ \}\ ]\ u^*$	**3.38**	ft / sec	**2021**	cfs
2. Roughness Coefficient: a) Manning's *n* from Friction Factor/Relative Roughness (Figs. 2-29, 2-30) $\bar{u} = 1.49 R^{2/3} S^{1/2} / n$ $n =$ **0.024**	**3.55**	ft / sec	**2122**	cfs
2. Roughness Coefficient: b) Manning's *n* from Stream Type (Fig. 2-31) $\bar{u} = 1.49 R^{2/3} S^{1/2} / n$ $n =$ **0.02**	**4.27**	ft / sec	**2546**	cfs
2. Roughness Coefficient: c) Manning's *n* from Jarrett (USGS): $\bar{u} = 1.49 R^{2/3} S^{1/2} / n$ $n = 0.39 S^{0.38} R^{-0.16}$ **Note:** This equation is applicable to **steep, step/pool, high boundary roughness, cobble- and boulder-dominated stream systems**; i.e., for Stream Types A1, A2, A3, B1, B2, B3, C2 & E3 $n =$		ft / sec		cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)		ft / sec		cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)		ft / sec		cfs
4. Continuity Equations: a) USGS Gage Data $\bar{u} = Q / A$ **Return Period for Bankfull Q** $Q =$ **1.5** year	**4.00**	ft / sec	**2388.0**	cfs
4. Continuity Equations: b) Regional Curves $\bar{u} = Q / A$	**3.26**	ft / sec	**1946.2**	cfs

Protrusion Height Options for the D_{84} Term in the Relative Roughness Relation (R/D_{84}) – Estimation Method 1

Option 1.	For **sand-bed** channels: Measure 100 **"protrusion heights"** of sand dunes from the downstream side of feature to the top of feature. Substitute the D_{84} sand dune protrusion height in ft for the D_{84} term in method 1.
Option 2.	For **boulder-dominated** channels: Measure 100 **"protrusion heights"** of boulders on the sides from the bed elevation to the top of the rock on that side. Substitute the D_{84} boulder protrusion height in ft for the D_{84} term in method 1.
Option 3.	For **bedrock-dominated** channels: Measure 100 **"protrusion heights"** of rock separations, steps, joints or uplifted surfaces above channel bed elevation. Substitute the D_{84} bedrock protrusion height in ft for the D_{84} term in method 1.
Option 4.	For **log-influenced** channels: Measure "**protrustion heights**" proportionate to channel width of log diameters or the height of the log on upstream side if embedded. Substitute the D_{84} protrusion height in ft for the D_{84} term in method 1.

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Worksheet 2-3. Field form for *Level II* stream classification.

Stream:	**Housatonic River Reach 5A-3**				
Basin:	**Housatonic River**	Drainage Area:	acres	**143**	mi^2
Location:	**Pittsfield MA**				
Twp.&Rge:		Sec.&Qtr.:			
Cross-Section Monuments (Lat./Long.):				Date:	**1/19/2026**
Observers:	**RGJ**			Landscape Type:	**U-AL-FD**

Bankfull Width (W_{bkf}) The surface width of the stream at bankfull stage elevation, in a riffle section.	**137.0**	ft
Bankfull Mean Depth (d_{bkf}) Mean depth of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A_{bkf} / W_{bkf}$).	**4.35**	ft
Bankfull Cross-Sectional Area (A_{bkf}) Area of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**597.0**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) *Bankfull Width* divided by *Bankfull Mean Depth*, in a riffle section.	**31.5**	ft/ft
Bankfull Maximum Depth (d_{max}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	**7.61**	ft
Flood-Prone Area Width (W_{fpa}) Width of the channel at an elevation that is twice the *Bankfull Maximum Depth*, measured perpendicular to the fall line of the valley in a riffle section.	**580.00**	ft
Entrenchment Ratio (ER) The *Flood-Prone Area Width* divided by *Bankfull Width* (W_{fpa} / W_{bkf}), in a riffle section.	**4.20**	ft/ft
Channel Materials (Particle Size Index D_{50}) The D_{50} particle size index represents the median or dominant diameter of channel materials, as sampled proportionately from the channel surface between the bankfull stage and Thalweg elevations.	**9**	mm
Average Water Surface Slope (S) The elevation difference of water surface measurements over the stream length between two similar bed features (e.g., start of riffle to start of last riffle) for several riffle–pool or step–pool sequences, representing channel gradient.	**0.0005**	ft/ft
Channel Sinuosity (k) An index of channel pattern determined from stream length divided by valley length (SL / VL), or from valley slope divided by average water surface slope (S_{val} / S).	**2.65**	ft/ft

Stream Type **C4** **See Classification Key (Figure 2-35)**

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Worksheet 2-4a. Morphological relations, including dimensionless ratios of river reach sites.

Stream: **Housatonic River Reach 5A-3** Location: **Pittsfield MA**

Observers: **RGJ** Date: **1/19/2026** Landscape Type: **U-AL-FD** Stream Type: **C4**

River Reach Dimension Summary Data…..1

Riffle Dimensions*, **, *

Riffle Dimensions*, **, ***	Mean	Min.	Max.		Riffle Dimensions & Dimensionless Ratios****	Mean	Min.	Max.
Riffle Width (W_{bkf})	**120.0**	**86.0**	**162.0**	ft	Riffle Cross-Sectional Area (A_{bkf}) (ft^2)	**578.0**	**500.0**	**617.0**
Riffle Mean Depth (d_{bkf})	**5.06**	**3.67**	**6.42**	ft	Riffle Width/Depth Ratio (W_{bkf} / d_{bkf})	**26.4**	**15.0**	**44.0**
Riffle Maximum Depth (d_{max})	**7.56**	**6.86**	**8.33**	ft	Riffle Max Depth to Riffle Mean Depth (d_{max} / d_{bkf})	**1.6**	**1.2**	**2.0**
Width of Flood-Prone Area (W_{fpa})	**1527**	**580**	**2600**	ft	Entrenchment Ratio (W_{fpa} / W_{bkf})	**14.6**	**4.2**	**30.2**
Riffle Inner Berm Width (W_{ib})				ft	Riffle Inner Berm Width to Riffle Width (W_{ib} / W_{bkf})			
Riffle Inner Berm Depth (d_{ib})				ft	Riffle Inner Berm Depth to Mean Depth (d_{ib} / d_{bkf})			
Riffle Inner Berm Area (A_{ib})				ft^2	Riffle Inner Berm Area to Riffle Area (A_{ib} / A_{bkf})			
Riffle Inner Berm W/d Ratio (W_{ib} / d_{ib})								

Pool Dimensions*, **, *

Pool Dimensions*, **, ***	Mean	Min.	Max.		Pool Dimensions & Dimensionless Ratios****	Mean	Min.	Max.
Pool Width (W_{bkfp})	**95.8**	**75.6**	**110.2**	ft	Pool Width to Riffle Width (W_{bkfp} / W_{bkf})	**0.79**		
Pool Mean Depth (d_{bkfp})	**5.64**	**4.22**	**6.99**	ft	Pool Mean Depth to Riffle Mean Depth (d_{bkfp} / d_{bkf})	**1.11**		
Pool Cross-Sectional Area (A_{bkfp})	**529.0**	**428.0**	**630.0**	ft	Pool Area to Riffle Area (A_{bkfp} / A_{bkf})	**0.91**		
Pool Maximum Depth (d_{maxp})	**10.70**	**9.64**	**11.51**	ft	Pool Max Depth to Riffle Mean Depth (d_{maxp} / d_{bkf})	**2.12**		
Pool Inner Berm Width (W_{ibp})				ft	Pool Inner Berm Width to Pool Width (W_{ibp} / W_{bkfp})			
Pool Inner Berm Depth (d_{ibp})				ft	Pool Inner Berm Depth to Pool Depth (d_{ibp} / d_{bkfp})			
Pool Inner Berm Area (A_{ibp})				ft^2	Pool Inner Berm Area to Pool Area (A_{ibp} / A_{bkfp})			
Point Bar Slope (S_{pb})				ft/ft	Pool Inner Berm Width/Depth Ratio (W_{ibp} / d_{ibp})			

Run Dimensions*

Run Dimensions*	Mean	Min.	Max.		Run Dimensionless Ratios****	Mean	Min.	Max.
Run Width (W_{bkfr})				ft	Run Width to Riffle Width (W_{bkfr} / W_{bkf})			
Run Mean Depth (d_{bkfr})				ft	Run Mean Depth to Riffle Mean Depth (d_{bkfr} / d_{bkf})			
Run Cross-Sectional Area (A_{bkfr})				ft	Run Area to Riffle Area (A_{bkfr} / A_{bkf})			
Run Maximum Depth (d_{maxr})				ft	Run Max Depth to Riffle Mean Depth (d_{maxr} / d_{bkf})			
Run Width/Depth Ratio (W_{bkfr} / d_{bkfr})				ft				

Glide Dimensions*

Glide Dimensions*	Mean	Min.	Max.		Glide Dimensions & Dimensionless Ratios****	Mean	Min.	Max.
Glide Width (W_{bkfg})				ft	Glide Width to Riffle Width (W_{bkfg} / W_{bkf})			
Glide Mean Depth (d_{bkfg})				ft	Glide Mean Depth to Riffle Mean Depth (d_{bkfg} / d_{bkf})			
Glide Cross-Sectional Area (A_{bkfg})				ft	Glide Area to Riffle Area (A_{bkfg} / A_{bkf})			
Glide Maximum Depth (d_{maxg})				ft	Glide Max Depth to Riffle Mean Depth (d_{maxg} / d_{bkf})			
Glide Width/Depth Ratio (W_{bkfg} / d_{bkfg})				ft/ft	Glide Inner Berm Width/Depth Ratio (W_{ibg} / d_{ibg})			
Glide Inner Berm Width (W_{ibg})				ft	Glide Inner Berm Width to Glide Width (W_{ibg}/W_{bkfg})			
Glide Inner Berm Depth (d_{ibg})				ft	Glide Inner Berm Depth to Glide Depth (d_{ibg} / d_{bkfg})			
Glide Inner Berm Area (A_{ibg})				ft^2	Glide Inner Berm Area to Glide Area (A_{ibg} / A_{bkfg})			

Step Dimensions**

Step Dimensions**	Mean	Min.	Max.		Step Dimensionless Ratios****	Mean	Min.	Max.
Step Width (W_{bkfs})				ft	Step Width to Riffle Width (W_{bkfs} / W_{bkf})			
Step Mean Depth (d_{bkfs})				ft	Step Mean Depth to Riffle Mean Depth (d_{bkfs} / d_{bkf})			
Step Cross-Sectional Area (A_{bkfs})				ft	Step Area to Riffle Area (A_{bkfs} / A_{bkf})			
Step Maximum Depth (d_{maxs})				ft	Step Max Depth to Riffle Mean Depth (d_{maxs} / d_{bkf})			
Step Width/Depth Ratio (W_{bkfs} / d_{bkfs})				ft/ft				

*Riffle–Pool system (i.e., C, E, F stream types) bed features include riffles, runs, pools, and glides.

**Step–Pool system (i.e., A, B, G stream types) bed features include riffles, rapids, chutes, pools, and steps (note: include rapids and chutes in riffle category).

***Convergence-Divergence system (i.e., D stream types) bed features include riffles and pools; cross-sections taken at riffles for classification purposes.

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Worksheet 2-4b. Morphological relations, including dimensionless ratios of river reach sites.

Stream: **Housatonic River Reach 5A-3** Location: **Pittsfield MA**

Observers: **RGJ** Date: **1/19/2026** Landscape Type: **U-AL-FD** Stream Type: **C4**

River Reach Summary Data…..2

Hydraulics

Streamflow: Estimated Mean Velocity at Bankfull Stage ($\bar{u}_{bkf}$)	**3.3**	ft/sec	Estimation Method	**Regional Curve**	
Streamflow: Estimated Discharge at Bankfull Stage (Q_{bkf})	**1946.0**	cfs	Drainage Area	**143.0**	mi^2

Channel Pattern

Geometry	Mean	Min.	Max.		Dimensionless Geometry Ratios	Mean	Min.	Max.
Linear Wavelength (λ)	**470.3**	**163.0**	**802.0**	ft	Linear Wavelength to Riffle Width (λ / W_{bkf})	**3.92**	**1.36**	**6.68**
Stream Meander Length (L_m)	**612.8**	**173.0**	**945.0**	ft	Stream Meander Length Ratio (L_m / W_{bkf})	**5.11**	**1.44**	**7.88**
Radius of Curvature (R_c)	**185.6**	**100.0**	**732.0**	ft	Radius of Curvature to Riffle Width (R_c / W_{bkf})	**1.55**	**0.83**	**6.10**
Belt Width (W_{blt})	**176.0**	**65.0**	**456.0**	ft	Meander Width Ratio (W_{blt} / W_{bkf})	**1.47**	**0.54**	**3.80**
Arc Length (L_a)	**127.0**	**30.0**	**413.0**	ft	Arc Length to Riffle Width (L_a / W_{bkf})	**1.06**	**0.25**	**3.44**
Riffle Length (L_r)				ft	Riffle Length to Riffle Width (L_r / W_{bkf})			
Individual Pool Length (L_p)				ft	Individual Pool Length to Riffle Width (L_p / W_{bkf})			
Pool-to-Pool Spacing (P_s)				ft	Pool-to-Pool Spacing to Riffle Width (P_s / W_{bkf})			

Channel Profile

Valley Slope (S_{val})	**0.0012**	ft/ft	Average Water Surface Slope (S)	**0.0005**	ft/ft	Sinuosity (S_{val} / S)		**2.67**
Stream Length (SL)	**8200.0**	ft	Valley Length (VL)	**3100.0**	ft	Sinuosity (SL / VL)		**2.65**
Low Bank Height (LBH)	start **9.38** ft end **7.18** ft		Bankfull Max Depth (d_{max})	start **6.86** ft end **8.33** ft		Bank-Height Ratio (BHR) (LBH / d_{max})	start **1.4** end **0.9**	

Facet Slopes	Mean	Min.	Max.		Dimensionless Facet Slope Ratios	Mean	Min.	Max.
Riffle Slope (S_{rif})				ft/ft	Riffle Slope to Average Water Surface Slope (S_{rif} / S)			
Run Slope (S_{run})				ft/ft	Run Slope to Average Water Surface Slope (S_{run} / S)			
Pool Slope (S_p)				ft/ft	Pool Slope to Average Water Surface Slope (S_p / S)			
Glide Slope (S_g)				ft/ft	Glide Slope to Average Water Surface Slope (S_g / S)			
Step Slope (S_s)				ft/ft	Step Slope to Average Water Surface Slope (S_s / S)			

Max Depths[a]	Mean	Min.	Max.		Dimensionless Depth Ratios	Mean	Min.	Max.
Max Riffle Depth (d_{max})				ft	Max Riffle Depth to Mean Riffle Depth (d_{max} / d_{bkf})			
Max Run Depth (d_{maxr})				ft	Max Run Depth to Mean Riffle Depth (d_{maxr} / d_{bkf})			
Max Pool Depth (d_{maxp})				ft	Max Pool Depth to Mean Riffle Depth (d_{maxp} / d_{bkf})			
Max Glide Depth (d_{maxg})				ft	Max Glide Depth to Mean Riffle Depth (d_{maxg} / d_{bkf})			
Max Step Depth (d_{maxs})				ft	Max Step Depth to Mean Riffle Depth (d_{maxs} / d_{bkf})			

Channel Materials

	Reach[b]	Riffle[c]	Bar		Reach[b]	Riffle[c]	Bar	Protrusion Height[d]	
% Silt/Clay		**0**	**0**	D_{16}		**1.71**	**0.00**		mm
% Sand		**18**	**67**	D_{35}		**6.79**	**0.00**		mm
% Gravel		**82**	**33**	D_{50}		**9.27**	**0.00**		mm
% Cobble		**0**	**0**	D_{84}		**18.54**	**3.82**		mm
% Boulder		**0**	**0**	D_{95}		**27.30**	**7.44**		mm
% Bedrock		**0**	**0**	D_{100}		**64.00**	**29.20**		mm

[a] *Mean* , *Min* ., and *Max* . depths are measured from Thalweg to bankfull at mid-point of feature for riffles, runs, and steps, the deepest part of pools, and at the tail-out of glides.

[b] Composite sample of riffles and pools within the designated reach. [c] Active bed of a riffle. [d] Height of roughness feature above bed.

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Worksheet 3-2. Flow regime variables that influence channel characteristics, sediment regime, and biological interpretations.

Flow Regime

Stream:	**Housatonic River Reach 5A-3**				Stream Type:	**C4**		
Location:	**Pittsfield MA**				Landscape Type:	**U-AL-FD**		
Observers:	**RGJ**				Date:	**1/19/2026**		
List ALL COMBINATIONS that APPLY……..☞	**P2**							

General Category

E	***Ephemeral stream channel:*** Flows only in response to precipitation.
S	***Subterranean stream channel:*** Flows parallel to and near the surface for various seasons – a sub-surface flow that follows the stream bed.
I	***Intermittent stream channel:*** Surface water flows discontinuously along its length. Often associated with sporadic or seasonal flows and also with Karst (limestone) geology where losing/gaining reaches create flows that disappear then reappear farther downstream.
P	***Perennial stream channels:*** Surface water persists yearlong.

Specific Category

1	Seasonal variation in streamflow dominated primarily by snowmelt runoff.
2	Seasonal variation in streamflow dominated primarily by stormflow runoff.
3	Uniform stage and associated streamflow due to spring-fed condition, backwater, etc.
4	Streamflow regulated by glacial melt.
5	Ice flows/ice torrents from ice dam breaches.
6	Alternating flow/backwater due to tidal influence.
7	Regulated streamflow due to diversions, dam release, dewatering, etc.
8	Altered due to development, such as urban streams, cut-over watersheds, or vegetation conversions (forested to grassland) that change flow response to precipitation events.
9	Rain-on-snow generated runoff.

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Worksheet 3-3. Stream order and stream size categories for stratification by stream type.

Stream Size and Order			
Stream:	**Housatonic River Reach 5A-3**		
Location:	**Pittsfield MA**		
Observers:	**RGJ**	Stream Type:	**C4**
Landscape Type:	**U-AL-FD**	Date:	**1/19/2026**

Stream Size Category and Order ☞	**S-8(4)**

Category	STREAM SIZE: Bankfull Width		Check (✓) Appropriate Category
	meters	feet	
S-1	0.305	<1	☐
S-2	0.3 – 1.5	1 – 5	☐
S-3	1.5 – 4.6	5 – 15	☐
S-4	4.6 – 9.0	15 – 30	☐
S-5	9.0 – 15.0	30 – 50	☐
S-6	15.0 – 22.8	50 – 75	☐
S-7	22.8 – 30.5	75 – 100	☐
S-8	30.5 – 46.0	100 – 150	☑
S-9	46 – 76	150 – 250	☐
S-10	76 – 107	250 – 350	☐
S-11	107 – 150	350 – 500	☐
S-12	150 – 305	500 – 1000	☐
S-13	>305	>1000	☐

Stream Order

Add categories in parenthesis for specific stream order of reach. For example, a third-order stream with a bankfull width of 6.1 meters (20 feet) would be indexed as: S-4(3).

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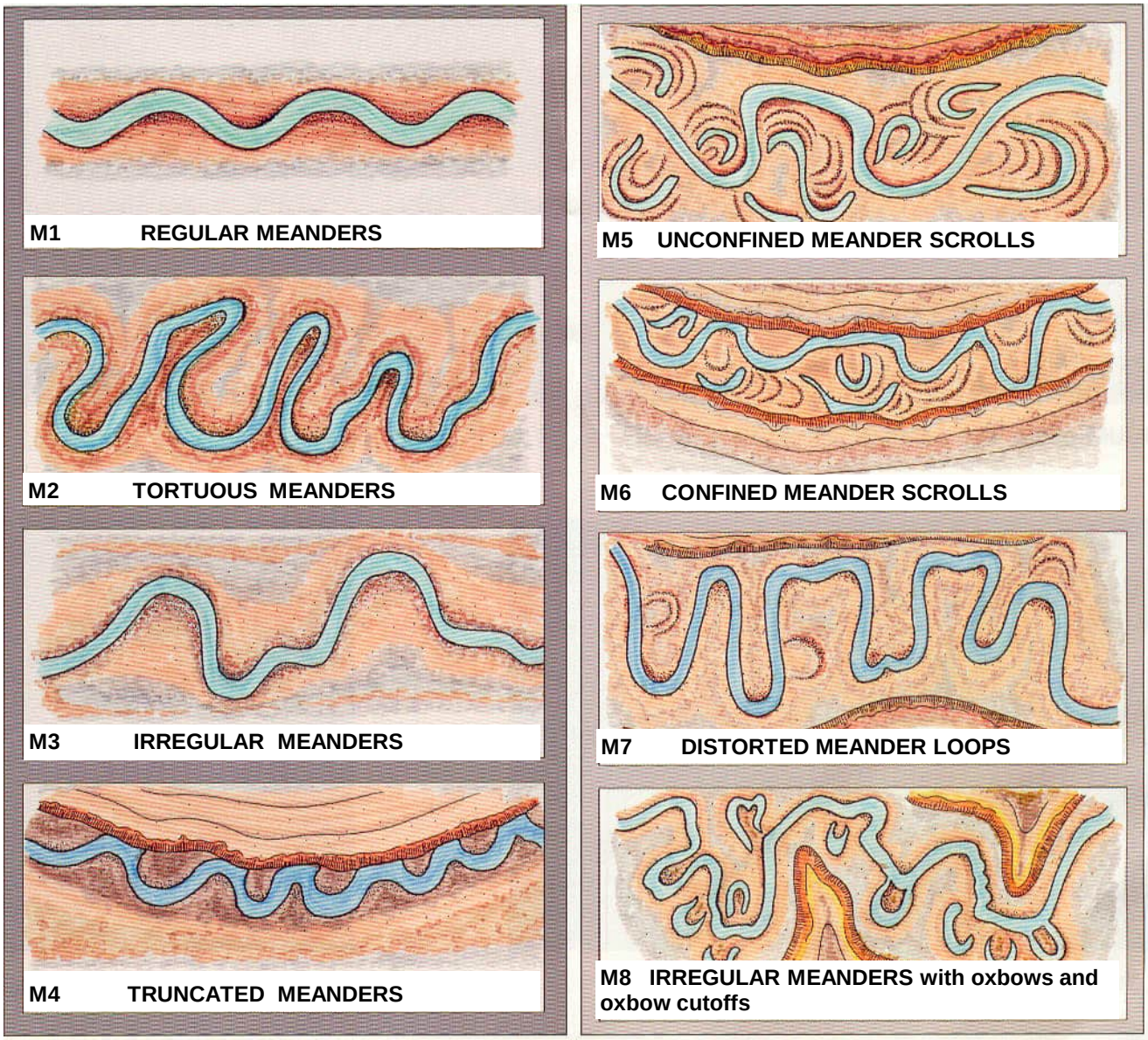
Worksheet 3-4. Meander pattern relations used for interpretations for river stability.

Meander Patterns

Stream:	**Housatonic River Reach 5A-3**	Stream Type:	**C4**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

List ALL CATEGORIES that APPLY ☞	M3	M2	M8		

Various Meander Pattern Variables modified from Galay et al. (1973)



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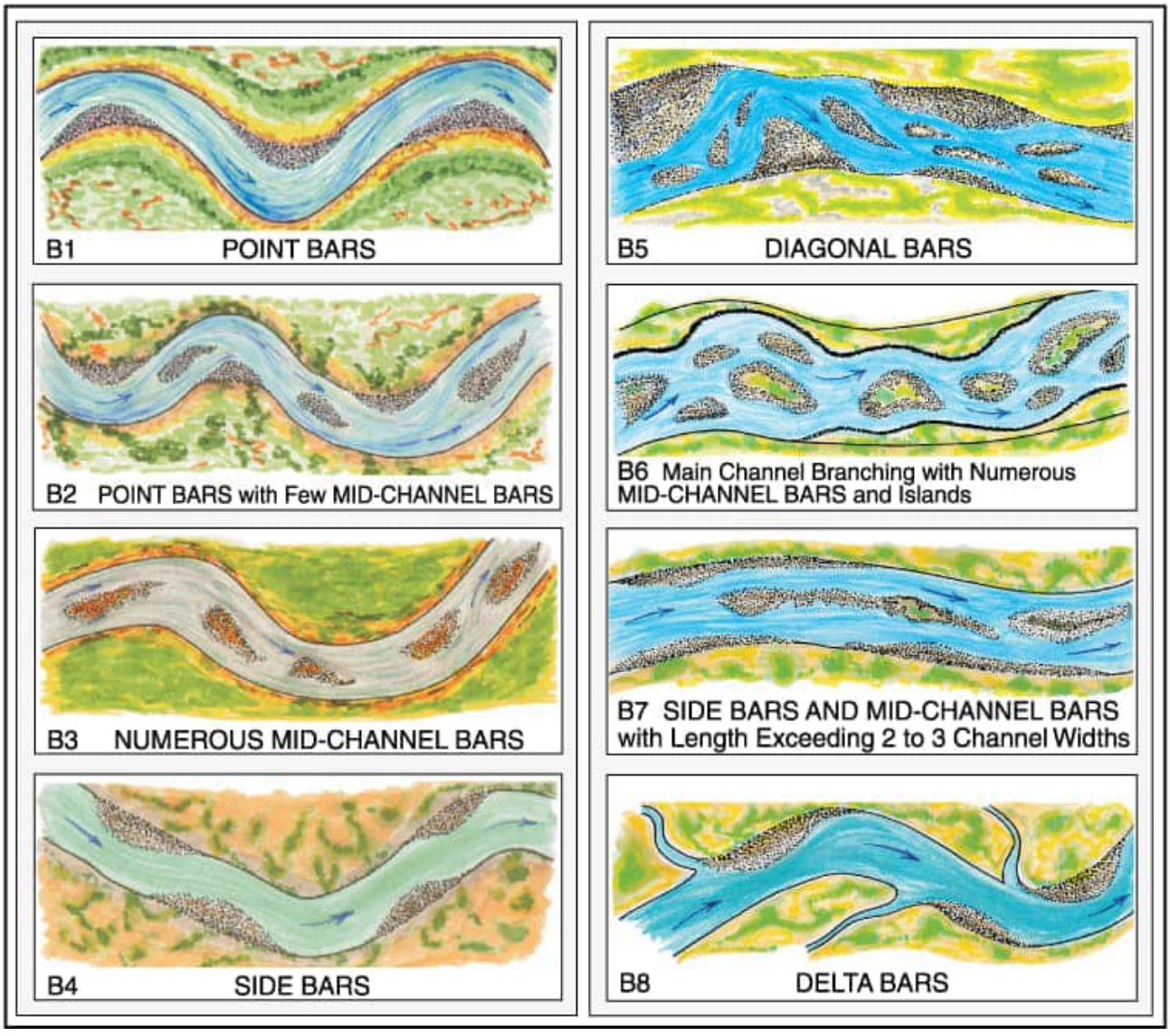
Worksheet 3-5. Depositional patterns used for stabiilty assessments.

Depositional Patterns

Stream:	**Housatonic River Reach 5A-3**	Stream Type:	**C4**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

List ALL CATEGORIES that APPLY ☞	B2	B3	B4	B5	

Various Depositional Features modified from Galay et al. (1973)



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Worksheet 3-6. Various categories of in-channel debris, dams, and channel blockages used to evaluate channel stability.

Channel Blockages			
Stream:	**Housatonic River Reach 5A-3**	Stream Type:	**C4**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

Description/Extent		Materials that upon placement into the active channel or flood-prone area may cause adjustments in channel dimensions or conditions due to influences on the existing flow regime.	Check (✓) all that apply
D1	None	Minor amounts of small, floatable material.	☐
D2	Infrequent	Debris consists of small, easily moved, floatable material, e.g., leaves, needles, small limbs, and twigs.	☐
D3	Moderate	Increasing frequency of small- to medium-sized material, such as large limbs, branches, and small logs, that when accumulated affect 10% or less of the active channel cross-sectional area.	☐
D4	Numerous	Significant build-up of medium- to large-sized materials, e.g., large limbs, branches, small logs, or portions of trees, occupying 10–30% of the active channel cross-sectional area.	☑
D5	Extensive	Debris "dams" of predominantly larger materials, e.g., branches, logs, and trees, occupying 30–50% of the active channel cross-sectional area, often extending across the width of the active channel.	☑
D6	Dominating	Large, somewhat continuous, debris "dams," extensive in nature and occupying over 50% of the active channel cross-sectional area. Such accumulations may divert water into the flood-prone areas and form fish migration barriers, even when flows are at less than bankfull.	☐
D7	Beaver Dams: Few	An infrequent number of dams spaced such that normal streamflow and expected channel conditions exist in the reaches between dams.	☐
D8	Beaver Dams: Frequent	Frequency of dams is such that backwater conditions exist for channel reaches between structures where streamflow velocities are reduced and channel dimensions or conditions are influenced.	☐
D9	Beaver Dams: Abandoned	Numerous abandoned dams, many of which have filled with sediment or breached, initiating a series of channel adjustments, such as streambank erosion, lateral migration, avulsion, aggradation, or degradation.	☐
D10	Human Influences	Structures, facilities, or materials related to land uses or development located within the flood-prone area, such as diversions or low-head dams, controlled by-pass channels, velocity control structures, and various transportation encroachments that have an influence on the existing flow regime, such that significant channel adjustments occur.	☐

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Worksheet 3-7. Relationship of Bank-Height Ratio (BHR) ranges to corresponding stream stability ratings.

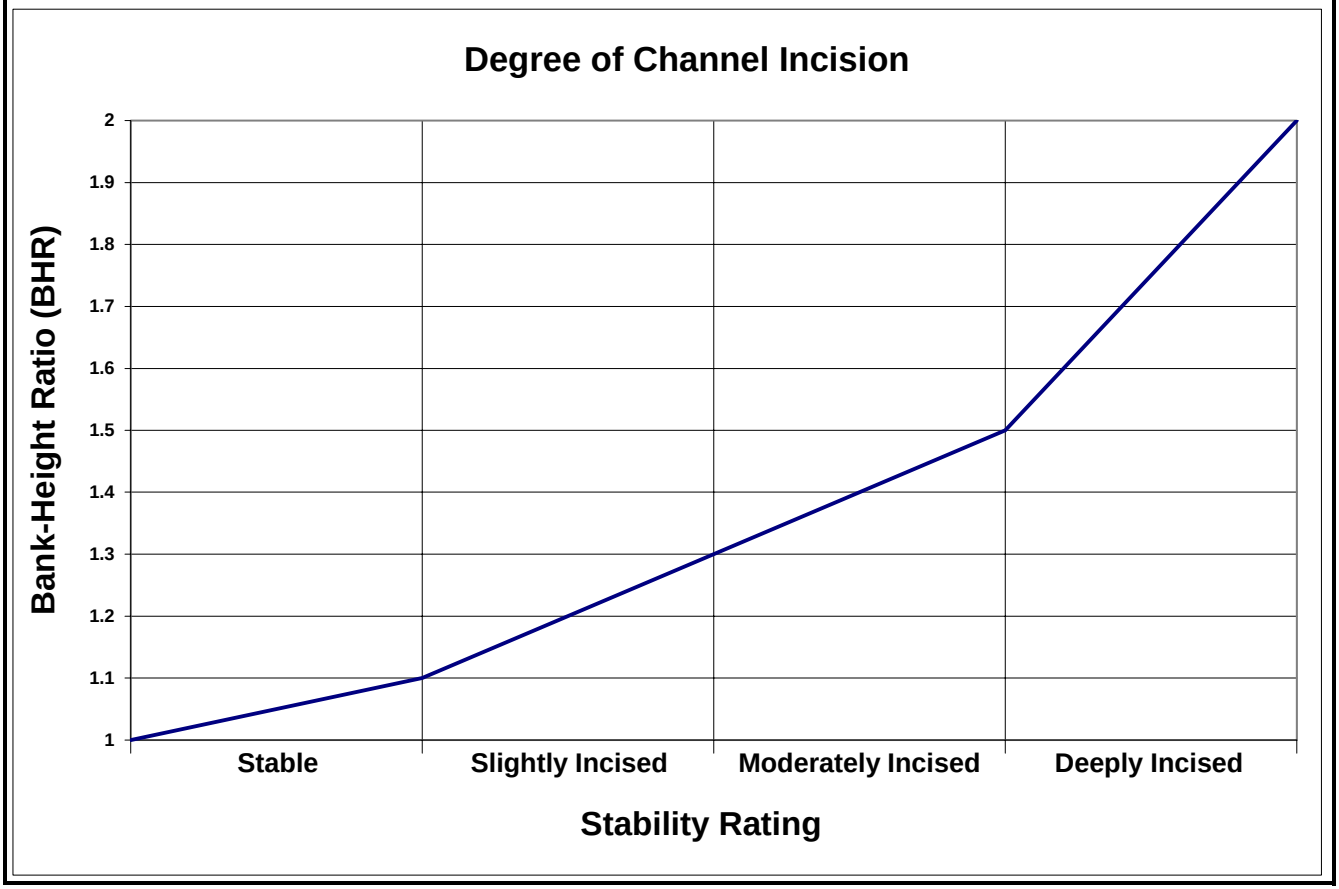
Degree of Channel Incision

Stream:	**Housatonic River Reach 5A-3**	Stream Type:	**C4**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

Low Bank Height:	**7.92**
Bankfull Max Depth:	**7.61**

Bank-Height Ratio (BHR):	**1.04**

Degree of Channel Incision Stability Rating ☞ **Stable**



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Worksheet 3-8. Stability ratings based on departure of width/depth ratio from reference condition.

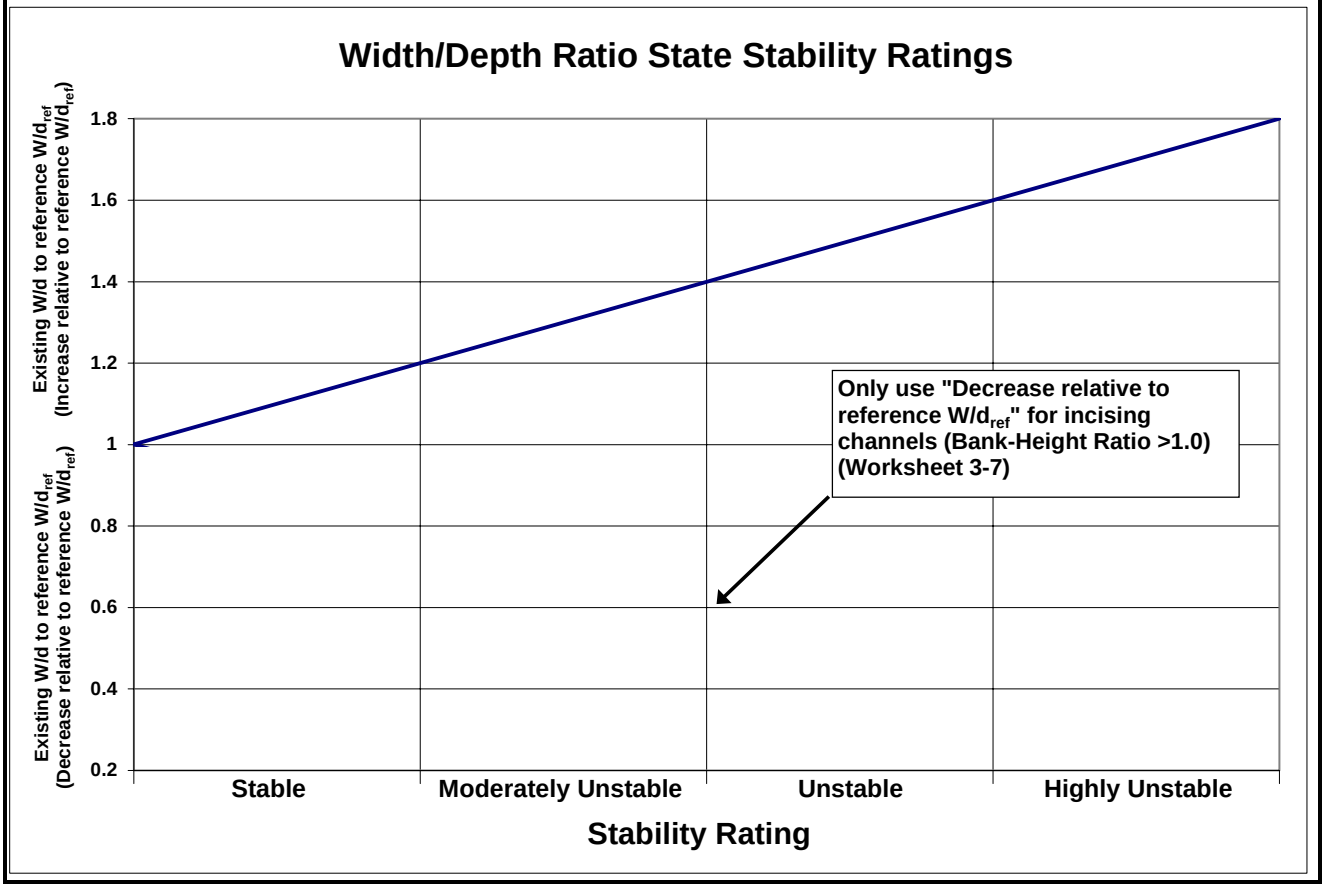
Width/Depth Ratio State

Stream:	**Housatonic River Reach 5A-3**	Stream Type:	**C4**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

Existing Width/Depth Ratio (W/d):	**26**
Reference Width/Depth Ratio (W/d_{ref}):	**14**

Existing W/d to Reference W/d_{ref} :	**1.86**

Width/Depth Ratio State Stability Rating ☞ **Highly Unstable**



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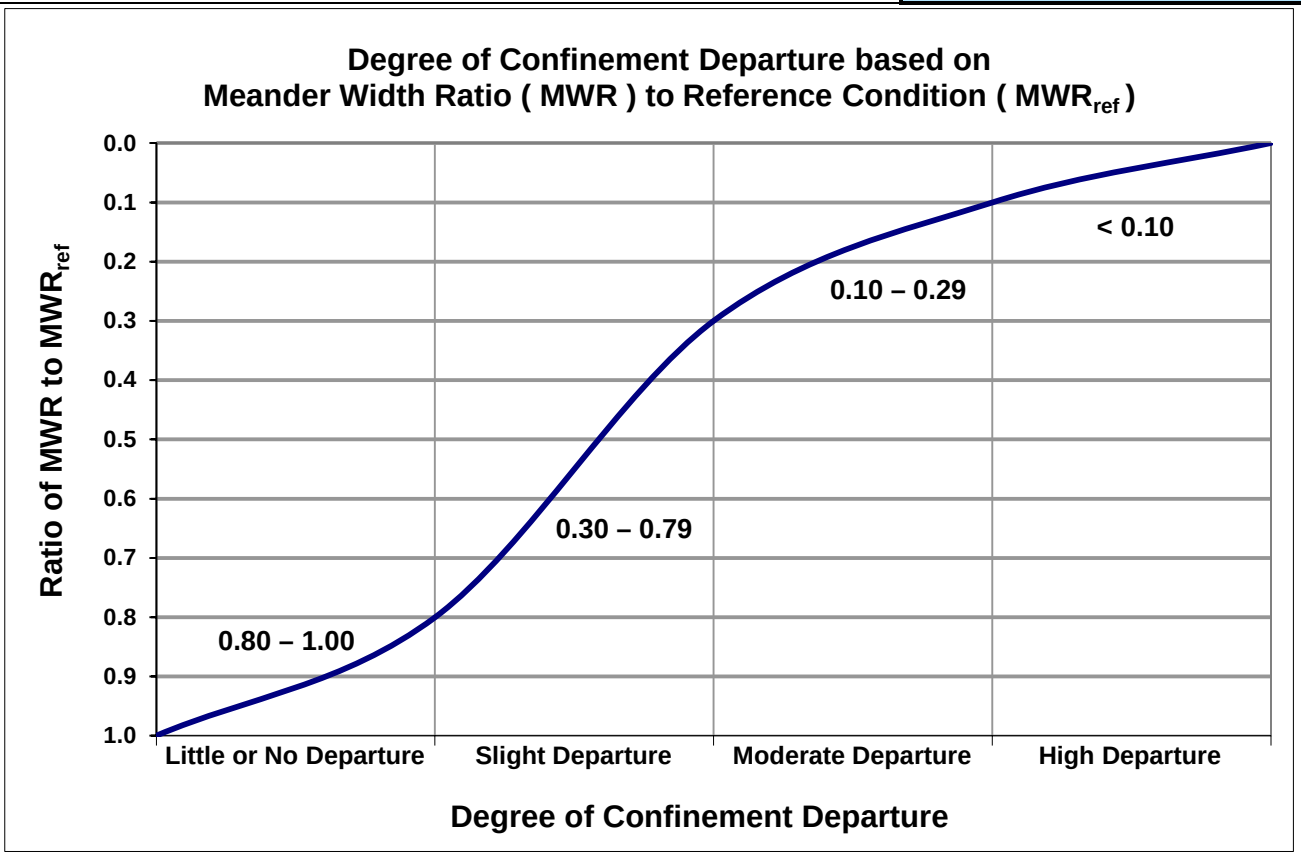
Worksheet 3-9. Degree of confinement departure based on Meander Width Ratio (MWR) divided by reference condition Meander Width Ratio (MWR_{ref}).

Degree of Confinement

Stream:	**Housatonic River Reach 5A-3**	Stream Type:	**C4**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

Existing Meander Width Ratio (MWR):	**1.47**	Ratio of MWR to MWR_{ref} :	**0.29**
Reference Meander Width Ratio (MWR_{ref}):	**5**		

Degree of Confinement Stability Rating ☞ **Moderate Departure**



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Worksheet 3-10. Pfankuch (1975) channel stability rating procedure, as modified by Rosgen (1996, 2006b).

Stream: Housatonic River Reach 5A-3 **Location:** Pittsfield MA **Landscape Type:** U-AL-FD **Observers:** RGJ **Date:** 1/19/2026

Loca-tion	Key	Category	Excellent		Good		Fair		Poor	
			Description	Rating	Description	Rating	Description	Rating	Description	Rating
Upper banks	1	Landform slope	Bank slope gradient <30%.	2	Bank slope gradient 30–40%.	4	Bank slope gradient 40–60%.	6	Bank slope gradient > 60%.	8
	2	Mass erosion	No evidence of past or future mass erosion.	3	Infrequent. Mostly healed over. Low future potential.	6	Frequent or large, causing sediment nearly yearlong.	9	Frequent or large, causing sediment nearly yearlong OR imminent danger of same.	12
	3	Debris jam potential	Essentially absent from immediate channel area.	2	Present, but mostly small twigs and limbs.	4	Moderate to heavy amounts, mostly larger sizes.	6	Moderate to heavy amounts, predominantly larger sizes.	8
	4	Vegetative bank protection	> 90% plant density. Vigor and variety suggest a deep, dense, soil-binding root mass.	3	70–90% density. Fewer species or less vigor suggest less dense or deep root mass.	6	50–70% density. Lower vigor and fewer species from a shallow, discontinuous root mass.	9	<50% density plus fewer species and less vigor indicating poor, discontinuous, and shallow root mass.	12
Lower banks	5	Channel capacity	Bank heights sufficient to contain the bankfull stage. Width/depth ratio departure from reference width/depth ratio = 1.0. Bank-Height Ratio (BHR) = 1.0.	1	Bankfull stage is contained within banks. Width/depth ratio departure from reference width/depth ratio = 1.0–1.2. Bank-Height Ratio (BHR) = 1.0–1.1.	2	Bankfull stage is not contained. Width/depth ratio departure from reference width/depth ratio = 1.2–1.4. Bank-Height Ratio (BHR) = 1.1–1.3.	3	Bankfull stage is not contained; over-bank flows are common with flows less than bankfull. Width/depth ratio departure from reference width/depth ratio > 1.4. Bank-Height Ratio (BHR) > 1.3.	4
	6	Bank rock content	> 65% with large angular boulders. 12"+ common.	2	40–65%. Mostly boulders and small cobbles 6–12".	4	20–40%. Most in the 3–6" diameter class.	6	<20% rock fragments of gravel sizes, 1–3" or less.	8
	7	Obstructions to flow	Rocks and logs firmly imbedded. Flow pattern w/o cutting or deposition. Stable bed.	2	Some present causing erosive cross currents and minor pool filling. Obstructions fewer and less firm.	4	Moderately frequent, unstable obstructions move with high flows causing bank cutting and pool filling.	6	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	8
	8	Cutting	Little or none. Infrequent raw banks <6".	4	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12".	6	Significant. Cuts 12–24" high. Root mat overhangs and sloughing evident.	12	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
	9	Deposition	Little or no enlargement of channel or point bars.	4	Some new bar increase, mostly from coarse gravel.	8	Moderate depostion of new gravel and coarse sand on old and some new bars.	12	Extensive deposit of predominantly fine particles. Accelerated bar development.	16
Bottom	10	Rock angularity	Sharp edges and corners. Plane surfaces rough.	1	Rounded corners and edges. Surfaces smooth and flat.	2	Corners and edges well-rounded in two dimensions.	3	Well-rounded in all dimensions, surfaces smooth.	4
	11	Brightness	Surfaces dull, dark, or stained. Generally not bright.	1	Mostly dull, but may have <35% bright surfaces.	2	Mixture dull and bright, i.e., 35–65% mixture range.	3	Predominantly bright, > 65%, exposed or scoured surfaces.	4
	12	Consolidation of particles	Assorted sizes tightly packed or overlapping.	2	Moderately packed with some overlapping.	4	Mostly loose assortment with no apparent overlap.	6	No packing evident. Loose assortment, easily moved.	8
	13	Bottom size distribution	No size change evident. Stable material 80–100%.	4	Distribution shift light. Stable material 50–80%.	8	Moderate change in sizes. Stable materials 20–50%.	12	Marked distribution change. Stable materials 0–20%.	16
	14	Scouring and deposition	<5% of bottom affected by scour or deposition.	6	5–30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12	30–50% affected. Deposits and scour at obstructions, constrictions, and bends. Some filling of pools.	18	More than 50% of the bottom in a state of flux or change nearly yearlong.	24
	15	Aquatic vegetation	Abundant growth moss-like, dark green perennial. In swift water too.	1	Common. Algae forms in low velocity and pool areas. Moss here too.	2	Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick.	3	Perennial types scarce or absent. Yellow-green, short-term bloom may be present.	4
			Excellent Total =		**Good Total =**	**10**	**Fair Total =**	**66**	**Poor Total =**	**44**

Stream type	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6	D3	D4	D5	D6
Good (Stable)	38-43	38-43	54-90	60-95	60-95	50-80	38-45	38-45	40-60	40-64	48-68	40-60	38-50	38-50	60-85	70-90	70-90	60-85	85-107	85-107	85-107	67-98
Fair (Mod. unstable)	44-47	44-47	91-129	96-132	96-142	81-110	46-58	46-58	61-78	65-84	69-88	61-78	51-61	51-61	86-105	91-110	91-110	86-105	108-132	108-132	108-132	99-125
Poor (Unstable)	48+	48+	130+	133+	143+	111+	59+	59+	79+	85+	89+	79+	62+	62+	106+	111+	111+	106+	133+	133+	133+	126+

Stream type	DA3	DA4	DA5	DA6	E3	E4	E5	E6	F1	F2	F3	F4	F5	F6	G1	G2	G3	G4	G5	G6
Good (Stable)	40-63	40-63	40-63	40-63	40-63	50-75	50-75	40-63	60-85	60-85	85-110	85-110	90-115	80-95	40-60	40-60	85-107	85-107	90-112	85-107
Fair (Mod. unstable)	64-86	64-86	64-86	64-86	64-86	76-96	76-96	64-86	86-105	86-105	111-125	111-125	116-130	96-110	61-78	61-78	108-120	108-120	113-125	108-120
Poor (Unstable)	87+	87+	87+	87+	87+	97+	97+	87+	106+	106+	126+	126+	131+	111+	79+	79+	121+	121+	126+	121+

Grand Total =	**120**
Existing Stream Type =	**C4**
***Potential Stream Type =**	**C4**
Modified channel stability rating =	**Poor**

***Rating is adjusted to *potential* stream type, not existing stream type**

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Worksheet 3-14. Sediment competence calculation form to assess bed stability.

Sediment Competence using Dimensional and Dimensionless Shear Stress Methods

Stream:	**Housatonic River Reach 5A-3**		Stream Type: **C4**		
Location:	**Pittsfield MA**		Landscape Type: **U-AL-FD**		
Observers:	**RGJ**		Date: **1/19/2026**		

Enter Required Information for Existing Condition

9.3	D_{50}	Median particle size of riffle bed material (mm)			
0.1	$\hat{D}_{50}$	Median particle size of bar or sub-pavement sample (mm)			
0.10	D_{max}	Largest particle from bar sample (ft)	**29.21**	**(mm)**	304.8 mm/ft
0.0006	S	Existing average water surface slope (ft/ft)			
7.61	d	Existing bankfull mean depth (ft)			
1.65	γ_s-γ/γ	Immersed specific gravity of sediment			

Select the Appropriate Equation and Calculate Critical Dimensionless Shear Stress

92.70	$D_{50}/\hat{D}_{50}$	Range: 3 – 7	Use EQUATION 1:	$\tau^* = 0.0834 \left(D_{50}/\hat{D}_{50} \right)^{-0.872}$
3.15	D_{max}/D_{50}	Range: 1.3 – 3.0	Use EQUATION 2:	$\tau^* = 0.0384 \left(D_{max}/D_{50} \right)^{-0.887}$
N/A	τ^*	Bankfull Dimensionless Shear Stress	EQUATION USED:	**N/A**

Calculate Bankfull Mean Depth Required for Entrainment of Largest Particle in Bar Sample

N/A	**d**	Required bankfull mean depth (ft) $d = \frac{\tau^* (\gamma_s - 1) D_{max}}{S}$	(use D_{max} in ft)

Calculate Average Water Surface Slope Required for Entrainment of Largest Particle in Bar Sample

N/A	**S**	Required average water surface slope (ft/ft) $S = \frac{\tau^* (\gamma_s - 1) D_{max}}{d}$	(use D_{max} in ft)

Check: ☐ Stable ☐ Aggrading ☐ Degrading

Sediment Competence Using Dimensional Shear Stress

0.285		Bankfull shear stress $\tau = \gamma d S$ (lbs/ft^2) (substitute hydraulic radius, R, with mean depth, d) γ = 62.43, d = existing depth, S = existing slope
Shields **21**	CO **60**	Predicted largest moveable particle size (mm) at bankfull shear stress τ **(Figure 3-11)**
Shields **0.390**	CO **0.106**	Predicted shear stress required to initiate movement of measured D_{max} (mm) **(Figure 3-11)**
Shields **10.41**	CO **2.84**	Predicted mean depth required to initiate movement of measured D_{max} (mm) $d = \frac{\tau}{\gamma S}$ τ = predicted shear stress, γ = 62.43, S = existing slope
Shields **0.0008**	CO **0.0002**	Predicted slope required to initiate movement of measured D_{max} (mm) $S = \frac{\tau}{\gamma d}$ τ = predicted shear stress, γ = 62.43, d = existing depth

Check: ☐ Stable ☐ Aggrading ☑ Degrading

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Worksheet 3-15. Stability ratings for stream type stage shifts.

Stream Succession Stage Shifts			
Stream:	**Housatonic River Reach 5A-3**	Stream Type:	**C4**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

Stream Type Stage Shifts (Figure 3-14)	**Stability Rating (Check ✓ Appropriate Rating)**
Stream Type at Potential, (C→E), (F_b→B), (F→B_c), (F→C), (G→B), (D→C)	☐ Stable
(E→C), (B→High W/d B), (C→High W/d C)	☑ Moderately Unstable
(G_c→F), (G→F_b), (F→D), (C→F)	☐ Unstable
(C→D), (A→G), (B→G), (D→G), (C→G), (E→G), (E→A)	☐ Highly Unstable

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Worksheet 3-16. Lateral stability prediction summary.

Lateral Stability Prediction					
Stream: **Housatonic River Reach 5A-3**			Stream Type: **C4**		
Location: **Pittsfield MA**			Landscape Type: **U-AL-FD**		
Observers: **RGJ**			Date: **1/19/2026**		
Lateral stability criteria (choose one stability category for each criterion 1–5)	**Lateral Stability Categories**				**Selected Points (from each row)**
	Stable	***Moderately Unstable***	***Unstable***	***Highly Unstable***	
1 W/d Ratio State (Worksheet 3-8)	< 1.2	1.2 – 1.4	1.4 – 1.6	> 1.6	**8**
	(2)	**(4)**	**(6)**	**(8)**	
2 Depositional Patterns (Worksheet 3-5)	B1, B2	B4, B8	B3	B5, B6, B7	**3**
	(1)	**(2)**	**(3)**	**(4)**	
3 Meander Patterns (Worksheet 3-4)	M1, M3, M4		M2, M5, M6, M7, M8		**3**
	(1)		**(3)**		
4 Streambank Erosion: Unit Rate (Worksheet 3-13)	< 0.006	0.006 – 0.04	0.041 – 0.07	> 0.07	**6**
	(2)	**(4)**	**(6)**	**(8)**	
5 Degree of Confinement (MWR / MWR_{ref}) (Worksheet 3-9)	> 0.8	0.3 – 0.79	0.1 – 0.29	< 0.1	**3**
	(1)	**(2)**	**(3)**	**(4)**	
				Total Points	**23**
	Lateral Stability Category Point Range				
Overall Lateral Stability Category (use total points and check ✓ stability rating)	***Stable*** **< 10** ☐	***Moderately Unstable*** **10 – 12** ☐	***Unstable*** **13 – 21** ☐	***Highly Unstable*** **> 21** ☑	

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Worksheet 3-17. Vertical stability prediction for excess deposition and aggradation.

Vertical Stability Prediction for Excess Deposition and Aggradation					
Stream:	**Housatonic River Reach 5A-3**		Stream Type: **C4**		
Location:	**Pittsfield MA**		Landscape Type: **U-AL-FD**		
Observers:	**RGJ**		Date: **1/19/2026**		

Vertical Stability Criteria (choose one stability category for each criterion 1–6)	**Vertical Stability Categories for Excess Deposition / Aggradation**				**Selected Points** (from each row)
	No Deposition	***Moderate Deposition***	***Excess Deposition***	***Aggradation***	
1 Sediment Competence (Worksheet 3-14)	Sufficient depth and slope to transport largest size available	Trend toward insufficient depth or slope-slightly incompetent	Cannot move D_{35} of bed material and/or D_{100} of bar material	Cannot move D_{16} of bed material and/or D_{100} of bar or sub-pavement size	**2**
	(2)	**(4)**	**(6)**	**(8)**	
2 Sediment Capacity (POWERSED)	Sufficient capacity to transport annual load	Trend toward insufficient sediment capacity	Reduction up to 25% of annual sediment yield of bedload or suspended sand	Reduction over 25% of annual sediment yield for bedload or suspended sand	**4**
	(2)	**(4)**	**(6)**	**(8)**	
3 W/d Ratio State (Worksheet 3-8)	< 1.2	1.2 – 1.4	1.4 – 1.6	> 1.6	**8**
	(2)	**(4)**	**(6)**	**(8)**	
4 Stream Succession Stage Shifts (Worksheet 3-15)	Current stream type at potential or does not indicate deposition/ aggradation	(E→C)	(B→High W/d B), (C→High W/d C), (C→F), (G_c→F), (G→F_b)	(C→D), (F→D)	**4**
	(2)	**(4)**	**(6)**	**(8)**	
5 Depositional Patterns (Worksheet 3-5)	B1	B2, B4	B3, B5	B6, B7, B8	**3**
	(1)	**(2)**	**(3)**	**(4)**	
6 Debris / Blockages (Worksheet 3-6)	D1, D2, D3	D4, D7	D5, D8	D6, D9, D10	**3**
	(1)	**(2)**	**(3)**	**(4)**	
				Total Points	**24**

	Vertical Stability Category Point Range for Excess Deposition and Aggradation				
Vertical Stability for Excess Deposition / Aggradation (use total points and check ✓ stability rating)	***No Deposition*** **< 15** ☐	***Moderate Deposition*** **15 – 20** ☐	***Excess Deposition*** **21 – 30** ☑	***Aggradation*** **> 30** ☐	

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Worksheet 3-18. Vertical stability prediction for channel incision and degradation.

Vertical Stability Prediction for Channel Incision and Degradation					
Stream: **Housatonic River Reach 5A-3**			Stream Type: **C4**		
Location: **Pittsfield MA**			Landscape Type: **U-AL-FD**		
Observers: **RGJ**			Date: **1/19/2026**		
Vertical Stability Criteria (choose one stability category for each criterion 1–5)	**Vertical Stability Categories for Channel Incision / Degradation**				**Selected Points (from each row)**
	Not Incised	***Slightly Incised***	***Moderately Incised***	***Degradation***	
1 Sediment Competence (Worksheet 3-14)	Does not indicate excess competence	Trend to move larger sizes than D_{100} of bar or D_{84} of bed	D_{100} of bed moved	Particles much larger than D_{100} of bed moved	**6**
	(2)	**(4)**	**(6)**	**(8)**	
2 Sediment Capacity (POWERSED)	Does not indicate excess capacity	Slight excess energy: up to 10% increase above reference	Excess energy sufficient to increase load up to 50% of annual load	Excess energy transporting more than 50% of annual load	**4**
	(2)	**(4)**	**(6)**	**(8)**	
3 Degree of Channel Incision (BHR) (Worksheet 3-7)	1.00 – 1.10	1.11 – 1.30	1.31 – 1.50	> 1.50	**2**
	(2)	**(4)**	**(6)**	**(8)**	
4 Stream Succession States (Worksheets 3-15 and 3-7)	Does not indicate incision or degradation	If BHR > 1.1 and stream type has W/d between 5–10	If BHR > 1.1 and stream type has W/d less than 5	(B→G), (C→G), (E→G), (D→G), (A→G), (E→A)	**2**
	(2)	**(4)**	**(6)**	**(8)**	
5 Confinement (MWR / MWR_{ref}) (Worksheet 3-9)	0.80 – 1.00	0.30 – 0.79	0.10 – 0.29	< 0.10	**3**
	(1)	**(2)**	**(3)**	**(4)**	
				Total Points	**17**
	Vertical Stability Category Point Range for Channel Incision and Degradation				
Vertical Stability for Channel Incision/ Degradation (use total points and check ✓ stability rating)	***Not Incised*** **< 12** ☐	***Slightly Incised*** **12 – 18** ☑	***Moderately Incised*** **19 – 27** ☐	***Degradation*** **> 27** ☐	

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Worksheet 3-19. Channel enlargement prediction summary.

Channel Enlargement Prediction					
Stream: **Housatonic River Reach 5A-3**			Stream Type: **C4**		
Location: **Pittsfield MA**			Landscape Type: **U-AL-FD**		
Observers: **RGJ**			Date: **1/19/2026**		
Channel Enlargement Prediction Criteria (choose one stability category for each criterion 1–4)	**Channel Enlargement Prediction Categories**				**Selected Points (from each row)**
	No Increase	***Slight Increase***	***Moderate Increase***	***Extensive***	
1 Stream Succession Stage Shifts (Worksheet 3-15)	Stream Type at Potential, (C→E), (F_b→B), (G→B), (F→B_c), (F→C), (D→C)	(B→High W/d B), (C→High W/d C), (E→C)	(G→F), (F→D)	(C→D), (A→G), (B→G), (D→G), (C→G), (E→G), (E→A), (C→F)	**4**
	(2)	**(4)**	**(6)**	**(8)**	
2 Lateral Stability (Worksheet 3-16)	*Stable*	*Moderately Unstable*	*Unstable*	*Highly Unstable*	**8**
	(2)	**(4)**	**(6)**	**(8)**	
3 Vertical Stability Excess Deposition and Aggradation (Worksheet 3-17)	*No Deposition*	*Moderate Deposition*	*Excess Deposition*	*Aggradation*	**6**
	(2)	**(4)**	**(6)**	**(8)**	
4 Vertical Stability Channel Incision and Degradation (Worksheet 3-18)	*Not Incised*	*Slightly Incised*	*Moderately Incised*	*Degradation*	**4**
	(2)	**(4)**	**(6)**	**(8)**	
				Total Points	**22**
	Category Point Range				
Channel Enlargement Prediction (use total points and check ✓ stability rating)	***No Increase*** **< 11** ☐	***Slight Increase*** **11 – 16** ☐	***Moderate Increase*** **17 – 24** ☑	***Extensive*** **> 24** ☐	

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Worksheet 3-20. Overall sediment supply rating determined from individual stability rating categories.

Overall Sediment Supply Prediction			
Stream: **Housatonic River Reach 5A-3**		Stream Type: **C4**	
Location: **Pittsfield MA**		Landscape Type: **U-AL-FD**	
Observers: **RGJ**		Date: **1/19/2026**	
Overall Sediment Supply Prediction Criteria (choose corresponding points for each criterion 1–5)	**Stability Rating**	**Points**	**Selected Points**
1 Lateral Stability (Worksheet 3-16)	***Stable***	**1**	**4**
	Mod. Unstable	**2**	
	Unstable	**3**	
	Highly Unstable	**4**	
2 Vertical Stability Excess Deposition or Aggradation (Worksheet 3-17)	***No Deposition***	**1**	**3**
	Mod. Deposition	**2**	
	Excess Deposition	**3**	
	Aggradation	**4**	
3 Vertical Stability Channel Incision or Degradation (Worksheet 3-18)	***Not Incised***	**1**	**3**
	Slightly Incised	**2**	
	Mod. Incised	**3**	
	Degradation	**4**	
4 Channel Enlargement Prediction (Worksheet 3-19)	***No Increase***	**1**	**3**
	Slight Increase	**2**	
	Mod. Increase	**3**	
	Extensive	**4**	
5 Pfankuch Channel Stability (Worksheet 3-10)	***Good: Stable***	**1**	**4**
	Fair: Mod. Unstable	**2**	
	Poor: Unstable	**4**	
		Total Points	**17**

	Category Point Range			
Overall Sediment Supply Rating (use total points and check ✓ stability rating)	***Low*** **< 6** ☐	***Moderate*** **6 – 10** ☐	***High*** **11 – 15** ☐	***Very High*** **> 15** ☑

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Worksheet 3-21. Summary of stability condition categories.

Summary of Stability Conditions

Stream:	**Housatonic River Reach 5A-3**					Location: **Pittsfield MA**					
Observers:	**RGJ**			Date: **1/19/2026**		Stream Type: **C4**			Landscape Type: **U-AL-FD**		
Channel Dimension	Bankfull Mean Depth (ft): **4.35**		Bankfull Width (ft): **137**		Cross-Sectional Area (ft^2): **597**		Width/Depth Ratio: **31.5**		Entrenchment Ratio: **4.2**		
Channel Pattern	Mean:	λ/W_{bkf}:	L_m/W_{bkf}:		R_c/W_{bkf}:		MWR:		Sinuosity: **2.65**		
	Range:	**470** / **163-803**	**612** / **173-945**		**185.6** / **100-732**		**1.47** / **0.54-3.8**				
Streamflow	Bankfull Mean Velocity ($\bar{u}_{bkf}$) (ft/sec): **3.3**		Bankfull Discharge (Q_{bkf}): **1946**		Estimation Method: **Regional Curve**				Drainage Area (mi^2): **143**		
River Profile & Bed Features	Check: ☑ Riffle/Pool ☐ Step/Pool ☐ Plane Bed ☐ Convergence/Divergence ☐ Dunes/Antidunes/Smooth Bed										
	Bankfull Max Depth (ft):	Riffle: **7.56**	Pool: **5.64**	Depth Ratio (max to mean):	Riffle: **1.6**	Pool: **1.95**	Pool-to-Pool Spacing:	Ratio:	Slope — Valley: **0.0001**	Water Surface: **0.0005**	
Level III Stream Stability Indices	Riparian Vegetation	Current Composition/Density:		Potential Composition/Density:			Remarks: Condition, Vigor & Usage of Existing Reach:				
	Flow Regime: **P2**	Stream Size & Order: **S-8(4)**		Meander Patterns: **M2, M3, M8**			Depositional Patterns: **B2, B3, B4**		Debris/Channel Blockages: **D4, D5**		
	Degree of Incision (Bank-Height Ratio): **1.04**	Degree of Incision Stability Rating: **Stabel**					Modified Pfankuch Stability Rating (Numeric & Adjective Rating): **120 Poor**				
	W/d Ratio State $(W/d)/(W/d_{ref})$: **1.86**	W/d Ratio State Stability Rating: **Highly Unstable**		Degree of Confinement (MWR/MWR_{ref}): **0.29**			MWR/MWR_{ref} Stability Rating: **Moderate Departure**				
Bank Erosion Summary	Length of Reach Studied (ft): **8250**	Annual Streambank Erosion Rate: **895** (tons/yr)	**0.05** (tons/yr/ft)	Curve Used: **Housatonic**	Remarks:						
Sediment Capacity (POWERSED)	☐ *Sufficient Capacity* ☐ *Insufficient Capacity* ☑ *Excess Capacity*						Remarks:				
Entrainment/ Competence	Largest Particle from Bar Sample (mm): **29.2**	$\tau =$	$\tau^* =$	Existing Depth: **7.6**	Required Depth: **2.8**	Existing Slope: **0.0006**	Required Slope: **0.0002**				
Stream Succession	**E** → **C** → → → →	Existing Stream State (Type): **C**	Potential Stream State (Type): **C**								
Lateral Stability	☐ *Stable*	☐ *Mod. Unstable*	☐ *Unstable*	☑ *Highly Unstable*	Remarks:						
Vertical Stability (Aggradation)	☐ *No Deposition*	☐ *Mod. Deposition*	☑ *Ex. Deposition*	☐ *Aggradation*	Remarks:						
Vertical Stability (Degradation)	☐ *Not Incised*	☑ *Slightly Incised*	☐ *Mod. Incised*	☐ *Degradation*	Remarks:						
Channel Enlargement	☐ *No Increase*	☐ *Slight Increase*	☑ *Mod. Increase*	☐ *Extensive*	Remarks:						
Sediment Supply (Channel Source)	☐ *Low*	☐ *Moderate*	☐ *High*	☑ *Very High*	Remarks:						

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Worksheet 2-2. Computations of bankfull mean velocity and bankfull discharge using various methods.

Bankfull VELOCITY & DISCHARGE Estimates

Stream:	**Housatonic Reach 5A-4**			Location:	**Pittsfield MA**
Date:	**1/19/2026**	Stream Type:	**C5**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**			HUC:	_ _ _ _ _ _ _ _ _ _ _ _

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional Area	**637**	**A_{bkf}** (ft^2)	Bankfull Riffle Mean Depth	**6.37**	**d_{bkf}** (ft)
Bankfull Riffle Width	**100**	**W_{bkf}** (ft)	Wetted Perimeter ≈ (2 * d_{bkf}) + W_{bkf}	**112.74**	**W_p** (ft)
D_{84} Particle Size at Riffle	**1**	**D_{84}** (mm)	D_{84} Particle Size in Feet D_{84} (mm) / 304.8	**0.00**	**D_{84}** (ft)
Bankfull Slope	**0.0003**	**S_{bkf}** (ft / ft)	Hydraulic Radius A_{bkf} / W_p	**5.65**	**R** (ft)
Gravitational Acceleration	**32.2**	**g** (ft / sec^2)	Relative Roughness R (ft) / D_{84} (ft)	**1722.17**	**R / D_{84}** (ft / ft)
Drainage Area	**145**	**DA** (mi^2)	Shear Velocity $u^* = (gRS)^{½}$	**0.23362**	**u*** (ft / sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $\bar{u} = [\ 2.83 + 5.66 * Log\ \{\ R / D_{84}\ \}\ ]\ u^*$	**4.94**	ft / sec	**3146.96**	cfs
2. Roughness Coefficient: a) Manning's *n* from Friction Factor/Relative Roughness (Figs. 2-29, 2-30) $\bar{u} = 1.49 R^{2/3} S^{1/2} / n$ $n =$		ft / sec		cfs
2. Roughness Coefficient: b) Manning's *n* from Stream Type (Fig. 2-31) $\bar{u} = 1.49 R^{2/3} S^{1/2} / n$ $n =$ **0.02**	**4.09**	ft / sec	**2607.54**	cfs
2. Roughness Coefficient: c) Manning's *n* from Jarrett (USGS): $\bar{u} = 1.49 R^{2/3} S^{1/2} / n$ $n = 0.39 S^{0.38} R^{-0.16}$ **Note:** This equation is applicable to **steep, step/pool, high boundary roughness, cobble- and boulder-dominated stream systems**; i.e., for Stream Types A1, A2, A3, B1, B2, B3, C2 & E3 $n =$		ft / sec		cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)		ft / sec		cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)		ft / sec		cfs
4. Continuity Equations: a) USGS Gage Data $\bar{u} = Q / A$ **Return Period for Bankfull Q** $Q =$ **1.5** year	**4.00**	ft / sec	**2548.0**	cfs
4. Continuity Equations: b) Regional Curves $\bar{u} = Q / A$	**3.26**	ft / sec	**2076.6**	cfs

Protrusion Height Options for the D_{84} Term in the Relative Roughness Relation (R/D_{84}) – Estimation Method 1

Option 1. For **sand-bed** channels: Measure 100 **"protrusion heights"** of sand dunes from the downstream side of feature to the top of feature. Substitute the D_{84} sand dune protrusion height in ft for the D_{84} term in method 1.

Option 2. For **boulder-dominated** channels: Measure 100 **"protrusion heights"** of boulders on the sides from the bed elevation to the top of the rock on that side. Substitute the D_{84} boulder protrusion height in ft for the D_{84} term in method 1.

Option 3. For **bedrock-dominated** channels: Measure 100 **"protrusion heights"** of rock separations, steps, joints or uplifted surfaces above channel bed elevation. Substitute the D_{84} bedrock protrusion height in ft for the D_{84} term in method 1.

Option 4. For **log-influenced** channels: Measure "**protrustion heights**" proportionate to channel width of log diameters or the height of the log on upstream side if embedded. Substitute the D_{84} protrusion height in ft for the D_{84} term in method 1.

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Worksheet 2-3. Field form for *Level II* stream classification.

Stream:	**Housatonic Reach 5A-4**			
Basin:	**Housatonic River**	Drainage Area:	acres	mi^2
Location:	**Pittsfield MA**			
Twp.&Rge:		Sec.&Qtr.:		
Cross-Section Monuments (Lat./Long.):			Date:	**1/19/2026**
Observers:	**RGJ**		Landscape Type:	**U-AL-FD**

Bankfull Width (W_{bkf}) The surface width of the stream at bankfull stage elevation, in a riffle section.	**100.4**	ft
Bankfull Mean Depth (d_{bkf}) Mean depth of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A_{bkf} / W_{bkf}$).	**6.35**	ft
Bankfull Cross-Sectional Area (A_{bkf}) Area of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**637.0**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) *Bankfull Width* divided by *Bankfull Mean Depth*, in a riffle section.	**15.8**	ft/ft
Bankfull Maximum Depth (d_{max}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	**7.40**	ft
Flood-Prone Area Width (W_{fpa}) Width of the channel at an elevation that is twice the *Bankfull Maximum Depth*, measured perpendicular to the fall line of the valley in a riffle section.	**1340.00**	ft
Entrenchment Ratio (ER) The *Flood-Prone Area Width* divided by *Bankfull Width* (W_{fpa} / W_{bkf}), in a riffle section.	**13.30**	ft/ft
Channel Materials (Particle Size Index D_{50}) The D_{50} particle size index represents the median or dominant diameter of channel materials, as sampled proportionately from the channel surface between the bankfull stage and Thalweg elevations.	**1**	mm
Average Water Surface Slope (S) The elevation difference of water surface measurements over the stream length between two similar bed features (e.g., start of riffle to start of last riffle) for several riffle–pool or step–pool sequences, representing channel gradient.	**0.0003**	ft/ft
Channel Sinuosity (k) An index of channel pattern determined from stream length divided by valley length (SL / VL), or from valley slope divided by average water surface slope (S_{val} / S).	**1.46**	ft/ft

Stream Type **C5** **See Classification Key (Figure 2-35)**

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Worksheet 2-4a. Morphological relations, including dimensionless ratios of river reach sites.

Stream: **Housatonic Reach 5A-4** Location: **Pittsfield MA**

Observers: **RGJ** Date: **1/19/2026** Landscape Type: **U-AL-FD** Stream Type: **C5**

River Reach Dimension Summary Data…..1

Riffle Dimensions*, **, *

Riffle Dimensions*, **, ***	Mean	Min.	Max.		Riffle Dimensions & Dimensionless Ratios****	Mean	Min.	Max.
Riffle Width (W_{bkf})	**111.7**	**100.4**	**118.3**	ft	Riffle Cross-Sectional Area (A_{bkf}) (ft^2)	**611.0**	**574.0**	**637.0**
Riffle Mean Depth (d_{bkf})	**5.51**	**4.93**	**6.35**	ft	Riffle Width/Depth Ratio (W_{bkf} / d_{bkf})	**20.6**	**15.8**	**23.6**
Riffle Maximum Depth (d_{max})	**7.43**	**7.19**	**7.70**	ft	Riffle Max Depth to Riffle Mean Depth (d_{max} / d_{bkf})	**1.4**	**1.2**	**1.5**
Width of Flood-Prone Area (W_{fpa})	**1086**	**720**	**1340**	ft	Entrenchment Ratio (W_{fpa} / W_{bkf})	**9.9**	**6.2**	**13.3**
Riffle Inner Berm Width (W_{ib})				ft	Riffle Inner Berm Width to Riffle Width (W_{ib} / W_{bkf})			
Riffle Inner Berm Depth (d_{ib})				ft	Riffle Inner Berm Depth to Mean Depth (d_{ib} / d_{bkf})			
Riffle Inner Berm Area (A_{ib})				ft^2	Riffle Inner Berm Area to Riffle Area (A_{ib} / A_{bkf})			
Riffle Inner Berm W/d Ratio (W_{ib} / d_{ib})								

Pool Dimensions*, **, *

Pool Dimensions*, **, ***	Mean	Min.	Max.		Pool Dimensions & Dimensionless Ratios****	Mean	Min.	Max.
Pool Width (W_{bkfp})	**98.2**	**73.9**	**121.1**	ft	Pool Width to Riffle Width (W_{bkfp} / W_{bkf})	**0.88**		
Pool Mean Depth (d_{bkfp})	**6.51**	**5.51**	**8.22**	ft	Pool Mean Depth to Riffle Mean Depth (d_{bkfp} / d_{bkf})	**1.18**		
Pool Cross-Sectional Area (A_{bkfp})	**617.0**	**576.0**	**667.0**	ft	Pool Area to Riffle Area (A_{bkfp} / A_{bkf})	**1.01**		
Pool Maximum Depth (d_{maxp})	**9.68**	**8.69**	**10.73**	ft	Pool Max Depth to Riffle Mean Depth (d_{maxp} / d_{bkf})	**1.75**		
Pool Inner Berm Width (W_{ibp})				ft	Pool Inner Berm Width to Pool Width (W_{ibp} / W_{bkfp})			
Pool Inner Berm Depth (d_{ibp})				ft	Pool Inner Berm Depth to Pool Depth (d_{ibp} / d_{bkfp})			
Pool Inner Berm Area (A_{ibp})				ft^2	Pool Inner Berm Area to Pool Area (A_{ibp} / A_{bkfp})			
Point Bar Slope (S_{pb})				ft/ft	Pool Inner Berm Width/Depth Ratio (W_{ibp} / d_{ibp})			

Run Dimensions*

Run Dimensions*	Mean	Min.	Max.		Run Dimensionless Ratios****	Mean	Min.	Max.
Run Width (W_{bkfr})				ft	Run Width to Riffle Width (W_{bkfr} / W_{bkf})			
Run Mean Depth (d_{bkfr})				ft	Run Mean Depth to Riffle Mean Depth (d_{bkfr} / d_{bkf})			
Run Cross-Sectional Area (A_{bkfr})				ft	Run Area to Riffle Area (A_{bkfr} / A_{bkf})			
Run Maximum Depth (d_{maxr})				ft	Run Max Depth to Riffle Mean Depth (d_{maxr} / d_{bkf})			
Run Width/Depth Ratio (W_{bkfr} / d_{bkfr})				ft				

Glide Dimensions*

Glide Dimensions*	Mean	Min.	Max.		Glide Dimensions & Dimensionless Ratios****	Mean	Min.	Max.
Glide Width (W_{bkfg})				ft	Glide Width to Riffle Width (W_{bkfg} / W_{bkf})			
Glide Mean Depth (d_{bkfg})				ft	Glide Mean Depth to Riffle Mean Depth (d_{bkfg} / d_{bkf})			
Glide Cross-Sectional Area (A_{bkfg})				ft	Glide Area to Riffle Area (A_{bkfg} / A_{bkf})			
Glide Maximum Depth (d_{maxg})				ft	Glide Max Depth to Riffle Mean Depth (d_{maxg} / d_{bkf})			
Glide Width/Depth Ratio (W_{bkfg} / d_{bkfg})				ft/ft	Glide Inner Berm Width/Depth Ratio (W_{ibg} / d_{ibg})			
Glide Inner Berm Width (W_{ibg})				ft	Glide Inner Berm Width to Glide Width (W_{ibg}/W_{bkfg})			
Glide Inner Berm Depth (d_{ibg})				ft	Glide Inner Berm Depth to Glide Depth (d_{ibg} / d_{bkfg})			
Glide Inner Berm Area (A_{ibg})				ft^2	Glide Inner Berm Area to Glide Area (A_{ibg} / A_{bkfg})			

Step Dimensions**

Step Dimensions**	Mean	Min.	Max.		Step Dimensionless Ratios****	Mean	Min.	Max.
Step Width (W_{bkfs})				ft	Step Width to Riffle Width (W_{bkfs} / W_{bkf})			
Step Mean Depth (d_{bkfs})				ft	Step Mean Depth to Riffle Mean Depth (d_{bkfs} / d_{bkf})			
Step Cross-Sectional Area (A_{bkfs})				ft	Step Area to Riffle Area (A_{bkfs} / A_{bkf})			
Step Maximum Depth (d_{maxs})				ft	Step Max Depth to Riffle Mean Depth (d_{maxs} / d_{bkf})			
Step Width/Depth Ratio (W_{bkfs} / d_{bkfs})				ft/ft				

*Riffle–Pool system (i.e., C, E, F stream types) bed features include riffles, runs, pools, and glides.

**Step–Pool system (i.e., A, B, G stream types) bed features include riffles, rapids, chutes, pools, and steps (note: include rapids and chutes in riffle category).

***Convergence-Divergence system (i.e., D stream types) bed features include riffles and pools; cross-sections taken at riffles for classification purposes.

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Worksheet 2-4b. Morphological relations, including dimensionless ratios of river reach sites.

Stream: **Housatonic Reach 5A-4** Location: **Pittsfield MA**

Observers: **RGJ** Date: **1/19/2026** Landscape Type: **U-AL-FD** Stream Type: **C5**

River Reach Summary Data…..2

Hydraulics

Streamflow: Estimated Mean Velocity at Bankfull Stage ($\bar{u}_{bkf}$)	**3.3**	ft/sec	Estimation Method	**Regional Curve**	
Streamflow: Estimated Discharge at Bankfull Stage (Q_{bkf})	**2076.0**	cfs	Drainage Area	**145.0**	mi^2

Channel Pattern

Geometry	Mean	Min.	Max.		Dimensionless Geometry Ratios	Mean	Min.	Max.
Linear Wavelength (λ)	**609.5**	**428.0**	**1085.0**	ft	Linear Wavelength to Riffle Width (λ / W_{bkf})	**5.46**	**3.83**	**9.71**
Stream Meander Length (L_m)	**640.0**	**456.0**	**1124.0**	ft	Stream Meander Length Ratio (L_m / W_{bkf})	**5.73**	**4.08**	**10.06**
Radius of Curvature (R_c)	**270.0**	**114.0**	**537.0**	ft	Radius of Curvature to Riffle Width (R_c / W_{bkf})	**2.42**	**1.02**	**4.81**
Belt Width (W_{blt})	**129.0**	**84.0**	**188.0**	ft	Meander Width Ratio (W_{blt} / W_{bkf})	**1.15**	**0.75**	**1.68**
Arc Length (L_a)	**100.0**	**29.9**	**198.1**	ft	Arc Length to Riffle Width (L_a / W_{bkf})	**0.90**	**0.27**	**1.77**
Riffle Length (L_r)				ft	Riffle Length to Riffle Width (L_r / W_{bkf})			
Individual Pool Length (L_p)				ft	Individual Pool Length to Riffle Width (L_p / W_{bkf})			
Pool-to-Pool Spacing (P_s)				ft	Pool-to-Pool Spacing to Riffle Width (P_s / W_{bkf})			

Channel Profile

Valley Slope (S_{val})	**0.0005**	ft/ft	Average Water Surface Slope (S)	**0.0003**	ft/ft	Sinuosity (S_{val} / S)		**1.67**
Stream Length (SL)	**2900.0**	ft	Valley Length (VL)	**1980.0**	ft	Sinuosity (SL / VL)		**1.46**
Low Bank Height (LBH)	start **8.83** ft end **9.06** ft		Bankfull Max Depth (d_{max})	start **7.40** ft end **7.19** ft		Bank-Height Ratio (BHR) (LBH / d_{max})	start **1.2** end **1.3**	

Facet Slopes	Mean	Min.	Max.		Dimensionless Facet Slope Ratios	Mean	Min.	Max.
Riffle Slope (S_{rif})				ft/ft	Riffle Slope to Average Water Surface Slope (S_{rif} / S)			
Run Slope (S_{run})				ft/ft	Run Slope to Average Water Surface Slope (S_{run} / S)			
Pool Slope (S_p)				ft/ft	Pool Slope to Average Water Surface Slope (S_p / S)			
Glide Slope (S_g)				ft/ft	Glide Slope to Average Water Surface Slope (S_g / S)			
Step Slope (S_s)				ft/ft	Step Slope to Average Water Surface Slope (S_s / S)			

Max Depths[a]	Mean	Min.	Max.		Dimensionless Depth Ratios	Mean	Min.	Max.
Max Riffle Depth (d_{max})				ft	Max Riffle Depth to Mean Riffle Depth (d_{max} / d_{bkf})			
Max Run Depth (d_{maxr})				ft	Max Run Depth to Mean Riffle Depth (d_{maxr} / d_{bkf})			
Max Pool Depth (d_{maxp})				ft	Max Pool Depth to Mean Riffle Depth (d_{maxp} / d_{bkf})			
Max Glide Depth (d_{maxg})				ft	Max Glide Depth to Mean Riffle Depth (d_{maxg} / d_{bkf})			
Max Step Depth (d_{maxs})				ft	Max Step Depth to Mean Riffle Depth (d_{maxs} / d_{bkf})			

Channel Materials

	Reach[b]	Riffle[c]	Bar		Reach[b]	Riffle[c]	Bar	Protrusion Height[d]	
% Silt/Clay		**0**		D_{16}		**0.31**			mm
% Sand		**86**		D_{35}		**0.38**			mm
% Gravel		**14**		D_{50}		**0.43**			mm
% Cobble		**0**		D_{84}		**1.00**			mm
% Boulder		**0**		D_{95}		**6.85**			mm
% Bedrock		**0**		D_{100}		**11.30**			mm

[a] *Mean*, *Min*., and *Max*. depths are measured from Thalweg to bankfull at mid-point of feature for riffles, runs, and steps, the deepest part of pools, and at the tail-out of glides.

[b] Composite sample of riffles and pools within the designated reach. [c] Active bed of a riffle. [d] Height of roughness feature above bed.

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Worksheet 3-2. Flow regime variables that influence channel characteristics, sediment regime, and biological interpretations.

Flow Regime

Stream:	**Housatonic Reach 5A-4**				Stream Type:	**C5**		
Location:	**Pittsfield MA**				Landscape Type:	**U-AL-FD**		
Observers:	**RGJ**				Date:	**1/19/2026**		
List ALL COMBINATIONS that APPLY……..☞	**P2**							

General Category

E	***Ephemeral stream channel:*** Flows only in response to precipitation.
S	***Subterranean stream channel:*** Flows parallel to and near the surface for various seasons – a sub-surface flow that follows the stream bed.
I	***Intermittent stream channel:*** Surface water flows discontinuously along its length. Often associated with sporadic or seasonal flows and also with Karst (limestone) geology where losing/gaining reaches create flows that disappear then reappear farther downstream.
P	***Perennial stream channels:*** Surface water persists yearlong.

Specific Category

1	Seasonal variation in streamflow dominated primarily by snowmelt runoff.
2	Seasonal variation in streamflow dominated primarily by stormflow runoff.
3	Uniform stage and associated streamflow due to spring-fed condition, backwater, etc.
4	Streamflow regulated by glacial melt.
5	Ice flows/ice torrents from ice dam breaches.
6	Alternating flow/backwater due to tidal influence.
7	Regulated streamflow due to diversions, dam release, dewatering, etc.
8	Altered due to development, such as urban streams, cut-over watersheds, or vegetation conversions (forested to grassland) that change flow response to precipitation events.
9	Rain-on-snow generated runoff.

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Worksheet 3-3. Stream order and stream size categories for stratification by stream type.

Stream Size and Order			
Stream:	**Housatonic Reach 5A-4**		
Location:	**Pittsfield MA**		
Observers:	**RGJ**	Stream Type:	**C5**
Landscape Type:	**U-AL-FD**	Date:	**1/19/2026**

Stream Size Category and Order ☞	**S-8(4)**

Category	STREAM SIZE: Bankfull Width		Check (✓) Appropriate Category
	meters	feet	
S-1	0.305	<1	☐
S-2	0.3 – 1.5	1 – 5	☐
S-3	1.5 – 4.6	5 – 15	☐
S-4	4.6 – 9.0	15 – 30	☐
S-5	9.0 – 15.0	30 – 50	☐
S-6	15.0 – 22.8	50 – 75	☐
S-7	22.8 – 30.5	75 – 100	☐
S-8	30.5 – 46.0	100 – 150	☑
S-9	46 – 76	150 – 250	☐
S-10	76 – 107	250 – 350	☐
S-11	107 – 150	350 – 500	☐
S-12	150 – 305	500 – 1000	☐
S-13	>305	>1000	☐

Stream Order

Add categories in parenthesis for specific stream order of reach. For example, a third-order stream with a bankfull width of 6.1 meters (20 feet) would be indexed as: S-4(3).

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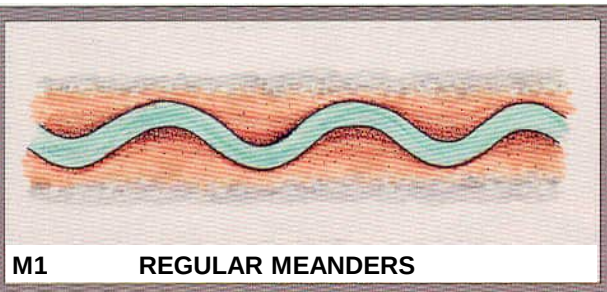
Worksheet 3-4. Meander pattern relations used for interpretations for river stability.

Meander Patterns

Stream:	**Housatonic Reach 5A-4**	Stream Type:	**C5**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

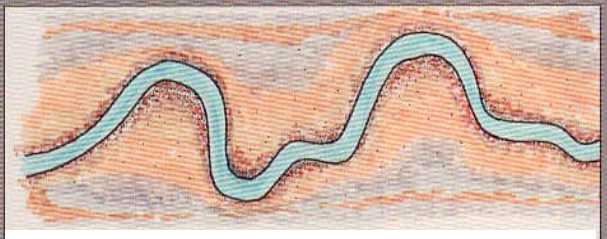
List ALL CATEGORIES that APPLY ☞	M3				

Various Meander Pattern Variables modified from Galay et al. (1973)

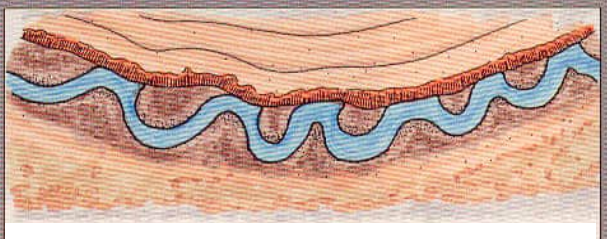


M1 REGULAR MEANDERS

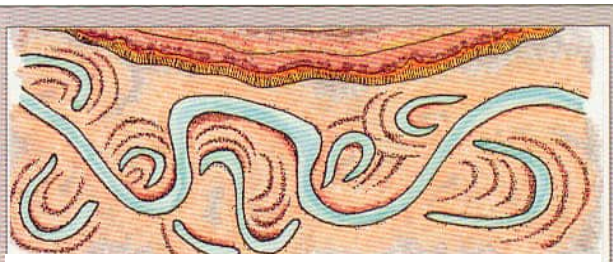
M2 TORTUOUS MEANDERS



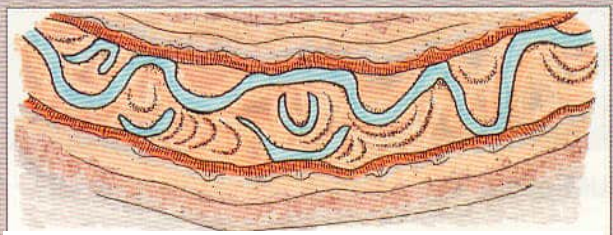
M3 IRREGULAR MEANDERS



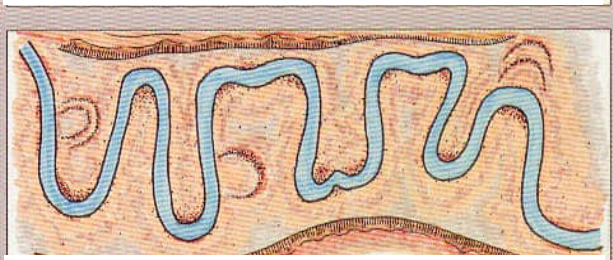
M4 TRUNCATED MEANDERS



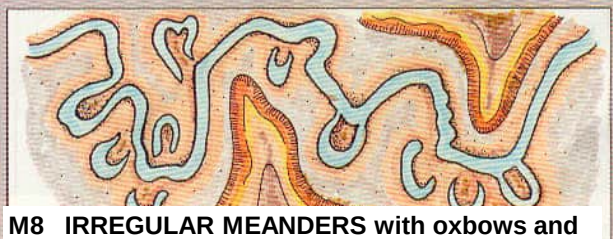
M5 UNCONFINED MEANDER SCROLLS



M6 CONFINED MEANDER SCROLLS



M7 DISTORTED MEANDER LOOPS



M8 IRREGULAR MEANDERS with oxbows and oxbow cutoffs

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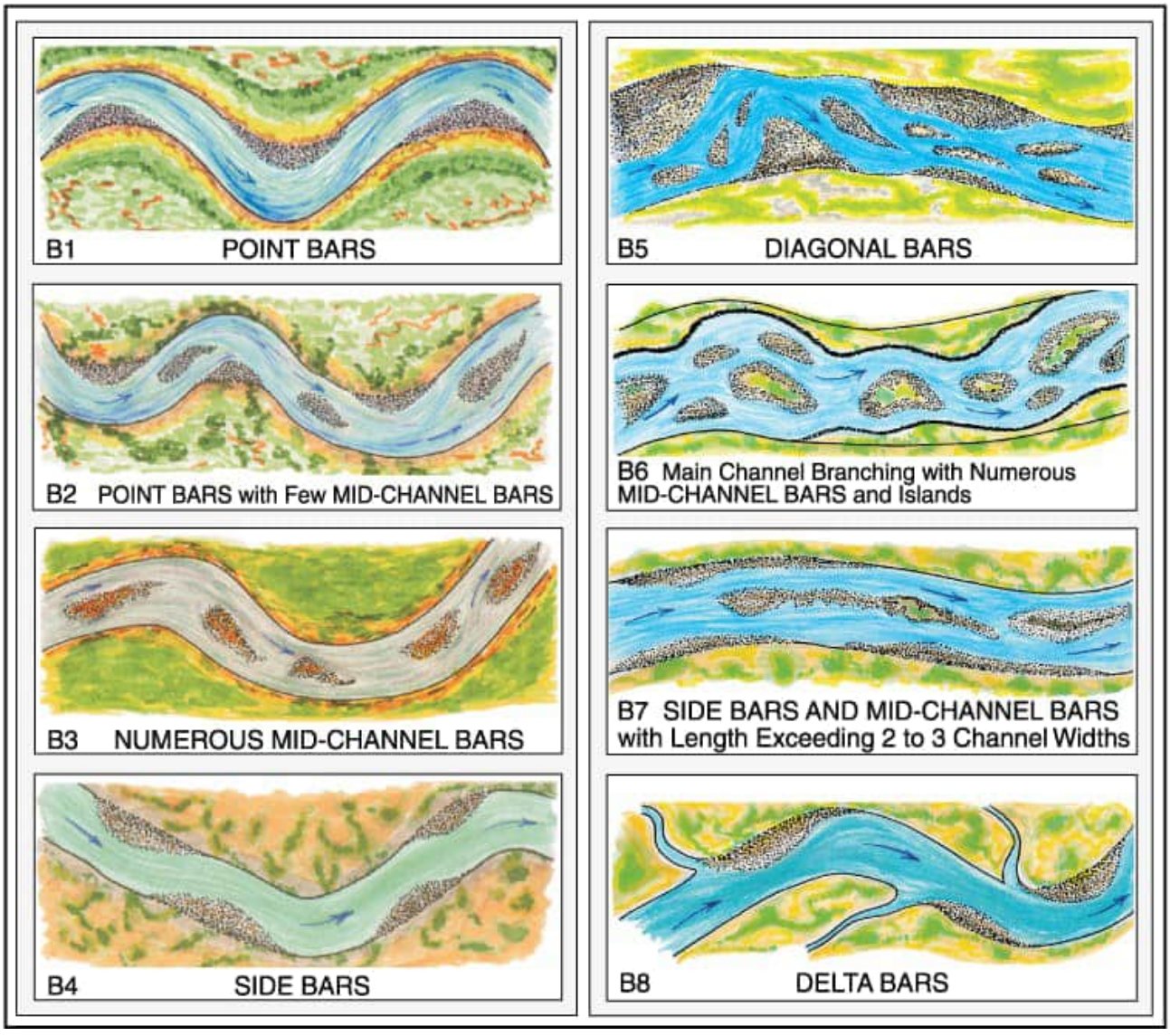
Worksheet 3-5. Depositional patterns used for stabiilty assessments.

Depositional Patterns			
Stream:	**Housatonic Reach 5A-4**	Stream Type:	**C5**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

List ALL CATEGORIES that APPLY ☞	B4				

Various Depositional Features modified from Galay et al. (1973)



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Worksheet 3-6. Various categories of in-channel debris, dams, and channel blockages used to evaluate channel stability.

Channel Blockages			
Stream:	**Housatonic Reach 5A-4**	Stream Type:	**C5**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

Description/Extent		**Materials that upon placement into the active channel or flood-prone area may cause adjustments in channel dimensions or conditions due to influences on the existing flow regime.**	**Check (✓) all that apply**
D1	None	Minor amounts of small, floatable material.	☐
D2	Infrequent	Debris consists of small, easily moved, floatable material, e.g., leaves, needles, small limbs, and twigs.	☑
D3	Moderate	Increasing frequency of small- to medium-sized material, such as large limbs, branches, and small logs, that when accumulated affect 10% or less of the active channel cross-sectional area.	☐
D4	Numerous	Significant build-up of medium- to large-sized materials, e.g., large limbs, branches, small logs, or portions of trees, occupying 10–30% of the active channel cross-sectional area.	☐
D5	Extensive	Debris "dams" of predominantly larger materials, e.g., branches, logs, and trees, occupying 30–50% of the active channel cross-sectional area, often extending across the width of the active channel.	☐
D6	Dominating	Large, somewhat continuous, debris "dams," extensive in nature and occupying over 50% of the active channel cross-sectional area. Such accumulations may divert water into the flood-prone areas and form fish migration barriers, even when flows are at less than bankfull.	☐
D7	Beaver Dams: Few	An infrequent number of dams spaced such that normal streamflow and expected channel conditions exist in the reaches between dams.	☐
D8	Beaver Dams: Frequent	Frequency of dams is such that backwater conditions exist for channel reaches between structures where streamflow velocities are reduced and channel dimensions or conditions are influenced.	☐
D9	Beaver Dams: Abandoned	Numerous abandoned dams, many of which have filled with sediment or breached, initiating a series of channel adjustments, such as streambank erosion, lateral migration, avulsion, aggradation, or degradation.	☐
D10	Human Influences	Structures, facilities, or materials related to land uses or development located within the flood-prone area, such as diversions or low-head dams, controlled by-pass channels, velocity control structures, and various transportation encroachments that have an influence on the existing flow regime, such that significant channel adjustments occur.	☐

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Worksheet 3-7. Relationship of Bank-Height Ratio (BHR) ranges to corresponding stream stability ratings.

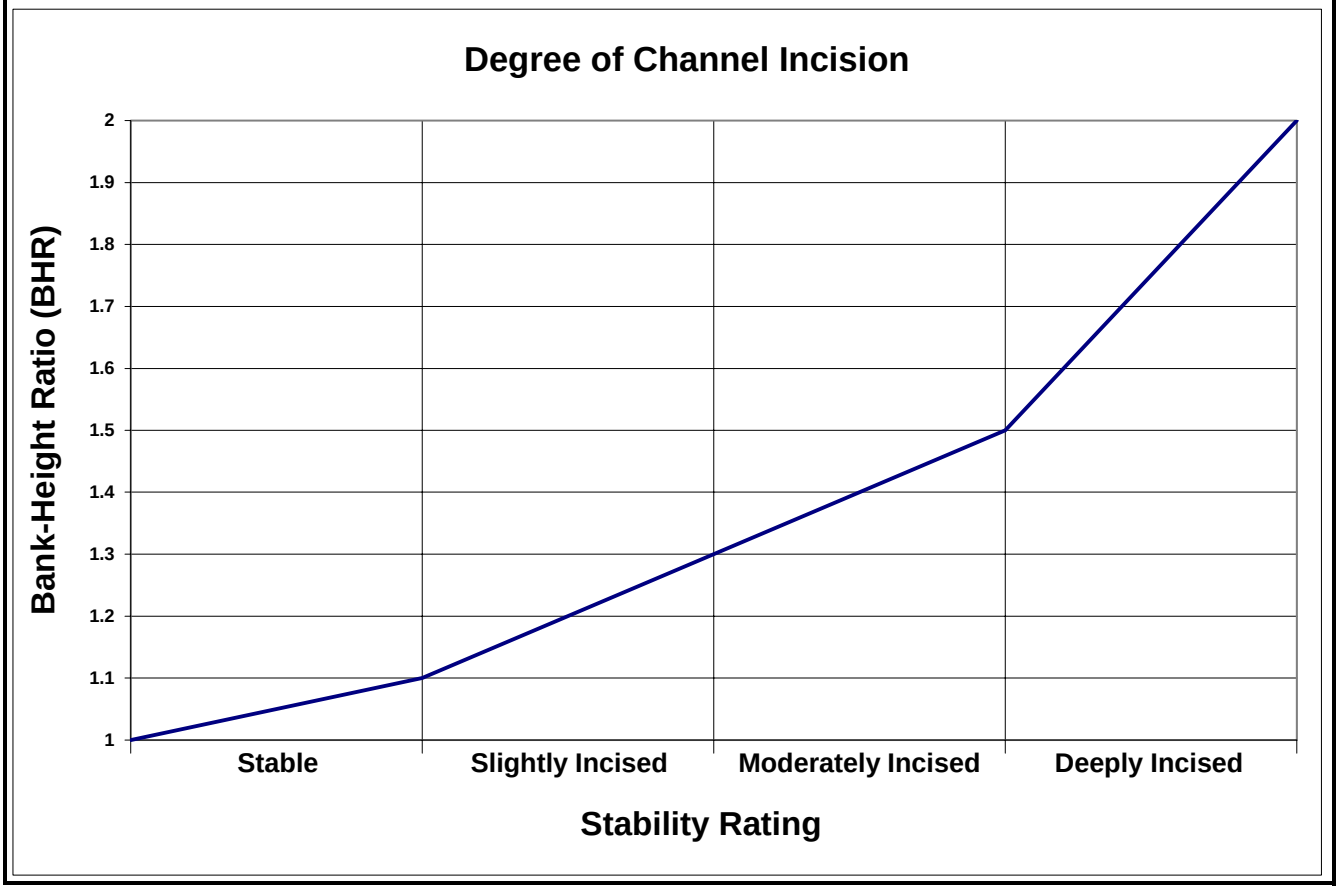
Degree of Channel Incision

Stream:	**Housatonic Reach 5A-4**	Stream Type:	**C5**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

Low Bank Height:	**8.8**
Bankfull Max Depth:	**7.4**

Bank-Height Ratio (BHR):	**1.19**

Degree of Channel Incision Stability Rating ☞ **Slightly Incised**



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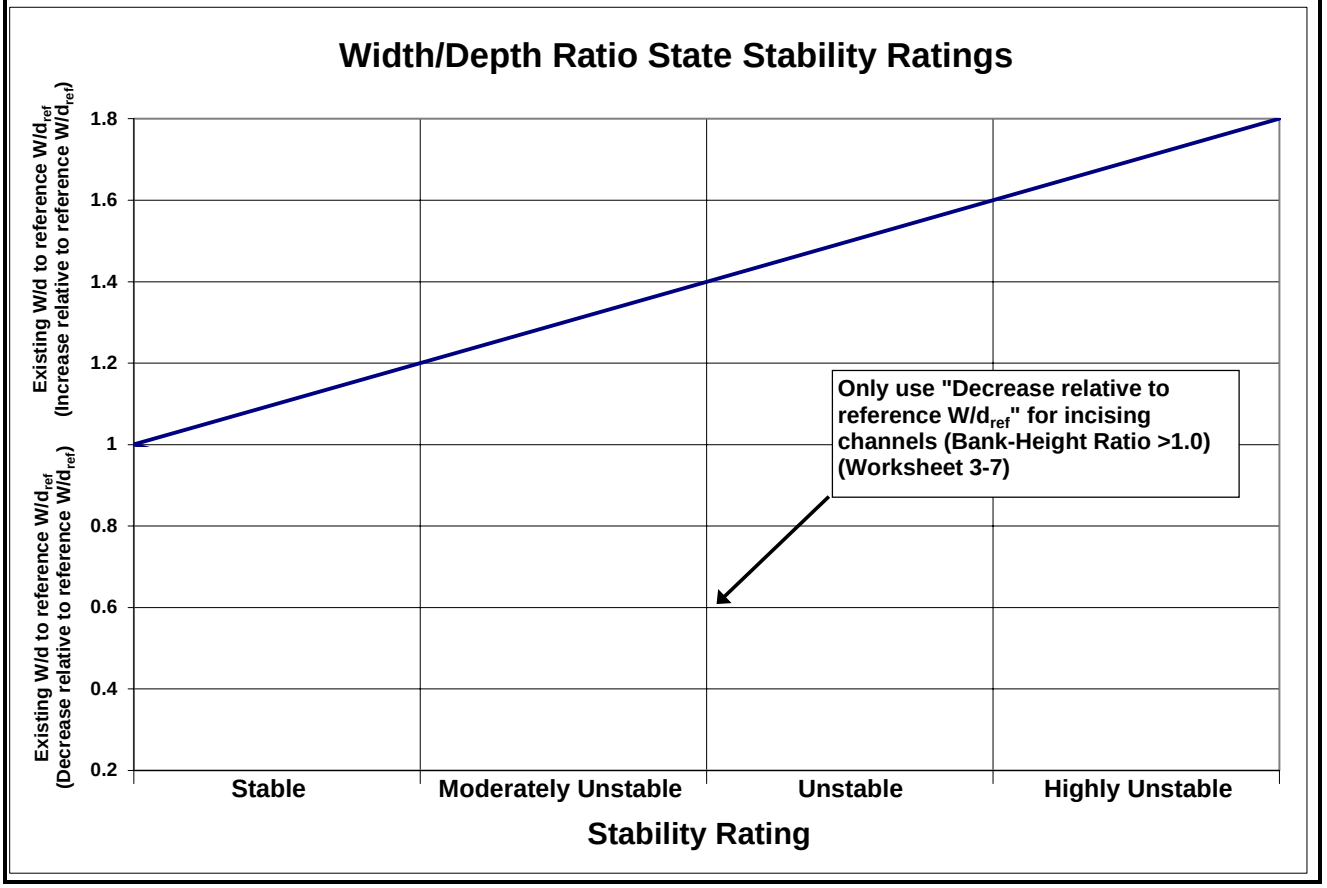
Worksheet 3-8. Stability ratings based on departure of width/depth ratio from reference condition.

Width/Depth Ratio State

Stream:	**Housatonic Reach 5A-4**	Stream Type:	**C5**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

Existing Width/Depth Ratio (W/d):	**15.8**	Existing W/d to Reference W/d_{ref} :	**1.13**
Reference Width/Depth Ratio (W/d_{ref}):	**14**		

Width/Depth Ratio State Stability Rating ☞ **Stable**



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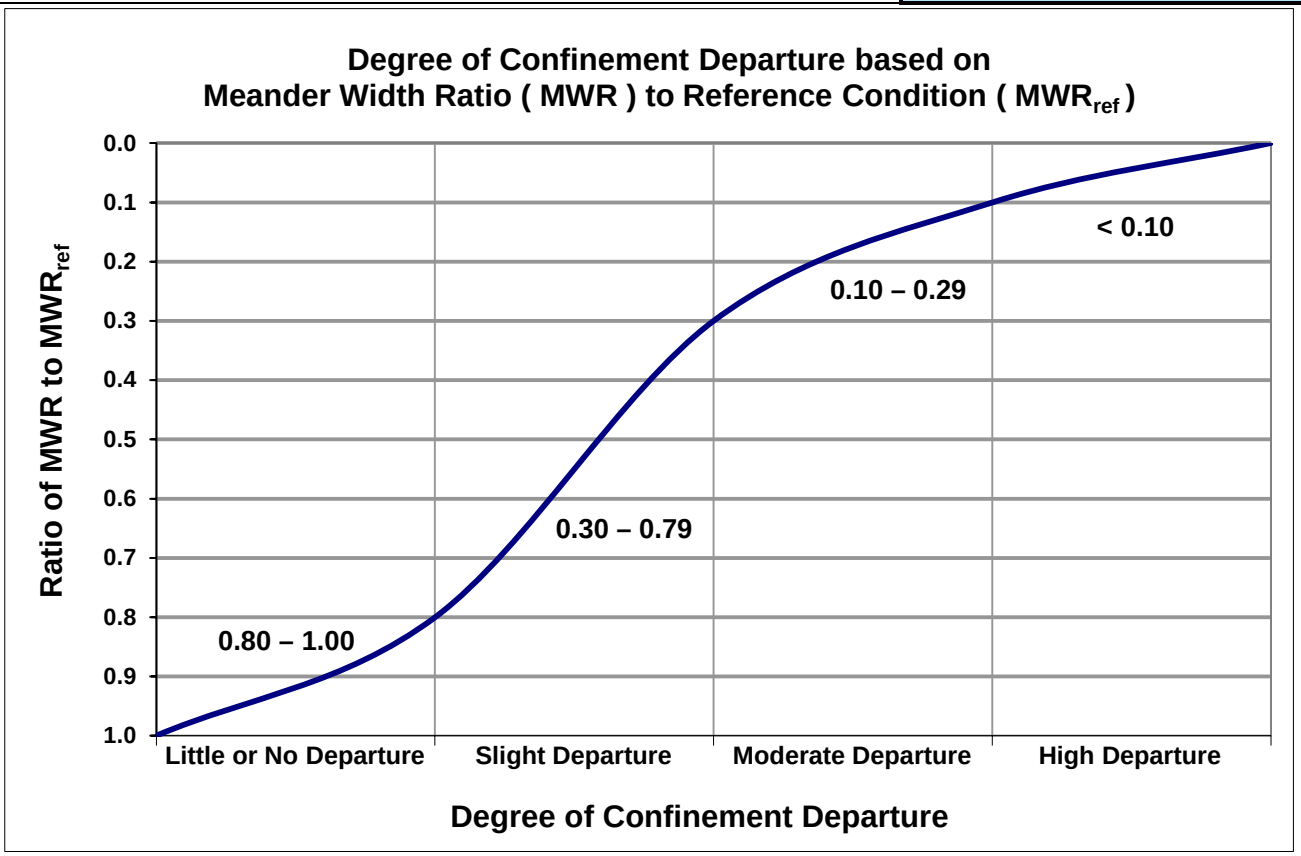
Worksheet 3-9. Degree of confinement departure based on Meander Width Ratio (MWR) divided by reference condition Meander Width Ratio (MWR_{ref}).

Degree of Confinement

Stream:	**Housatonic Reach 5A-4**	Stream Type:	**C5**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

Existing Meander Width Ratio (MWR):	**1.15**	Ratio of MWR to MWR_{ref} :	**0.23**
Reference Meander Width Ratio (MWR_{ref}):	**5**		

Degree of Confinement Stability Rating ☞ **Moderate Departure**



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Worksheet 3-10. Pfankuch (1975) channel stability rating procedure, as modified by Rosgen (1996, 2006b).

Stream: Housatonic Reach 5A-4 **Location:** Pittsfield MA **Landscape Type:** U-AL-FD **Observers:** RGJ **Date:** 1/19/2026

Loca-tion	Key	Category	Excellent		Good		Fair		Poor	
			Description	Rating	Description	Rating	Description	Rating	Description	Rating
Upper banks	1	Landform slope	Bank slope gradient <30%.	2	Bank slope gradient 30–40%.	4	Bank slope gradient 40–60%.	6	Bank slope gradient > 60%.	8
	2	Mass erosion	No evidence of past or future mass erosion.	3	Infrequent. Mostly healed over. Low future potential.	6	Frequent or large, causing sediment nearly yearlong.	9	Frequent or large, causing sediment nearly yearlong OR imminent danger of same.	12
	3	Debris jam potential	Essentially absent from immediate channel area.	2	Present, but mostly small twigs and limbs.	4	Moderate to heavy amounts, mostly larger sizes.	6	Moderate to heavy amounts, predominantly larger sizes.	8
	4	Vegetative bank protection	> 90% plant density. Vigor and variety suggest a deep, dense, soil-binding root mass.	3	70–90% density. Fewer species or less vigor suggest less dense or deep root mass.	6	50–70% density. Lower vigor and fewer species from a shallow, discontinuous root mass.	9	<50% density plus fewer species and less vigor indicating poor, discontinuous, and shallow root mass.	12
Lower banks	5	Channel capacity	Bank heights sufficient to contain the bankfull stage. Width/depth ratio departure from reference width/depth ratio = 1.0. Bank-Height Ratio (BHR) = 1.0.	1	Bankfull stage is contained within banks. Width/depth ratio departure from reference width/depth ratio = 1.0–1.2. Bank-Height Ratio (BHR) = 1.0–1.1.	2	Bankfull stage is not contained. Width/depth ratio departure from reference width/depth ratio = 1.2–1.4. Bank-Height Ratio (BHR) = 1.1–1.3.	3	Bankfull stage is not contained; over-bank flows are common with flows less than bankfull. Width/depth ratio departure from reference width/depth ratio > 1.4. Bank-Height Ratio (BHR) > 1.3.	4
	6	Bank rock content	> 65% with large angular boulders. 12"+ common.	2	40–65%. Mostly boulders and small cobbles 6–12".	4	20–40%. Most in the 3–6" diameter class.	6	<20% rock fragments of gravel sizes, 1–3" or less.	8
	7	Obstructions to flow	Rocks and logs firmly imbedded. Flow pattern w/o cutting or deposition. Stable bed.	2	Some present causing erosive cross currents and minor pool filling. Obstructions fewer and less firm.	4	Moderately frequent, unstable obstructions move with high flows causing bank cutting and pool filling.	6	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	8
	8	Cutting	Little or none. Infrequent raw banks <6".	4	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12".	6	Significant. Cuts 12–24" high. Root mat overhangs and sloughing evident.	12	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
	9	Deposition	Little or no enlargement of channel or point bars.	4	Some new bar increase, mostly from coarse gravel.	8	Moderate depostion of new gravel and coarse sand on old and some new bars.	12	Extensive deposit of predominantly fine particles. Accelerated bar development.	16
Bottom	10	Rock angularity	Sharp edges and corners. Plane surfaces rough.	1	Rounded corners and edges. Surfaces smooth and flat.	2	Corners and edges well-rounded in two dimensions.	3	Well-rounded in all dimensions, surfaces smooth.	4
	11	Brightness	Surfaces dull, dark, or stained. Generally not bright.	1	Mostly dull, but may have <35% bright surfaces.	2	Mixture dull and bright, i.e., 35–65% mixture range.	3	Predominantly bright, > 65%, exposed or scoured surfaces.	4
	12	Consolidation of particles	Assorted sizes tightly packed or overlapping.	2	Moderately packed with some overlapping.	4	Mostly loose assortment with no apparent overlap.	6	No packing evident. Loose assortment, easily moved.	8
	13	Bottom size distribution	No size change evident. Stable material 80–100%.	4	Distribution shift light. Stable material 50–80%.	8	Moderate change in sizes. Stable materials 20–50%.	12	Marked distribution change. Stable materials 0–20%.	16
	14	Scouring and deposition	<5% of bottom affected by scour or deposition.	6	5–30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12	30–50% affected. Deposits and scour at obstructions, constrictions, and bends. Some filling of pools.	18	More than 50% of the bottom in a state of flux or change nearly yearlong.	24
	15	Aquatic vegetation	Abundant growth moss-like, dark green perennial. In swift water too.	1	Common. Algae forms in low velocity and pool areas. Moss here too.	2	Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick.	3	Perennial types scarce or absent. Yellow-green, short-term bloom may be present.	4
			Excellent Total =	**3**	**Good Total =**	**22**	**Fair Total =**	**24**	**Poor Total =**	**60**

Stream type	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6	D3	D4	D5	D6
Good (Stable)	38-43	38-43	54-90	60-95	60-95	50-80	38-45	38-45	40-60	40-64	48-68	40-60	38-50	38-50	60-85	70-90	70-90	60-85	85-107	85-107	85-107	67-98
Fair (Mod. unstable)	44-47	44-47	91-129	96-132	96-142	81-110	46-58	46-58	61-78	65-84	69-88	61-78	51-61	51-61	86-105	91-110	91-110	86-105	108-132	108-132	108-132	99-125
Poor (Unstable)	48+	48+	130+	133+	143+	111+	59+	59+	79+	85+	89+	79+	62+	62+	106+	111+	111+	106+	133+	133+	133+	126+

Stream type	DA3	DA4	DA5	DA6	E3	E4	E5	E6	F1	F2	F3	F4	F5	F6	G1	G2	G3	G4	G5	G6
Good (Stable)	40-63	40-63	40-63	40-63	40-63	50-75	50-75	40-63	60-85	60-85	85-110	85-110	90-115	80-95	40-60	40-60	85-107	85-107	90-112	85-107
Fair (Mod. unstable)	64-86	64-86	64-86	64-86	64-86	76-96	76-96	64-86	86-105	86-105	111-125	111-125	116-130	96-110	61-78	61-78	108-120	108-120	113-125	108-120
Poor (Unstable)	87+	87+	87+	87+	87+	97+	97+	87+	106+	106+	126+	126+	131+	111+	79+	79+	121+	121+	126+	121+

Grand Total =	**109**
Existing Stream Type =	**C5**
***Potential Stream Type =**	**C4**
Modified channel stability rating =	**Fair**

***Rating is adjusted to *potential* stream type, not existing stream type**

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Worksheet 3-14. Sediment competence calculation form to assess bed stability.

Sediment Competence using Dimensional and Dimensionless Shear Stress Methods

Stream:	**Housatonic Reach 5A-4**		Stream Type: **C5**		
Location:	**Pittsfield MA**		Landscape Type: **U-AL-FD**		
Observers:	**RGJ**		Date: **1/19/2026**		

Enter Required Information for Existing Condition

0.4	D_{50}	Median particle size of riffle bed material (mm)			
	$\hat{D}_{50}$	Median particle size of bar or sub-pavement sample (mm)			
	D_{max}	Largest particle from bar sample (ft)		**(mm)**	304.8 mm/ft
0.0003	S	Existing average water surface slope (ft/ft)			
6.35	d	Existing bankfull mean depth (ft)			
1.65	γ_s-γ/γ	Immersed specific gravity of sediment			

Select the Appropriate Equation and Calculate Critical Dimensionless Shear Stress

	$D_{50}/\hat{D}_{50}$	Range: 3 – 7	Use EQUATION 1:	$\tau^* = 0.0834 \left(D_{50}/\hat{D}_{50} \right)^{-0.872}$
	D_{max}/D_{50}	Range: 1.3 – 3.0	Use EQUATION 2:	$\tau^* = 0.0384 \left(D_{max}/D_{50} \right)^{-0.887}$
	τ^*	Bankfull Dimensionless Shear Stress	EQUATION USED:	

Calculate Bankfull Mean Depth Required for Entrainment of Largest Particle in Bar Sample

	d	Required bankfull mean depth (ft) $d = \frac{\tau^* (\gamma_s - 1) D_{max}}{S}$	(use D_{max} in ft)

Calculate Average Water Surface Slope Required for Entrainment of Largest Particle in Bar Sample

	S	Required average water surface slope (ft/ft) $S = \frac{\tau^* (\gamma_s - 1) D_{max}}{d}$	(use D_{max} in ft)

Check: ☐ Stable ☐ Aggrading ☐ Degrading

Sediment Competence Using Dimensional Shear Stress

0.119		Bankfull shear stress $\tau = \gamma d S$ (lbs/ft^2) (substitute hydraulic radius, R, with mean depth, d) γ = 62.43, d = existing depth, S = existing slope
Shields **8**	CO **32**	Predicted largest moveable particle size (mm) at bankfull shear stress τ **(Figure 3-11)**
Shields	CO	Predicted shear stress required to initiate movement of measured D_{max} (mm) **(Figure 3-11)**
Shields	CO	Predicted mean depth required to initiate movement of measured D_{max} (mm) $d = \frac{\tau}{\gamma S}$ τ = predicted shear stress, γ = 62.43, S = existing slope
Shields	CO	Predicted slope required to initiate movement of measured D_{max} (mm) $S = \frac{\tau}{\gamma d}$ τ = predicted shear stress, γ = 62.43, d = existing depth

Check: ☐ Stable ☐ Aggrading ☑ Degrading

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Worksheet 3-15. Stability ratings for stream type stage shifts.

Stream Succession Stage Shifts			
Stream:	**Housatonic Reach 5A-4**	Stream Type:	**C5**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

Stream Type Stage Shifts (Figure 3-14)	**Stability Rating (Check ✓ Appropriate Rating)**
Stream Type at Potential, (C→E), (F_b→B), (F→B_c), (F→C), (G→B), (D→C)	☐ Stable
(E→C), (B→High W/d B), (C→High W/d C)	☑ Moderately Unstable
(G_c→F), (G→F_b), (F→D), (C→F)	☐ Unstable
(C→D), (A→G), (B→G), (D→G), (C→G), (E→G), (E→A)	☐ Highly Unstable

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Worksheet 3-16. Lateral stability prediction summary.

Lateral Stability Prediction					
Stream: **Housatonic Reach 5A-4**			Stream Type: **C5**		
Location: **Pittsfield MA**			Landscape Type: **U-AL-FD**		
Observers: **RGJ**			Date: **1/19/2026**		
Lateral stability criteria (choose one stability category for each criterion 1–5)	**Lateral Stability Categories**				**Selected Points (from each row)**
	Stable	***Moderately Unstable***	***Unstable***	***Highly Unstable***	
1 W/d Ratio State (Worksheet 3-8)	< 1.2	1.2 – 1.4	1.4 – 1.6	> 1.6	**2**
	(2)	**(4)**	**(6)**	**(8)**	
2 Depositional Patterns (Worksheet 3-5)	B1, B2	B4, B8	B3	B5, B6, B7	**2**
	(1)	**(2)**	**(3)**	**(4)**	
3 Meander Patterns (Worksheet 3-4)	M1, M3, M4		M2, M5, M6, M7, M8		**1**
	(1)		**(3)**		
4 Streambank Erosion: Unit Rate (Worksheet 3-13)	< 0.006	0.006 – 0.04	0.041 – 0.07	> 0.07	**6**
	(2)	**(4)**	**(6)**	**(8)**	
5 Degree of Confinement (MWR / MWR_{ref}) (Worksheet 3-9)	> 0.8	0.3 – 0.79	0.1 – 0.29	< 0.1	**3**
	(1)	**(2)**	**(3)**	**(4)**	
				Total Points	**14**
	Lateral Stability Category Point Range				
Overall Lateral Stability Category (use total points and check ✓ stability rating)	***Stable*** **< 10** ☐	***Moderately Unstable*** **10 – 12** ☐	***Unstable*** **13 – 21** ☑	***Highly Unstable*** **> 21** ☐	

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Worksheet 3-17. Vertical stability prediction for excess deposition and aggradation.

Vertical Stability Prediction for Excess Deposition and Aggradation					
Stream: **Housatonic Reach 5A-4**			Stream Type: **C5**		
Location: **Pittsfield MA**			Landscape Type: **U-AL-FD**		
Observers: **RGJ**			Date: **1/19/2026**		
Vertical Stability Criteria (choose one stability category for each criterion 1–6)	**Vertical Stability Categories for Excess Deposition / Aggradation**				**Selected Points (from each row)**
	No Deposition	***Moderate Deposition***	***Excess Deposition***	***Aggradation***	
1 Sediment Competence (Worksheet 3-14)	Sufficient depth and slope to transport largest size available	Trend toward insufficient depth or slope-slightly incompetent	Cannot move D_{35} of bed material and/or D_{100} of bar material	Cannot move D_{16} of bed material and/or D_{100} of bar or sub-pavement size	**2**
	(2)	**(4)**	**(6)**	**(8)**	
2 Sediment Capacity (POWERSED)	Sufficient capacity to transport annual load	Trend toward insufficient sediment capacity	Reduction up to 25% of annual sediment yield of bedload or suspended sand	Reduction over 25% of annual sediment yield for bedload or suspended sand	**2**
	(2)	**(4)**	**(6)**	**(8)**	
3 W/d Ratio State (Worksheet 3-8)	< 1.2	1.2 – 1.4	1.4 – 1.6	> 1.6	**2**
	(2)	**(4)**	**(6)**	**(8)**	
4 Stream Succession Stage Shifts (Worksheet 3-15)	Current stream type at potential or does not indicate deposition/ aggradation	(E→C)	(B→High W/d B), (C→High W/d C), (C→F), (G_c→F), (G→F_b)	(C→D), (F→D)	**4**
	(2)	**(4)**	**(6)**	**(8)**	
5 Depositional Patterns (Worksheet 3-5)	B1	B2, B4	B3, B5	B6, B7, B8	**2**
	(1)	**(2)**	**(3)**	**(4)**	
6 Debris / Blockages (Worksheet 3-6)	D1, D2, D3	D4, D7	D5, D8	D6, D9, D10	**1**
	(1)	**(2)**	**(3)**	**(4)**	
				Total Points	**13**
	Vertical Stability Category Point Range for Excess Deposition and Aggradation				
Vertical Stability for Excess Deposition / Aggradation (use total points and check ✓ stability rating)	***No Deposition*** **< 15** ☑	***Moderate Deposition*** **15 – 20** ☐	***Excess Deposition*** **21 – 30** ☐	***Aggradation*** **> 30** ☐	

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Worksheet 3-18. Vertical stability prediction for channel incision and degradation.

Vertical Stability Prediction for Channel Incision and Degradation					
Stream: **Housatonic Reach 5A-4**			Stream Type: **C5**		
Location: **Pittsfield MA**			Landscape Type: **U-AL-FD**		
Observers: **RGJ**			Date: **1/19/2026**		
Vertical Stability Criteria (choose one stability category for each criterion 1–5)	**Vertical Stability Categories for Channel Incision / Degradation**				**Selected Points (from each row)**
	Not Incised	***Slightly Incised***	***Moderately Incised***	***Degradation***	
1 Sediment Competence (Worksheet 3-14)	Does not indicate excess competence	Trend to move larger sizes than D_{100} of bar or D_{84} of bed	D_{100} of bed moved	Particles much larger than D_{100} of bed moved	**6**
	(2)	**(4)**	**(6)**	**(8)**	
2 Sediment Capacity (POWERSED)	Does not indicate excess capacity	Slight excess energy: up to 10% increase above reference	Excess energy sufficient to increase load up to 50% of annual load	Excess energy transporting more than 50% of annual load	**2**
	(2)	**(4)**	**(6)**	**(8)**	
3 Degree of Channel Incision (BHR) (Worksheet 3-7)	1.00 – 1.10	1.11 – 1.30	1.31 – 1.50	> 1.50	**4**
	(2)	**(4)**	**(6)**	**(8)**	
4 Stream Succession States (Worksheets 3-15 and 3-7)	Does not indicate incision or degradation	If BHR > 1.1 and stream type has W/d between 5–10	If BHR > 1.1 and stream type has W/d less than 5	(B→G), (C→G), (E→G), (D→G), (A→G), (E→A)	**2**
	(2)	**(4)**	**(6)**	**(8)**	
5 Confinement (MWR / MWR_{ref}) (Worksheet 3-9)	0.80 – 1.00	0.30 – 0.79	0.10 – 0.29	< 0.10	**3**
	(1)	**(2)**	**(3)**	**(4)**	
				Total Points	**17**
	Vertical Stability Category Point Range for Channel Incision and Degradation				
Vertical Stability for Channel Incision/ Degradation (use total points and check ✓ stability rating)	***Not Incised*** **< 12** ☐	***Slightly Incised*** **12 – 18** ☑	***Moderately Incised*** **19 – 27** ☐	***Degradation*** **> 27** ☐	

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Worksheet 3-19. Channel enlargement prediction summary.

Channel Enlargement Prediction					
Stream: **Housatonic Reach 5A-4**			Stream Type: **C5**		
Location: **Pittsfield MA**			Landscape Type: **U-AL-FD**		
Observers: **RGJ**			Date: **1/19/2026**		
Channel Enlargement Prediction Criteria (choose one stability category for each criterion 1–4)	**Channel Enlargement Prediction Categories**				**Selected Points (from each row)**
	No Increase	***Slight Increase***	***Moderate Increase***	***Extensive***	
1 Stream Succession Stage Shifts (Worksheet 3-15)	Stream Type at Potential, (C→E), (F_b→B), (G→B), (F→B_c), (F→C), (D→C)	(B→High W/d B), (C→High W/d C), (E→C)	(G→F), (F→D)	(C→D), (A→G), (B→G), (D→G), (C→G), (E→G), (E→A), (C→F)	**4**
	(2)	**(4)**	**(6)**	**(8)**	
2 Lateral Stability (Worksheet 3-16)	*Stable*	*Moderately Unstable*	*Unstable*	*Highly Unstable*	**6**
	(2)	**(4)**	**(6)**	**(8)**	
3 Vertical Stability Excess Deposition and Aggradation (Worksheet 3-17)	*No Deposition*	*Moderate Deposition*	*Excess Deposition*	*Aggradation*	**2**
	(2)	**(4)**	**(6)**	**(8)**	
4 Vertical Stability Channel Incision and Degradation (Worksheet 3-18)	*Not Incised*	*Slightly Incised*	*Moderately Incised*	*Degradation*	**4**
	(2)	**(4)**	**(6)**	**(8)**	
				Total Points	**16**
	Category Point Range				
Channel Enlargement Prediction (use total points and check ✓ stability rating)	***No Increase*** **< 11** ☐	***Slight Increase*** **11 – 16** ☑	***Moderate Increase*** **17 – 24** ☐	***Extensive*** **> 24** ☐	

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Worksheet 3-20. Overall sediment supply rating determined from individual stability rating categories.

Overall Sediment Supply Prediction			
Stream: **Housatonic Reach 5A-4**		Stream Type: **C5**	
Location: **Pittsfield MA**		Landscape Type: **U-AL-FD**	
Observers: **RGJ**		Date: **1/19/2026**	
Overall Sediment Supply Prediction Criteria (choose corresponding points for each criterion 1–5)	**Stability Rating**	**Points**	**Selected Points**
1 Lateral Stability (Worksheet 3-16)	***Stable***	**1**	**3**
	Mod. Unstable	**2**	
	Unstable	**3**	
	Highly Unstable	**4**	
2 Vertical Stability Excess Deposition or Aggradation (Worksheet 3-17)	***No Deposition***	**1**	**1**
	Mod. Deposition	**2**	
	Excess Deposition	**3**	
	Aggradation	**4**	
3 Vertical Stability Channel Incision or Degradation (Worksheet 3-18)	***Not Incised***	**1**	**2**
	Slightly Incised	**2**	
	Mod. Incised	**3**	
	Degradation	**4**	
4 Channel Enlargement Prediction (Worksheet 3-19)	***No Increase***	**1**	**2**
	Slight Increase	**2**	
	Mod. Increase	**3**	
	Extensive	**4**	
5 Pfankuch Channel Stability (Worksheet 3-10)	***Good: Stable***	**1**	**2**
	Fair: Mod. Unstable	**2**	
	Poor: Unstable	**4**	
		Total Points	**10**

	Category Point Range			
Overall Sediment Supply Rating (use total points and check ✓ stability rating)	***Low*** **< 6** ☐	***Moderate*** **6 – 10** ☑	***High*** **11 – 15** ☐	***Very High*** **> 15** ☐

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Worksheet 3-21. Summary of stability condition categories.

Summary of Stability Conditions

Stream:	**Housatonic Reach 5A-4**					Location: **Pittsfield MA**					
Observers:	**RGJ**			Date: **1/19/2026**		Stream Type: **C5**			Landscape Type: **U-AL-FD**		
Channel Dimension	Bankfull Mean Depth (ft): **6.35**		Bankfull Width (ft): **100**		Cross-Sectional Area (ft^2): **637**		Width/Depth Ratio: **15.8**		Entrenchment Ratio: **13.3**		
Channel Pattern	Mean:	λ/W_{bkf}: **609.5**	L_m/W_{bkf}: **640**		R_c/W_{bkf}: **270**		MWR: **1.15**		Sinuosity: **1.67**		
	Range:	**428-1085**	**456-1124**		**114-537**		**0.75-1.68**				
Streamflow	Bankfull Mean Velocity ($\bar{u}_{bkf}$) (ft/sec): **3.26**		Bankfull Discharge (Q_{bkf}): **2076**		Estimation Method: **Regional Curve**				Drainage Area (mi^2): **145**		
River Profile & Bed Features	Check: ☑ Riffle/Pool ☐ Step/Pool ☐ Plane Bed ☐ Convergence/Divergence ☐ Dunes/Antidunes/Smooth Bed										
	Bankfull Max Depth (ft):	Riffle **7,43**	Pool **9.68**	Depth Ratio (max to mean):	Riffle **1.4**	Pool **1.5**	Pool-to-Pool Spacing:	Ratio	Slope Valley: **0.0005**	Water Surface: **0.0003**	
Level III Stream Stability Indices	Riparian Vegetation	Current Composition/Density:		Potential Composition/Density:			Remarks: Condition, Vigor & Usage of Existing Reach:				
	Flow Regime: **P2**	Stream Size & Order: **S-8(4)**		Meander Patterns: **M3**			Depositional Patterns: **B4**		Debris/Channel Blockages: **D2**		
	Degree of Incision (Bank-Height Ratio): **1.19**	Degree of Incision Stability Rating: **Slightly Incised**					Modified Pfankuch Stability Rating (Numeric & Adjective Rating): **109 Fair**				
	W/d Ratio State (W/d) / (W/d_{ref}): **1.13**	W/d Ratio State Stability Rating: **Stable**		Degree of Confinement (MWR / MWR_{ref}): **0.23**			MWR / MWR_{ref} Stability Rating: **Moderate Departure**				
Bank Erosion Summary	Length of Reach Studied (ft): **3010**	Annual Streambank Erosion Rate: **258** (tons/yr)	**0.04** (tons/yr/ft)	Curve Used: **Housatonic**	Remarks:						
Sediment Capacity (POWERSED)	☑ *Sufficient Capacity* ☐ *Insufficient Capacity* ☐ *Excess Capacity*	Remarks:									
Entrainment/ Competence	Largest Particle from Bar Sample (mm):	$\tau =$	$\tau^* =$	Existing Depth:	Required Depth:	Existing Slope:	Required Slope:				
Stream Succession	**E** → **C** → → → →	Existing Stream State (Type): **C**	Potential Stream State (Type): **C**								
Lateral Stability	☐ *Stable* ☐ *Mod. Unstable* ☑ *Unstable* ☐ *Highly Unstable*	Remarks:									
Vertical Stability (Aggradation)	☑ *No Deposition* ☐ *Mod. Deposition* ☐ *Ex. Deposition* ☐ *Aggradation*	Remarks:									
Vertical Stability (Degradation)	☐ *Not Incised* ☑ *Slightly Incised* ☐ *Mod. Incised* ☐ *Degradation*	Remarks:									
Channel Enlargement	☐ *No Increase* ☑ *Slight Increase* ☐ *Mod. Increase* ☐ *Extensive*	Remarks:									
Sediment Supply (Channel Source)	☐ *Low* ☑ *Moderate* ☐ *High* ☐ *Very High*	Remarks:									

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Worksheet 2-2. Computations of bankfull mean velocity and bankfull discharge using various methods.

Bankfull VELOCITY & DISCHARGE Estimates

Stream:	**Housatonic River Reach 5A-5**			Location:	**Pittsfield MA**
Date:	**1/19/2026**	Stream Type:	**C5**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**			HUC:	_ _ _ _ _ _ _ _ _ _ _ _

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional Area	**518**	**A_{bkf}** (ft^2)	Bankfull Riffle Mean Depth	**5.13**	**d_{bkf}** (ft)
Bankfull Riffle Width	**101**	**W_{bkf}** (ft)	Wetted Perimeter ≈ (2 * d_{bkf}) + W_{bkf}	**111.26**	**W_p** (ft)
D_{84} Particle Size at Riffle	**1**	**D_{84}** (mm)	D_{84} Particle Size in Feet D_{84} (mm) / 304.8	**0.00**	**D_{84}** (ft)
Bankfull Slope	**0.0002**	**S_{bkf}** (ft / ft)	Hydraulic Radius A_{bkf} / W_p	**4.66**	**R** (ft)
Gravitational Acceleration	**32.2**	**g** (ft / sec^2)	Relative Roughness R (ft) / D_{84} (ft)	**1419.11**	**R / D_{84}** (ft / ft)
Drainage Area	**146**	**DA** (mi^2)	Shear Velocity $u^* = (gRS)^{½}$	**0.1732**	**u*** (ft / sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $\bar{u} = [\ 2.83 + 5.66 * Log\ \{\ R / D_{84}\ \}\ ]\ u^*$	**3.58**	ft / sec	**1854.05**	cfs
2. Roughness Coefficient: a) Manning's *n* from Friction Factor/Relative Roughness (Figs. 2-29, 2-30) $\bar{u} = 1.49 R^{2/3} S^{1/2} / n$ $n =$		ft / sec		cfs
2. Roughness Coefficient: b) Manning's *n* from Stream Type (Fig. 2-31) $\bar{u} = 1.49 R^{2/3} S^{1/2} / n$ $n =$ **0.02**	**2.94**	ft / sec	**1521.72**	cfs
2. Roughness Coefficient: c) Manning's *n* from Jarrett (USGS): $\bar{u} = 1.49 R^{2/3} S^{1/2} / n$ $n = 0.39 S^{0.38} R^{-0.16}$ **Note:** This equation is applicable to **steep, step/pool, high boundary roughness, cobble- and boulder-dominated stream systems**; i.e., for Stream Types A1, A2, A3, B1, B2, B3, C2 & E3 $n =$		ft / sec		cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)		ft / sec		cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)		ft / sec		cfs
4. Continuity Equations: a) USGS Gage Data $\bar{u} = Q / A$ **Return Period for Bankfull Q** $Q =$ **1.5** year	**3.00**	ft / sec	**1554.0**	cfs
4. Continuity Equations: b) Regional Curves $\bar{u} = Q / A$	**3.26**	ft / sec	**1688.7**	cfs

Protrusion Height Options for the D_{84} Term in the Relative Roughness Relation (R/D_{84}) – Estimation Method 1

Option 1.	For **sand-bed** channels: Measure 100 **"protrusion heights"** of sand dunes from the downstream side of feature to the top of feature. Substitute the D_{84} sand dune protrusion height in ft for the D_{84} term in method 1.
Option 2.	For **boulder-dominated** channels: Measure 100 **"protrusion heights"** of boulders on the sides from the bed elevation to the top of the rock on that side. Substitute the D_{84} boulder protrusion height in ft for the D_{84} term in method 1.
Option 3.	For **bedrock-dominated** channels: Measure 100 **"protrusion heights"** of rock separations, steps, joints or uplifted surfaces above channel bed elevation. Substitute the D_{84} bedrock protrusion height in ft for the D_{84} term in method 1.
Option 4.	For **log-influenced** channels: Measure "**protrustion heights**" proportionate to channel width of log diameters or the height of the log on upstream side if embedded. Substitute the D_{84} protrusion height in ft for the D_{84} term in method 1.

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Worksheet 2-3. Field form for *Level II* stream classification.

Stream:	**Housatonic River Reach 5A-5**				
Basin:	**Housatonic River**	Drainage Area:	acres	**146**	mi^2
Location:	**Pittsfield MA**				
Twp.&Rge:		Sec.&Qtr.:			
Cross-Section Monuments (Lat./Long.):				Date:	**1/19/2026**
Observers:	**RGJ**			Landscape Type:	**U-AL-FD**

Bankfull Width (W_{bkf}) The surface width of the stream at bankfull stage elevation, in a riffle section.	**101.0**	ft
Bankfull Mean Depth (d_{bkf}) Mean depth of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A_{bkf} / W_{bkf}$).	**5.14**	ft
Bankfull Cross-Sectional Area (A_{bkf}) Area of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**519.0**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) *Bankfull Width* divided by *Bankfull Mean Depth*, in a riffle section.	**19.6**	ft/ft
Bankfull Maximum Depth (d_{max}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	**7.00**	ft
Flood-Prone Area Width (W_{fpa}) Width of the channel at an elevation that is twice the *Bankfull Maximum Depth*, measured perpendicular to the fall line of the valley in a riffle section.	**590.00**	ft
Entrenchment Ratio (ER) The *Flood-Prone Area Width* divided by *Bankfull Width* (W_{fpa} / W_{bkf}), in a riffle section.	**5.80**	ft/ft
Channel Materials (Particle Size Index D_{50}) The D_{50} particle size index represents the median or dominant diameter of channel materials, as sampled proportionately from the channel surface between the bankfull stage and Thalweg elevations.	**1**	mm
Average Water Surface Slope (S) The elevation difference of water surface measurements over the stream length between two similar bed features (e.g., start of riffle to start of last riffle) for several riffle–pool or step–pool sequences, representing channel gradient.	**0.0002**	ft/ft
Channel Sinuosity (k) An index of channel pattern determined from stream length divided by valley length (SL / VL), or from valley slope divided by average water surface slope (S_{val} / S).	**2.95**	ft/ft

Stream Type **C5** **See Classification Key (Figure 2-35)**

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Worksheet 2-4a. Morphological relations, including dimensionless ratios of river reach sites.

Stream: **Housatonic River Reach 5A-5** Location: **Pittsfield MA**

Observers: **RGJ** Date: **1/19/2026** Landscape Type: **U-AL-FD** Stream Type: **C5**

River Reach Dimension Summary Data…..1

Riffle Dimensions*, **, *

Riffle Dimensions*, **, ***	Mean	Min.	Max.		Riffle Dimensions & Dimensionless Ratios****	Mean	Min.	Max.
Riffle Width (W_{bkf})	**104.0**	**100.0**	**108.0**	ft	Riffle Cross-Sectional Area (A_{bkf}) (ft^2)	**584.0**	**519.0**	**567.0**
Riffle Mean Depth (d_{bkf})	**5.30**	**5.14**	**5.60**	ft	Riffle Width/Depth Ratio (W_{bkf} / d_{bkf})	**19.7**	**17.9**	**20.8**
Riffle Maximum Depth (d_{max})	**7.38**	**7.00**	**7.64**	ft	Riffle Max Depth to Riffle Mean Depth (d_{max} / d_{bkf})	**1.4**	**1.4**	**1.5**
Width of Flood-Prone Area (W_{fpa})	**805**	**450**	**1500**	ft	Entrenchment Ratio (W_{fpa} / W_{bkf})	**7.6**	**4.5**	**13.9**
Riffle Inner Berm Width (W_{ib})				ft	Riffle Inner Berm Width to Riffle Width (W_{ib} / W_{bkf})			
Riffle Inner Berm Depth (d_{ib})				ft	Riffle Inner Berm Depth to Mean Depth (d_{ib} / d_{bkf})			
Riffle Inner Berm Area (A_{ib})				ft^2	Riffle Inner Berm Area to Riffle Area (A_{ib} / A_{bkf})			
Riffle Inner Berm W/d Ratio (W_{ib} / d_{ib})								

Pool Dimensions*, **, *

Pool Dimensions*, **, ***	Mean	Min.	Max.		Pool Dimensions & Dimensionless Ratios****	Mean	Min.	Max.
Pool Width (W_{bkfp})	**81.6**	**74.7**	**88.4**	ft	Pool Width to Riffle Width (W_{bkfp} / W_{bkf})	**0.78**		
Pool Mean Depth (d_{bkfp})	**6.22**	**6.18**	**6.25**	ft	Pool Mean Depth to Riffle Mean Depth (d_{bkfp} / d_{bkf})	**1.17**		
Pool Cross-Sectional Area (A_{bkfp})	**507.0**	**462.0**	**553.0**	ft	Pool Area to Riffle Area (A_{bkfp} / A_{bkf})	**0.92**		
Pool Maximum Depth (d_{maxp})	**8.15**	**8.02**	**8.28**	ft	Pool Max Depth to Riffle Mean Depth (d_{maxp} / d_{bkf})	**1.50**		
Pool Inner Berm Width (W_{ibp})				ft	Pool Inner Berm Width to Pool Width (W_{ibp} / W_{bkfp})			
Pool Inner Berm Depth (d_{ibp})				ft	Pool Inner Berm Depth to Pool Depth (d_{ibp} / d_{bkfp})			
Pool Inner Berm Area (A_{ibp})				ft^2	Pool Inner Berm Area to Pool Area (A_{ibp} / A_{bkfp})			
Point Bar Slope (S_{pb})				ft/ft	Pool Inner Berm Width/Depth Ratio (W_{ibp} / d_{ibp})			

Run Dimensions*

Run Dimensions*	Mean	Min.	Max.		Run Dimensionless Ratios****	Mean	Min.	Max.
Run Width (W_{bkfr})				ft	Run Width to Riffle Width (W_{bkfr} / W_{bkf})			
Run Mean Depth (d_{bkfr})				ft	Run Mean Depth to Riffle Mean Depth (d_{bkfr} / d_{bkf})			
Run Cross-Sectional Area (A_{bkfr})				ft	Run Area to Riffle Area (A_{bkfr} / A_{bkf})			
Run Maximum Depth (d_{maxr})				ft	Run Max Depth to Riffle Mean Depth (d_{maxr} / d_{bkf})			
Run Width/Depth Ratio (W_{bkfr} / d_{bkfr})				ft				

Glide Dimensions*

Glide Dimensions*	Mean	Min.	Max.		Glide Dimensions & Dimensionless Ratios****	Mean	Min.	Max.
Glide Width (W_{bkfg})				ft	Glide Width to Riffle Width (W_{bkfg} / W_{bkf})			
Glide Mean Depth (d_{bkfg})				ft	Glide Mean Depth to Riffle Mean Depth (d_{bkfg} / d_{bkf})			
Glide Cross-Sectional Area (A_{bkfg})				ft	Glide Area to Riffle Area (A_{bkfg} / A_{bkf})			
Glide Maximum Depth (d_{maxg})				ft	Glide Max Depth to Riffle Mean Depth (d_{maxg} / d_{bkf})			
Glide Width/Depth Ratio (W_{bkfg} / d_{bkfg})				ft/ft	Glide Inner Berm Width/Depth Ratio (W_{ibg} / d_{ibg})			
Glide Inner Berm Width (W_{ibg})				ft	Glide Inner Berm Width to Glide Width (W_{ibg}/W_{bkfg})			
Glide Inner Berm Depth (d_{ibg})				ft	Glide Inner Berm Depth to Glide Depth (d_{ibg} / d_{bkfg})			
Glide Inner Berm Area (A_{ibg})				ft^2	Glide Inner Berm Area to Glide Area (A_{ibg} / A_{bkfg})			

Step Dimensions**

Step Dimensions**	Mean	Min.	Max.		Step Dimensionless Ratios****	Mean	Min.	Max.
Step Width (W_{bkfs})				ft	Step Width to Riffle Width (W_{bkfs} / W_{bkf})			
Step Mean Depth (d_{bkfs})				ft	Step Mean Depth to Riffle Mean Depth (d_{bkfs} / d_{bkf})			
Step Cross-Sectional Area (A_{bkfs})				ft	Step Area to Riffle Area (A_{bkfs} / A_{bkf})			
Step Maximum Depth (d_{maxs})				ft	Step Max Depth to Riffle Mean Depth (d_{maxs} / d_{bkf})			
Step Width/Depth Ratio (W_{bkfs} / d_{bkfs})				ft/ft				

*Riffle–Pool system (i.e., C, E, F stream types) bed features include riffles, runs, pools, and glides.

**Step–Pool system (i.e., A, B, G stream types) bed features include riffles, rapids, chutes, pools, and steps (note: include rapids and chutes in riffle category).

***Convergence-Divergence system (i.e., D stream types) bed features include riffles and pools; cross-sections taken at riffles for classification purposes.

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Worksheet 2-4b. Morphological relations, including dimensionless ratios of river reach sites.

Stream: **Housatonic River Reach 5A-5** Location: **Pittsfield MA**

Observers: **RGJ** Date: **1/19/2026** Landscape Type: **U-AL-FD** Stream Type: **C5**

River Reach Summary Data…..2

Hydraulics

Streamflow: Estimated Mean Velocity at Bankfull Stage ($\bar{u}_{bkf}$)	**3.3**	ft/sec	Estimation Method	**Regional Curve**	
Streamflow: Estimated Discharge at Bankfull Stage (Q_{bkf})	**1688.0**	cfs	Drainage Area	**146.0**	mi^2

Channel Pattern

Geometry	Mean	Min.	Max.		Dimensionless Geometry Ratios	Mean	Min.	Max.
Linear Wavelength (λ)	**586.1**	**188.0**	**1126.0**	ft	Linear Wavelength to Riffle Width (λ / W_{bkf})	**5.64**	**1.81**	**10.83**
Stream Meander Length (L_m)	**862.9**	**480.0**	**1326.0**	ft	Stream Meander Length Ratio (L_m / W_{bkf})	**8.30**	**4.62**	**12.75**
Radius of Curvature (R_c)	**291.2**	**97.0**	**672.0**	ft	Radius of Curvature to Riffle Width (R_c / W_{bkf})	**2.80**	**0.93**	**6.46**
Belt Width (W_{blt})	**180.0**	**76.0**	**339.0**	ft	Meander Width Ratio (W_{blt} / W_{bkf})	**1.73**	**0.73**	**3.26**
Arc Length (L_a)	**193.5**	**63.5**	**470.7**	ft	Arc Length to Riffle Width (L_a / W_{bkf})	**1.86**	**0.61**	**4.53**
Riffle Length (L_r)				ft	Riffle Length to Riffle Width (L_r / W_{bkf})			
Individual Pool Length (L_p)				ft	Individual Pool Length to Riffle Width (L_p / W_{bkf})			
Pool-to-Pool Spacing (P_s)				ft	Pool-to-Pool Spacing to Riffle Width (P_s / W_{bkf})			

Channel Profile

Valley Slope (S_{val})	**0.0006**	ft/ft	Average Water Surface Slope (S)	**0.0003**	ft/ft	Sinuosity (S_{val} / S)	**2.00**		
Stream Length (SL)	**5700.0**	ft	Valley Length (VL)	**2750.0**	ft	Sinuosity (SL / VL)	**2.07**		
Low Bank Height (LBH)	start **9.20** ft end **10.15** ft		Bankfull Max Depth (d_{max})	start **7.00** ft end **7.28** ft		Bank-Height Ratio (BHR) (LBH / d_{max})	start **1.3** end **1.4**		

Facet Slopes	Mean	Min.	Max.		Dimensionless Facet Slope Ratios	Mean	Min.	Max.
Riffle Slope (S_{rif})				ft/ft	Riffle Slope to Average Water Surface Slope (S_{rif} / S)			
Run Slope (S_{run})				ft/ft	Run Slope to Average Water Surface Slope (S_{run} / S)			
Pool Slope (S_p)				ft/ft	Pool Slope to Average Water Surface Slope (S_p / S)			
Glide Slope (S_g)				ft/ft	Glide Slope to Average Water Surface Slope (S_g / S)			
Step Slope (S_s)				ft/ft	Step Slope to Average Water Surface Slope (S_s / S)			

Max Depths[a]	Mean	Min.	Max.		Dimensionless Depth Ratios	Mean	Min.	Max.
Max Riffle Depth (d_{max})				ft	Max Riffle Depth to Mean Riffle Depth (d_{max} / d_{bkf})			
Max Run Depth (d_{maxr})				ft	Max Run Depth to Mean Riffle Depth (d_{maxr} / d_{bkf})			
Max Pool Depth (d_{maxp})				ft	Max Pool Depth to Mean Riffle Depth (d_{maxp} / d_{bkf})			
Max Glide Depth (d_{maxg})				ft	Max Glide Depth to Mean Riffle Depth (d_{maxg} / d_{bkf})			
Max Step Depth (d_{maxs})				ft	Max Step Depth to Mean Riffle Depth (d_{maxs} / d_{bkf})			

Channel Materials

	Reach[b]	Riffle[c]	Bar		Reach[b]	Riffle[c]	Bar	Protrusion Height[d]	
% Silt/Clay		**0**		D_{16}		**0.58**			mm
% Sand		**100**		D_{35}		**0.68**			mm
% Gravel		**0**		D_{50}		**0.75**			mm
% Cobble		**0**		D_{84}		**0.92**			mm
% Boulder		**0**		D_{95}		**0.97**			mm
% Bedrock		**0**		D_{100}		**1.00**			mm

[a] *Mean*, *Min*., and *Max*. depths are measured from Thalweg to bankfull at mid-point of feature for riffles, runs, and steps, the deepest part of pools, and at the tail-out of glides.

[b] Composite sample of riffles and pools within the designated reach. [c] Active bed of a riffle. [d] Height of roughness feature above bed.

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Worksheet 3-2. Flow regime variables that influence channel characteristics, sediment regime, and biological interpretations.

Flow Regime

Stream:	**Housatonic River Reach 5A-5**				Stream Type:	**C5**		
Location:	**Pittsfield MA**				Landscape Type:	**U-AL-FD**		
Observers:	**RGJ**				Date:	**1/19/2026**		
List ALL COMBINATIONS that APPLY……..☞	**P2**							

General Category

E	***Ephemeral stream channel:*** Flows only in response to precipitation.
S	***Subterranean stream channel:*** Flows parallel to and near the surface for various seasons – a sub-surface flow that follows the stream bed.
I	***Intermittent stream channel:*** Surface water flows discontinuously along its length. Often associated with sporadic or seasonal flows and also with Karst (limestone) geology where losing/gaining reaches create flows that disappear then reappear farther downstream.
P	***Perennial stream channels:*** Surface water persists yearlong.

Specific Category

1	Seasonal variation in streamflow dominated primarily by snowmelt runoff.
2	Seasonal variation in streamflow dominated primarily by stormflow runoff.
3	Uniform stage and associated streamflow due to spring-fed condition, backwater, etc.
4	Streamflow regulated by glacial melt.
5	Ice flows/ice torrents from ice dam breaches.
6	Alternating flow/backwater due to tidal influence.
7	Regulated streamflow due to diversions, dam release, dewatering, etc.
8	Altered due to development, such as urban streams, cut-over watersheds, or vegetation conversions (forested to grassland) that change flow response to precipitation events.
9	Rain-on-snow generated runoff.

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Worksheet 3-3. Stream order and stream size categories for stratification by stream type.

Stream Size and Order			
Stream:	**Housatonic River Reach 5A-5**		
Location:	**Pittsfield MA**		
Observers:	**RGJ**	Stream Type:	**C5**
Landscape Type:	**U-AL-FD**	Date:	**1/19/2026**

Stream Size Category and Order ☞	**S-8(4)**

Category	STREAM SIZE: Bankfull Width		Check (✓) Appropriate Category
	meters	feet	
S-1	0.305	<1	☐
S-2	0.3 – 1.5	1 – 5	☐
S-3	1.5 – 4.6	5 – 15	☐
S-4	4.6 – 9.0	15 – 30	☐
S-5	9.0 – 15.0	30 – 50	☐
S-6	15.0 – 22.8	50 – 75	☐
S-7	22.8 – 30.5	75 – 100	☐
S-8	30.5 – 46.0	100 – 150	☑
S-9	46 – 76	150 – 250	☐
S-10	76 – 107	250 – 350	☐
S-11	107 – 150	350 – 500	☐
S-12	150 – 305	500 – 1000	☐
S-13	>305	>1000	☐

Stream Order

Add categories in parenthesis for specific stream order of reach. For example, a third-order stream with a bankfull width of 6.1 meters (20 feet) would be indexed as: S-4(3).

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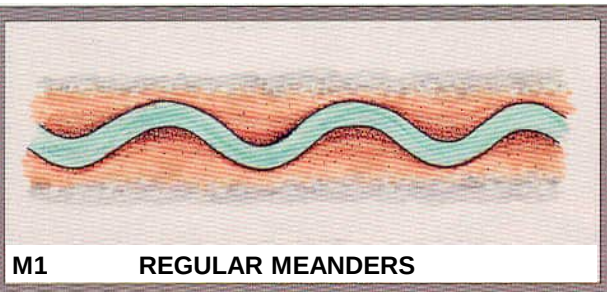
Worksheet 3-4. Meander pattern relations used for interpretations for river stability.

Meander Patterns

Stream:	**Housatonic River Reach 5A-5**	Stream Type:	**C5**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

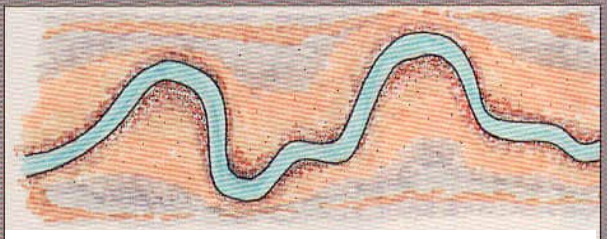
List ALL CATEGORIES that APPLY ☞	M2				

Various Meander Pattern Variables modified from Galay et al. (1973)

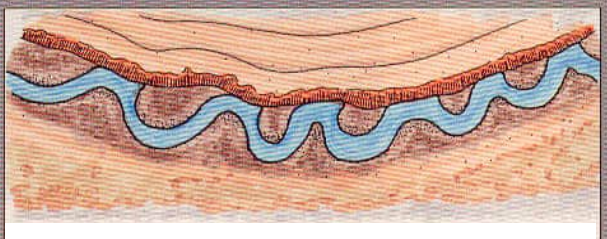


M1 REGULAR MEANDERS

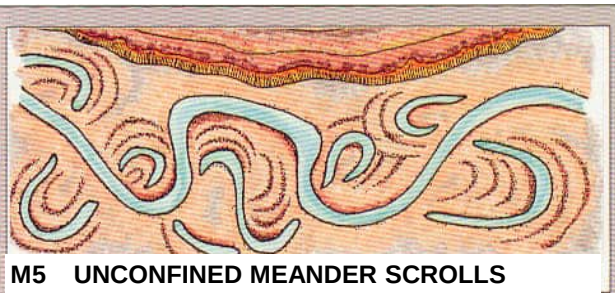
M2 TORTUOUS MEANDERS



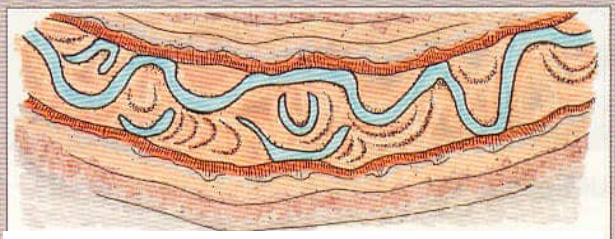
M3 IRREGULAR MEANDERS



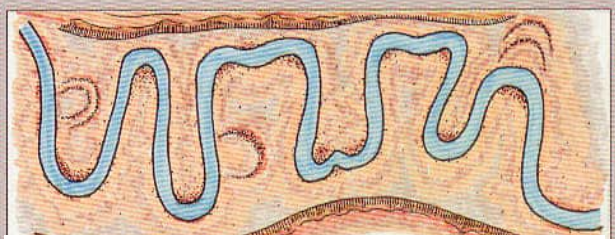
M4 TRUNCATED MEANDERS



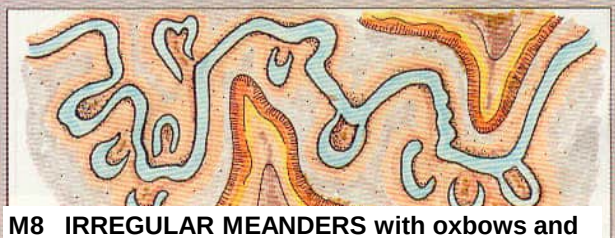
M5 UNCONFINED MEANDER SCROLLS



M6 CONFINED MEANDER SCROLLS



M7 DISTORTED MEANDER LOOPS



M8 IRREGULAR MEANDERS with oxbows and oxbow cutoffs

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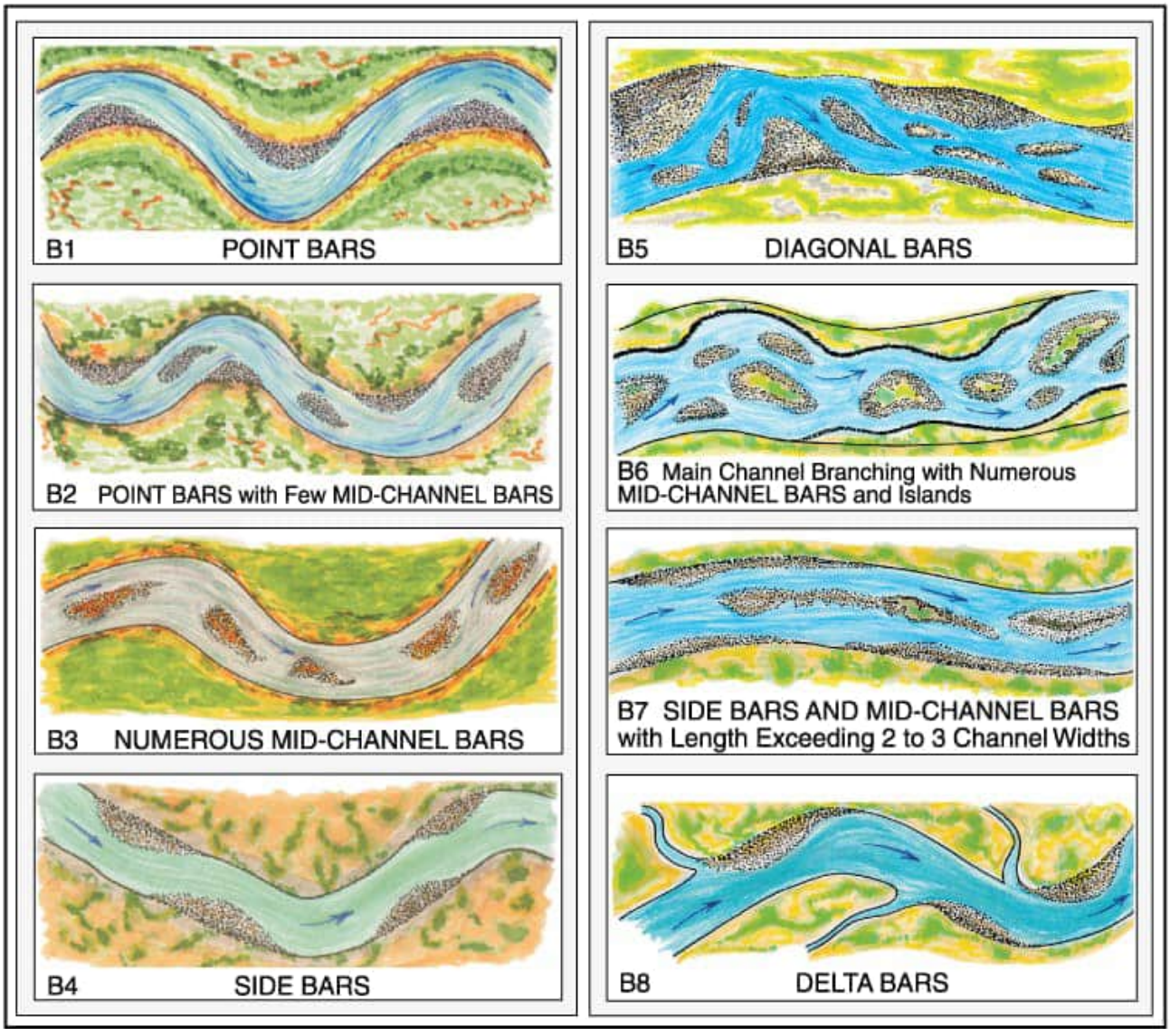
Worksheet 3-5. Depositional patterns used for stabiilty assessments.

Depositional Patterns			
Stream:	**Housatonic River Reach 5A-5**	Stream Type:	**C5**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

List ALL CATEGORIES that APPLY ☞	B4				

Various Depositional Features modified from Galay et al. (1973)



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Worksheet 3-6. Various categories of in-channel debris, dams, and channel blockages used to evaluate channel stability.

Channel Blockages			
Stream:	**Housatonic River Reach 5A-5**	Stream Type:	**C5**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

Description/Extent		**Materials that upon placement into the active channel or flood-prone area may cause adjustments in channel dimensions or conditions due to influences on the existing flow regime.**	**Check (✓) all that apply**
D1	None	Minor amounts of small, floatable material.	☐
D2	Infrequent	Debris consists of small, easily moved, floatable material, e.g., leaves, needles, small limbs, and twigs.	☐
D3	Moderate	Increasing frequency of small- to medium-sized material, such as large limbs, branches, and small logs, that when accumulated affect 10% or less of the active channel cross-sectional area.	☑
D4	Numerous	Significant build-up of medium- to large-sized materials, e.g., large limbs, branches, small logs, or portions of trees, occupying 10–30% of the active channel cross-sectional area.	☑
D5	Extensive	Debris "dams" of predominantly larger materials, e.g., branches, logs, and trees, occupying 30–50% of the active channel cross-sectional area, often extending across the width of the active channel.	☐
D6	Dominating	Large, somewhat continuous, debris "dams," extensive in nature and occupying over 50% of the active channel cross-sectional area. Such accumulations may divert water into the flood-prone areas and form fish migration barriers, even when flows are at less than bankfull.	☐
D7	Beaver Dams: Few	An infrequent number of dams spaced such that normal streamflow and expected channel conditions exist in the reaches between dams.	☐
D8	Beaver Dams: Frequent	Frequency of dams is such that backwater conditions exist for channel reaches between structures where streamflow velocities are reduced and channel dimensions or conditions are influenced.	☐
D9	Beaver Dams: Abandoned	Numerous abandoned dams, many of which have filled with sediment or breached, initiating a series of channel adjustments, such as streambank erosion, lateral migration, avulsion, aggradation, or degradation.	☐
D10	Human Influences	Structures, facilities, or materials related to land uses or development located within the flood-prone area, such as diversions or low-head dams, controlled by-pass channels, velocity control structures, and various transportation encroachments that have an influence on the existing flow regime, such that significant channel adjustments occur.	☐

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Worksheet 3-7. Relationship of Bank-Height Ratio (BHR) ranges to corresponding stream stability ratings.

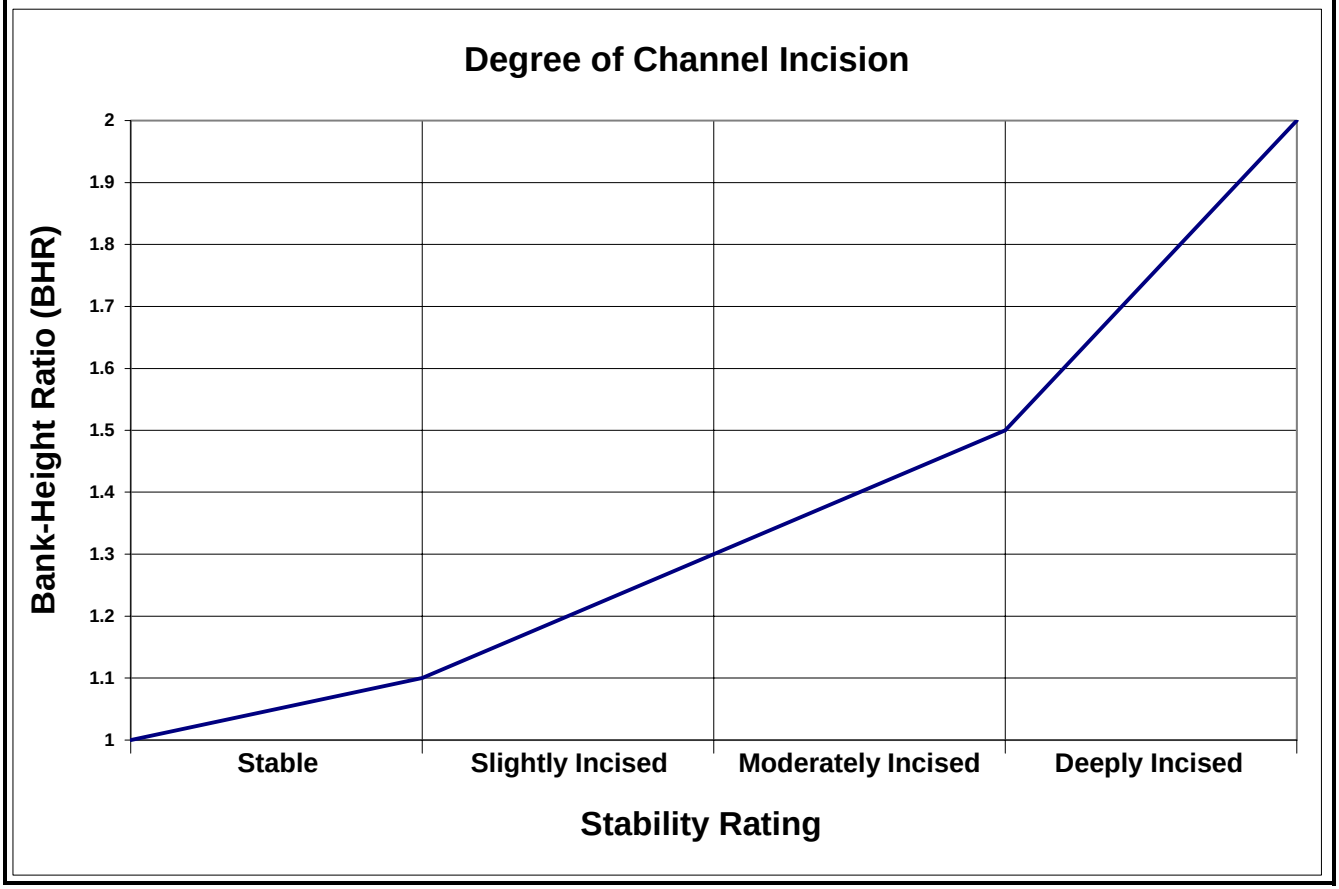
Degree of Channel Incision

Stream:	**Housatonic River Reach 5A-5**	Stream Type:	**C5**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

Low Bank Height:	**9.46**
Bankfull Max Depth:	**7**

Bank-Height Ratio (BHR):	**1.35**

Degree of Channel Incision Stability Rating ☞ **Moderately Incised**



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Worksheet 3-8. Stability ratings based on departure of width/depth ratio from reference condition.

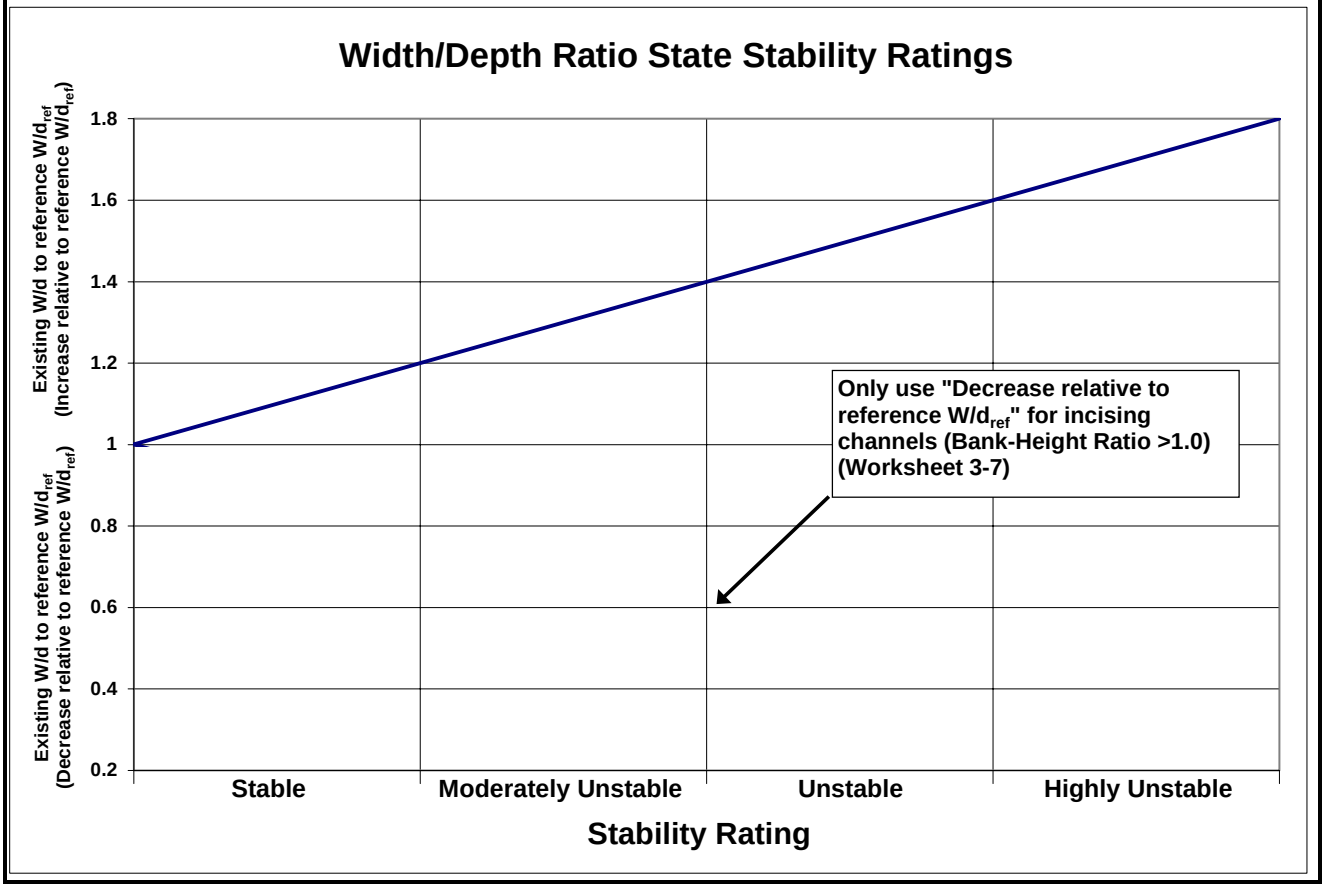
Width/Depth Ratio State

Stream:	**Housatonic River Reach 5A-5**	Stream Type:	**C5**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

Existing Width/Depth Ratio (W/d):	**19.6**
Reference Width/Depth Ratio (W/d_{ref}):	**14**

Existing W/d to Reference W/d_{ref} :	**1.40**

Width/Depth Ratio State Stability Rating ☞ **Moderately Unstable**



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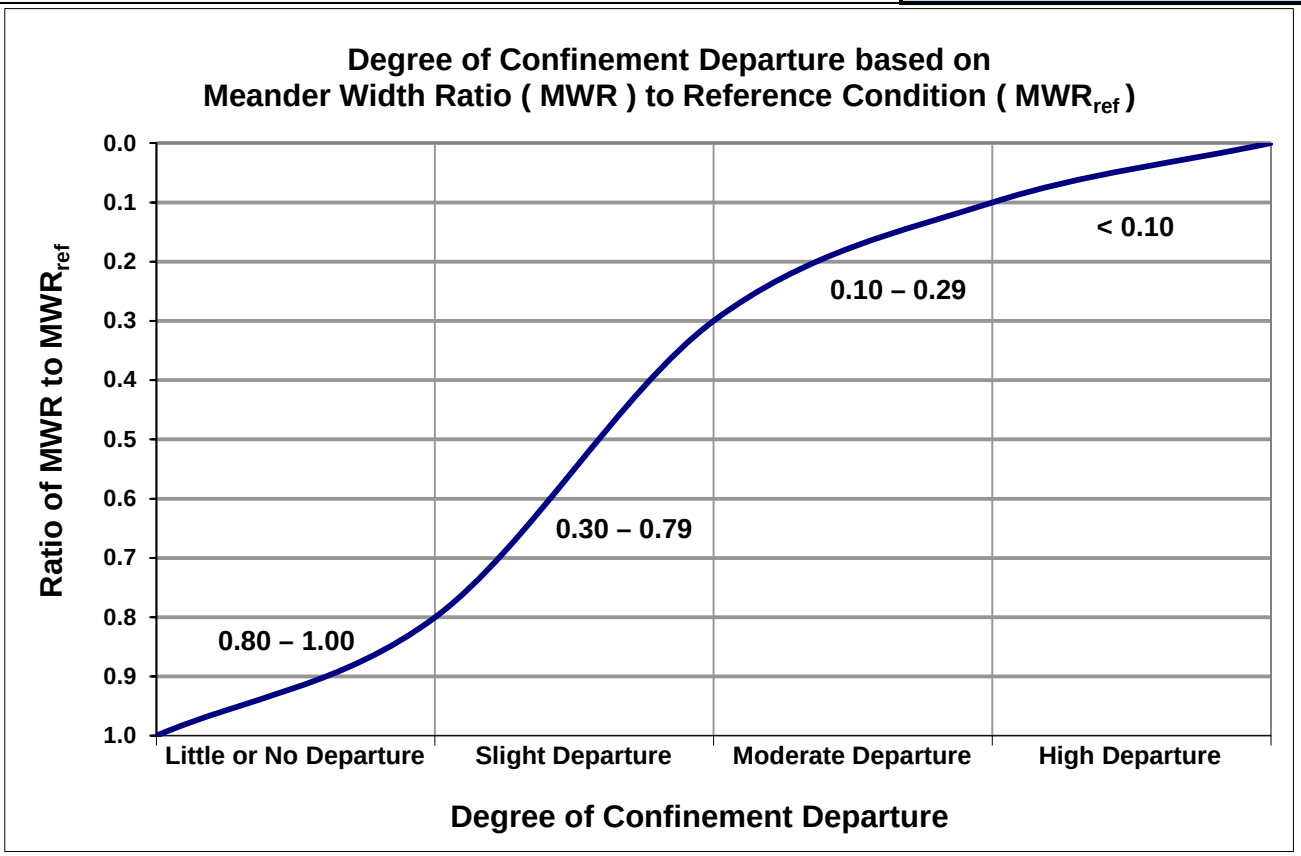
Worksheet 3-9. Degree of confinement departure based on Meander Width Ratio (MWR) divided by reference condition Meander Width Ratio (MWR_{ref}).

Degree of Confinement

Stream:	**Housatonic River Reach 5A-5**	Stream Type:	**C5**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

Existing Meander Width Ratio (MWR):	**1.73**	Ratio of MWR to MWR_{ref} :	**0.35**
Reference Meander Width Ratio (MWR_{ref}):	**5**		

Degree of Confinement Stability Rating ☞ **Slight Departure**



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Worksheet 3-10. Pfankuch (1975) channel stability rating procedure, as modified by Rosgen (1996, 2006b).

Stream: Housatonic River Reach 5A-5 **Location:** Pittsfield MA **Landscape Type:** U-AL-FD **Observers:** RGJ **Date:** 1/19/2026

Loca-tion	Key	Category	Excellent		Good		Fair		Poor	
			Description	Rating	Description	Rating	Description	Rating	Description	Rating
Upper banks	1	Landform slope	Bank slope gradient <30%.	2	Bank slope gradient 30–40%.	4	Bank slope gradient 40–60%.	6	Bank slope gradient > 60%.	8
	2	Mass erosion	No evidence of past or future mass erosion.	3	Infrequent. Mostly healed over. Low future potential.	6	Frequent or large, causing sediment nearly yearlong.	9	Frequent or large, causing sediment nearly yearlong OR imminent danger of same.	12
	3	Debris jam potential	Essentially absent from immediate channel area.	2	Present, but mostly small twigs and limbs.	4	Moderate to heavy amounts, mostly larger sizes.	6	Moderate to heavy amounts, predominantly larger sizes.	8
	4	Vegetative bank protection	> 90% plant density. Vigor and variety suggest a deep, dense, soil-binding root mass.	3	70–90% density. Fewer species or less vigor suggest less dense or deep root mass.	6	50–70% density. Lower vigor and fewer species from a shallow, discontinuous root mass.	9	<50% density plus fewer species and less vigor indicating poor, discontinuous, and shallow root mass.	12
Lower banks	5	Channel capacity	Bank heights sufficient to contain the bankfull stage. Width/depth ratio departure from reference width/depth ratio = 1.0. Bank-Height Ratio (BHR) = 1.0.	1	Bankfull stage is contained within banks. Width/depth ratio departure from reference width/depth ratio = 1.0–1.2. Bank-Height Ratio (BHR) = 1.0–1.1.	2	Bankfull stage is not contained. Width/depth ratio departure from reference width/depth ratio = 1.2–1.4. Bank-Height Ratio (BHR) = 1.1–1.3.	3	Bankfull stage is not contained; over-bank flows are common with flows less than bankfull. Width/depth ratio departure from reference width/depth ratio > 1.4. Bank-Height Ratio (BHR) > 1.3.	4
	6	Bank rock content	> 65% with large angular boulders. 12"+ common.	2	40–65%. Mostly boulders and small cobbles 6–12".	4	20–40%. Most in the 3–6" diameter class.	6	<20% rock fragments of gravel sizes, 1–3" or less.	8
	7	Obstructions to flow	Rocks and logs firmly imbedded. Flow pattern w/o cutting or deposition. Stable bed.	2	Some present causing erosive cross currents and minor pool filling. Obstructions fewer and less firm.	4	Moderately frequent, unstable obstructions move with high flows causing bank cutting and pool filling.	6	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	8
	8	Cutting	Little or none. Infrequent raw banks <6".	4	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12".	6	Significant. Cuts 12–24" high. Root mat overhangs and sloughing evident.	12	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
	9	Deposition	Little or no enlargement of channel or point bars.	4	Some new bar increase, mostly from coarse gravel.	8	Moderate depostion of new gravel and coarse sand on old and some new bars.	12	Extensive deposit of predominantly fine particles. Accelerated bar development.	16
Bottom	10	Rock angularity	Sharp edges and corners. Plane surfaces rough.	1	Rounded corners and edges. Surfaces smooth and flat.	2	Corners and edges well-rounded in two dimensions.	3	Well-rounded in all dimensions, surfaces smooth.	4
	11	Brightness	Surfaces dull, dark, or stained. Generally not bright.	1	Mostly dull, but may have <35% bright surfaces.	2	Mixture dull and bright, i.e., 35–65% mixture range.	3	Predominantly bright, > 65%, exposed or scoured surfaces.	4
	12	Consolidation of particles	Assorted sizes tightly packed or overlapping.	2	Moderately packed with some overlapping.	4	Mostly loose assortment with no apparent overlap.	6	No packing evident. Loose assortment, easily moved.	8
	13	Bottom size distribution	No size change evident. Stable material 80–100%.	4	Distribution shift light. Stable material 50–80%.	8	Moderate change in sizes. Stable materials 20–50%.	12	Marked distribution change. Stable materials 0–20%.	16
	14	Scouring and deposition	<5% of bottom affected by scour or deposition.	6	5–30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12	30–50% affected. Deposits and scour at obstructions, constrictions, and bends. Some filling of pools.	18	More than 50% of the bottom in a state of flux or change nearly yearlong.	24
	15	Aquatic vegetation	Abundant growth moss-like, dark green perennial. In swift water too.	1	Common. Algae forms in low velocity and pool areas. Moss here too.	2	Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick.	3	Perennial types scarce or absent. Yellow-green, short-term bloom may be present.	4
			Excellent Total =		**Good Total =**	**12**	**Fair Total =**	**51**	**Poor Total =**	**60**

Stream type	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6	D3	D4	D5	D6
Good (Stable)	38-43	38-43	54-90	60-95	60-95	50-80	38-45	38-45	40-60	40-64	48-68	40-60	38-50	38-50	60-85	70-90	70-90	60-85	85-107	85-107	85-107	67-98
Fair (Mod. unstable)	44-47	44-47	91-129	96-132	96-142	81-110	46-58	46-58	61-78	65-84	69-88	61-78	51-61	51-61	86-105	91-110	91-110	86-105	108-132	108-132	108-132	99-125
Poor (Unstable)	48+	48+	130+	133+	143+	111+	59+	59+	79+	85+	89+	79+	62+	62+	106+	111+	111+	106+	133+	133+	133+	126+

Stream type	DA3	DA4	DA5	DA6	E3	E4	E5	E6	F1	F2	F3	F4	F5	F6	G1	G2	G3	G4	G5	G6
Good (Stable)	40-63	40-63	40-63	40-63	40-63	50-75	50-75	40-63	60-85	60-85	85-110	85-110	90-115	80-95	40-60	40-60	85-107	85-107	90-112	85-107
Fair (Mod. unstable)	64-86	64-86	64-86	64-86	64-86	76-96	76-96	64-86	86-105	86-105	111-125	111-125	116-130	96-110	61-78	61-78	108-120	108-120	113-125	108-120
Poor (Unstable)	87+	87+	87+	87+	87+	97+	97+	87+	106+	106+	126+	126+	131+	111+	79+	79+	121+	121+	126+	121+

Grand Total =	**123**
Existing Stream Type =	**C5**
***Potential Stream Type =**	**C4**
Modified channel stability rating =	**Poor**

***Rating is adjusted to *potential* stream type, not existing stream type**

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Worksheet 3-14. Sediment competence calculation form to assess bed stability.

Sediment Competence using Dimensional and Dimensionless Shear Stress Methods

Stream:	**Housatonic River Reach 5A-5**		Stream Type:	**C5**	
Location:	**Pittsfield MA**		Landscape Type:	**U-AL-FD**	
Observers:	**RGJ**		Date:	**1/19/2026**	

Enter Required Information for Existing Condition

1.0	D_{50}	Median particle size of riffle bed material (mm)			
1.0	$\hat{D}_{50}$	Median particle size of bar or sub-pavement sample (mm)			
0.00	D_{max}	Largest particle from bar sample (ft)	**1**	**(mm)**	304.8 mm/ft
0.0002	S	Existing average water surface slope (ft/ft)			
5.14	d	Existing bankfull mean depth (ft)			
1.65	γ_s-γ/γ	Immersed specific gravity of sediment			

Select the Appropriate Equation and Calculate Critical Dimensionless Shear Stress

1.00	$D_{50}/\hat{D}_{50}$	Range: 3 – 7	Use EQUATION 1:	$\tau^* = 0.0834 \left(D_{50}/\hat{D}_{50} \right)^{-0.872}$
1.00	D_{max}/D_{50}	Range: 1.3 – 3.0	Use EQUATION 2:	$\tau^* = 0.0384 \left(D_{max}/D_{50} \right)^{-0.887}$
N/A	τ^*	Bankfull Dimensionless Shear Stress	EQUATION USED:	**N/A**

Calculate Bankfull Mean Depth Required for Entrainment of Largest Particle in Bar Sample

N/A	**d**	Required bankfull mean depth (ft) $d = \frac{\tau^* (\gamma_s - 1) D_{max}}{S}$	(use D_{max} in ft)

Calculate Average Water Surface Slope Required for Entrainment of Largest Particle in Bar Sample

N/A	**S**	Required average water surface slope (ft/ft) $S = \frac{\tau^* (\gamma_s - 1) D_{max}}{d}$	(use D_{max} in ft)

Check: ☐ Stable ☐ Aggrading ☐ Degrading

Sediment Competence Using Dimensional Shear Stress

Shields	CO	
0.064		Bankfull shear stress $\tau = \gamma d S$ (lbs/ft^2) (substitute hydraulic radius, R, with mean depth, d) γ = 62.43, d = existing depth, S = existing slope
4	**20**	Predicted largest moveable particle size (mm) at bankfull shear stress τ **(Figure 3-11)**
0.015	**0.001**	Predicted shear stress required to initiate movement of measured D_{max} (mm) **(Figure 3-11)**
1.23	**0.09**	Predicted mean depth required to initiate movement of measured D_{max} (mm) $d = \frac{\tau}{\gamma S}$ τ = predicted shear stress, γ = 62.43, S = existing slope
0.0000	**0.0000**	Predicted slope required to initiate movement of measured D_{max} (mm) $S = \frac{\tau}{\gamma d}$ τ = predicted shear stress, γ = 62.43, d = existing depth

Check: ☐ Stable ☐ Aggrading ☐ Degrading

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Worksheet 3-15. Stability ratings for stream type stage shifts.

Stream Succession Stage Shifts			
Stream:	**Housatonic River Reach 5A-5**	Stream Type:	**C5**
Location:	**Pittsfield MA**	Landscape Type:	**U-AL-FD**
Observers:	**RGJ**	Date:	**1/19/2026**

Stream Type Stage Shifts (Figure 3-14)	**Stability Rating (Check ✓ Appropriate Rating)**
Stream Type at Potential, (C→E), (F_b→B), (F→B_c), (F→C), (G→B), (D→C)	☐ Stable
(E→C), (B→High W/d B), (C→High W/d C)	☑ Moderately Unstable
(G_c→F), (G→F_b), (F→D), (C→F)	☐ Unstable
(C→D), (A→G), (B→G), (D→G), (C→G), (E→G), (E→A)	☐ Highly Unstable

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Worksheet 3-16. Lateral stability prediction summary.

Lateral Stability Prediction					
Stream:	**Housatonic River Reach 5A-5**		Stream Type: **C5**		
Location:	**Pittsfield MA**		Landscape Type: **U-AL-FD**		
Observers:	**RGJ**		Date: **1/19/2026**		
Lateral stability criteria (choose one stability category for each criterion 1–5)	**Lateral Stability Categories**				**Selected Points (from each row)**
	Stable	***Moderately Unstable***	***Unstable***	***Highly Unstable***	
1 W/d Ratio State (Worksheet 3-8)	< 1.2	1.2 – 1.4	1.4 – 1.6	> 1.6	**4**
	(2)	**(4)**	**(6)**	**(8)**	
2 Depositional Patterns (Worksheet 3-5)	B1, B2	B4, B8	B3	B5, B6, B7	**2**
	(1)	**(2)**	**(3)**	**(4)**	
3 Meander Patterns (Worksheet 3-4)	M1, M3, M4		M2, M5, M6, M7, M8		**3**
	(1)		**(3)**		
4 Streambank Erosion: Unit Rate (Worksheet 3-13)	< 0.006	0.006 – 0.04	0.041 – 0.07	> 0.07	**6**
	(2)	**(4)**	**(6)**	**(8)**	
5 Degree of Confinement (MWR / MWR_{ref}) (Worksheet 3-9)	> 0.8	0.3 – 0.79	0.1 – 0.29	< 0.1	**2**
	(1)	**(2)**	**(3)**	**(4)**	
				Total Points	**17**
	Lateral Stability Category Point Range				
Overall Lateral Stability Category (use total points and check ✓ stability rating)	***Stable*** **< 10** ☐	***Moderately Unstable*** **10 – 12** ☐	***Unstable*** **13 – 21** ☑	***Highly Unstable*** **> 21** ☐	

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Worksheet 3-17. Vertical stability prediction for excess deposition and aggradation.

Vertical Stability Prediction for Excess Deposition and Aggradation					
Stream: **Housatonic River Reach 5A-5**			Stream Type: **C5**		
Location: **Pittsfield MA**			Landscape Type: **U-AL-FD**		
Observers: **RGJ**			Date: **1/19/2026**		
Vertical Stability Criteria (choose one stability category for each criterion 1–6)	**Vertical Stability Categories for Excess Deposition / Aggradation**				**Selected Points (from each row)**
	No Deposition	***Moderate Deposition***	***Excess Deposition***	***Aggradation***	
1 Sediment Competence (Worksheet 3-14)	Sufficient depth and slope to transport largest size available	Trend toward insufficient depth or slope-slightly incompetent	Cannot move D_{35} of bed material and/or D_{100} of bar material	Cannot move D_{16} of bed material and/or D_{100} of bar or sub-pavement size	**2**
	(2)	**(4)**	**(6)**	**(8)**	
2 Sediment Capacity (POWERSED)	Sufficient capacity to transport annual load	Trend toward insufficient sediment capacity	Reduction up to 25% of annual sediment yield of bedload or suspended sand	Reduction over 25% of annual sediment yield for bedload or suspended sand	**2**
	(2)	**(4)**	**(6)**	**(8)**	
3 W/d Ratio State (Worksheet 3-8)	< 1.2	1.2 – 1.4	1.4 – 1.6	> 1.6	**4**
	(2)	**(4)**	**(6)**	**(8)**	
4 Stream Succession Stage Shifts (Worksheet 3-15)	Current stream type at potential or does not indicate deposition/ aggradation	(E→C)	(B→High W/d B), (C→High W/d C), (C→F), (G_c→F), (G→F_b)	(C→D), (F→D)	**4**
	(2)	**(4)**	**(6)**	**(8)**	
5 Depositional Patterns (Worksheet 3-5)	B1	B2, B4	B3, B5	B6, B7, B8	**3**
	(1)	**(2)**	**(3)**	**(4)**	
6 Debris / Blockages (Worksheet 3-6)	D1, D2, D3	D4, D7	D5, D8	D6, D9, D10	**2**
	(1)	**(2)**	**(3)**	**(4)**	
				Total Points	**17**
	Vertical Stability Category Point Range for Excess Deposition and Aggradation				
Vertical Stability for Excess Deposition / Aggradation (use total points and check ✓ stability rating)	***No Deposition*** **< 15** ☐	***Moderate Deposition*** **15 – 20** ☑	***Excess Deposition*** **21 – 30** ☐	***Aggradation*** **> 30** ☐	

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Worksheet 3-18. Vertical stability prediction for channel incision and degradation.

Vertical Stability Prediction for Channel Incision and Degradation					
Stream: **Housatonic River Reach 5A-5**			Stream Type: **C5**		
Location: **Pittsfield MA**			Landscape Type: **U-AL-FD**		
Observers: **RGJ**			Date: **1/19/2026**		
Vertical Stability Criteria (choose one stability category for each criterion 1–5)	**Vertical Stability Categories for Channel Incision / Degradation**				**Selected Points (from each row)**
	Not Incised	***Slightly Incised***	***Moderately Incised***	***Degradation***	
1 Sediment Competence (Worksheet 3-14)	Does not indicate excess competence	Trend to move larger sizes than D_{100} of bar or D_{84} of bed	D_{100} of bed moved	Particles much larger than D_{100} of bed moved	**6**
	(2)	**(4)**	**(6)**	**(8)**	
2 Sediment Capacity (POWERSED)	Does not indicate excess capacity	Slight excess energy: up to 10% increase above reference	Excess energy sufficient to increase load up to 50% of annual load	Excess energy transporting more than 50% of annual load	**4**
	(2)	**(4)**	**(6)**	**(8)**	
3 Degree of Channel Incision (BHR) (Worksheet 3-7)	1.00 – 1.10	1.11 – 1.30	1.31 – 1.50	> 1.50	**6**
	(2)	**(4)**	**(6)**	**(8)**	
4 Stream Succession States (Worksheets 3-15 and 3-7)	Does not indicate incision or degradation	If BHR > 1.1 and stream type has W/d between 5–10	If BHR > 1.1 and stream type has W/d less than 5	(B→G), (C→G), (E→G), (D→G), (A→G), (E→A)	**2**
	(2)	**(4)**	**(6)**	**(8)**	
5 Confinement (MWR / MWR_{ref}) (Worksheet 3-9)	0.80 – 1.00	0.30 – 0.79	0.10 – 0.29	< 0.10	**2**
	(1)	**(2)**	**(3)**	**(4)**	
				Total Points	**20**
	Vertical Stability Category Point Range for Channel Incision and Degradation				
Vertical Stability for Channel Incision/ Degradation (use total points and check ✓ stability rating)	***Not Incised*** **< 12** ☐	***Slightly Incised*** **12 – 18** ☐	***Moderately Incised*** **19 – 27** ☑	***Degradation*** **> 27** ☐	

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Worksheet 3-19. Channel enlargement prediction summary.

Channel Enlargement Prediction					
Stream: **Housatonic River Reach 5A-5**			Stream Type: **C5**		
Location: **Pittsfield MA**			Landscape Type: **U-AL-FD**		
Observers: **RGJ**			Date: **1/19/2026**		
Channel Enlargement Prediction Criteria (choose one stability category for each criterion 1–4)	**Channel Enlargement Prediction Categories**				**Selected Points (from each row)**
	No Increase	***Slight Increase***	***Moderate Increase***	***Extensive***	
1 Stream Succession Stage Shifts (Worksheet 3-15)	Stream Type at Potential, (C→E), (F_b→B), (G→B), (F→B_c), (F→C), (D→C)	(B→High W/d B), (C→High W/d C), (E→C)	(G→F), (F→D)	(C→D), (A→G), (B→G), (D→G), (C→G), (E→G), (E→A), (C→F)	**4**
	(2)	**(4)**	**(6)**	**(8)**	
2 Lateral Stability (Worksheet 3-16)	*Stable*	*Moderately Unstable*	*Unstable*	*Highly Unstable*	**6**
	(2)	**(4)**	**(6)**	**(8)**	
3 Vertical Stability Excess Deposition and Aggradation (Worksheet 3-17)	*No Deposition*	*Moderate Deposition*	*Excess Deposition*	*Aggradation*	**4**
	(2)	**(4)**	**(6)**	**(8)**	
4 Vertical Stability Channel Incision and Degradation (Worksheet 3-18)	*Not Incised*	*Slightly Incised*	*Moderately Incised*	*Degradation*	**6**
	(2)	**(4)**	**(6)**	**(8)**	
				Total Points	**20**
	Category Point Range				
Channel Enlargement Prediction (use total points and check ✓ stability rating)	***No Increase*** **< 11** ☐	***Slight Increase*** **11 – 16** ☐	***Moderate Increase*** **17 – 24** ☑	***Extensive*** **> 24** ☐	

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Worksheet 3-20. Overall sediment supply rating determined from individual stability rating categories.

Overall Sediment Supply Prediction			
Stream: **Housatonic River Reach 5A-5**		Stream Type: **C5**	
Location: **Pittsfield MA**		Landscape Type: **U-AL-FD**	
Observers: **RGJ**		Date: **1/19/2026**	
Overall Sediment Supply Prediction Criteria (choose corresponding points for each criterion 1–5)	**Stability Rating**	**Points**	**Selected Points**
1 Lateral Stability (Worksheet 3-16)	***Stable***	**1**	**3**
	Mod. Unstable	**2**	
	Unstable	**3**	
	Highly Unstable	**4**	
2 Vertical Stability Excess Deposition or Aggradation (Worksheet 3-17)	***No Deposition***	**1**	**2**
	Mod. Deposition	**2**	
	Excess Deposition	**3**	
	Aggradation	**4**	
3 Vertical Stability Channel Incision or Degradation (Worksheet 3-18)	***Not Incised***	**1**	**3**
	Slightly Incised	**2**	
	Mod. Incised	**3**	
	Degradation	**4**	
4 Channel Enlargement Prediction (Worksheet 3-19)	***No Increase***	**1**	**3**
	Slight Increase	**2**	
	Mod. Increase	**3**	
	Extensive	**4**	
5 Pfankuch Channel Stability (Worksheet 3-10)	***Good: Stable***	**1**	**4**
	Fair: Mod. Unstable	**2**	
	Poor: Unstable	**4**	
		Total Points	**15**
	Category Point Range		
Overall Sediment Supply Rating (use total points and check ✓ stability rating)	***Low*** **< 6** ☐	***Moderate*** **6 – 10** ☐	***High*** **11 – 15** ☑	***Very High*** **> 15** ☐

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Worksheet 3-21. Summary of stability condition categories.

Summary of Stability Conditions

Stream:	**Housatonic River Reach 5A-5**					Location: **Pittsfield MA**					
Observers:	**RGJ**			Date: **1/19/2026**		Stream Type: **C5**			Landscape Type: **U-AL-FD**		
Channel Dimension	Bankfull Mean Depth (ft): **5.14**		Bankfull Width (ft): **101**		Cross-Sectional Area (ft^2): **519**		Width/Depth Ratio: **19.6**		Entrenchment Ratio: **5.8**		
Channel Pattern	Mean:	λ/W_{bkf}: **586.1**	L_m/W_{bkf}: **862.9**		R_c/W_{bkf}: **291.2**		MWR: **1.73**		Sinuosity: **2.95**		
	Range:	**188-1126**	**480-1326**		**97-672**		**0.73-3.26**				
Streamflow	Bankfull Mean Velocity ($\bar{u}_{bkf}$) (ft/sec): **3.26**		Bankfull Discharge (Q_{bkf}): **1688**		Estimation Method: **Regional Curve**				Drainage Area (mi^2): **146**		
River Profile & Bed Features	Check: ☑ Riffle/Pool ☐ Step/Pool ☐ Plane Bed ☐ Convergence/Divergence ☐ Dunes/Antidunes/Smooth Bed										
	Bankfull Max Depth (ft):	Riffle **5.3**	Pool **6.2**	Depth Ratio (max to mean):	Riffle **1.39**	Pool **1.31**	Pool-to-Pool Spacing:	Ratio	Slope Valley: **0.0004**	Water Surface: **0.0003**	
Level III Stream Stability Indices	Riparian Vegetation	Current Composition/Density:		Potential Composition/Density:			Remarks: Condition, Vigor & Usage of Existing Reach:				
	Flow Regime: **P2**	Stream Size & Order: **S-8(4)**		Meander Patterns: **M2**			Depositional Patterns: **B4**		Debris/Channel Blockages: **D3, D4**		
	Degree of Incision (Bank-Height Ratio): **1.35**		Degree of Incision Stability Rating: **Moderately Incised**				Modified Pfankuch Stability Rating (Numeric & Adjective Rating):				
	W/d Ratio State (W/d) / (W/d_{ref}): **1.4**		W/d Ratio State Stability Rating: **Moderately Unstable**		Degree of Confinement (MWR / MWR_{ref}): **0.35**				MWR / MWR_{ref} Stability Rating: **Slight Departure**		
Bank Erosion Summary	Length of Reach Studied (ft): **5750**	Annual Streambank Erosion Rate: **553** (tons/yr)	**0.05** (tons/yr/ft)	Curve Used: **Housatonic**	Remarks:						
Sediment Capacity (POWERSED)	☑ *Sufficient Capacity* ☐ *Insufficient Capacity* ☐ *Excess Capacity*						Remarks:				
Entrainment/ Competence	Largest Particle from Bar Sample (mm):	$\tau =$	$\tau^* =$	Existing Depth:	Required Depth:	Existing Slope:	Required Slope:				
Stream Succession	**E** → **C** → → → →						Existing Stream State (Type): **C**		Potential Stream State (Type): **C**		
Lateral Stability	☐ *Stable*	☐ *Mod. Unstable*	☑ *Unstable*	☐ *Highly Unstable*	Remarks:						
Vertical Stability (Aggradation)	☐ *No Deposition*	☑ *Mod. Deposition*	☐ *Ex. Deposition*	☐ *Aggradation*	Remarks:						
Vertical Stability (Degradation)	☐ *Not Incised*	☐ *Slightly Incised*	☑ *Mod. Incised*	☐ *Degradation*	Remarks:						
Channel Enlargement	☐ *No Increase*	☐ *Slight Increase*	☑ *Mod. Increase*	☐ *Extensive*	Remarks:						
Sediment Supply (Channel Source)	☐ *Low*	☐ *Moderate*	☑ *High*	☐ *Very High*	Remarks:						

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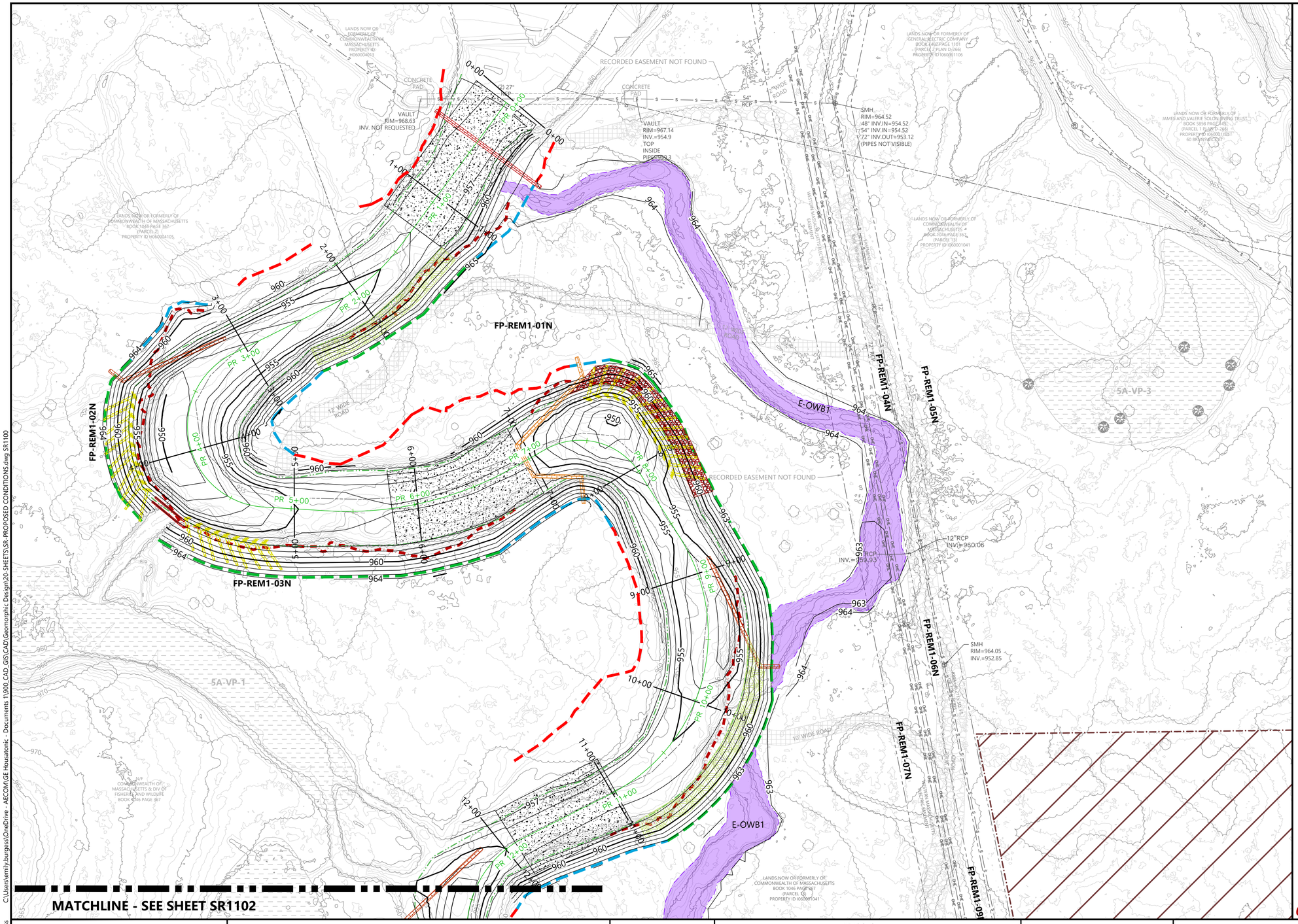
Attachment D Design Drawings

Geomorphic Design Plans SR1100-SR1106 to show the natural channel design from the Confluence (Station 00+00) to Pomeroy Ave Bridge (Station 48+00)



LEGEND:

- EXISTING CONTOURS (FEET NAVD88) (1-FOOT INTERVAL)
- PROPERTY BOUNDARY MASSGIS
- PUBLIC ROADWAY
- EXISTING FOOTPATH
- VERNAL POOL BOUNDARY
- REQUIRED RIVERBANK REMEDIATION REQUIRED
- EXISTING RIVER STATIONING
- OTHER WATERBODY BOUNDARY
- INTERMITTENT SIDE CHANNEL BACKFILL EXTENT
- TEMPORARY ACCESS ROAD
- PROPOSED STAGING/LAYDOWN LOCATION
- PROPOSED RIVER STATIONING
- PROPOSED CONTOURS (FEET NAVD88) (1-FOOT INTERVAL)
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- PROPOSED ROCK TOE
- PROPOSED WOOD & ROCK J-HOOK
- PROPOSED WOOD & ROCK BENDWAY WEIR
- PROPOSED WOOD & ROCK CROSS VANE
- PROPOSED WOOD & ROCK SILL

HORIZONTAL DATUM: MASSACHUSETTS STATE PLANE MAINLAND, (NAD83), U.S. FEET.

VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

NOTES:

1. SEE SHEET G0001 FOR GENERAL NOTES AND LEGEND.
2. LOCATIONS ARE APPROXIMATE FOR ALL UTILITIES.

NORTH

0 40 80

SCALE IN FEET

PLAN INTENDED TO BE VIEWED IN COLOR, ADJACENT BLOCK IS "BLUE"

ONE INCH AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

04-29-2026 DRAFT-NOT FOR CONSTRUCTION

AECOM

GENERAL ELECTRIC
1 PLASTICS AVENUE
PITTSFIELD, MA 01201

REVISIONS

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DRAWN BY:
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APPROVED BY:
SCALE: AS NOTED
DATE: APRIL 2026

HOUSATONIC RIVER
REACH 5A REMEDIATION
GENERAL ELECTRIC COMPANY

GEOMORPHIC DESIGN PLAN
STA. 00+00 TO STA. 12+50 &
INTERMITTENT SIDE CHANNEL (E-OWB1)

SR1100

SHEET # **1** OF **6**

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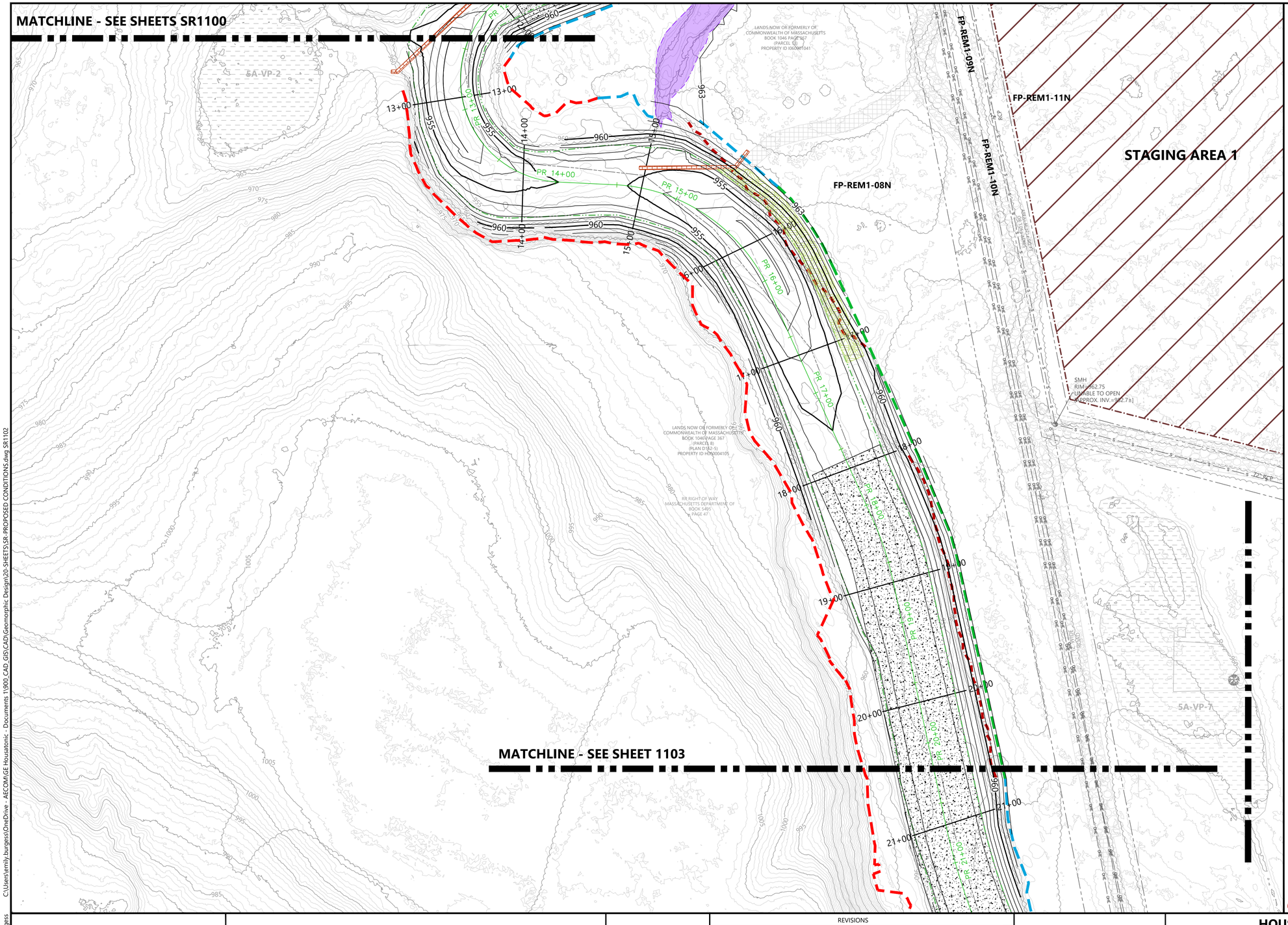

LEGEND:

- EXISTING CONTOURS (FEET NAVD88) (1-FOOT INTERVAL)
- PROPERTY BOUNDARY MASSGIS
- PUBLIC ROADWAY
- EXISTING FOOTPATH
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- PROPOSED WOOD & ROCK BENDWAY WEIR
- PROPOSED WOOD & ROCK CROSS VANE
- PROPOSED WOOD & ROCK SILL

HORIZONTAL DATUM: MASSACHUSETTS STATE PLANE MAINLAND, (NADB3), U.S. FEET.

VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

NOTES:

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NORTH

0 40 80

SCALE IN FEET

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PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH AT FULL SIZE. IF NOT ONE INCH SCALE ACCORDINGLY

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PITTSFIELD, MA 01201

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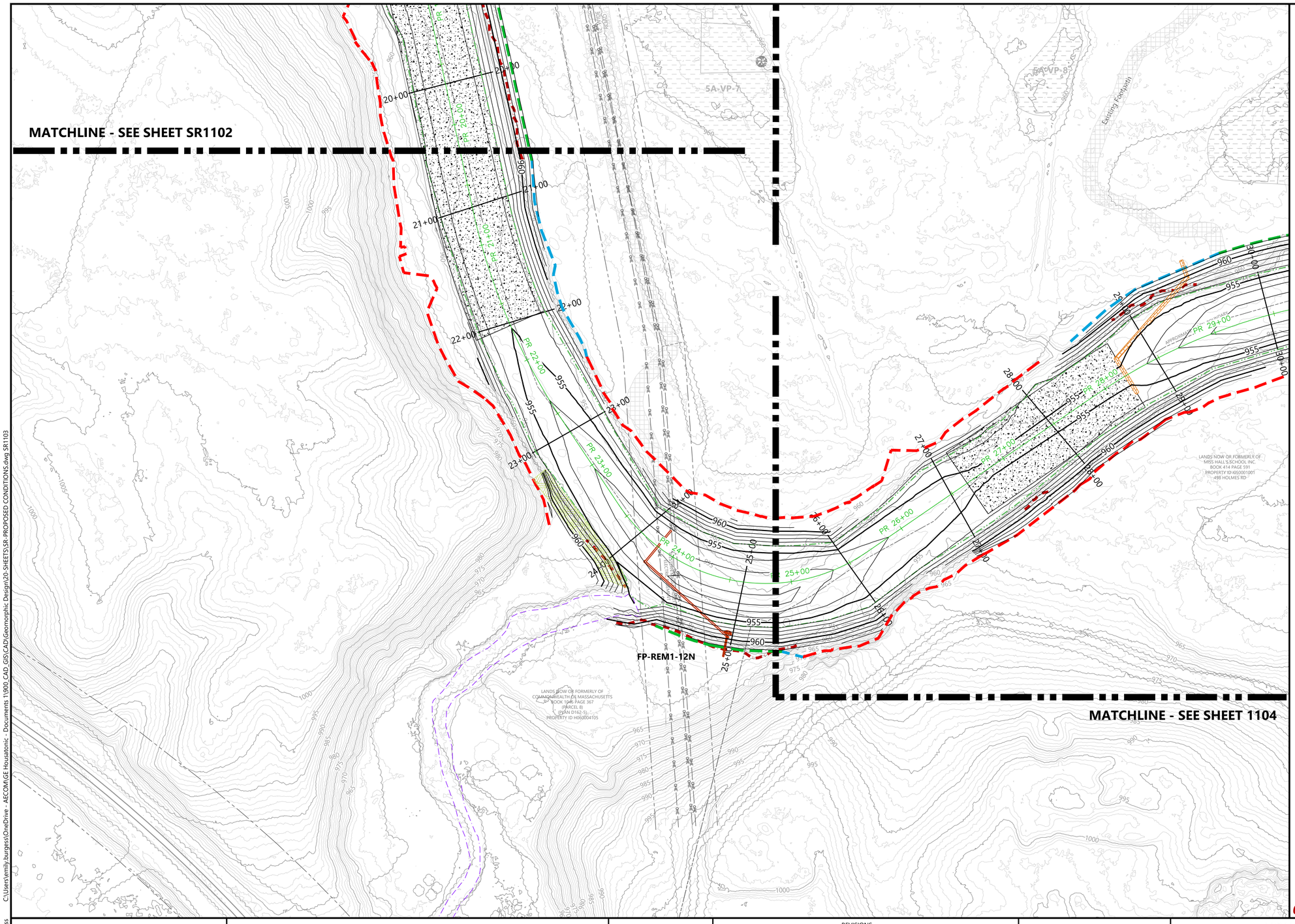
APPROVED BY:
SCALE: AS NOTED
DATE: APRIL 2026

HOUSATONIC RIVER
REACH 5A REMEDIATION
GENERAL ELECTRIC COMPANY

GEOMORPHIC DESIGN PLAN
STA. 12+50 TO STA. 21+50

SR1102

SHEET # **2** OF **6**



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- PROPOSED WOOD & ROCK CROSS VANE
- PROPOSED WOOD & ROCK SILL

HORIZONTAL DATUM: MASSACHUSETTS STATE PLANE MAINLAND, (NAD83), U.S. FEET.

VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

NOTES:

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NORTH

0 40 80

SCALE IN FEET

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04-29-2026 DRAFT-NOT FOR CONSTRUCTION

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PITTSFIELD, MA 01201

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DRAWN BY:
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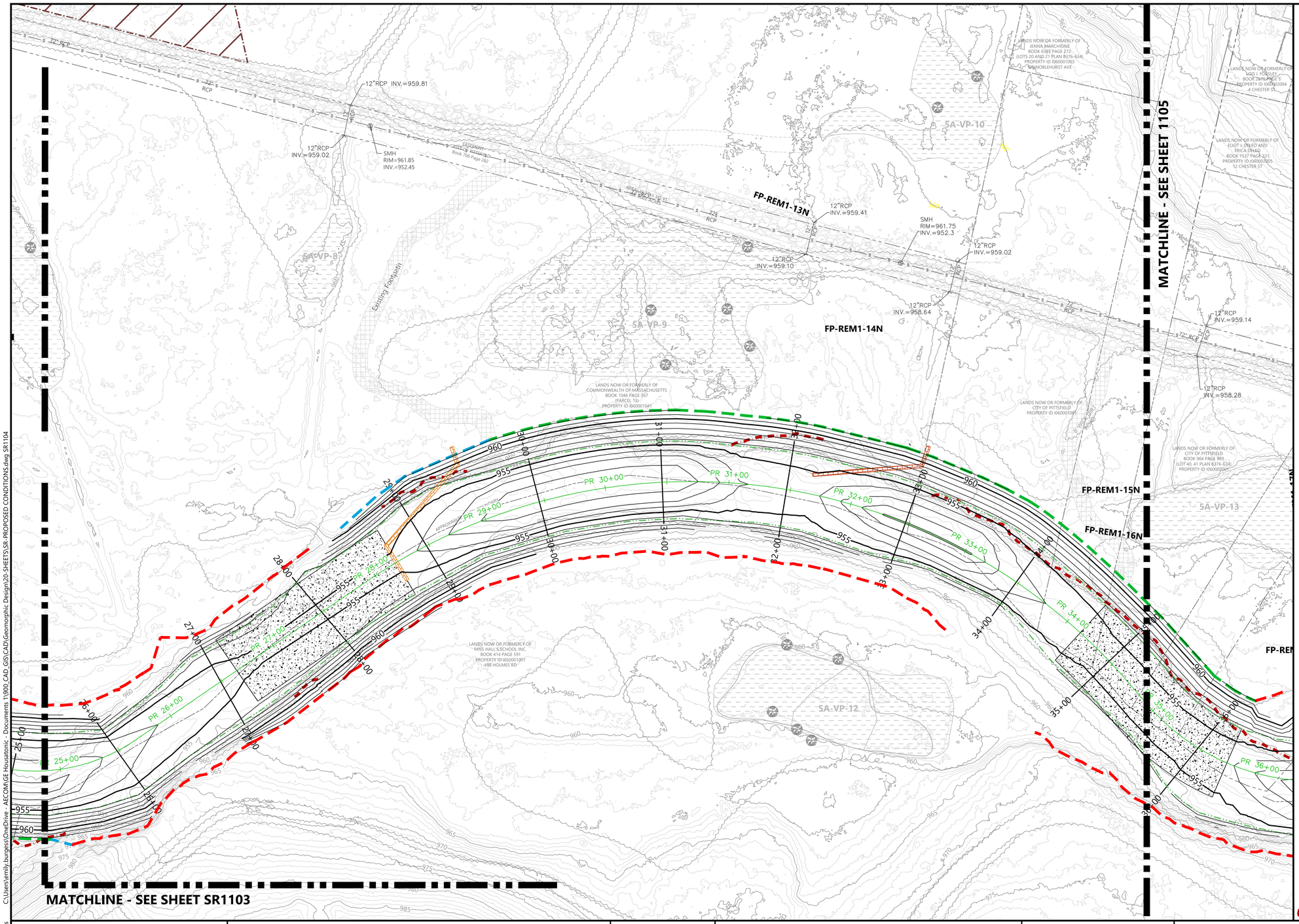
APPROVED BY:
SCALE: AS NOTED
DATE: APRIL 2026

HOUSATONIC RIVER
REACH 5A REMEDIATION
GENERAL ELECTRIC COMPANY

GEOMORPHIC DESIGN PLAN
STA. 21+50 TO STA. 30+00

SR1103

SHEET # **3** OF **6**



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- PROPOSED WOOD & ROCK CROSS VANE
- PROPOSED WOOD & ROCK SILL

HORIZONTAL DATUM: MASSACHUSETTS STATE PLANE MAINLAND, (NAD83), U.S. FEET.

VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

NOTES:

1. SEE SHEET G0001 FOR GENERAL NOTES AND LEGEND.
2. LOCATIONS ARE APPROXIMATE FOR ALL UTILITIES.

NORTH

0 40 80

SCALE IN FEET

04-29-2026 DRAFT-NOT FOR CONSTRUCTION

PLAN INTENDED TO BE VIEWED IN COLOR, ADJACENT BLOCK IS "BLUE"

ONE INCH AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

AECOM

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1 PLASTICS AVENUE
PITTSFIELD, MA 01201

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APPROVED BY:
SCALE: AS NOTED
DATE: APRIL 2026

HOUSATONIC RIVER
REACH 5A REMEDIATION
GENERAL ELECTRIC COMPANY

GEOMORPHIC DESIGN PLAN
STA. 30+00 TO STA. 36+50

SR1104

SHEET # 4 OF 6

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MATCHLINE - SEE SHEET SR1104

MATCHLINE - SEE SHEET SR1106

REVILLA TERRACE

LANDS NOW OR FORMERLY OF JENNA MARCHIONE BOOK 6385 PAGE 272 (LOTS 20 AND 21 PLAN B376-634) PROPERTY ID I060001003 6 NOBLEHURST AVE

LANDS NOW OR FORMERLY OF MOLLY FORSYTH BOOK 7691 PAGE 5 PROPERTY ID I060002004 4 CHESTER ST

LANDS NOW OR FORMERLY OF ELIOT L. ORLEO AND ERICA ORLEO BOOK 7537 PAGE 331 PROPERTY ID I060002005 12 CHESTER ST

LANDS NOW OR FORMERLY OF MATTHEW R. HARPER BOOK 6164 PAGE 250 PROPERTY ID I060002002 20 CHESTER ST

LANDS NOW OR FORMERLY OF DAVID J. LOTTO AND NORAH M. WALSH BOOK 1189 PAGE 476 PROPERTY ID I060002101 15 CHESTER ST

LANDS NOW OR FORMERLY OF CITY OF PITTSFIELD PROPERTY ID I060001001

LANDS NOW OR FORMERLY OF CITY OF PITTSFIELD BOOK 964 PAGE 909 (LOT 40, 41 PLAN B376-634) PROPERTY ID I060002001

NOBLEHURST AVE CITY OF PITTSFIELD BOOK PAGE

LANDS NOW OR FORMERLY OF EDUARD KOGAN AND BRITTANY A. CALLANDER BOOK 6919 PAGE 220 (LOTS 4 AND 5 PLAN B355-640) PROPERTY ID I060003010 49 REVILLA TER

LANDS NOW OR FORMERLY OF TCI HOLDINGS, LLC BOOK 5118 PAGE 171 PLAN B355-640) PROPERTY ID I060003012 55 REVILLA TER

LANDS NOW OR FORMERLY OF JUDY M. NORTH BOOK 3173 PAGE 111 PROPERTY ID I060003013 61 REVILLA TER

N/F EDITH SIMPSON MAP 106 BLOCK 3 LOT 12

N/F GEORGE & ROBERTA BEEKER BK 1003 PG 757

N/F GEORGE BEEKER AND ROBERTA A. BEEKER BOOK 1003, PAGE 757 MAP 106 BLOCK 3 LOT 1

LANDS NOW OR FORMERLY OF MISS HALL'S SCHOOL INC BOOK 414 PAGE 591 PROPERTY ID I050001001 486 HOLMES RD

12" RCP INV.=959.14

12" RCP INV.=958.28

12" RCP INV.=958.47

SMH RIM=961.59 INV.=952.29

SMH RIM=961.62 INV.=952.12

5A-VP-13

5A-VP-14

5A-VP-15

5A-VP-15A

5A-VP-16

FP-REM1-15N

FP-REM1-16N

FP-REM1-17N

FP-REM1-18R

FP-REM1-19N

PR 34+00

PR 35+00

PR 36+00

PR 37+00

PR 38+00

PR 39+00

PR 40+00

PR 41+00

PR 42+00

PR 43+00

PR 44+00

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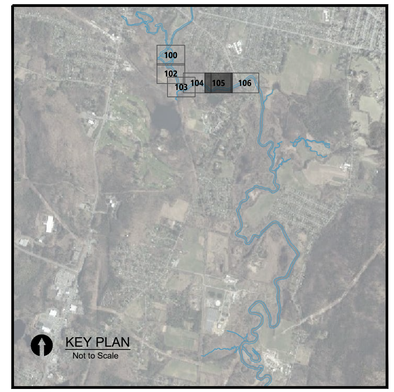
43+00

44+00

45+00



LEGEND:

- 950 — EXISTING CONTOURS (FEET NAVD88) (1-FOOT INTERVAL)
- PROPERTY BOUNDARY MASSGIS
- PUBLIC ROADWAY
- EXISTING FOOTPATH
- VERNAL POOL BOUNDARY
- REQUIRED RIVERBANK REMEDIATION REQUIRED
- 0+00 — 0+00 EXISTING RIVER STATIONING
- OTHER WATERBODY BOUNDARY
- INTERMITTENT SIDE CHANNEL BACKFILL EXTENT
- TEMPORARY ACCESS ROAD
- PROPOSED STAGING/LAYDOWN LOCATION
- PR 3+00 — PROPOSED RIVER STATIONING
- 950 — PROPOSED CONTOURS (FEET NAVD88) (1-FOOT INTERVAL)
- PROPOSED TOE OF BANK
- ESTIMATED BANKFULL EXTENTS (EXISTING, PROPOSED & TRANSITION)
- PROPOSED RIFFLE FEATURE
- PROPOSED BRUSH MATTRESS
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- PROPOSED WOOD & ROCK BENDWAY WEIR
- PROPOSED WOOD & ROCK CROSS VANE
- PROPOSED WOOD & ROCK SILL

HORIZONTAL DATUM: MASSACHUSETTS STATE PLANE MAINLAND, (NAD83), U.S. FEET.

VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

NOTES:

1. SEE SHEET G0001 FOR GENERAL NOTES AND LEGEND.
2. LOCATIONS ARE APPROXIMATE FOR ALL UTILITIES.

NORTH

0 40 80

SCALE IN FEET

PLAN INTENDED TO BE VIEWED IN COLOR, ADJACENT BLOCK IS "BLUE"

ONE INCH AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

04-29-2026 DRAFT-NOT FOR CONSTRUCTION

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1 PLASTICS AVENUE
PITTSFIELD, MA 01201

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

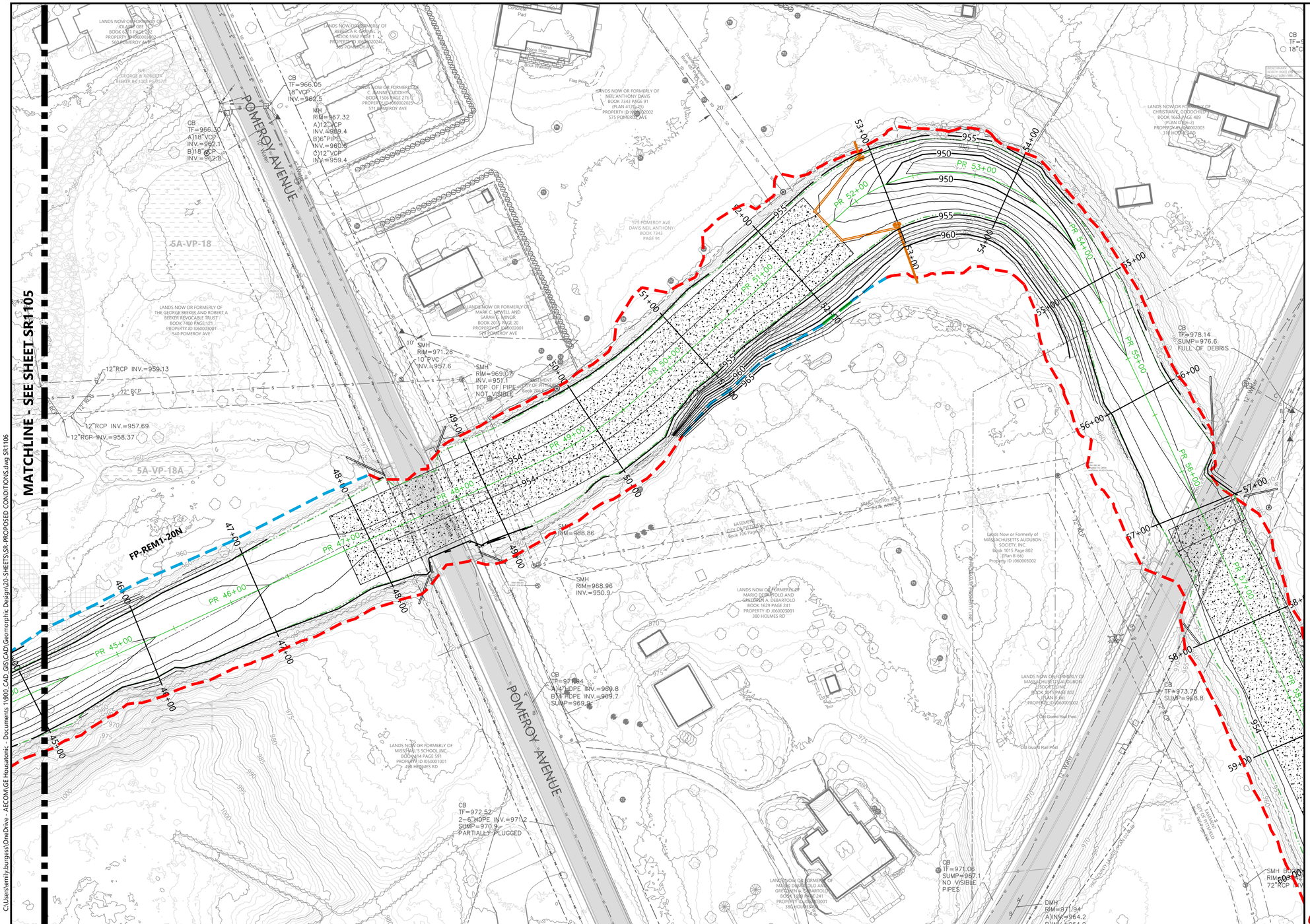
DESIGNED BY:
DRAWN BY:
CHECKED BY:
APPROVED BY:
SCALE: AS NOTED
DATE: APRIL 2026

HOUSATONIC RIVER
REACH 5A REMEDIATION
GENERAL ELECTRIC COMPANY

GEOMORPHIC DESIGN PLAN
STA. 36+50 TO STA. 45+00

SR1105

SHEET # **5** OF **6**


MATCHLINE - SEE SHEET SR1105
POMEROY AVENUE
FP-REM1-20N
5A-VP-18
5A-VP-18A
CB TF=966.05 18"VCP INV.=962.5
MH RIM=967.32 A)12"VCP INV.=959.4 B)6"PIPE INV.=960.6 C)12"VCP INV.=959.4
CB TF=966.10 A)18"VCP INV.=962.1 B)18"VCP INV.=962.8
SMH RIM=971.26 10"PVC INV.=957.6
SMH RIM=969.07 INV.=957.1 TOP OF PIPE NOT VISIBLE
12"RCP INV.=959.13
12"RCP INV.=957.69
12"RCP INV.=958.37
72" RCP
SMH RIM=988.86
SMH RIM=968.96 INV.=950.9
CB TF=971.84 A)4"HDPE INV.=969.8 B)4"HDPE INV.=969.7 SUMP=969.6
CB TF=972.52 2-6"HDPE INV.=971.2 SUMP=970.9 PARTIALLY PLUGGED
CB TF=971.06 SUMP=967.1 NO VISIBLE PIPES
DMH RIM=971.94 A)INV.=964.2 B)INV.=964.0
SMH RIM=970.90 72" RCP
CB TF=978.14 SUMP=976.6 FULL OF DEBRIS
CB TF=973.75 SUMP=968.8
PR 45+00
PR 46+00
PR 47+00
PR 48+00
PR 49+00
PR 50+00
PR 51+00
PR 52+00
PR 53+00
PR 54+00
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LANDS NOW OR FORMERLY OF THE GEORGE BEEKER AND ROBERT A BEEKER REVOCABLE TRUST BOOK 7400 PAGE 121 PROPERTY ID I06000300 1 540 POMEROY AVE
LANDS NOW OR FORMERLY OF MARK C. DEWELL AND SARAH L. MINOR BOOK 2071 PAGE 20 PROPERTY ID I04000200 1 565 POMEROY AVE
LANDS NOW OR FORMERLY OF NEIL ANTHONY DAVIS BOOK 7343 PAGE 91 (PLAN 417G-25) PROPERTY ID I06000302 575 POMEROY AVE
575 POMEROY AVE DAVIS NEIL ANTHONY BOOK 7343 PAGE 91
LANDS NOW OR FORMERLY OF MARIO DEBARTOLO AND GRETCHEN A. DEBARTOLO BOOK 1629 PAGE 241 PROPERTY ID I06000301 380 HOLMES RD
LANDS NOW OR FORMERLY OF MISSION HILLS SCHOOL INC BOOK 414 PAGE 591 PROPERTY ID I05000101 498 HOLMES RD
LANDS NOW OR FORMERLY OF MASSACHUSETTS AUDUBON SOCIETY, INC. BOOK 1015 PAGE 802 (PLAN B-66) PROPERTY ID I06000302
LANDS NOW OR FORMERLY OF CHRISTIAN K. OSZOCHIEJ BOOK 1663 PAGE 489 (PLAN 19M-2) PROPERTY ID I06002003 316 HOOSIC RD
LANDS NOW OR FORMERLY OF JOSEPH E. MEEHAN BOOK 1506 PAGE 276 PROPERTY ID I06002003 571 POMEROY AVE
LANDS NOW OR FORMERLY OF REBECCA R. DANIELL II BOOK 5562 PAGE 1 PROPERTY ID I06002042 567 POMEROY AVE
LANDS NOW OR FORMERLY OF JOSEPH E. MEEHAN BOOK 1506 PAGE 276 PROPERTY ID I06002003 571 POMEROY AVE
EASEMENT CITY OF PITTSFIELD Book 706 Page 71
Old Guard Rail Post
Old Guard Rail Post
Flag Pole
Pool
Pool Gas Tank (Underground)
Concrete Pad
Deck
Deck (Elevated)
Patio
Shed
Pavilion
Barn
Garage
Pump
Pump
Pump

aecom.com

Appendix B: Rare Species Conservation and Management Plan

Housatonic Rest of River - Reach 5A

Prepared for:

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Pittsfield, MA

Prepared by:

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April 29, 2026

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1. Introduction

This Rare Species Conservation and Management Plan (CMP) provides information regarding the avoidance, minimization, and mitigation of impacts to state-listed threatened, endangered, and special concern species (referred to collectively as rare species) from remediation and supporting activities in Reach 5A of the Housatonic River Rest of River (ROR). This CMP is provided as Appendix B to the Reach 5A Restoration Plan and is intended to address the substantive requirements of the Massachusetts Endangered Species Act (MESA) as an applicable or relevant and appropriate requirement (ARAR) for the ROR project.[1] In so doing, this CMP consolidates the rare species-specific program elements that will be applied before, during, and after construction in Reach 5A to comply with the substantive requirements of MESA. In addition, this assessment addresses federally listed species pursuant to the federal Endangered Species Act (ESA), which is also an ARAR for this project.

Reach 5A of the Housatonic River encompasses approximately 4.8 miles beginning at the confluence of the East and West Branches of the river in Pittsfield and extending downstream to the Pittsfield Wastewater Treatment Plant (WWTP) outfall for the river and to the Pittsfield-Lenox municipal boundary just south of the Pittsfield WWTP for the floodplain (**Figure 1-1**).

1.1 General Background

Reach 5A includes riverine, riverbank, backwater, floodplain, vernal pool, and associated upland habitats that will be affected by sediment and soil remediation, bank remediation and stabilization, and associated support activities (i.e., access roads and staging areas). These activities occur within areas mapped by MNHESP as Priority Habitat for state-listed species and within areas identified through federal screening tools as potentially supporting federally listed species and species proposed for federal listing.

Through a data sharing agreement between GE and Massachusetts Natural Heritage and Endangered Species Program (MNHESP), GE was provided with MNHESP-mapped Species Habitat in March of 2025, constituting MNHESP's state-listed species mapping for Reach 5A including an area extending 1,000 feet laterally out from the 1 milligram per kilogram (mg/kg) PCB isopleth (which approximates the 10-year floodplain and marks the lateral boundary of the GE-Pittsfield/Housatonic River Site).[2] This Species Habitat mapping indicated that 21 state-listed species have habitat mapped by MNHESP within Reach 5A. This species list was used as the initial basis for determining which rare species would be subject to this rare-species assessment, followed by species-specific surveys as described below.

Upon determining potential species applicable to the assessment, focus was then applied to whether the project may cause a "take" of a state-listed species, as described below.

For state-listed species determined to be subject to a take, MESA requires a conservation and management plan that provides a long-term net benefit to the conservation of the state-listed species. This CMP provides GE's assessment of state-listed rare species in Reach 5A, including identification of those species, determination of which ones are subject to a "take" (after consideration of impact avoidance measures), a description of measures to be implemented to minimize the impacts on these species, description of the extent of unavoidable takes, a discussion of the measures proposed by GE as mitigation for the unavoidable takes, and a description of the post-restoration monitoring and assessment of rare species. While focusing on state-listed species, this assessment also includes an evaluation of

[1] The ARARs table in the Revised Permit (Attachment C) states: "To the extent that unavoidable impacts result in a take of a state-listed species, EPA would follow the regulatory requirements [of the MESA regulations] with respect to implementing a conservation and management plan providing for a long-term net benefit to the affected state-listed species"

[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.

potential impacts to federally listed (or proposed) species and, for any such impacts, an identification of measures to avoid or minimize such impacts, as required by the federal ESA.

Rare-species baseline information supporting this CMP draws from the Revised Reach 5A Baseline Restoration Assessment (BRA) Report (AECOM 2024) and supplemental baseline surveys implemented under EPA-approved Standard Operating Procedures (SOPs) in 2025, including species-specific reports summarizing those surveys (AECOM, 2025a-f).

1.2 Applicable Requirements

Under MESA and its implementing regulations (321 CMR 10.00), a determination must be made as to whether a proposed project within mapped Priority Habitat would cause a "take" of a state-listed rare species. As defined in Section 1 of MESA: "Take, in reference to animals, means to harass, harm, pursue, hunt, shoot, hound, kill, trap, capture, collect, process, disrupt the nesting, breeding, feeding or migratory activity or attempt to engage in any such conduct, or to assist such conduct, and in reference to plants, means to collect, pick, kill, transplant, cut or process or attempt to engage or to assist in any such conduct. Disruption of nesting, breeding, feeding or migratory activity may result from, but is not limited to, the modification, degradation or destruction of Habitat."

At the federal level, the ESA requires projects that may result in the "take" of a federally-listed species to be reviewed under Section 7 Consultation. The ESA defines "take" (in Section 3(10) as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct."

For state-listed species determined to be subject to a take, MESA requires a conservation and management plan that provides a long-term net benefit to the conservation of the state-listed species.[3] The ESA requires that, if a project is likely to jeopardize the continued existence of a listed threatened or endangered species or result in destruction or adverse modification of its Critical Habitat (as defined in the ESA), "reasonable and prudent" measures must be taken to avoid and/or minimize such effects.

2. Existing Conditions

2.1 Natural Communities and Ecological Setting

Reach 5A includes approximately 409 acres of habitat within the 1 mg/kg PCB isopleth. Based on BRA data collection and mapping, this area comprises the following habitat types: 39 acres of riverine habitat and 50,240 linear feet of riverbanks associated with the Housatonic River; three acres of other stream habitat (e.g., Sykes Brook and Sackett Brook); 322 acres of floodplain wetland habitat (including vernal pools and backwater habitats); and 45 acres of upland floodplain habitat, of which approximately 31 acres is managed/disturbed habitat (i.e., agriculture and cultural grasslands). Reach 5A encompasses a free-flowing river channel with meanders and riffle/pool/run sequences, associated riverbanks, hydraulically connected backwaters, floodplain wetlands and uplands, numerous vernal pool features, and other hydrographic features (e.g., tributary confluences, ponded areas, and intermittent side channels). Natural communities within the Reach 5A floodplain include open water areas and streams, three forested wetland, four non-forested wetland, three forested upland, and other non-forested upland (e.g., cultural grasslands and agricultural fields) community cover types (**Table 2-1**). The Revised Reach 5A BRA Report provides the primary characterization of habitat conditions, functions, and values and is referenced for detailed descriptions, figures, and quantitative metrics as well as a summary of supporting investigations that have been conducted (AECOM, 2024).

Detailed assessments of physical and biological characteristics covered in the BRA include geomorphology, hydrology, and floodplain connectivity, soil/substrate composition, natural plant community classification, aquatic plant surveys, vernal pool certification, water quality, invasive plant surveys, benthic macroinvertebrate and fish community surveys, incidental wildlife observations and

[3] MESA also refers to an assessment of alternatives. In this case, EPA has selected the ROR Remedial Action after an extensive multi-year assessment of many different remedial alternatives. The Final Revised Permit issued by EPA prescribes that Remedial Action.

cataloging of special wildlife habitat features such as tree cavities, dens, large woody debris and turtle nesting habitats (AECOM, 2024). **Table 2-2** provides descriptions of the different habitat types and natural communities present in Reach 5A.

Supplemental baseline investigations performed in 2025 provided additional habitat documentation for specific remediation and support areas in riverbanks, floodplain remediation and staging areas, backwaters and other waterbodies (Anchor QEA et al., 2026b). These surveys included mapping of trees ≥10 inches in diameter at breast height (DBH), total counts of trees 4-10 inches DBH, documentation of wildlife habitat features within areas anticipated to be affected by Reach 5A activities (e.g., large woody debris, standing snags) and updated mapping on large monoculture stands of invasive plant species. Supplemental surveys also included rare species presence-absence and habitat surveys across remediation and support activity areas, which are further discussed below.

2.2 Identification of Rare Species

Rare species considerations for Reach 5A were identified through federal and state-level screening reviews and then refined through subsequent targeted field investigations implemented under EPA-approved SOPs in 2025. Federal review relied on U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) system to identify federally listed or species proposed for federal listing and potential habitat in Reach 5A. State review relied on information provided by MNHESP, including mapped Species Habitat (provided from MNHESP via a data sharing agreement with GE in March 2025), Priority Habitat, and Core Area mapping, and subsequent survey results.

The federal IPaC review initially identified the northern long-eared bat as a federally listed species with potential habitat in Reach 5A and identified the tricolored bat and monarch butterfly as federally proposed species with potential habitat in that reach. MNHESP mapping identified multiple (20) state-listed plant and animal species with mapped habitat in Reach 5A. One additional species (great blue lobelia) was observed during the 2025 plant surveys. The subsequent field survey program further refined which of those species are present, likely present, absent, or reasonably expected to be affected by remedial and support activities.

Based on the IPaC screening, MNHESP Species Habitat mapping, and the results of the 2025 surveys, a total of 30 state and federal species have been identified as potentially present or with habitat in Reach 5A. These species are listed in **Table 2-3**, which also lists the federal and state status of each. Surveyed taxonomic groups include bats, marsh birds, butterflies and moths, dragonflies, plants, and one reptile (i.e., wood turtle).

3. Remedial Action Description

An understanding of the remedial activities in each habitat type is critical to assessing whether each rare species will be subject to a take. As described in GE's Final Remedial Design/Remedial Action (RD/RA) Work Plan, Reach 5A remediation includes sediment removal and capping in the main channel and other aquatic settings, riverbank excavation and stabilization following Natural Channel Design (NCD) principles, floodplain soil excavation and backfill, remediation of backwaters, Other Waterbodies, and certified vernal pools.[4] In addition, associated site preparation and support activities such as vegetation clearing and grading for temporary access road and staging area construction will be necessary for equipment movement and materials storage. Rare-species risk is created not only by direct removal of sediments and soils, but also by clearing of vegetation and host plants, disturbance of existing bank and channel structure, temporary loss of habitat access, and construction traffic within mapped habitat.

[4] As discussed in that plan, Reach 5A has been subdivided into five subreaches (each approximately one mile long) corresponding to each anticipated year of construction, and the detailed remedial design involving NCD for instream and riverbank habitats has been provided in that plan and the Restoration Plan only for the portion of Reach 5A planned for Year 1 construction. Similarly, the discussion in this CMP that is based on such design relates only to that subreach of Reach 5A; comparable details for the remaining subreaches will be provided in addenda to the Restoration Plan and, if necessary, this CMP.

A total of approximately 127.6 acres of impacts will occur within Reach 5A associated with remediation and support activities, as shown in **Table 3-1** for the various remediation and supporting activities. This includes areas located both within and outside of the 1 mg/kg PCB isopleth, which approximates the 10-year floodplain.

Out of the total impacts, approximately 18.6 acres are associated with the vernal pool remediation. Reach 5A contains 59 seasonally wet depressions that meet the MNHESP criteria for certification as vernal pools. A total of 48 of these pools exceed the PCB Performance Standard for vernal pools and therefore will require remediation, consisting of either removal and replacement of soil or reduction in the bioavailability of PCBs within the pool through placement of activated carbon-based soil amendments. However, with one exception, those vernal pools are not covered by current restoration plans. Instead, beginning in 2026, GE will conduct a vernal pool pilot study of 10 pools requiring remediation to determine the appropriate remediation method for the remaining vernal pools. The one exception is vernal pool 5A-VP-13, which will be remediated along with floodplain remediation because it is located on a residential property. Impacts associated with vernal pool remediation (except for 5A-VP-13) are identified separately from other remediation activities in **Table 3-1** because the nature and extent of those impacts, including final placement of access roads and staging areas, will not be finalized until completion of the pilot study (anticipated for 2030).

Other impacts within Reach 5A total approximately 109 acres including 68.2 acres of riverine, riverbank, backwaters, Other Waterbody, and floodplain remediation, and 40.8 acres of access roads and staging areas (**Table 3-1**).

Total impacts (including disturbances from remediation, stabilization, access roads, and staging areas) are presented by natural community cover type in **Table 3-2**. The area of the river channel containing sediment that will be dredged totals approximately 39.1 acres. Impacts to other areas located within the 1 mg/kg PCB isopleth (not including vernal pools except for 5A-VP-13) total approximately 42.1 acres, with approximately 24.3 acres of that occurring in wetland floodplain forest, 12.7 acres in other wetland cover types, 0.3 acre in forested uplands and 4.8 acres in other upland habitats (i.e., agricultural fields, cultural grasslands and other developed/disturbed areas). There are an additional approximately 27.8 acres of impacts located outside of the 1 mg/kg PCB isopleth, primarily associated with access roads and staging areas located within cultural grasslands. Excluding impacts associated with vernal pools (apart from 5A-VP-13) or the 39.1 acres of dredging within the Housatonic River channel, approximately 11% of the total floodplain area (i.e., the area located between the toe of the riverbank and the 1 mg/kg PCB isopleth) will be impacted during remediation efforts. Based on conceptual layouts, an additional 18.5 acres of floodplain will be impacted during the separate vernal pool remediation efforts, for a total of about 15% of the total floodplain area.

The Reach 5A restoration approach is based on restoring habitats affected by remediation and support activities within the disturbed areas, to the extent feasible and consistent with the remedial requirements, so that restored riverine, riverbank, backwater, Other Waterbody, floodplain, and vernal pool habitats are returned to conditions capable of supporting the ecological functions and species use present prior to remediation. Across the project, this includes progressive restoration of disturbed areas, re-establishment of native vegetation, replacement of structural habitat features where feasible, implementation of NCD principles for river and riverbank restoration, and re-establishment of host plants or state-listed plants were incorporated into the restoration design.

Restoration will be implemented in coordination with the phased remedial work and will include the physical, hydrologic, structural, and vegetative measures needed for each habitat type, as described in the Restoration Plan. This CMP is intended to address only the rare-species conservation and management components of that work; the full restoration objectives, habitat-specific restoration design, performance criteria, and post-restoration monitoring framework are provided in the main text of the Reach 5A Restoration Plan.

For vernal pools, post-restoration conditions for the 10 pilot pools will be evaluated through the pilot study monitoring program, and the final restoration approach for the remaining Reach 5A vernal pools (except for 5A-VP-13) will be established following EPA review of the pilot study results. An addendum to this

CMP will be developed to address rare species avoidance, minimization, mitigation, and monitoring measures in connection with the remediation of the remaining vernal pools following the pilot study.

4. Determination of Takes

Of the 30 species presented in **Table 2-3**, impacts from remediation and support activities to 15 species have been determined to likely result in a take of the species and/or its habitats. This determination was based on several factors, including the following;

- The extent of MNHESP mapping and spatial distribution of impacts relative to actual species habitat within the mapped area;
- An assessment of the actual habitat requirements for each species and their sensitivity to habitat impacts;
- Results of the 2025 state-listed species surveys conducted in Reach 5A;
- Measures to be implemented to avoid impacts to the species; and
- Coordination and discussions with MNHESP.

The results of the take determination are presented in **Table 4-1** and discussed below, including which species have been determined to be subject to a take and which species have been determined not to be subject to a take. **Attachments A-1** through **A-4** provide detailed information on each of the state-listed species determined to be subject to a take, along with more descriptive information on the mapped habitat for each species and the results of site-specific surveys in 2025 in support of the take determinations.

4.1 Wood Turtle

The wood turtle is considered subject to a take. The 2025 surveys confirmed wood turtle presence in Reach 5A, and telemetry documented use of the Housatonic River, Sackett Brook, riverbanks, floodplain wetlands, floodplain forests, and adjacent terrestrial habitats during the active season. MNHESP maps wood turtle habitat throughout Reach 5A, including many remediation and support areas. Because Reach 5A remediation and support activities include disturbance to riverine, riverbank, floodplains, and some vernal pool settings within confirmed and mapped wood turtle habitat, this species is considered subject to a take from the remedial activities (AECOM, 2026c).

4.2 Plants

Six of the 10 state-listed plant species with MNHESP mapped habitat in Reach 5A were determined to likely be subject to a take. They are bristly buttercup, wapato, hairy wild rye, Frank's lovegrass, matted spike-sedge, and possibly Tuckerman's sedge. In addition, one other state-listed species, great blue lobelia, was not previously mapped by the MNHESP in Reach 5A but was observed during the 2025 field surveys.

Frank's lovegrass, matted spike-sedge, and great blue lobelia were confirmed to occur in river-margin and bank habitats that overlap anticipated remedial areas in Reach 5A. Bristly buttercup and Tuckerman's sedge were observed only in spatially discrete locations, and the presence of both wapato and hairy wild rye could not be confirmed. However, all four of these species are conservatively considered subject to a take because mapped habitat or potentially suitable habitat could be affected by project activities and because bristly buttercup is an annual plant that can germinate almost anywhere in the floodplain when conditions are suitable.

The Tuckerman's sedge take determination is tentative and subject to final refinement of work limits and habitat specific avoidance opportunities. This species occurs in only one location, a vernal pool that is subject to remediation. However, the extent of remediation within the pool and the remediation approach have not been finalized and it may be possible to avoid direct impacts to this occurrence.

Four of the state-listed plant species identified in **Tables 2-3** and **4-1** are considered as not subject to a take. These are Gray's sedge, great laurel, Culver's-root, and white adder's mouth. Gray's sedge was documented only within areas previously mapped by MNHESP as Priority Habitat and these observations were outside of remediation and support areas. Great laurel and Culver's-root were not observed during the 2025 surveys, and MNHESP-mapped habitats are not identified within or near any remediation or support activities. Finally, white adder's-mouth was not observed within remediation or support areas in Reach 5A, and the previously documented population mapped by MNHESP in the vicinity of proposed work along West Pond is considered likely to have been eliminated by flooding associated with active beaver dams. On that basis, it is not identified as subject to a take.

4.3 Lepidopterans

The rare lepidopteran surveys focused on two state-listed species – the mustard white butterfly and ostrich fern borer moth. Both state-listed lepidopteran species are considered subject to a take from remedial activities in Reach 5A. While neither species was observed during 2025 surveys, host plants for both of these species were documented within and adjacent to anticipated remediation and support areas and it is anticipated that remediation and support activities will remove or disturb host plants in floodplain and riverbank settings (AECOM, 2025b). In addition, in the absence of a formal flight period trapping survey and difficulty in locating larval stages of these two species, their presence is assumed consistent with presence of host plants, and therefore removal of host plants is assumed to result in a take of these species.

Host plants for the monarch butterfly, while not state-listed in Massachusetts, were included in the 2025 survey effort because it has been proposed for federal listing and the USFWS IPaC tool indicates that Reach 5A provides potential habitat for the species. The survey documented monarch host plants in Reach 5A, including common milkweed (*Asclepias syriaca*) and swamp milkweed (*Asclepias incarnata*), and one adult monarch butterfly was observed, although inspections of milkweed plants did not document eggs or larvae. Accordingly, remedial and support activities that remove or disturb milkweed host-plant habitat have the potential to affect monarch habitat in Reach 5A. Because the monarch butterfly is not a state-listed species and has only been proposed for federal listing, it was excluded from the species take analysis. However, impacts to host plants for the monarch butterfly will be addressed through protection and/or relocation of host plants (milkweeds) and inclusion of milkweed plugs in restoration planting plans.

4.4 Dragonflies

State-listed dragonfly surveys were conducted throughout Reach 5A riverine habitat using larval sampling and exuviae searches. Riffle snaketail was the only state-listed dragonfly confirmed present in Reach 5A during the 2025 survey effort (AECOM, 2025d). Brook snaketail, rapids clubtail, spine-crowned clubtail, and ocellated darner were not confirmed during the 2025 survey due to difficulties associated with identifying larval stages of these species, but it is assumed that these species will be subject to a take where their habitat will be disturbed by remedial activities. Dredging (sediment removal) and backfilling/capping, riverbank remediation and stabilization will temporarily remove larval substrate and food sources, alter bank conditions, and disturb emergence surfaces within habitat mapped or otherwise treated as suitable for these taxa. Accordingly, these dragonfly species are currently identified as species subject to a take from remedial activities in Reach 5A.

4.5 Bats

Eight federal and/or state-listed bat species were addressed during the 2025 acoustic survey program. The survey confirmed probable presence of tricolored bat, little brown bat, silver-haired bat, eastern red bat, and hoary bat within the survey area. Northern long-eared bat, eastern small-footed bat, and Indiana bat were not confirmed (AECOM, 2025a).

Bats are not currently considered subject to a take in Reach 5A because the current construction approach avoids impacts to roosting bats and natal colonies during the active season by limiting tree clearing to the period November through March, when the bats are hibernating. If active-season tree clearing is ultimately required in areas containing suitable roost habitat, pre-clearing surveys will be

conducted to identify potential roost trees and additional species-protective measures will be implemented as appropriate, including adjustment of clearing limits where practicable and site-specific avoidance or exclusion measures if needed.

4.6 Marsh Birds

The 2025 marsh-bird surveys focused on American bittern and common gallinule. Repeated surveys were conducted during the appropriate breeding-season windows and incorporated call-broadcast methods to improve detectability. Neither American bittern nor common gallinule was detected in Reach 5A during the 2025 survey effort, and the survey conclusions indicated that neither species was breeding in the surveyed areas during 2025 (AECOM, 2025c).

Although MNHESP Species Habitat mapping indicates that both species have been documented within or adjacent to Reach 5A in previous years, there is no recent evidence suggesting the presence of these species in Reach 5A. The last MNHESP-confirmed observations of American bittern and common gallinule are from 2012 and 2008, respectively, and the 2025 survey concluded that neither species was breeding in the surveyed portions of Reach 5A during 2025. In addition, there are little or no remediation-related impacts in the limited areas where suitable breeding habitat in Reach 5A does exist. Moreover, there are large expanses of suitable breeding habitat for these two species in downstream reaches (Reach 5B through Reach 6) where these birds can breed and nest while work is ongoing in Reach 5A. Given that neither species was observed or documented breeding in the surveyed areas during 2025, coupled with the foregoing facts, these birds are not expected to be impacted by project activities and are not considered as subject to a take from remedial activity in Reach 5A.

5. Pre-Restoration Measures to Minimize Rare Species Impacts

Pre-restoration measures to minimize rare-species impacts in Reach 5A have been incorporated into final design development, pre-construction planning, construction sequencing, and restoration implementation. In general, these measures include limiting active disturbance footprints to the minimum practicable area; sequencing work so that only a portion of Reach 5A is under active disturbance at a given time; progressively restoring completed areas as work advances; conducting pre-construction review of updated rare-species information and final work limits; implementing species-specific field controls such as exclusion fencing, work-area marking, screening, and construction oversight where warranted; and providing rare-species awareness training and encounter procedures for field staff and contractors. In addition, impacts associated with access roads and staging areas were minimized through careful layout and placement relative to required remediation areas within floodplain habitat, maximizing the location of these facilities in previously disturbed areas such as utility lines and mowed fields.

5.1 Wood Turtle

For wood turtle, minimization will include continued telemetry-informed management, pre-construction screening and clearance sweeps in affected habitats, and construction oversight by qualified herpetologists or other appropriately trained biologists. Additional wood turtle surveys will be conducted in 2026 and potentially in 2027 with the primary objective of outfitting as many wood turtles as possible with radio-transmitters. This will further refine active-season use areas, habitat use and home range, seasonal pattern shifts in habitat use and critical habitat features such as nesting and hibernation locations, which will shape requirements for targeting or species protective measures. Prior to work in suitable habitats, qualified biologists will conduct additional screening and clearance sweeps, and construction oversight will be provided in habitats where direct encounter risk is elevated.

Work-area controls and encounter procedures will be used to reduce the potential for direct mortality, injury, or displacement during remediation and support activities. These measures will include clearly marked limits of disturbance, restricted access to sensitive areas where practicable, species awareness training for field crews, temporary stop-work requirements in the event of a turtle encounter in active work areas, and implementation of handling or relocation measures only by appropriately qualified personnel under the applicable protocol.

A Wood Turtle Management Plan is provided in **Attachment B**. It provides more detailed information on wood turtle presence and habitat in Reach 5A, as well as pre-restoration and construction-phase measures to be implemented for minimizing impacts to wood turtles and associated habitat.

5.2 Plants

For state-listed plants, minimization will focus first on avoidance wherever feasible. Confirmed occurrences will be delineated in the field where needed, and exclusion fencing or other controls will be installed where plants occur outside or along the margins of work areas. As final annual work limits are developed, GE will use growing-season verification, minor layout refinement, and other practicable adjustments to reduce direct impacts to occupied habitat, particularly where occurrences are limited in extent or located near, rather than within, the final work footprint.

Where avoidance is not practicable, pre-construction plant-handling measures will be implemented to reduce direct loss and preserve local genetic material for re-establishment. These measures will include collection of seed from annuals and from perennial grasses and herbs where appropriate, collection of rhizomes or other plant material from suitable perennial species, and transplanting of state-listed plants to appropriate habitat outside active work limits where feasible. Host-plant and rare-plant occurrences outside work limits will be protected where practicable during remediation, access, staging, and restoration activities.

GE also proposes to use the Native Plant Trust (NPT; https://www.nativeplanttrust.org) to assist with collection and propagation of affected state-listed plants where avoidance is not practicable or certain. The NPT program is described in detail in **Attachment C** (Use of Native Plant Trust Program). Under the proposed scope, this work will include collection and handling of plant material from the species subject to a take – specifically. Frank's lovegrass, matted spike-sedge, hairy wild rye, bristly buttercup, wapato, great blue lobelia, and Tuckerman's sedge. For purposes of this section, the pre-disturbance collection of plant material as part of the NPT program is treated as minimization because it is intended to reduce immediate construction-related loss of existing plants and preserve local source material for prompt re-establishment outside active work areas. By contrast, the seed-banking, off-site propagation, planting, and ecotypic seed-mix development elements of the same NPT program are addressed in Section 7.3 as additional mitigation/conservation measures because they are intended to provide longer-term replacement, enhancement, and net benefit after remedial disturbance. Although the final NPT scope is still being finalized, this assessment reflects GE's current proposed approach and is presented here as the working conservation framework for rare plant protection and net benefit in Reach 5A.

In addition to the collection and preservation of seeds, rhizomes, and other plant material under the NPT program, GE will transplant existing state-listed plants to appropriate habitat outside of remediation and supporting areas where feasible. Opportunities for transplanting state-listed plants may arise during surveys and inspections conducted prior to vegetation clearing within remediation and support areas. Plants targeted for transplanting would focus on perennial herbaceous species including but not limited to hairy wild rye and great blue lobelia. State-listed plants would be relocated with an appropriately sized root ball of soil to suitable habitats located outside of remediation and support areas.

5.3 Lepidopterans

For rare lepidopterans, minimization will be implemented through an integrated host-plant management program tied to construction sequencing and restoration phasing. A principal minimization measure will be limiting the extent and duration of host-plant loss at any one time by sequencing work over five construction seasons and restoring disturbed areas progressively as work advances through Reach 5A. This approach is intended to reduce the area subject to concurrent host-plant disturbance and to shorten the period during which host-plant habitat is unavailable within any individual subreach.

Prior to construction, host-plant occurrences within and adjacent to annual work areas will be further documented where feasible so that plants outside the remedial footprint can be identified for protection and so that species-protective measures can be targeted to occupied or suitable habitat. Host plants

outside work limits will be protected where practicable through delineation, work-area marking, and avoidance during access, staging, and restoration activities.

In addition, within affected areas where avoidance is not practicable, GE proposes pre-disturbance collection of local plant material as part of the NPT program to reduce direct losses of host-plant resources. Depending on the species and plant form, this will include collection of seed, rhizomes, or other propagules, including fertile ostrich fern fronds, for propagation and subsequent planting in restored areas as discussed in Section 7.4. This host plant process will be implemented as an additional component of the NPT program, as described in **Attachment C** (Use of Native Plant Trust Program). Further, as with the state-listed plants, selected perennial host plants may be transplanted to unaffected areas prior to disturbance, where feasible.

5.4 Dragonflies

For dragonflies, minimization will rely primarily on phased in-river construction, minimization of vegetation cutting/removal, progressive restoration, and use of NCD-based channel and bank reconstruction measures that reduce the duration of habitat disruption and restore suitable larval and emergence conditions as work proceeds. Because only a portion of Reach 5A will be under active in-river disturbance at one time, the phased progression of sediment removal, capping/backfilling, and bank remediation is intended to limit the total extent of concurrently disturbed riverine habitat and allow recolonization of restored reaches as construction advances. In addition, natural bank stabilization and habitat reconstruction measures, such as root wads, boulders, gravel and cobble placement, riffle reconstruction, and localized substrate heterogeneity, will reduce the duration of effects on habitat. The additional open areas and corridors created near the river and wetlands are important habitats for adults of the five subject dragonfly species for travel and hunting. However, the minimization of vegetation removal in affected areas of the riverbanks and floodplain will result in the retention of perch, hunting, and cover habitat for adults. These measures are described in more detail in Sections 5.3 and 8.3 of the Restoration Plan.

6. Extent of Unavoidable Takes

The extent of impacts to the rare species subject to unavoidable take has been evaluated through a species-specific analysis that combines MNHESP Species Habitat mapping, 2025 survey results, and current remediation and support area footprints. This analysis does not rely solely on mapped habitat overlap but also refines the impacted acreage where appropriate based on confirmed species observations, actual habitat suitability within mapped polygons, and the likelihood that occurrences can be avoided through final design refinements or field controls. Accordingly, factors incorporated into the determination of the extent of take for the subject species are discussed below for each species or species groups. These are also shown on **Table 6-1,** which presents the actual metrics for each species or species groups.

This refinement step was used because the MNHESP-mapped habitat is intentionally broad and, for several species, includes areas that do not function as suitable habitat within the work area or does not fully capture suitable habitat documented during the 2025 field program. Accordingly, affected habitat acreage for a given species may be equal to the mapped overlap, less than the mapped overlap where unsuitable habitat was removed, or greater than the mapped overlap where field surveys documented suitable habitat or occurrences beyond the current mapped limits. The resulting values in **Table 6-1** are intended to represent the acreage of habitat reasonably treated as affected for species-specific take assessment purposes, rather than a simple GIS overlay of the project footprint with MNHESP mapping.

Unless otherwise noted below, remedial and support activity acreage considered in this analysis includes the project components relevant to the species in question, which may include riverine remediation, riverbank remediation and stabilization, backwater and Other Waterbody remediation, floodplain remediation, temporary access roads, and staging areas. This analysis (summarized in **Table 6-1**) also includes a preliminary estimate of impacts associated with vernal pool remediation and associated access and staging impacts, but those estimated impacts are subject to change since the extent of remediation

within each vernal pool and configuration of support areas will not be fully determined until after completion of the pilot study.

6.1 Wood Turtle

Wood turtle mapped habitat occurs along the entire extent of Reach 5A, including the full riverine limits as well as across the floodplain habitats to be affected by remediation and support activities. Surveys conducted in 2025 recorded this species consistent with the mapped habitat. Therefore, the entire MNHESP-mapped habitat within remediation and support areas has been included in the affected habitat acreage.

6.2 Plants

Adjustments or refinements to the affected habitat area for the seven state-listed plant species determined to be subject to a take were assessed. No changes were made to the total impacts associated with Tuckerman's sedge because this species is known to occur in only one discrete location, and depending on the results of the vernal pool pilot study, this colony may not be impacted. Due to the limited observations for bristly buttercup in 2025 and the nature of this species' germination, growth, and distribution as an annual plant, appearing only when conditions are suitable, no changes were made to the MNHESP-mapped habitats for this species either. For great blue lobelia, which was not previously mapped by MNHESP, the area of impact was determined based on the 2025 survey. Except for one observation, this plant was observed growing only within the river corridor, so for purposes of this impact assessment, the total area of habitat was calculated as a 20-foot wide swath along each riverbank from the most upstream observation to the most downstream observation ([redacted]).

Habitat limits for Frank's lovegrass were refined to focus on riverbank habitats. To accomplish this, a line following along the boundary between sediments and riverbank (located just upslope from the riverbank toe) was buffered by five feet (10-foot total width); and then using 2025 field observations, aerial photo interpretation. and in-river bathymetry, the boundary was adjusted to capture all observations, sandy point bars or in-river islands that may be exposed during low water. In a few cases, a clear shelf was present between the river and the top of bank that was wider than the five-foot buffer initially applied. In those cases, the boundaries of the impact area were expanded beyond the five-foot buffer. In addition, although the original MNHESP mapping limits included only portions of the river extending from BW5A-2 (river station 119+00) downstream, this species was observed [redacted]. Therefore, the impact area along the river was extended upstream to include these observations. Additional areas outside of the river corridor originally mapped by MNHESP were also included in the final determination of the impact area.

Both matted spike-sedge and wapato habitats are mapped throughout Reach 5A including the river and adjacent floodplain habitats. While the matted spike-sedge mapping is more appropriately confined to the river channel and areas of the floodplain with shallow and deep emergent marsh habitat, the MNHESP mapping for wapato includes extensive areas of forested floodplain (i.e., transitional floodplain forest and high terrace floodplain forest), which are not considered suitable habitat for this species. Because both of these species are typically observed on muddy/mucky substrates that are not necessarily flooded throughout the growing season, the MNHESP-mapped habitat for both species was adjusted by removing the permanently flooded portions of the river from the total MNHESP-mapped habitats. To accomplish this, a line following along the boundary between sediments and riverbank (located just upslope from the riverbank-toe) was buffered by 10 feet to create a within-river polygon representing the permanently flooded portions of the river. This polygon was further refined, using 2025 field observations, aerial photo interpretation, and in-river bathymetry, to adjust the limits of permanently flooded river excluding all observations, sandy point bars or in-river islands that may be exposed during low water. This resulted in a total of approximately 26.5 acres of permanently flooded river that was removed from the total area of MNHESP-mapped habitats for these species.

The extent of MNHESP-mapped habitat for the hairy wild rye is limited to a relatively small area of floodplain habitats between river stations 149+00 and 194+00. This species typically grows in well-

drained floodplain forests, meadows, and fields. When excluding impacts within mapped habitat associated with wetland and seasonally flooded areas, only about 2.1 acres of this species habitat will be impacted. In addition, although this species is a perennial and locations of growth are not expected to vary greatly between years, it was not observed during the 2025 surveys.

6.3 Lepidopterans

Nearly all the Reach 5A floodplain and adjacent upland areas from Holmes Road down to the Pittsfield-Lenox municipal boundary are mapped as habitat for the mustard white butterfly. Remediation and support activities will be conducted in 87.1 acres of the mapped habitat. Host plants for this species were documented sporadically throughout the mapped habitat in 2025, and therefore all this area is considered potential habitat for the species. However, because host plants for this species do not typically occur within riverine sediment, habitat impacts associated with dredging in the Housatonic River (30.7 acres) were removed, resulting in 56.4 acres of affected habitat.

For ostrich fern borer moth, the MNHESP-mapped habitat includes floodplain areas from just below Holmes Road (river station 63+00) down to just south of Joseph Drive (river station 134+00). Remediation and support activities will occur in 17.1 acres of the mapped habitat. As with mustard white, host plants for this species typically do not grow within riverine sediment so habitat impacts associated with dredging in the Housatonic River (11.1 acres) were removed from the total affected area. However, host plants were observed within floodplain habitats throughout all of Reach 5A. Therefore, a total of 34.3 acres of impact (not including areas of sediment removal or impacts associated with access and staging located in upland habitats outside of the floodplain) were added, for a total area of 52.2 acres of affected habitat.

6.4 Dragonflies

While approximately 39.1 acres of riverine habitat will be dredged, not all of this area provides suitable benthic habitat for each of the state-listed species. Suitable benthic habitat has been adjusted for each species according to Rapid Bioassessment Protocol (RBP) surveys characterizing the benthic habitat. In addition, acreage has been added to account for remedial activities to be conducted in the riparian zone along the edges of the river, which provide habitat for adult dragonflies. Additional habitat acreage was added for riffle snaketail, which was found outside of the MNHESP-mapped habitat.

Nearly all habitats within of the river corridor of Reach 5A are mapped habitat for the brook snaketail, ocellated darner, and spine-crowned clubtail. Ocellated darner mapped habitat also includes the open marsh area near Sackett and Sykes Brooks. Riffle snaketail is mapped from the Confluence down to river station 170+00, and rapids clubtail is only mapped downstream from station 180+00.

As noted above, suitable aquatic habitat calculations have been adjusted for dragonflies based on the aquatic habitat characterization of RBP surveys. The acres of the mapped suitable benthic substrate (silt, sand, gravel, cobble, or boulder) or suitable river morphology (riffle, run, pool) in the mapped habitats were designated based on the described habitat requirements for each species. The substrate type and morphology types overlap (e.g., riffle and gravel), so a conservative approach was applied whereby the habitat type with the greatest area was used. This resulted in a reduction of total habitat impacted for each species as presented in **Table 6-1**. The riffle snaketail was observed downstream of the MNHESP mapping. Therefore, all impacts associated with sediment removal in the river and floodplain activities within 350 feet of the river (30.6 acres) were added to the total impact area for this species.

6.5 Consideration of Additional Factors

While the affected habitat acreage has been quantified for each species determined to be subject to a take (as shown in **Table 6-1**), it is important to recognize that, in determining the actual extent of impacts for each species, several additional factors need to be taken into account. These include the mitigation ratios provided in the MESA regulations and the potential for additional, downstream impacts from the Reach 5A remediation. At the same time, the extent of impacts will be reduced by a number of factors specific to the ROR project, which are important to take into account but cannot practicably be quantified. These include the pre-restoration measures described in Section 5 to minimize impacts to the subject species and thus lessen the extent of the takes. In addition, because the work will be phased, the take of

any species that is distributed throughout the entire Reach 5A will apply to only a limited portion of the available habitat at a given time (e.g., 20% per year for a species that is equally distributed throughout the five-mile reach). Finally, the extent of take will be reduced by the fact that disturbed areas will be restored immediately as remediation progresses so that habitat functions are returned to pre-remediation conditions. The importance of this last factor will vary by species and will depend on how quickly substrate, hydrology, soils, vegetation, and food resources for the given species re-establish, as summarized below:

- Wood turtles are anticipated to use restored riverine, riverbank, and floodplain habitats fairly quickly after restoration, even within the first year. Within the river, wood turtles should find suitable habitat features in the toe wood, root wads, wood sills, and rock weirs soon after installation. The re-graded and vegetated riverbanks will afford additional habitat for turtle basking, and will also improve access between the river and adjacent floodplain in areas where existing vertical banks limit such access. Remaining undisturbed bank habitats, such as undercut banks, will also continue to provide suitable habitat features immediately after restoration. Similarly, the restored floodplain habitats will provide habitat needs for wood turtles within the first year after planting, and this habitat will continue to develop in cover and diversity each year thereafter.
- The temporal habitat suitability for plants after restoration will vary among species. Sandy exposed surfaces at restored point bars will be immediately suitable for planting Frank's lovegrass, while the silty/muddy shores preferred by matted spike-sedge and wapato will likely take at least a year or two depending on surface flow conditions. Suitable conditions on restored riverbanks and near-shore floodplains will allow for planting bristly buttercup and great blue lobelia within the initial planting efforts. Similarly, host plants for mustard white and ostrich fern borer moths will be included as part of the planting program for the restored floodplain areas, but may take a couple of years or so to re-establish. For example, ostrich fern growth would be more successful in shadier locations, which may take a few years to develop after restoration.
- For dragonflies, although suitable benthic habitat will be established concurrently with the restoration of the sediment layer (along with the surface habitat layer and NCD structures which support features such as riffles), the food base for odonates is expected to require up to two years to support larval development. Near-shore conditions along riverbanks are expected to be available after restoration for emergence and adult life cycle needs, especially given that more than one-half of the bank habitat and most of the floodplain habitats outside of the remedial impact zones will be available immediately following each subreach work effort.

While the several influences discussed above cannot practicably be quantified, they have been taken into account qualitatively in determining the extent of takes that will require mitigation and the adequacy of the proposed mitigation to achieve a long-term net benefit for the species subject to a take.

7. Proposed Mitigation/Conservation Measures for Unavoidable Takes

For the rare species that have been determined to be subject to a take, GE has developed a series of mitigation measures intended to provide a long-term net benefit to the affected species. These mitigation measures consist of a combination of (a) species-specific actions that can be implemented as part of the designed restoration and will provide enhancement of the habitat for the subject species or other net benefits to that species; and (b) protection or preservation of existing GE-owned properties along the ROR in Reach 5A that contain suitable habitat for the subject species through placement of conservation restrictions on the properties or transfer of the properties to the Massachusetts Division of Fisheries and Wildlife (MassDFW) within the Department of Fish and Game for preservation/conservation. The habitat enhancement activities incorporate selected invasive-species management actions where those actions will improve the long-term quality, availability or resilience of habitat used by the affected species.

7.1 Preservation/Protection of GE Properties

GE's proposed preservation-based mitigation includes placement of conservation restrictions on, or transfer to MassDFW of, a number of GE-owned properties that abut the Housatonic River and contain habitat suitable for the subject state-listed species and documented to support such species in many cases. The properties are GE-owned floodplain at the former Noble Farm, the GE-owned former Butler Farm, and a property immediately upstream of the confluence of the East and West Branches of the Housatonic River (the "Confluence property").

7.1.1 Confluence Property

The GE-owned Confluence property consists of three parcels comprising approximately four acres with 690 linear feet (LF) of riverbank along the East Branch of the Housatonic River immediately upstream of the confluence with the West Branch. This property is shown on **Figure 7-1** with the natural communities on it. It is contiguous with MassDFW-owned protected open space that extends south along the Housatonic River. This property includes wetland and floodplain habitats with certified vernal pools. While the ecological surveys conducted in areas subject to remediation and support activities did not include an assessment of this property, [redacted] The acreage at this property that contains MNHESP-mapped habitat for each of the state-listed species subject to a take is shown in **Table 7-1**, and **Figure 7-2** shows the state-listed species that have been identified near this property.

7.1.2 GE-Owned Floodplain at Former Noble Farm

The GE-owned floodplain at the former Noble Farm, which was purchased by GE in 2007, comprises approximately 61.8 acres and has 6,020 LF of frontage along the Housatonic River, 600 LF of frontage along Sackett Brook, and 1,430 LF of frontage along Sykes Brook. This property is shown on **Figure 7-3** along with the natural communities on it. It has connectivity with MassDFW-owned protected open space and the Canoe Meadows Audubon property. This property includes 33 acres of diverse wetland and floodplain habitats with certified vernal pools. [redacted]. The acreage at this property that contains MNHESP-mapped habitat for each of the state-listed species subject to a take is shown in **Table 7-1**, and **Figure 7-4** shows the state-listed species that have been identified on and near this property. This GE-owned property is subject to an Amended Agricultural Preservation Restriction (APR) under Massachusetts law. That Amended APR exempts from its prohibitions any activities required by the 2000 CD, including the Revised Permit, which would include required mitigation measures such as restriction or transfer of the property for conservation purposes if required by EPA. However, such restriction or transfer of this property will need to resolve any issues stemming from the Amended APR with the relevant state agencies.

7.1.3 GE-Owned Former Butler Farm

The GE-owned former Butler Farm comprises approximately 38.8 acres and was purchased by GE in the mid-2000s. This property has 4,070 LF of frontage along the Housatonic River and has connectivity with MassDFW-owned protected open space. It is shown on **Figure 7-5** along with the natural communities on it. The property includes 23.5 acres of contiguous grassland habitats as well as floodplain and wetland habitats with certified vernal pools. [redacted] The acreage at this property that contains MNHESP-mapped habitat for each of the state-listed species subject to a take is shown in **Table 7-1**, and **Figure 7-6** shows the state-listed species that have been identified on and near this property.

7.1.4 Mechanism for Conservation

GE is willing to either place conservation restrictions on these properties or transfer the properties to MassDFW for preservation/conservation. The appropriate mechanism for such protection or transfer will need to be worked out in discussions with EPA and MassDFW (and, as necessary, other state agencies).[5]

7.2 Wood Turtle Habitat Enhancements

For wood turtle, in addition to the preservation of suitable wood turtle habitat on GE-owned properties as described above, proposed mitigation includes incorporation of habitat features into the final river and riverbank restoration design that are expected to enhance habitat suitability for various life-cycle needs of this species and provide long-term benefit to wood turtles beyond what is required to return the habitat to pre-remediation conditions. These features include deep pools, sheltered aquatic refuge areas, undercut-bank habitat formed through toe wood and root wad structures, sandy or gravelly point bars and adjacent floodplain areas that can support nesting, basking, overwintering, refuge, and movement functions. Additional large woody debris complexes will also be incorporated where compatible with cap integrity. More generally, structural elements already included within the broader NCD stabilization and habitat-restoration toolbox, such as rock toe treatments, J-hooks/cross weirs, bendway weirs, wood sills, root wads, and toe wood, are also expected to contribute to wood turtle habitat function even where their primary purpose is channel or bank stability.

As described in the Restoration Plan, NCD of the first one-mile subreach of Reach 5A has progressed to final design details. Consistent with the above description of wood turtle enhancements, specific NCD structures or features have been established through this detailed design for this first subreach and are shown in Appendix A to the Restoration Plan (Geomorphic Assessment and Natural Channel Design), including the design drawings attached to it. Components of the NCD within this first subreach include nine riffle/run/pool sequences, 13 coir matting treatments, five areas of brush mattresses, two J-hooks, five bendway weirs, one cross vane, and three areas of toe wood. These NCD components will provide enhanced habitat features for wood turtles and greater stability than afforded by the current river channel geomorphology. The NCD features included in the restoration design have been determined to best address the dual goals of achieving channel and bank stability while maintaining or enhancing habitat conditions. Similar NCD structures will be included in the design plans for the remaining downstream subreaches in Reach 5A and will be described in detail in a revision of or addendum to the Final RD/RA Work Plan and in a later addendum to the Restoration Plan and, if necessary, this CMP.

The availability of suitable nesting habitats within a wood turtle's home range area is critical for reproduction and recruitment into the local population and is often a limiting factor in the landscape. Wood turtles typically nest in open sunny areas with well-drained soils and sparse vegetation, including sandy to gravelly substates along riverbanks, point bars, and gravel pits proximate to the river. These features are often temporary in nature and can become unsuitable through natural plant succession or when they become impacted by invasive plant species.

This is true for the Reach 5A wood turtle population. Suitable nesting habitats are limited and, where they are present, they have been impacted by invasive species, natural plant succession, or other human disturbances. For example, riverine point bars known to previously provide nesting habitats are now dominated by Japanese knotweed and can no longer function as nesting habitat. In addition, the former sand and gravel pit located on the George L. Darey Housatonic Valley Wildlife Management Area (WMA) north of the Pittsfield WWTP is known to provide nesting habitat for wood turtles, as well as painted and snapping turtles. However, suitable nesting is rapidly decreasing as portions of that site develop into dense shrub and sapling cover dominated by invasive plant species, while other areas are completely devoid of vegetation cover and composed of loose sand through constant impacts from moto-cross and All-Terrain Vehicle (ATV) usage.

[5] As noted above, although the Amended APR on the GE-owned floodplain portion of the former Noble Farm property would not prohibit any activities required by the Revised Permit (including required mitigation measures), any issues stemming from that Amended APR will need to be addressed in the conservation restriction or transfer of this property.

Therefore, to provide a net benefit for the wood turtle population in Reach 5A, steps will be taken to create, restore, and preserve suitable nesting habitats proximate to the river. This will include creation of new nesting features as part of the NCD process and management of invasive plants on point bars and riverbanks within and adjacent to the river. In addition, GE will conduct a one-time habitat improvement project within the former gravel pit located on the George L. Darey WMA to improve nesting opportunities there, subject to agreement with MassDFW. This restoration project could include vegetation removal and invasive plant control within select areas to create additional nesting habitats, replanting of the heavily disturbed open sandy areas with sparse native shrubs and little blue stem bunch grasses, and placement of signs and barriers to eliminate ATV impacts on the site.

Finally, the proposed mitigation framework for wood turtles includes broader habitat improvement through overall invasive species management. Excavation and restoration within remediation areas, herbicide treatment buffers adjacent to restoration areas, and additional invasive treatment in expanded areas are expected to improve floodplain and river-corridor habitat quality at a broader scale for wood turtle. These measures are described in the Invasive Species Control Plan (ISCP) that is Appendix C to the Restoration Plan.

7.3 Rare Plant Species Habitat Enhancements and NPT Program

For rare plants, in addition to the preservation of suitable habitat on GE-owned properties as described above, proposed mitigation includes habitat enhancement within restored areas in concert with the NPT program of collection, propagation, seed-banking and plant species planting measures. As noted above, although the NPT effort is a single coordinated program, this CMP distinguishes between its near-term loss-reduction functions, which are addressed in Section 5.2, and its longer-term habitat replacement and enhancement functions, which are addressed in this section. Coordination with the NPT program (https://www.nativeplanttrust.org), as proposed by GE, will enable the collection, storage, propagation, and re-establishment or expansion of affected state-listed plants, particularly where avoidance is not practicable. As also noted above, the NPT program is described in detail in **Attachment C** (Use of Native Plant Trust Program). The seed-banking, off-site propagation, ecotypic seed-mix development, and plant re-establishment elements of that program constitute mitigation because they will provide long-term replacement, enhancement, and net benefit after remedial disturbance.

The current proposed NPT plant-mitigation scope is organized around two related tasks. The first task covers collection of seed and/or other plant material from the seven state-listed plants in the project area for off-site propagation at NPT's Nasami Farm, together with collection of seeds for long-term storage in the NPT Seed Bank Program. The species currently included in that scope are Frank's lovegrass, matted spike-sedge, hairy wild rye, bristly buttercup, wapato, Tuckerman's sedge, and great blue lobelia. For annual species such as Frank's lovegrass and matted spike-sedge, the current scope is framed primarily around seed collection, processing, storage, germination/viability testing, production and eventually re-establishment. For the perennial species, the scope is framed primarily around plug production or other propagated plant material suitable for later installation. Because some species depend on re-creation of specific physical habitat conditions before they can be successfully re-established, plant mitigation will not be implemented as a uniform planting program across all species or habitats. For example, re-establishment of matted spike-sedge is expected to follow restoration of appropriate depositional river-margin settings rather than immediate replacement into freshly disturbed areas lacking the hydrologic and geomorphic conditions that the species requires. Likewise, installation of propagated plant material will be tied to the development of appropriate restored habitat conditions, rather than to a single construction milestone. As noted above, although the final NPT scope is still being finalized, this assessment reflects GE's current proposed approach and is presented here as the working conservation framework for rare plant protection and net benefit in Reach 5A.[6]

[6] It is noted that GE's use of the NPT program is subject to further scope development and execution of formal agreement(s). It is anticipated that NPT will handle pre-disturbance collections, seed banking, and off-site propagation at Nasami Farm and that planting will be conducted either directly by NPT (if appropriate contractual provisions can be worked out) or by a separate qualified planting contractor retained by GE.

A second plant-related NPT task, related to overall plant community habitat restoration (and thus relevant to establishing conditions suitable for re-establishing state-listed species in suitable habitats), pertains to the collection of seed from more common project-area plants for development of local ecotypic native seed mixes to support broader restoration. The current approach contemplates a combined transitional floodplain forest/high-terrace floodplain forest seed mix and an ecotypic native wetland seed mix. Together with species-specific propagation, these materials will be used in remediated areas and, where appropriate, adjacent habitats, staging areas, and access road restoration as part of the rare-plant mitigation and long-term net-benefit package.

Rare plant mitigation will also include species-specific habitat enhancement in restored areas. This will include creation or restoration of sandy point-bar settings suitable for Frank's lovegrass; development of quiescent, depositional river-margin or lee-zone settings suitable for matted spike-sedge; riverbank and lowland floodplain planting opportunities for great blue lobelia and other appropriate species; and, if Tuckerman's sedge is ultimately determined to be unavoidably affected, evaluation of suitable floodplain/vernal-pool-associated restoration opportunities. For other species subject to a take, restored wetland, river-margin, floodplain, and lowland habitats will be evaluated for species-appropriate re-establishment based on habitat suitability established in the field and verified by field assessments. These details will be presented in the applicable Supplemental Information Packages (SIPs).

Finally, as part of mitigation for the take of state-listed plants, GE will conduct invasive plant control through excavation and restoration in remediation areas and herbicide treatments within a 25-foot buffer of restoration areas, plus 8.5 acres of additional invasive species control in expanded treatment areas, including 2.8+ acres of Japanese knotweed and 5.7+ acres of common reed (phragmites). These control activities will improve habitats on a broader landscape scale for rare plant species across the floodplain. For more information on invasive species control, see the ISCP in Appendix C to the Restoration Plan.

7.4 Rare Lepidopteran Habitat Enhancements and NPT Program

For rare lepidopterans, in addition to the preservation of suitable habitat on GE-owned properties, habitat enhancements will involve restoration planting of host plants in remediated habitats, development of local host-plant source material through the NPT, and vegetation-management actions that improve host-plant habitat quality over the long term.

Specifically, as discussed in Attachment C, GE proposes to use NPT to bank host plant seeds collected from Reach 5A source material, propagate host plants off-site for later installation, and develop project-specific local ecotype seed mixes for restored wetland, river-margin, and upland/open-field habitats. These activities constitute mitigation because they will restore and expand host-plant availability after remedial disturbance and provide a durable habitat benefit over time.

Restoration planting and seeding will incorporate host plants in the habitat settings appropriate to the target species. For mustard white, this includes re-establishment of suitable host plants in mesic floodplain and riverbank habitats, including toothworts, cuckoo flower, and other appropriate mustards or bittercresses. Under the current NPT coordination approach, host-plant production includes toothwort-related materials and Pennsylvania bittercress through the wetland seed mix where suitable. For ostrich fern borer moth, mitigation includes propagation and re-establishment of ostrich fern in appropriate floodplain forest and wooded wetland habitats using project-derived source material. In addition, the current NPT coordination approach includes an upland/open-field enhancement mix containing species such as rock cress, Virginia pepperweed, and tower mustard for use in restored open habitats where appropriate.

Finally, although the monarch butterfly is not a state-listed species and has only been proposed for federal listing, inclusion of milkweed plugs in planting plans will promote the growth of milkweeds, which are host plants for the monarch butterfly, and thus provide mitigation for potential impact on this species, as well as broader pollinator benefit as part of the overall habitat enhancement program.[7]

[7] NPT will likely not be used for milkweed propagation, as this species is readily available from multiple sources.

Long-term invasive-species control is also an important component of the proposed lepidopteran mitigation. Garlic mustard control is particularly relevant because garlic mustard can function as a sink for mustard white by attracting oviposition while providing poor larval habitat (Keeler & Chew, 2008). Control of that plant species will reduce degradation of mustard white habitat and improve the viability of native host-plant communities that are being protected or re-established as part of the phased restoration. Similarly, control of extensive Japanese knotweed stands, as described in the ISCP, is expected to improve opportunities for re-establishment of native host-plant communities within floodplain and riverbank habitats. These vegetation-management measures will be implemented in conjunction with restoration planting and seeding to improve establishment success and long-term host-plant habitat function.

7.5 Rare Dragonfly Habitat Enhancements

For the state-listed dragonflies, in addition to preservation/protection of suitable stream-corridor habitat on GE-owned land as described above, mitigation for the takes will be carried out largely through the NCD-based river and riverbank restoration design described in the Restoration Plan and Appendix A to it. Proposed measures include replacement and addition of coarse substrates such as gravel and cobble, reconstruction and addition of riffles and riffle-run transitions, incorporation of localized hydraulic and substrate heterogeneity, placement or retention of near-bank structures and large wood where feasible, and restoration of river margins that provide suitable emergence and refuge conditions. These measures are described in Appendix A to the Restoration Plan. For the upper one-mile subreach, where final NCD design has been completed, the restoration design will increase riffle habitat from approximately 17% of existing riverine habitat to approximately 32% of restored riverine habitat. For all of Reach 5A, the current NCD design would increase riffle habitat by 23%, subject to refinement as the final design details for the remaining subreaches are completed. This shift is expected to improve the availability of riffle and riffle-run habitat relevant to the affected dragonfly assemblage, particularly taxa associated with faster-flowing habitats and coarser or mixed substrates and therefore is an important component of the in-project mitigation framework. These measures overlap substantially with the broader river restoration program and are therefore expected to function both as general habitat restoration and as species-relevant mitigation for dragonflies.

Where compatible with final design and habitat objectives, some of these measures can also be targeted to conditions relevant to individual taxa. For example, rocky bank-toe and large woody features, such as those described to date for the upper one-mile subreach and to be included for the remaining subreaches, will provide added value for species associated with rocky or structurally complex margins, while finer silty or sandy depositional settings at and below riffles may be beneficial for species associated with finer-grained substrates. The overall mitigation framework is to use the NCD-based channel and bank reconstruction program to provide a net increase in habitat complexity and improve long-term riverine habitat function for the affected state-listed dragonfly assemblage.

7.6 Net Benefit Assessment

Given both the quantitative impacts and qualitative factors discussed in Section 6, as well as the comprehensive assemblage of rare species protection, conservation, and mitigation measures described above, GE submits that the proposed mitigation measures will provide a long-term net benefit to the conservation of the state-listed species that will be subject to a take in Reach 5A. This assessment recognizes that the NPT program and the land preservation or transfer proposal require completion of details and agreements. GE is committed to working to achieve these measures along with the full complement of protection, conservation, and restoration measures described herein. In addition, GE plans to discuss with EPA the extent to which the proposed mitigation measures can also be used as mitigation for rare species takes in downstream reaches of the ROR that will require later remediation.

8. Monitoring and Assessment of Post-Restoration Conditions

8.1 General

Post-restoration monitoring for rare species in Reach 5A will be implemented to evaluate whether habitats affected by remediation and support activities are restored to conditions capable of supporting the identified rare species, whether species-specific mitigation and habitat enhancement measures are functioning as intended, and whether additional adaptive management is warranted. This monitoring will be coordinated with the broader Reach 5A post-restoration monitoring program described in the Restoration Plan. As discussed there, consistent with the Revised Restoration Performance Objectives and Evaluation Criteria (RPOEC) Report (Arcadis and AECOM 2024), the post-construction monitoring program for each subreach is expected to extend for seven years, with the first year consisting of the first full growing season following completion of restoration in the initial subreach. As noted in the Restoration Plan, this monitoring will be incorporated into the future Inspection, Monitoring, and Maintenance Plan discussed in Section 20 of the Final RD/RA Work Plan.

8.2 Wood Turtles

For wood turtles, post-restoration monitoring will include telemetry-based monitoring of tagged turtles following restoration of affected riverine, riverbank, and floodplain habitats for seven years following completion of restoration in each subreach of Reach 5A. This monitoring will document habitat use, movement through restored areas, and apparent use of implemented habitat features. Annual reporting will summarize observations relevant to survivorship, injury, mortality, nesting, and use or avoidance of restored areas consistent with monitoring as set forth in the Reach 5A Restoration Plan and the RPOEC Report.

8.3 Rare Plants and Lepidopteran Host Plants

For state-listed plants and lepidopteran host plants, post-restoration monitoring will include annual growing-season inspection for seven years at all locations where state-listed plants or host plants were reintroduced, propagated, transplanted, or otherwise established as part of mitigation or restoration. The monitoring will document survival, percent cover or abundance, invasive-species encroachment, and the extent to which restored or protected habitat conditions remain suitable. Where NPT-produced plugs, ferns, or seed mixes are installed, monitoring will also document installation locations, initial quantities, establishment success, and whether supplemental planting, reseeding, invasive-species control, herbivory protection, or other maintenance measures are warranted.

8.4 Dragonflies

For rare dragonflies, post-restoration monitoring will include larval sampling and exuviae surveys during Years 3, 5, and 7 of the seven-year post-restoration monitoring period, to be conducted in restored riverine habitats within areas mapped by MNHESP for the relevant species and in areas where target species were previously encountered or where suitable habitat was restored. Monitoring locations will correspond, to the extent practicable, with previously surveyed BRA and supplemental-survey locations (see AECOM, 2025d) and with restored habitat expected to provide suitable larval habitat conditions.

9. General Implementation

9.1 Roles, Responsibilities, and Qualifications

GE will retain qualified biologists with taxon-appropriate experience to implement rare-species protection, minimization, and mitigation measures. At a minimum, wood turtle clearance sweeps and active-construction oversight will be performed by qualified herpetologists or other appropriately trained biologists; rare-plant surveys and any collection, salvage, or relocation work should be overseen by qualified botanists; and any follow-up monitoring for dragonflies or lepidopterans will be performed by experienced specialists where appropriate. In addition, all general contractors, on-site professional project

engineers, and construction field personnel will receive state-listed-species awareness training so they understand the sensitivity of the site, the required response procedures, and how individual actions can help avoid and minimize impacts. The Wood Turtle Management Plan in **Attachment B** provides additional details for procedures specific to wood turtles. Observations will be submitted to EPA and MNHESP, as applicable, including upload of appropriate observations to the MNHESP Heritage Hub online reporting system.

9.2 Encounter Response

If a wood turtle is observed within an active work area, the procedures specified in the Wood Turtle Management Plan (**Attachment B**) for response to such observation by the designated herpetologist in coordination with the Construction Manager will be followed.

In the event of an observation of or encounter with another known rare faunal species at direct risk of injury or mortality in a work area during construction, the relevant on-site environmental specialist and the Construction Manager will be notified immediately and the Construction Manager will direct the cessation of work in the immediate area of the observation or encounter. The observation or encounter will be documented, the species will be protected from further disturbance, EPA and MNHESP will be notified, and a species-specific response action will be implemented as determined by consultation among a GE representative, the Construction Manager, EPA, and MNHESP.[8]

9.3 Reporting / Adaptive Management

Rare-species monitoring during construction, notable encounters, implementation of minimization and mitigation measures, and post-restoration monitoring results will be documented in the annual restoration reports to EPA, as described in Section 13 of the Restoration Plan, with copies to MNHESP. Reporting will include a description of annual work activities, observed effects, implemented mitigation, and any recommended modifications to field procedures or restoration measures.

Adaptive management is expected to be an integral part of the CMP. Consistent with the RPOEC Report, monitoring results will be used to evaluate whether additional data collection is needed and, where sufficient information exists, to direct adaptive habitat management and corrective actions such as supplemental planting, reseeding, invasive-species control, herbivory protection, repair or replacement of restoration structures, or other targeted habitat adjustments.

This CMP may be updated based on EPA comments and/or further coordination with MNHESP. In addition, addenda to this CMP will prepared as necessary to address changes in remediation or restoration activities or in avoidance, minimization, mitigation, or monitoring measures. Also, a specific addendum will be prepared to describe rare species avoidance, minimization, mitigation, and monitoring measures for the remediation of the remaining vernal pools following the vernal pool pilot study.

10. References

AECOM 2024. *Revised Housatonic River Reach 5A Baseline Restoration Assessment Report*. Prepared for General Electric Company, Pittsfield, Massachusetts. February 2024

AECOM 2025a. *Housatonic River Reach 5A - Federal and State-Listed Bat Species Acoustic Survey Report*. Prepared for General Electric Company. October 16, 2025.

AECOM 2025b. *Housatonic River Reach 5A - Rare Butterfly and Moth Survey Report*. Prepared for General Electric Company. November 17, 2025.

AECOM 2025c. *Housatonic River Reach 5A - State-Listed Bird Species Survey Report*. Prepared for General Electric Company. October 16, 2025.

[8] In addition, any observation of a known state-listed species will be reported to EPA and MNHESP.

AECOM 2025d. *Housatonic River Reach 5A State-Listed Dragonfly Species Survey Report*. Prepared for General Electric Company. December 16, 2025. (Submitted as containing Confidential Business Information, with public review version submitted on February 13, 2026.)

AECOM 2025e. *Housatonic River Reach 5A - State-Listed Plant Survey Report*. Prepared for General Electric Company. December 16, 2025. (Submitted as containing Confidential Business Information, with public review version submitted on February 13, 2026.)

AECOM 2025f. *Housatonic River Reach 5A - State-Listed Wood Turtle Survey Report*. Prepared for General Electric Company. December 16, 2025. (Submitted as containing Confidential Business Information, with public review version submitted on February 13, 2026.)

Anchor QEA, AECOM, and Arcadis 2026. *Supplemental Data Collection Summary Report for Reach 5A*. Prepared for General Electric Company, Pittsfield, Massachusetts. February 4, 2026.

Arcadis and AECOM 2024. *Revised Restoration Performance Objectives and Evaluation Criteria Report*. Prepared for General Electric Company, Pittsfield, Massachusetts. April 2024.

Keeler, M.S., and F.S. Chew 2008. Escaping an evolutionary trap: Preference and performance of a native insect on an exotic invasive host. *Oecologia* 156(3): 559-568.

Tables

Table 2-1. Total Acreage of Natural Communities Mapped in Reach 5A

Group	Natural Community	Total (Acres)
Open Water	Lake/Pond	7.9
Streams	Housatonic River	39.1
	Other Streams	3.1
	Total Stream	42.2
Floodplain Wetlands	High-terrace floodplain forest	10.8
	Transitional floodplain forest	147.3
	Red maple swamp	8.9
	Deep emergent marsh	12.0
	Shallow emergent marsh	47.1
	Shrub swamp	64.4
	Wet meadow	23.9
Forested Uplands	Red oak-sugar maple transition forest	2.6
	Successional Northern Hardwoods	3.7
	Northern hardwoods-hemlock-white pine forest	7.6
Other Uplands	Agricultural Field	4.4
	Cultural grasslands	26.3
	Developed / Disturbed	0.6
		409.6

Table 2-2. Descriptions of Natural Community Types Mapped in Reach 5A

Abbreviation	Natural Community	Description
WMD	Wet Meadow	Herbaceous emergent wetlands that are periodically disturbed by mowing or grazing or possibly sustained by hydrologic factors.
SEM	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.
DEM	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.
PSS	Shrub Swamp	Hydric shrublands lacking a closed canopy.
RMS	Red Maple Swamp	Hydric forests dominated by red maple.
TFF	Transitional Floodplain Forest	Riparian forests dominated by silver maple, box-elder, and American elm.
HTFF	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.
MALP	Moderately alkaline lake/pond	Ponds located in the central valley region with calcareous bedrock underneath.
SNH	Successional Northern Hardwood Forests	Early successional forests growing on formerly disturbed sites (fire, silvicultural, agricultural) well drained upland mineral soils. Dominant plants include quaking aspen, white pine, white birch, gray birch, and black birch in the canopy with willows, goldenrods, clovers beneath.
RSMTF	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.
NHWP	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.

Abbreviation	Natural Community	Description
CGL	Cultural Grasslands	Includes open, upland fields dominated by grass-like herbs that are periodically disturbed (mowed) but may include sparse and stunted shrubs in unmanaged areas. Typical vegetation includes reed fescue, Timothy, Kentucky blue-grass, poverty grass, little bluestem, goldenrods, common milkweed, wild carrot, common evening primrose, spreading dogbane, common flat-topped goldenrod, and spotted knapweed. Shrubs may include willows, dogwoods, staghorn sumac, buckthorn. Upland mineral Soils are well drained.
VP	Vernal Pool	Seasonally inundated depressions
STR	Stream	Low gradient and medium gradient streams.

Table 2-3. Rare Species Identified through IPaC and MNHESP Mapping or Field Surveys as Potentially Present in Reach 5A

Taxon/Survey Group	Common Name	Scientific Name	Federal Status	State Status
Bats	Northern long-eared bat	*Myotis septentrionalis*	E	E
	Tricolored bat/Eastern pipistrelle	*Perimyotis subflavus*	P	E
	Indiana bat	*Myotis sodalis*	E	E
	Silver-haired bat	*Lasionycteris noctivagans*	NA	SC
	Eastern red bat	*Lasiurus borealis*	NA	SC
	Hoary bat	*Lasiurus cinereus*	NA	SC
	Small-footed bat/Eastern small-footed myotis	*Myotis leibii*	NA	E
	Little brown bat/Little brown myotis	*Myotis lucifugus*	NA	E
Birds	American bittern	*Botaurus lentiginosus*	NA	E
	Common gallinule	*Gallinula galeata*	NA	SC
Butterflies/ moths	Monarch butterfly	*Danaus plexippus*	P	NA
	Mustard white	*Pieris oleracea*	NA	T
	Ostrich fern borer	*Papaipema sp.*	NA	SC
Dragonflies	Rapids clubtail	*Phanogomphus quadricolor*	NA	E
	Ocellated darner	*Boyeria grafiana*	NA	SC
	Spine-crowned clubtail	Hylog*omphus abbreviatus*	NA	SC
	Brook snaketail	*Ophiogomphus aspersus*	NA	SC
	Riffle snaketail	*Ophiogomphus carolus*	NA	T
Plants	Hairy wild rye	*Elymus villosus*	NA	E
	Tuckerman's sedge	*Carex tuckermanii*	NA	E
	White adder's-mouth	*Malaxis monophyllos var. brachypoda*	NA	E
	Bristly buttercup	*Ranunculus pensylvanicus*	NA	SC
	Frank's lovegrass	*Eragrostis frankii*	NA	SC
	Culver's-root	*Veronicastrum virginicum*	NA	T
	Gray's sedge	*Carex grayi*	NA	T
	Great blue lobelia	*Lobelia siphilitica*	NA	E
	Great laurel	*Rhododendron maximum*	NA	T
	Matted spike-sedge	*Eleocharis intermedia*	NA	T
	Wapato	*Sagittaria cuneata*	NA	T
Reptile	Wood turtle	*Glyptemys insculpta*	NA	SC

Notes:

E - endangered
NA – not applicable
P – proposed for federal listing
SC – species of special concern
T – threatened
IPaC – Information for Planning and Consultation
MNHESP - Massachusetts Natural Heritage and Endangered Species Program

Table 3-1. Reach 5A Impacts by Remediation Type

Remediation Type	Impacts Relative to 1 mg/kg PCB Isopleth (Acres)[1] IN	OUT	Total
Impacts (Excluding Vernal Pools Addressed Separately)[2]			
Floodplain Remediation	12.9		12.9
Backwaters and Other Waterbodies	6.4		6.4
River Sediment Removal	39.1		39.1
Riverbank Remediation and Grading	9.5	0.3	9.8
Primary Access Roads	5.1	7.9	13.0
Secondary Access Roads	3.0	0.8	3.8
Staging Areas	5.2	18.8	24.0
Total	*81.2*	*27.8*	*109.0*
Vernal Pool Impacts (Based on Conceptual Layout)[2]			
Vernal Pool Remediation	16.1		16.1
Secondary Access Roads	0.9	0.03	0.9
Staging Areas	1.5	0.07	1.6
Total	*18.5*	*0.1*	*18.6*
Grand Total	***99.7***	***27.9***	***127.6***

Notes:

1. The 1 mg/kg isopleth approximates the 10-year floodplain; impacts are noted as inside or outside of the isopleth.
2. Impacts associated with 5A-VP-13 (0.23 acres) are included under impacts for Floodplain Remediation and are not included in the separate vernal pool impacts.

Table 3-2. Reach 5A Impacts by Natural Community Cover Type

		Impacts Relative to 1 mg/kg PCB Isopleth (Acres)[1]		
	Natural Community Cover Type	**IN**	**OUT**	**Total**
	Impacts (Excluding Vernal Pools Addressed Separately)[2]			
Open Water	Lake/Pond	1.7		1.7
Streams	Housatonic River	39.1		39.1
	Other Streams	0.6		0.6
Floodplain Wetlands	Transitional floodplain forest	22.9		22.9
	High-terrace floodplain forest	1.4		1.4
	Deep emergent marsh	2.6		2.6
	Shallow emergent marsh	1.1		1.1
	Shrub swamp	1.3		1.3
	Wet meadow	5.4		5.4
Forested Uplands	Northern hardwoods-hemlock-white pine forest	0.1	0.7	0.8
	Red oak-sugar maple transition forest	0.2		0.2
	Successional Northern Hardwoods	0.03		0.0
Other Uplands	Agricultural Field	0.5	0.1	0.5
	Cultural grasslands	4.3	24.3	28.6
	Developed / Disturbed	0.1	2.7	2.8
	Total	*81.2*	*27.8*	*109.0*
	Vernal Pool Impacts (Based on Conceptual Layout)[2]			
Open Water	Lake/Pond	0.3		0.3
Floodplain Wetlands	Transitional floodplain forest	4.3		4.3
	High-terrace floodplain forest	0.1		0.1
	Deep emergent marsh	0.2		0.2
	Shallow emergent marsh	5.7		5.7
	Shrub swamp	7.3		7.3
	Wet meadow	0.4		0.4
Forested Uplands	Northern hardwoods-hemlock-white pine forest	0.2		0.2
Other Uplands	Cultural grasslands	0.1	0.1	0.2
	Total	*18.5*	*0.1*	*18.6*
	Grand Total	***99.7***	***27.9***	***127.6***

Notes:

1. The 1 mg/kg isopleth approximates the 10-year floodplain; impacts are noted as inside or outside of the isopleth.

2. Impacts associated with 5A-VP-13 are included under the floodplain impacts for shallow emergent (0.10 acres) and deep emergent (0.13 acres) marshes and are not included in the separate vernal pool impacts.

Table 4-1. Take Determinations for MNHESP State-listed Species in Reach 5A

	Common Name	Scientific Name	Species Considered Subject to a Take	Take Determination Rationale
Reptile	Wood Turtle	*Glyptemys insculpta*	Yes	The 2025 surveys confirmed wood turtle presence in Reach 5A, and telemetry documented use of the Housatonic River, Sackett Brook, riverbanks, floodplain wetlands, floodplain forests, and adjacent terrestrial habitats during the active season. Because remediation and support activities will disturb riverine, riverbank, floodplain, and some vernal-pool settings within confirmed and mapped habitat, the species is treated as subject to a take.
Plants	Bristly Buttercup	*Ranunculus pensylvanicus*	Yes	This species was observed only in spatially discrete locations during the 2025 surveys, but it is conservatively treated as subject to a take because mapped habitat or potentially suitable habitat could be affected by project activities. This conclusion also reflects that bristly buttercup is an annual plant that can germinate broadly in the floodplain when conditions are suitable.
	Frank's Lovegrass	*Eragrostis frankii*	Yes	This species was confirmed during the 2025 surveys in river-margin and bank habitats that overlap anticipated remedial areas in Reach 5A. Because those occupied habitats will be directly disturbed by remedial activities, the species is treated as subject to a take.
	Great blue lobelia	*Lobelia siphilitica*	Yes	This species was not previously mapped by MNHESP in Reach 5A, but it was observed during the 2025 surveys in river-margin and bank habitats that overlap anticipated remedial areas. Because those occupied habitats will be directly disturbed by remedial activities, the species is treated as subject to a take.
	Hairy Wild Rye	*Elymus villosus*	Yes	This species was not confirmed during the 2025 surveys, but mapped habitat or potentially suitable habitat could be affected by project activities in Reach 5A. It is therefore conservatively treated as subject to a take.
	Matted Spike-sedge	*Eleocharis intermedia*	Yes	This species was confirmed during the 2025 surveys in river-margin and bank habitats that overlap anticipated remedial areas in Reach 5A. Because those occupied habitats will be directly disturbed by remedial activities, the species is treated as subject to a take.
	Tuckerman's Sedge	*Carex tuckermanii*	Yes	This species is currently treated as subject to a take on a conservative basis because its only known occurrence is in a vernal pool that is subject to remediation. However, this determination remains tentative because final work limits and the remediation approach for that pool have not yet been finalized, and direct impacts may still be avoidable.
	Wapato	*Sagittaria cuneata*	Yes	This species was not confirmed during the 2025 surveys, but mapped habitat or potentially suitable habitat could be affected by project areas in Reach 5A. It is therefore conservatively treated as subject to a take.
	Great laurel	*Rhododendron maximum*	No	This species was not observed during the 2025 surveys, and MNHESP-mapped habitat for it is not identified within or near remediation or support areas. On that basis, it is not considered subject to a take.
	Gray’s sedge	*Carex grayi*	No	This species was documented only in previously mapped priority-habitat areas outside remediation and support areas. On that basis, it is not considered subject to a take.
	Culver’s-root	*Veronicastrum virginicum*	No	This species was not observed during the 2025 surveys, and MNHESP-mapped habitat for it is not identified within or near remediation or support activities. On that basis, it is not considered subject to a take.
	White adder’s-mouth	*Malaxis monophyllos var. brachypoda*	No	This species was not observed within remediation or support areas in Reach 5A, and the previously documented population near West Pond is considered likely to have been eliminated by flooding associated with active beaver dams. On that basis, it is not considered subject to a take.
Butterflies/moths	Mustard White	*Pieris oleracea*	Yes	Although this species was not observed during the 2025 survey effort, host plants were documented within and adjacent to anticipated remediation and support areas. Because remediation and support activities are expected to remove or disturb host plants in floodplain and riverbank settings, and because larval stages are difficult to locate without formal flight-period trapping, the species is conservatively treated as subject to a take.
	Ostrich Fern Borer	*Papaipema sp.*	Yes	Although this species was not observed during the 2025 survey effort, host plants were documented within and adjacent to anticipated remediation and support areas. Because remediation and support activities are expected to remove or disturb host plants in floodplain and riverbank settings, and because larval stages are difficult to locate without formal flight-period trapping, the species is conservatively treated as subject to a take.
	Monarch butterfly	*Danaus plexippus*	NA	Monarch butterfly host plants were documented in Reach 5A and one adult monarch was observed, but no eggs or larvae were found. This species is not state-listed in Massachusetts and has only been proposed for federal listing; and it was therefore excluded from the species take analysis, although impacts to milkweed host plants are addressed in the restoration program.
Dragonflies	Rapids Clubtail	*Phanogomphus quadricolor*	Yes	Mapped habitat for these species overlaps riverine and riparian areas that will be disturbed by sediment removal, backfilling/capping, and riverbank remediation and stabilization. Although these species were not confirmed during the 2025 dragonfly survey, the survey methods have limitations for detecting and identifying all larval stages, and the planned work will temporarily remove larval substrate and food sources and disturb emergence surfaces, so the species are treated as subject to a take.
	Ocellated Darner	*Boyeria grafiana*	Yes	
	Spine-crowned Clubtail	*Hylogomphus abbreviatus*	Yes	
	Brook Snaketail	*Ophiogomphus aspersus*	Yes	
	Riffle Snaketail	*Ophiogomphus carolus*	Yes	This was the only state-listed dragonfly confirmed present in Reach 5A during the 2025 survey effort. Because sediment removal, backfilling/capping, and riverbank remediation will temporarily remove larval substrate and food sources, alter bank conditions, and disturb emergence surfaces within suitable habitat, the species is treated as subject to a take.

	Common Name	Scientific Name	Species Considered Subject to a Take	Take Determination Rationale
Bats	Northern long-eared bat	*Myotis septentrionalis*	No	This species was evaluated because federal screening indicated potential habitat in Reach 5A, but it was not confirmed during the 2025 acoustic survey. It is not considered subject to a take because it was not found in Reach 5A and because the current construction approach limits tree clearing to November through March, thereby avoiding active-season impacts to roosting bats and natal colonies.
	Tricolored bat/Eastern pipistrelle	*Perimyotis subflavus*	No	Probable presence of this species was confirmed during the 2025 acoustic survey. It is not considered subject to a take because the current construction approach limits tree clearing to November through March, thereby avoiding active-season impacts to roosting bats and natal colonies.
	Indiana bat	*Myotis sodalis*	No	This species was included in the bat survey program, but it was not confirmed during the 2025 acoustic survey. It is not considered subject to a take because it was not found in Reach 5A and because the current construction approach limits tree clearing to November through March, thereby avoiding active-season impacts to roosting bats and natal colonies.
	Silver-haired bat	*Lasionycteris noctivagans*	No	Probable presence of this species was confirmed during the 2025 acoustic survey. It is not considered subject to a take because the current construction approach limits tree clearing to November through March, thereby avoiding active-season impacts to roosting bats and natal colonies.
	Eastern red bat	*Lasiurus borealis*	No	Probable presence of this species was confirmed during the 2025 acoustic survey. It is not considered subject to a take because the current construction approach limits tree clearing to November through March, thereby avoiding active-season impacts to roosting bats and natal colonies.
	Hoary bat	*Lasiurus cinereus*	No	Probable presence of this species was confirmed during the 2025 acoustic survey. It is not considered subject to a take because the current construction approach limits tree clearing to November through March, thereby avoiding active-season impacts to roosting bats and natal colonies.
	Small-footed bat/Eastern small-footed myotis	*Myotis leibii*	No	This species was included in the bat survey program, but it was not confirmed during the 2025 acoustic survey. It is not considered subject to a take because it was not found in Reach 5A and because the current construction approach limits tree clearing to November through March, thereby avoiding active-season impacts to roosting bats and natal colonies.
	Little brown bat/Little brown myotis	*Myotis lucifugus*	No	Probable presence of this species was confirmed during the 2025 acoustic survey. It is not considered subject to a take because the current construction approach limits tree clearing to November through March, thereby avoiding active-season impacts to roosting bats and natal colonies.
Birds	American Bittern	*Botarus lentiginosus*	No	This species was not detected during the 2025 breeding-season marsh-bird surveys, and the survey concluded that it was not breeding in the surveyed areas of Reach 5A during 2025. In addition, the last MNHESP-confirmed observation of this species in Reach 5A occurred in 2012, there are little or no remediation-related impacts where suitable breeding habitat does exist in Reach 5A, and extensive downstream breeding habitat remains available while work is ongoing.
	Common Galinule	*Gallinula galeata*	No	This species was not detected during the 2025 breeding-season marsh-bird surveys, and the survey concluded that it was not breeding in the surveyed areas of Reach 5A during 2025. In addition, the last MNHESP-confirmed observation of this species in Reach 5A occurred in 2008, there are little or no remediation-related impacts where suitable breeding habitat does exist in Reach 5A, and extensive downstream breeding habitat remains available while work is ongoing.

Table 6-1: NHESP Mapped Species Habitat Acreage of all State-Listed Species Considered Subject to a Take on GE-Owned Properties

Species	Total Acreage of NHESP Mapped Habitat in R5A	Acreage of Remedial & Support Activities within Mapped Habitat	Affected Habitat Acreage Based on Species Factors	Summary of Factors Applied in Determining Affected Habitat Acreage
Mustard White	523.1	87.1	56.4	Nearly all the Reach 5A floodplain and adjacent upland areas from Holmes Road down to the Pittsfield WWTP outfall are mapped as habitat for the mustard white butterfly. Remedial and support activities will be conducted in 87.1 acres of the mapped habitat. Host plants for this species were documented sporadically throughout the mapped habitat in 2025 and therefore, all this area is considered potential habitat for the species. However, because host plants for this species do not typically occur within riverine sediment, habitat impacts associated with dredging in the Housatonic River (30.7 acres) were removed, resulting in 56.4 acres of affected habitat.
Ostrich Fern Borer	193.3	29.0	52.2	Ostrich fern borer moth MNHESP mapped habitat includes floodplain areas from just below Holmes Road down to just south of Joseph Drive. Remediation and support activities will occur in 29.0 acres of the mapped habitat. As with Mustard White, host plants for this species typically do not grow within riverine sediment, so habitat impacts associated with dredging in the Housatonic River (11.1 acres) were removed from the total affected area. However, host plants were observed within floodplain habitats throughout all of Reach 5A. Therefore, 34.3 acres of impact were added, excluding areas of sediment removal and impacts associated with access and staging located in upland habitats outside of the floodplain, for a total of 52.2 acres of affected habitat.
Rapids Clubtail	91.4	26.8	16.2	While approximately 45 acres of riverine habitat will be dredged, not all of this area provides suitable benthic habitat for these species. Suitable benthic habitat has been adjusted according to RBP surveys characterizing the benthic habitat. In addition, acreage has been added to account for remedial activities to be conducted in the riparian zone outside of the river but along the river edges, which provide habitat for adult dragonflies. Additional habitat acreage was added for riffle snaketail where it was found outside of the NHESP-mapped habitat.
Ocellated Darner	423	90.5	69.2	
Spine-crowned Clubtail	362	98.9	96.2	
Brook Snaketail	340.6	92.2	78.1	
Riffle Snaketail	254.6	69.1	84.4	
Bristly Buttercup	29.4	4.1	4.1	Mapped habitat occurs only in Core Area 1 habitat where only vernal pool remediation will occur (not defined yet). No bristly buttercups were observed in any of these areas. This species was found in 2025 in one location near remedial activity, where direct impacts may be avoided. Recognizing that locations of this species can vary between years, and that some suitable habitat for this species will be subject to remedial and support activities, the 4.1-acre area appears to be a suitable amount of habitat to use for the affected area.
Frank's Lovegrass	26.6	22.6	15.4	Habitat limits for Frank's lovegrass were refined to focus on sandy riverbank and exposed river-margin settings rather than the full bank-to-bank river width. The refined limits were developed using 2025 field observations, aerial photo interpretation, in-river bathymetry, and local point-bar and shelf features, and were extended upstream to the confluence where surveys documented the species. Based on that refinement, 15.4 acres of affected habitat remain.
Great blue lobelia*	N/A	N/A	16.7	This species was not previously mapped by MNHESP in Reach 5A. Except for one observation on the floodplain outside the remediation area, it was only recorded within the river corridor. Therefore, affected habitat was calculated as a 20-foot-wide swath along each riverbank from the most upstream to the most downstream observation, approximately river station 38+00 to 217+00, resulting in 16.7 acres of affected habitat.
Hairy Wild Rye	27.1	5.7	2.1	Hairy wild rye is mapped only in Core Area 1 habitat where only vernal pool remediation will occur (not defined yet), but vernal pool habitat is not typical habitat for this species. Hairy wild rye was not recorded within the mapped habitat area. This species typically grows in well-drained floodplain forests, meadows, and fields; when wetland and seasonally flooded areas were excluded from the mapped overlap, 2.1 acres of affected habitat remain.
Matted Spike-sedge	125.8	60.6	34.0	Matted spike-sedge is mapped along the entire extent of Reach 5A, including river and adjacent floodplain habitats. Surveys for this species in 2025 recorded it consistent with the mapped habitat. Because this species occurs on muddy or mucky substrates that are not necessarily flooded throughout the growing season, permanently flooded portions of the river were removed from the mapped habitat. The within-river exclusion was refined using 2025 field observations, aerial photo interpretation, and in-river bathymetry, resulting in 34.0 acres of affected habitat.
Tuckerman's Sedge	0.9	0.3	0.3	Tuckerman's sedge is mapped only in one vernal pool in Reach 5A. Surveys in 2025 confirmed the presence of this species in that vernal pool. While direct impacts to this species may be avoided by the remedial design, the remedial activity within this pool is not yet delineated, and therefore it is assumed that this species will be subject to a take over the area as mapped.
Wapato	185	72.9	46.4	Wapato is mapped along the entire extent of Reach 5A, including river and adjacent floodplain habitats. Surveys for this species in 2025 did not confirm its presence in Reach 5A, but the difficulty in identification has been acknowledged. Because this species occurs on muddy or mucky substrates rather than in permanently flooded river habitat, permanently flooded portions of the river were removed from the mapped habitat. The within-river exclusion was refined using 2025 field observations, aerial photo interpretation, and in-river bathymetry, resulting in 46.4 acres of affected habitat.

Table 6-1: NHESP Mapped Species Habitat Acreage of all State-Listed Species Considered Subject to a Take on GE-Owned Properties

Species	Total Acreage of NHESP Mapped Habitat in R5A	Acreage of Remedial & Support Activities within Mapped Habitat	Affected Habitat Acreage Based on Species Factors	Summary of Factors Applied in Determining Affected Habitat Acreage
Wood Turtle	776	123.7	123.7	Wood turtle mapped habitat occurs along the entire extent of Reach 5A, including the full riverine limits as well as across the floodplain habitats to be affected by remediation and support activities. Surveys for this species in 2025 recorded this species consistent with the mapped habitat. Therefore, the entire mapped habitat within remediation and support areas has been included in the affected habitat acreage.

Notes:

Total NHESP mapped habitat acreage includes areas within the Reach 5A Isopleth and within 1000 feet (i.e., mapping limits of the species-specific data provided by NHESP in March 2025).

* Great blue lobelia was not mapped by MNHESP; affected habitat acreage was estimated based on field observations.

Table 7-1: NHESP-Mapped Species Habitat Acreage of all State-Listed Species Considered Subject to a Take on GE-Owned Properties

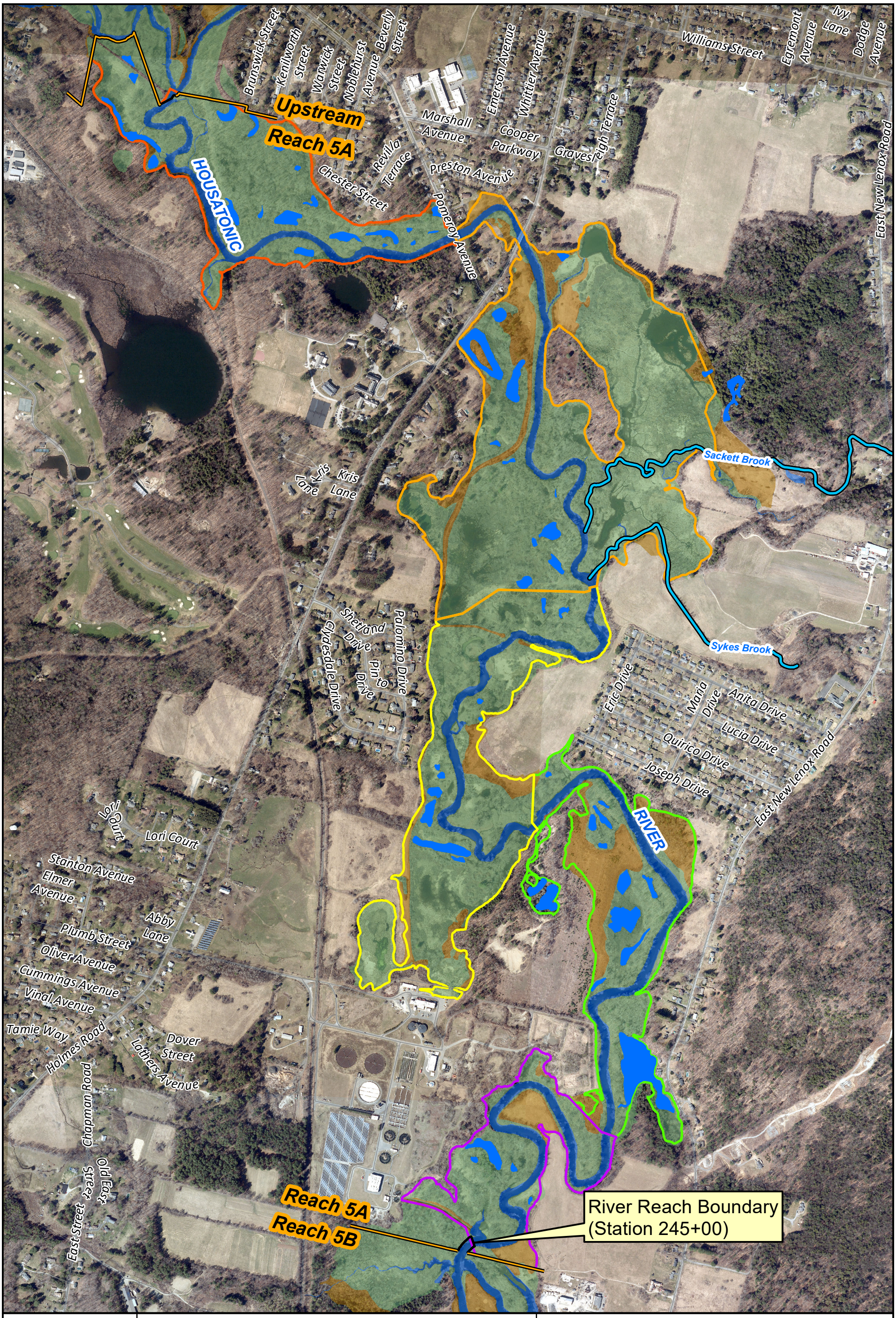
Taxon/Survey Group	Common Name	Scientific Name	Total NHESP Mapped Habitat overlapping with Former Noble Farm Floodplain Property (Acres)	Total NHESP Mapped Habitat overlapping with Former Butler Farm Property (Acres)	Total NHESP Mapped Habitat overlapping with Confluence Property (Acres)
Reptile	Wood turtle	*Glyptemys insculpta*	55.4*	25.1*	3.7
Dragonflies	Brook snaketail	*Ophiogomphus aspersus*	35.8	11.9	3.5
	Ocellated darner	*Boyeria grafiana*	44.8	2.4	3.5
	Rapids clubtail	*Phanogomphus quadricolor*	0.0	22.6	0.0
	Spine-crowned clubtail	Hylog*omphus abbreviatus*	35.8	22.5	3.5
	Riffle snaketail	*Ophiogomphus carolus*	35.8*	0.0*	3.5
Plants	Frank's lovegrass	*Eragrostis frankii*	0.9*	3.7*	0.0
	Matted spike-sedge	*Eleocharis intermedia*	10.4*	6.0*	0.3
	Wapato	*Sagittaria cuneata*	11.6	6.8	1.1
	Bristly buttercup	*Ranunculus pensylvanicus*	0.0	0.0	0.0
	Hairy wild rye	*Elymus villosus*	0.0	0.0	0.0
	Tuckerman's sedge	*Carex tuckermanii*	0.0	0.0	0.0
	Great blue lobelia	*Lobelia siphilitica*	0.0*	0.0*	0.0
Butterflies/ Moths	Mustard white	*Pieris oleracea*	36.0*	16.0*	0.0
	Ostrich fern borer	*Papaipema sp.*	31.9*	0.0*	0.0

Notes:

*Species or host plant presence confirmed within or directly adjacent to the property during the 2025 field surveys.

No surveys were performed within the Confluence property during 2025 rare species field surveys as it is not within the limits of Reach 5A.

Figures

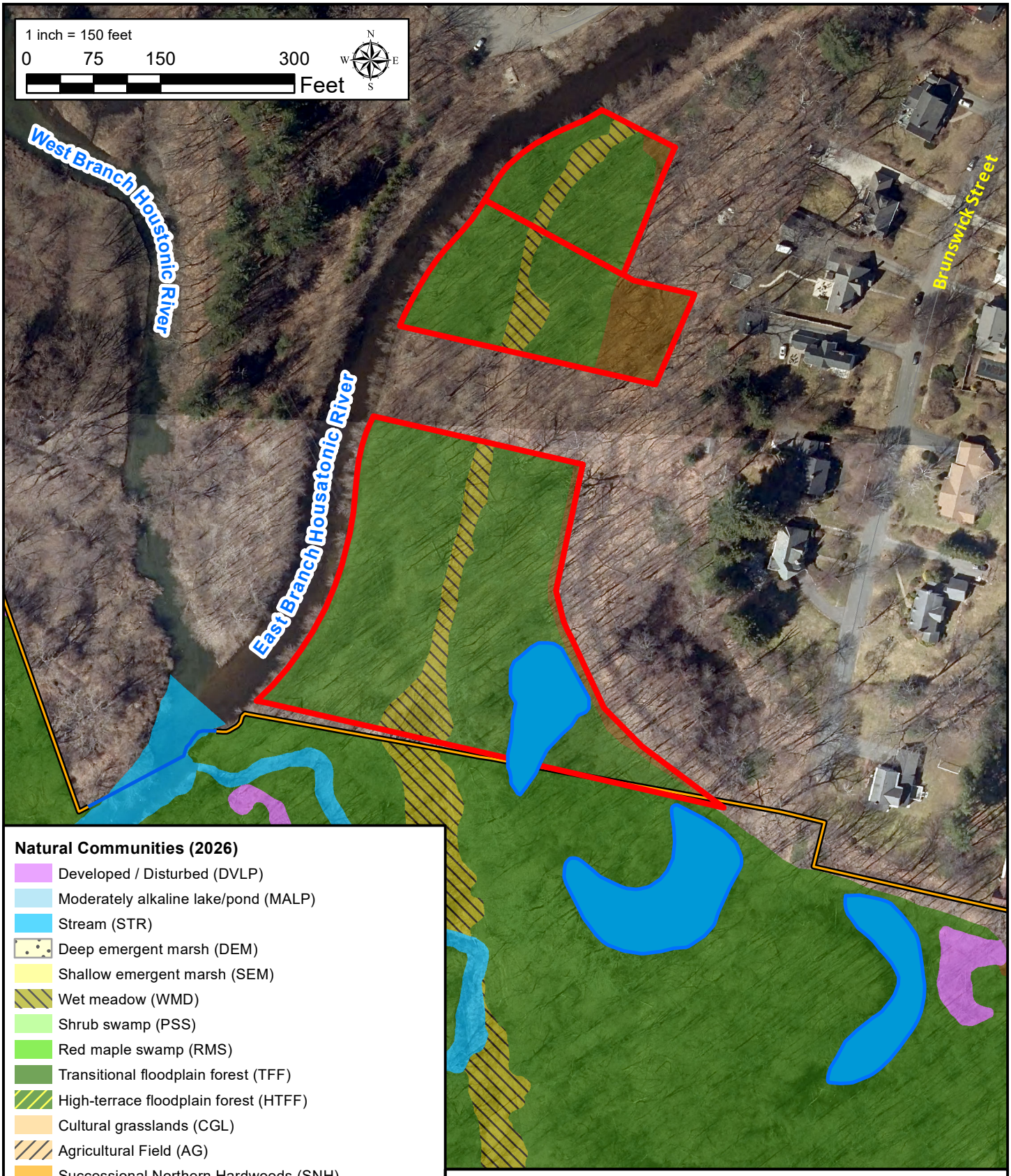


Reach 5A Limits
Conservation and Management Plan
Housatonic River

SCALE	DATE	PROJECT NO.
1:2,500	4/22/2026	60719336

AECOM

Figure 1-1
Map Sheet 1 of 1



Natural Communities (2026)

- Developed / Disturbed (DVLP)
- Moderately alkaline lake/pond (MALP)
- Stream (STR)
- Deep emergent marsh (DEM)
- Shallow emergent marsh (SEM)
- Wet meadow (WMD)
- Shrub swamp (PSS)
- Red maple swamp (RMS)
- Transitional floodplain forest (TFF)
- High-terrace floodplain forest (HTFF)
- Cultural grasslands (CGL)
- Agricultural Field (AG)
- Successional Northern Hardwoods (SNH)
- Northern hardwoods-hemlock-white pine forest (NHWP)
- Red oak-sugar maple transition forest (RSMTF)
- Certified Vernal Pools
- GE-Owned Parcel Boundaries
- Floodplain Reach Boundary
- River Reach Boundary

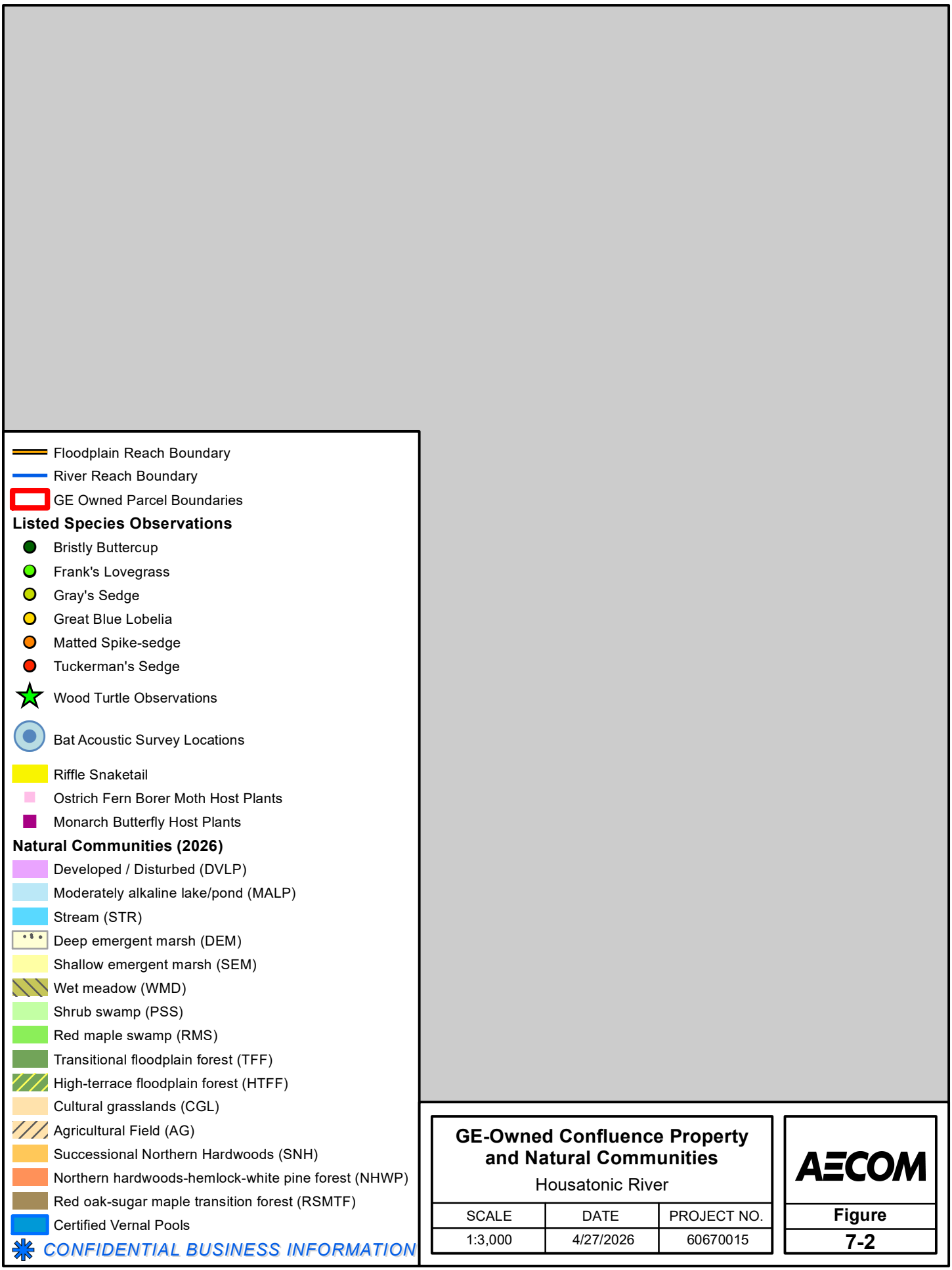
GE-Owned Confluence Property and Natural Communities

Housatonic River

SCALE	DATE	PROJECT NO.
1:1,800	4/22/2026	60670015

AECOM

Figure 7-1



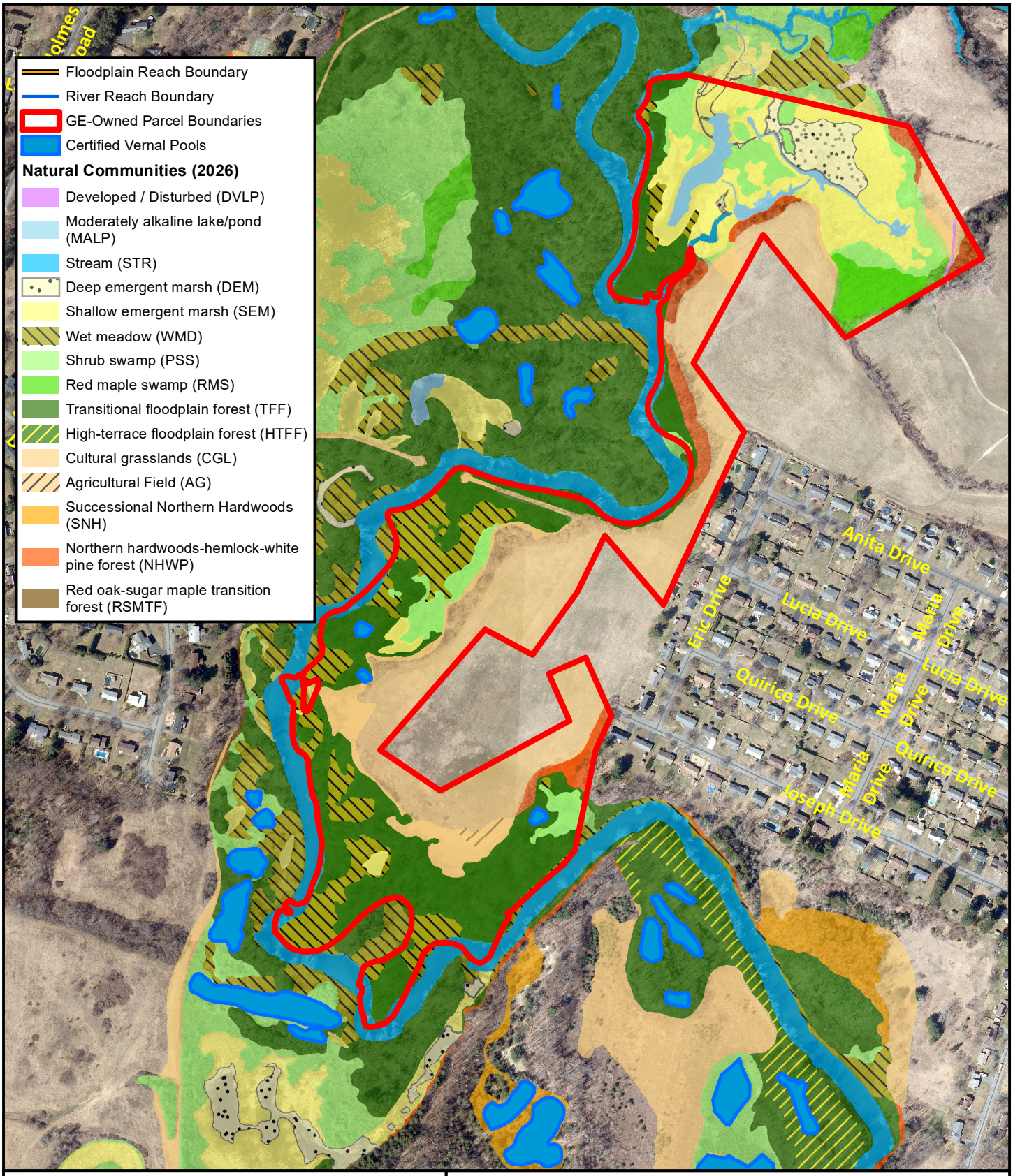
GE-Owned Confluence Property and Natural Communities

Housatonic River

SCALE	DATE	PROJECT NO.
1:3,000	4/27/2026	60670015

AECOM

Figure 7-2



1 inch = 500 feet

0 175 350 700 Feet

N W E S

GE-Owned Floodplain at Former Noble Farm and Natural Communities

Housatonic River

SCALE	DATE	PROJECT NO.
1:6,000	4/27/2026	60670015

AECOM

Figure 7-3

Bat Acoustic Survey Locations

Wood Turtle Observations

Listed Species Observations

- Bristly Buttercup
- Frank's Lovegrass
- Gray's Sedge
- Great Blue Lobelia
- Matted Spike-sedge
- Tuckerman's Sedge
- Riffle Snaketail
- Ostrich Fern Borer Moth Host Plants
- Mustard White Host Plants
- Monarch Butterfly Host Plants
- Certified Vernal Pools
- GE-Owned Parcel Boundaries
- Floodplain Reach Boundary
- River Reach Boundary

Natural Communities (2026)

- Developed / Disturbed (DVLP)
- Moderately alkaline lake/pond (MALP)
- Stream (STR)
- Deep emergent marsh (DEM)
- Shallow emergent marsh (SEM)
- Wet meadow (WMD)
- Shrub swamp (PSS)
- Red maple swamp (RMS)
- Transitional floodplain forest (TFF)
- High-terrace floodplain forest (HTFF)
- Cultural grasslands (CGL)
- Agricultural Field (AG)
- Successional Northern Hardwoods (SNH)
- Northern hardwoods-hemlock-white pine forest (NHWP)
- Red oak-sugar maple transition forest (RSMTF)

1 inch = 350 feet

0 175 350 700 Feet

N W E S

CONFIDENTIAL BUSINESS INFORMATION

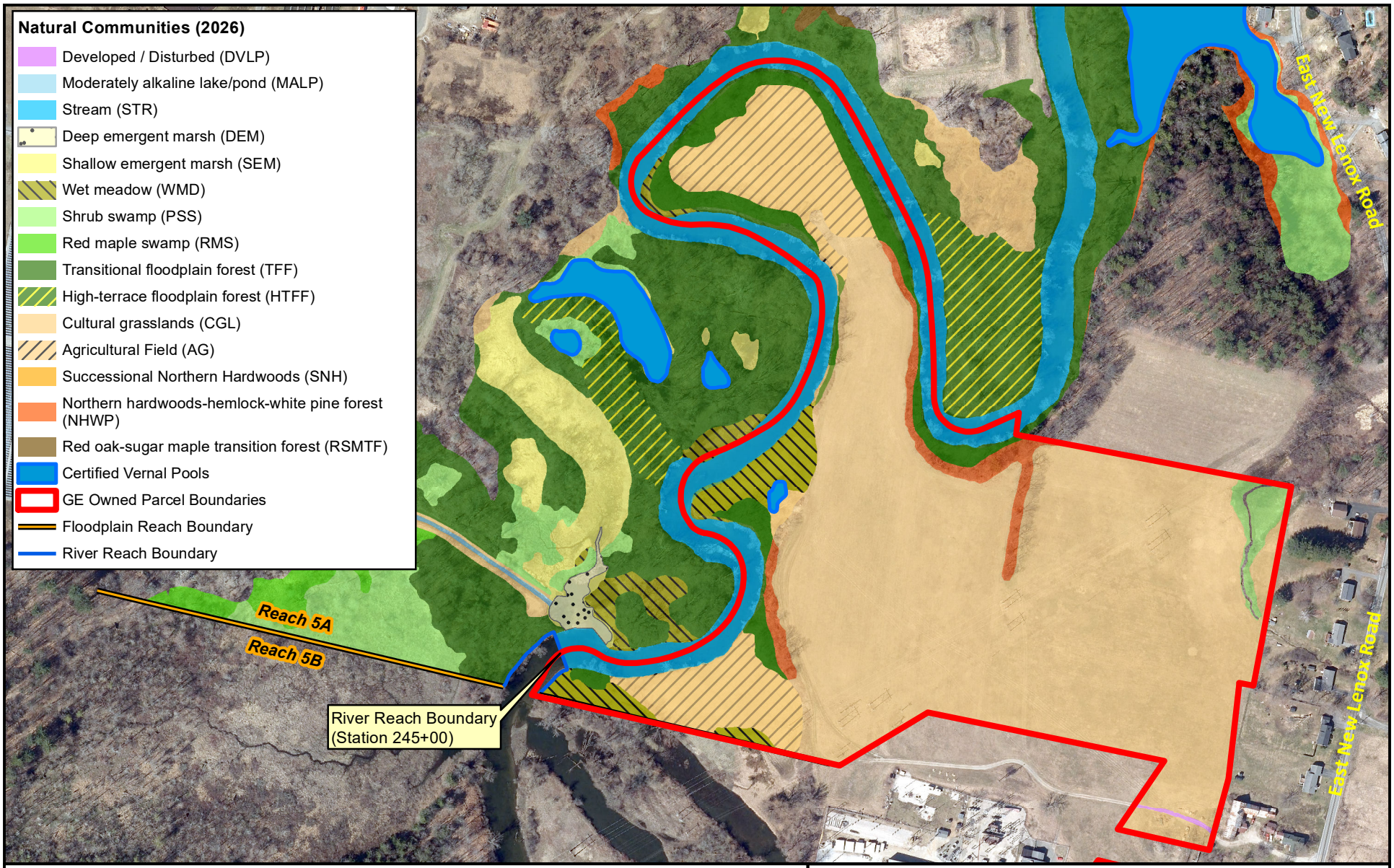
GE-Owned Floodplain at Former Noble Farm and Natural Communities

Housatonic River

SCALE	DATE	PROJECT NO.
1:4,200	4/27/2026	60670015

AECOM

Figure 7-4



1 inch = 350 feet

0 175 350 700 Feet

N W E S

GE-Owned Former Butler Farm and Natural Communities

Housatonic River

SCALE	DATE	PROJECT NO.
1:4,200	4/23/2026	60670015

AECOM

Figure 7-5

GE Owned Parcel Boundaries
Floodplain Reach Boundary
River Reach Boundary

Listed Species Observations

Bristly Buttercup
Frank's Lovegrass
Gray's Sedge
Great Blue Lobelia
Matted Spike-sedge
Tuckerman's Sedge
Bat Acoustic Survey
Wood Turtle Observations
Riffle Snaketail
Ostrich Fern Borer Moth Host Plants
Mustard White Host Plants
Monarch Butterfly Host Plants

Natural Communities (2026)

Developed / Disturbed (DVLP)
Moderately alkaline lake/pond (MALP)
Stream (STR)
Deep emergent marsh (DEM)
Shallow emergent marsh (SEM)
Wet meadow (WMD)
Shrub swamp (PSS)
Red maple swamp (RMS)
Transitional floodplain forest (TFF)
High-terrace floodplain forest (HTFF)
Cultural grasslands (CGL)
Agricultural Field (AG)
Successional Northern Hardwoods (SNH)
Northern hardwoods-hemlock-white pine forest (NHWP)
Red oak-sugar maple transition forest (RSMTF)
Certified Vernal Pools

CONFIDENTIAL BUSINESS INFORMATION

1 inch = 250 feet

0 125 250 500 Feet

N W E S

GE-Owned Former Butler Farm and Natural Communities

Housatonic River

SCALE	DATE	PROJECT NO.
1:3,000	4/27/2026	60670015

AECOM

Figure 7-6

AECOM

Attachment A: Descriptions of State-Listed Species Subject to a Take

Delivering a better world

AECOM

Attachment A-1: Wood Turtle Life History and Habitat Use

Delivering a better world

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   2.3 Nesting, Reproduction, and Movements A1-2
3. References A1-2

1. Introduction

This attachment to the Rare Species Conservation and Management Plan (Appendix B of the Housatonic River Reach 5A Restoration Plan) provides a focused synthesis of the life history and habitat use of the wood turtle (*Glyptemys insculpta*) with emphasis on how those life-history functions apply to Reach 5A of the Housatonic Rest of River project. Mapped wood turtle habitat extends across the full Reach 5A riverine and floodplain corridor, including riverine, riverbank, backwater, and floodplain habitats.

2. Life History and Habitat Use

The wood turtle is a semi-aquatic, riverine-riparian turtle that depends on both instream and adjacent terrestrial habitats to complete its annual cycle. Across the Northeast, the species uses streams and rivers for overwintering, spring emergence, basking, courtship, and mating, while floodplain forests, shrublands, wetlands, open fields, and adjacent uplands are used extensively for foraging, thermoregulation, cover, and nesting (Jones & Willey, 2015; Jones & Willey, 2021).

Its annual activity cycle is commonly described as emergence and pre-nesting, nesting, post-nesting, pre-brumation, and brumation. This seasonal shifting among habitat types is central to understanding wood turtle habitat use in Reach 5A and to identifying the habitat elements that are most important to avoid, maintain, or restore (Jones & Willey, 2015; Jones & Willey, 2021).

2.1 Aquatic Life History and Habitat Use

Across the annual cycle, wood turtles concentrate in aquatic habitats during spring emergence, courtship, and overwintering, shift into open terrestrial habitats for nesting in late spring and early summer, use floodplain and adjacent upland habitats extensively during summer, and then return to aquatic refuge areas during pre-brumation (Jones & Willey, 2015; Jones & Willey, 2021).

Wood turtles are strongly associated with clear, relatively cool streams and rivers that include slower sections embedded within otherwise moderate to faster current systems and that contain sand, gravel, cobble, rock, or fine-sediment refuge areas. Streams are used during spring emergence, basking, courtship, and mating, and they remain the core habitat for overwintering. Courtship and mating primarily occur underwater in quiet pools and slow-moving reaches, often near overwintering areas or other aquatic refuge features (Jones & Willey, 2015; Jones & Willey, 2021).

Overwintering sites are typically located within the stream channel or in closely connected aquatic habitats. Published studies describe use of deep pools, undercut banks, muddy or mucky bottoms, root masses of large trees, submerged logs, logjams, woody debris piles, muskrat dens, and other sheltered instream structure (Jones & Willey, 2015; Jones & Willey, 2021). In Reach 5A, 2025 surveys mapped potential hibernacula, undercut banks, sandy point bars, and large woody debris jams. Radio-tracked turtles were frequently associated with woody debris piles during aquatic observations, and late-season observations found overwintering locations in soft-bottom river sections adjacent to undercut banks, overhanging shrub cover, and large fallen trees or debris accumulations (AECOM, 2025).

2.1.1 Reach 5A Aquatic Habitat Characteristics

Reach 5A contains many of the aquatic habitat elements commonly used by wood turtles. Riverbanks and backwaters include undercut or overhanging banks, large woody debris, roots and logs at the water edge, mud flats, soft-bottom or fine-sediment areas, and sheltered backwater conditions (AECOM, 2024). These features provide basking sites, escape cover, movement corridors, and overwintering refuge. Overhanging mature trees and dense riparian vegetation also increase structural complexity and create shaded microhabitats along the river margin.

2.2 Terrestrial Life History and Habitat Use

Although dependent on streams for overwintering, wood turtles spend much of late spring through early fall in surrounding terrestrial habitats, sometimes hundreds of meters from the overwintering stream. Typical habitats include floodplain forest, wet meadow, shrub thickets, field edges, early-successional openings, agricultural openings, and adjacent uplands. Edge habitats and ecotones are consistently identified as important because they provide a combination of basking opportunities, food resources, and cover. Wood turtles are opportunistic omnivores; reported foods include earthworms and other invertebrates, slugs, green leaves, berries and other fruits, fungi, carrion, and occasionally amphibian egg masses or other animal matter (Jones & Willey, 2015; Jones & Willey, 2021). In Reach 5A, summer telemetry tracking found turtles utilizing shrub thickets, open fields, forested floodplain habitats, and edge habitat as well as riverine areas, riverbanks, and tributary streams (AECOM, 2025).

2.3 Nesting, Reproduction, and Movements

Nesting typically occurs from late May through early July, with June being the principal nesting period in much of the Northeast. Preferred nesting sites are open, well-drained, elevated areas of sand, fine to medium gravel, sandy loam, or exposed alluvium, including point bars, cutbanks, sand and gravel bars, and anthropogenic features such as sand pits and gravelly openings. Wood turtles exhibit delayed maturity, with published age at maturity ranging from roughly 11 to 20 years depending on region and sex. Females generally lay no more than one clutch per year, and average clutch size is commonly about 7 to 11 eggs (Jones & Willey, 2015; Jones & Willey, 2021). In Reach 5A, 2025 surveys specifically assessed former sand and gravel pit areas, point bars, and open field habitats for nesting, but resulted in no female wood turtle observations. While 2025 telemetry results were limited to male turtles, they documented use of diverse habitats with home ranges from 68 to 415 acres and movements between weekly observations of approximately 1.3 to 2.5 miles (AECOM, 2025). While the Reach 5A telemetry sample is small and male-biased, it confirms the use of a mosaic of habitats throughout the annual life cycle, including aquatic refuge areas and adjacent floodplain and upland foraging habitat.

3. References

AECOM. 2024. *Revised Housatonic River Reach 5A Baseline Restoration Assessment Report*. Prepared for General Electric Company, Pittsfield, Massachusetts. February 2024.

AECOM. 2025. *Housatonic River Reach 5A - State-Listed Wood Turtle Survey Report*. Prepared for General Electric Company. December 16, 2025. (Submitted as containing Confidential Business Information, with public review version submitted on February 13, 2026.)

Jones, M.T., and L.L. Willey. 2015. Status and Conservation of the Wood Turtle in the Northeastern United States.

Jones, M.T., and L.L. Willey. 2021. Biology and Conservation of the Wood Turtle. Northeast Association of Fish and Wildlife Agencies, Inc.

Attachment A-2:
Reach 5A State-Listed Plant Species and Habitats

Delivering a better world

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   2.7 Great Blue Lobelia A2-6
3. References A2-7

1. Introduction

This attachment to the Rare Species Conservation and Management Plan (Appendix B of the Housatonic River Reach 5A Restoration Plan) has been prepared to provide descriptions of habitat requirements and phenology of state-listed plant species subject to a take in Reach 5A (**Table 1**). Mapped habitat for state listed plants extends across most of Reach 5A riverine and floodplain corridor, including riverine, riverbank, backwater, and floodplain habitats.

Surveys for state listed plants and suitable habitats within the limits of proposed remediation and support areas were conducted in 2025 by a qualified botanist using methodologies generally consistent with the applicable portions of *State-listed Species Habitat Assessment & Survey Guidelines: Plants* (MassDFW 2026a). Frank's lovegrass, matted spike-sedge, and great blue lobelia were confirmed to occur in river-margin and bank habitats that overlap anticipated remedial areas in Reach 5A. Bristly buttercup and Tuckerman's sedge were observed only in spatially discrete locations, and the presence of both wapato and hairy wild rye could not be confirmed. However, all four of these species are conservatively considered subject to a take because mapped habitat or potentially suitable habitat could be affected by project activities and because bristly buttercup is an annual plant that can germinate almost anywhere in the floodplain when conditions are suitable.

Table 1. State-Listed Plant Species in Reach 5A Subject to a Take

Scientific Name	Common Name	State Status[1]
Ranunculus pensylvanicus	Bristly Buttercup	SC
Eragrostis frankii	Frank's Lovegrass	SC
Elymus villosus	Hairy Wild Rye	E
Eleocharis intermedia	Matted Spikerush	T
Carex tuckermanii	Tuckerman's Sedge	E
Sagittaria cuneata	Wapato	T
Lobelia siphilitica	Great blue lobelia	E

Notes

1. T = Threatened; E = Endangered; SC = Special Concern

2. Rare Plant Species Descriptions

2.1 Bristly Buttercup

Summary of Species Life Cycle and Habitat Requirements

Bristly buttercup is an annual or short-lived perennial member of the buttercup family (Ranunculus). Bristly buttercup is a Species of Special Concern under the Massachusetts Endangered Species Act (MESA) (MESA 2024). Bristly buttercup is differentiated from other buttercups by its leaves, hairy (pubescent) stem, flowers and fruits. Leaves are alternate, toothed, and trifoliate with three deeply cut lobes. Stiff, bristly, spreading hairs cover the tall branched or unbranched stems (1 to 2.25 ft), creating a distinctive pubescence. The small, pale-yellow flowers (0.6 to 0.8 cm wide) form on short stalks and are composed of 5 egg-shaped petals which turn whitish over time. The achenes (small dry fruits) have short, stout, but not hooked, appendages projecting from their tips that form a short cylindrical cluster (0.8 cm to 1.3 cm long). In Massachusetts, bristly buttercup flowers from the beginning of July through September.

Bristly buttercup is not typically capable of spreading vegetatively, although is able to colonize a variety of habitats through seed dispersal by water and wildlife. The successful germination of its seeds and seedling establishment are critical to its persistence. Suitable habitats for colonization have open to filtered light and wet to periodically flooded conditions including marshes, bogs, moist clearings, wet

woods, stream banks, and ditches. Bristly buttercup may often inhabit disturbed riverbanks and managed wetland communities in utility corridors, as well as other disturbed areas. Massachusetts populations have been documented in marsh edges, vernal pools, seasonally flooded riverbanks, wet swales, drawn down glacial kettle holes, shrub swamps, and edges of, or openings in, floodplain forests. Bristly buttercup populations are currently known to occur in Berkshire County in the towns of Pittsfield, Lenox, Sheffield, and New Marlborough; and 14 towns from Hampden and Worcester Counties (MassDFW 2026b).

Bristly Buttercup Habitat in Reach 5A

According to 2025 MNHESP database information, habitats of the bristly buttercup occur in one area of Reach 5A, approximately 29.4 acres in size in the central portion of Reach 5A to the west of the Housatonic River. This area contains riverbank and a diversity of floodplain habitats conducive to the growth of the bristly buttercup, including floodplain forests, wet meadows, shallow emergent marshes, and shrub swamps. Due to the ability of bristly buttercup to grow successfully in many different wetland and floodplain habitats, it could potentially be found within any of the habitat types which have been mapped by MNHESP (other than any strictly aquatic habitat in Reach 5A), and most of the mapped species habitat appears suitable for this species. In addition, due to the annual nature of this species, plants may not always occur in the same areas from year to year.

AECOM encountered one individual of bristly buttercup during the 2025 survey in Reach 5A (AECOM 2025). [redacted]. AECOM did not observe bristly buttercup within the portion of the survey area mapped as habitat for this species by the MNHESP.

2.2 Frank's Lovegrass

Summary of Species Life Cycle and Habitat Requirements

Frank's lovegrass, also known as sandbar lovegrass, is an annual grass species identified by its repeatedly branching clusters on straight stems from about four inches up to a foot high. Frank's lovegrass is listed as a Species of Special Concern under MESA (2024). It has narrow blades measuring 5-13 cm long and 1-3 mm wide, and tiny ovate spikelets with typically 3-5 flowers that are present from August-September. In Massachusetts, Frank's lovegrass occurs on sandbars and sandy riverbanks found only along the Housatonic and Connecticut Rivers. Despite the current Frank's lovegrass habitat mapping from MNHESP extending throughout the southern portion of Reach 5A, the MNHESP (2015) Frank's lovegrass fact sheet does not show this species occurring in Pittsfield on the MNHESP distribution map; however, does show it occurring in Berkshire County in the towns of Lee, Cheshire, Windsor, Richmond, Great Barrington, Alford, Sheffield, and New Marlborough; as well as in eight towns throughout Franklin, Hampshire, and Hampden Counties. Eighteen current occurrences have been verified (MassDFW 2026b).

Mapped Species Habitat in Reach 5A

According to the 2010 NHESP database information, Species habitat mapping for Frank's lovegrass did not occur in Reach 5A. According to the 2025 MNHESP database information, the species habitat mapping for Frank's lovegrass now covers the lower half of Reach 5A, as well as further downstream as in 2010. The mapped habitat for Frank's lovegrass is composed of river channel, including sandbars within the river, riverbank, and some floodplain habitat, and totals approximately 25.9 acres in size along a roughly 2.5-mile stretch of the river in the downstream end of Reach 5A. This species prefers sandy substrate within or at edges of the river channel. Based upon the recent surveys of habitat conditions along the Housatonic River in Reach 5A, suitable conditions to support the growth of Frank's lovegrass appear to occur throughout this portion of Reach 5A.

[redacted], this

species was not as densely established as matted spike-sedge. Although mapped by the MNHESP as occurring in the southern half of Reach 5A, [redacted]
The total estimated population of Frank's lovegrass in Reach 5A was 600 individuals.

2.3 Hairy Wild Rye

Summary of Species Life Cycle and Habitat Requirements

Hairy wild rye is a native perennial, tufted grass in the family Poaceae distinguished by its bristly, white pubescent "bottle-brush" inflorescence. Hairy wild rye is an Endangered Species under the MESA (2024). It grows to just over a meter high with stems topped by an elongate, often arching terminal spike (inflorescence) which is densely covered with whitish villous pubescence, creating the very bristly appearance distinctive of hairy wild rye. Spikelets form tightly within the typically arching spike. Each spikelet has 1 or 2 florets containing a mature single seeded fruit or grain for much of the summer (mid-June through September). Its dark green, evenly distributed leaf blades are 4-12 millimeters wide with a dense villous upper surface.

Hairy wild rye is found in floodplain forests, rich moist thickets, and rocky woodlands. In Massachusetts, hairy wild rye inhabits high terrace floodplain forests with moist alluvial soils, and moist to dry, rich, rocky open woods and thickets. Hairy wild rye is currently known from Berkshire County in the towns of Pittsfield, Great Barrington, and Sheffield, and Worcester County (MassDFW 2026b).

Hairy Wild Rye Habitat in Reach 5A

According to 2025 MNHESP database information, [redacted]. Hairy wild rye mapped habitat comprises approximately 18.9 acres. The areal extent of the mapped habitat includes the riverbanks as well as forested, shrub swamp, and emergent marsh areas in the floodplain. The species habitat contains high-quality habitat suitable for hairy wild rye. Specific occurrences of hairy wild rye have been reported within the forested floodplain habitat in Reach 5A (Woodlot 2002). AECOM did not observe hairy wild rye within the remediation or support areas in Reach 5A during the 2025 surveys (AECOM 2025).

2.4 Matted Spike-Sedge

Summary of Species Life Cycle and Habitat Requirements

The matted spike-sedge is an annual herb belonging to the sedge family and is a Threatened Species under MESA (2024). The matted spike-sedge is a small, tufted plant, about 2-10 inches tall with thin, wiry, leafless-looking stems of different lengths that typically clump together to form the appearance of a mat as shorter stems stand erect and taller stems bend and lay horizontally. The very slender, round stem has a single vertical groove up it and only leaf sheaths surround it, no leaf blades, which gives its leafless appearance. The apex of each stem has a tight cluster of inconspicuous flowers forming the spike appearance of the spike-sedge. A hard, nut-like, tiny achene (dry, one-seeded fruit about 1 mm wide) or fruit of the matted spike-sedge protects its single seed, and the characteristic narrow, small dunce cap appearance of the achene's tubercle (protuberance) distinguishes it from other spike-sedges. As an annual plant, the occurrence and distribution of the matted spike-sedge may vary from year to year depending on the presence of suitable habitat and seed production. The achenes of these species are distributed by moving water and germinate when conditions are suitable at their dispersed location. The light brown to pale olive or yellow achene matures in mid to late summer, and flowers from August-October.

The matted spike-sedge is typically found in marshes, freshwater mudflats, or in other wet areas with muddy substrates. Based on the occurrence of matted spike-sedge in freshwater marsh mudflats or muddy soils, observations of populations in Massachusetts established that matted spike-sedge habitat

involves an essential proximity to a freshwater source, particularly with beneficial fluctuating water levels that create exposed mud conditions during low-water years, such as rivers, ponds, and streams. Regular flooding and/or gentle wave action create the low-level disturbance needed to maintain the more open, muddy habitat conditions where matted spike-sedge thrive. In Massachusetts, the matted spike-sedge is found on muddy, alkaline riverbanks and pond shores, usually during periods of low water when mud is exposed. It is reported only in the western part of the state from twelve towns of Berkshire County including Pittsfield, Lenox and Lee; and four towns from Franklin and Hampshire counties (MassDFW 2026b).

Matted Spike-Sedge Habitat in Reach 5A

According to 2025 MNHESP database information, mapped habitats of the matted spike-sedge extend from the East-West Branch onfluence of the Housatonic River south through all of Reach 5A. Occurrences of the matted spike-sedge have historically been reported along the Housatonic River within Reach 5A west of the Joseph Road area (Woodlot 2002). This species prefers muddy shoreline habitat, and such habitat is broadly distributed along the river margins and shallow backwaters throughout the mapped habitat. The total MNHESP mapped habitat of the matted spike-sedge in Reach 5A covers 116.8 acres. The areal extent of the mapped habitat in Reach 5A is primarily confined to the main channel of the Housatonic River, its riverbanks, and the contiguous backwater areas; however, mapped species habitat also includes areas of forested floodplain, shrub swamp, and emergent marsh along the margins of the river. It is assumed that plants or achenes are also broadly distributed throughout the river and backwater areas, as well as emergent marsh habitats, within the mapped species habitat; however, as this species is an annual plant, the locations of growing plants within the species habitat from year to year are likely to vary.

[redacted] AECOM estimated the total occurrence of matted spike-sedge at approximately 2,000 individuals. It is possible that the extent of matted spike-sedge was increased from typical amounts by the very low water levels of the Housatonic River, which resulted in many exposed mud flats, sand flats, mid-point bars, and shoals. Eroded and steep undercut banks, typical of outside meander bends, were observed to support a few matted spike-sedge plants.

2.5 Tuckerman's Sedge

Summary of Species Life Cycle and Habitat Requirements

Tuckerman's sedge is a perennial herbaceous wetland sedge (family Cyperaceae) that grows in loose clumps up to a meter tall in habitats including river and lake shores, swamps, and vernal pools. It is an Endangered Species under MESA (2024). Tuckerman's sedge has short rhizomes, and erect to arching stems with flat, slender linear leaves and reddish-purple basal sheaths. Its triangular reproductive stems or culms have both staminate spikes that are terminal and pistillate spikes having cylindrical rows of ascending perigyna that typically droop pendulously from the stalk. Its most recognizable feature is the distinctive female flowering spike comprised of clusters of pendulous, inflated teardrop-shaped perigynia that encase the achenes, its one seeded fruit. Perigynia are mature throughout most of the summer, from June through August.

In Massachusetts, Tuckerman's sedge inhabits the rich soils of lowland river floodplain habitats such as oxbows (C-shaped wetlands adjacent to river channels), low depressions, forests, meadows, swales, and vernal pools in the western and central part of the state. Populations that have persisted over time in Massachusetts are found in low depressions or swales within forested floodplains, and apparently thrive with periodic inundation, also benefiting from flooding as a dispersal mechanism. Reported occurrences of Tuckerman's sedge are from Berkshire County in the towns of Pittsfield, Stockbridge, Tyringham,

Sheffield and New Marlboro; and from four towns in Franklin, Hampshire and Worcester Counties (MassDFW 2026b).

Tuckerman's Sedge Habitat in Reach 5A

According to 2025 MNHESP database information, species habitats of Tuckerman's sedge occur in the central portion of Reach 5A northeast of the City of Pittsfield Wastewater Treatment Facility on the west side of the Housatonic River. MNHESP-mapped habitat for Tuckerman sedge comprises approximately 0.9 acres. This area contains a seasonal pool which has a closed canopy and is bordered by shrub swamp habitat to the north and high terrace floodplain forest on the other three sides. All the area within the mapped species habitat in Reach 5A would be suitable for this species.

[redacted] The plants were established too densely to be accurately counted without harming them. The population, estimated at 200 tussocks, was surveyed in 2025 as five separate but closely situated groups, forming a total area of approximately 200 square feet. Tuckerman's sedge was not observed elsewhere in Reach 5A during the 2025 survey.

2.6 Wapato

Summary of Species Life Cycle and Habitat Requirements

Wapato is an aquatic emergent-herbaceous perennial of the water-plantain or arrowhead family (Alismataceae) found in nearly neutral to slightly basic, open-water habitats. Wapato is a Threatened Species under MESA (2024). 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 2 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 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 Hampden County in the town of Holyoke (MassDFW 2026b).

Wapato Habitat in Reach 5A

According to the 2025 MNHESP database information, the MNHESP mapped habitat of wapato extends from the East-West Branch Confluence of the Housatonic River south along the river corridor through Reach 5A. The total mapped species habitat for this species in Reaches 5A comprises 171 acres. Principal natural communities identified within the mapped species habitat include muddy substrates along the shallow edges of the main stem of the river, backwater habitats, and a variety of floodplain habitats, including emergent marsh, floodplain forest, and shrub swamps bordering the river channel. This species requires total to partial submersion in water during most of its life cycle. Thus, seasonally exposed muddy substrates along the river channel, toe of the riverbank slopes, backwater areas, emergent marshes, and seasonal pools in the floodplain forest constitute the primary habitat for this species.

No confirmed observations of wapato were made within the survey area in 2025 (AECOM 2025). [redacted] This individual had leaves somewhat typical of an emersed wapato, but there were no flowers or fruit available to confirm identification to species level. Several common arrowhead were in the vicinity, and this species is well-known to exhibit an extremely high diversity of leaf shapes. The unknown *Sagittaria* was surveyed as a potential wapato.

2.7 Great Blue Lobelia

Summary of Species Life Cycle and Habitat Requirements

Great blue lobelia is a tall, showy, perennial wildflower of the bellflower family (Campanulaceae) that grows in moist to wet open sites with circumneutral soils. Great blue lobelia is a Threatened Species under MESA (2024). In Massachusetts, Great blue lobelia inhabits circumneutral wetland and transitional habitats (wet meadows, fens, swamps, stream sides, moist woodland borders, roadside ditches, and thicket edges of fields and old pastures). Plants generally favor open areas or those with light shade but have also been found in small openings of wooded areas or in shrub thickets (*ibid.*). The common species, Indian-tobacco (*Lobelia inflata*), was also observed in the survey area, but is not a state-listed species.

Plants are stout and erect, up to 1.5 meters (five feet) in height. The alternate sessile leaves are generally oblanceolate and are irregularly toothed along the margins. Great blue lobelia has an angular, pubescent stem, which emerges from a central taproot. The leaves are mostly 8-12 cm long (~3-4 inches), thin, and narrowed toward the base. The inflorescence is a sizable raceme (10-30 cm; ~ 4-12 inches) made up of multiple blue (rarely white) flowers nestled in leafy bracts. The corolla (petal whorl) is fenestrate (with a slit or “window”) on each side near the base, and irregular; the lower side is three-lobed, and the upper lip is two-lobed and split nearly to the base. The base of the three-lobed lip is white with two tubercles. The filaments and anthers are fused together into a tube with the lower two anthers shorter and bearded at the tip. The style grows through the tube and the stigma is two-lobed. The calyx is distinctive, comprising foliaceous, pubescent bracts that are basally lobed with auricles (ear-shaped appendages). The fruits are two-chambered capsules that split open at maturity to disperse copious tiny seeds. Great Blue Lobelia flowers in late summer, when it is unlikely to be confused with any other species (MassDFW 2026b).

Great Blue Lobelia Habitat in Reach 5A

Great blue lobelia was observed during the 2025 field surveys (AECOM 2025). However, it was not previously mapped by the MNHESP in Reach 5A or within Pittsfield, Massachusetts but it is known from a few municipalities in southern Berkshire County. [redacted]

Because no MNHESP mapped habitat is available for this species along the Housatonic River, the total area of potential habitat was calculated as a 20-foot wide swath along each riverbank from the most upstream observation to the most downstream observation for a total of approximately 16.7 acres.

This state-listed endangered species is known from a few municipalities in southern Berkshire County but has not been documented in Pittsfield, was not included in the MNHESP Species Habitat mapping and therefore was not on the list of target species.

3. References

AECOM 2024. *Revised Housatonic River Reach 5A Baseline Restoration Assessment Report*. Prepared for General Electric Company, Pittsfield, Massachusetts. February 2024.

AECOM 2025. *Housatonic River Reach 5A - State-Listed Plant Survey Report*. Prepared for General Electric Company. December 16, 2025. (Submitted as Confidential Business Information, with public review version submitted on February 13, 2026.)

Massachusetts Division of Fisheries & Wildlife (MassDFW). 2026a. State-listed Species Habitat Assessment & Survey Guidelines: Plants. Available URL: download.

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Woodlot (Woodlot Alternatives, Inc.), 2002. Ecological Characterization of the Housatonic River. Prepared for EPA Region 1, Boston. Contract No. DACW33-94-D-0009/032. September 2002.

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Attachment A-3: State-Listed Lepidopterans and Habitats

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1. Introduction

This attachment to the Rare Species Conservation and Management Plan (Appendix B of the Housatonic River Reach 5A Restoration Plan) has been prepared to provide descriptions of habitat requirements for two state-listed lepidopterans – the mustard white butterfly (*Pieris oleracea*) and the ostrich fern borer moth (*Papaipema sp.*).

The surveys for these insect species were conducted in the riverbank, backwater, Other Waterbody, floodplain, and vernal pool areas in Reach 5A that are currently anticipated to be subject to remediation or to support activities (i.e., access roads or staging areas) and focused on the host plants used by these insects. The results of these surveys were presented in the *Housatonic River Reach 5A Rare Butterfly and Moth Species Survey Report* (AECOM 2025).

2. State-listed Species Descriptions

2.1 Mustard White Butterfly

Summary of Species Life Cycle and Habitat Requirements

The mustard white butterfly is a Threatened Species under the Massachusetts Endangered Species Act (MESA; 2024). It is a pierid butterfly with a wingspan of 32-50 mm. The wings are white, and the underside of the hind wing has a small yellow spot at the humeral angle and gray to black scales outlining the wing veins in the spring brood. Outlining of the veins is faint, almost absent, in later broods. The wings are unmarked above except for a small amount of gray to black shading along the costa and at the apex of the forewing (MassDFW 2026).

The mustard white butterfly inhabits openings in mesic forest, including riparian floodplains, margins of fens and marshes, streamsides, wet meadows, fields and pastures (*ibid.*). There are three to four broods of butterflies per year with flight periods beginning in mid- to late-April and continuing through early September. Adult butterflies feed on nectar from their host plants as well as a variety of other flowers. Larvae feed on two-leaved toothwort (*Cardamine diphylla*), cuckoo-flower (*Cardamine pratensis*), watercress (*Nasturtium* spp.), and other mustard family plants (Brassicaceae). Female butterflies will also lay eggs on the invasive species garlic mustard (*Alliaria petiolata*), which has contributed to this species decline as larval growth is slower and survivorship poor on this plant. Massachusetts is at the southernmost extent of the mustard white's range in eastern North America and occurs in seven towns in Berkshire County, including Pittsfield, Lenox and Lee (MassDFW 2026).

Mustard White Habitat in Reach 5A

Based on the MNHESP habitat mapping provided by MNHESP, habitats for the mustard white butterfly includes the Reach 5A floodplain from Holmes Road to the downstream limits at the Pittsfield/Lenox town line, comprising a total of 327 acres within the 1 mg/kg isopleth and an additional 196 acres within 1,000 feet of the isopleth. This area contains riverbank and a diversity of floodplain habitats including floodplain forests, wet meadows, vernal pools and shrub swamps where mustard white host plants can grow.

AECOM did not observe the mustard white butterfly within the remediation or support areas in Reach 5A during the 2025 surveys (AECOM 2025). However, although surveys were conducted during the flight period for this species, the effort focused on identification and mapping of host plants for this species. A total of 13 species of the Mustard family were observed in Reach 5A. Pennsylvania bittercress, cuckoo flower, poorman's-pepperwort, and creeping yellowcress are native species. Garlic mustard and dame's-rocket are listed as Massachusetts invasive species, and narrow-leaf bittercress is listed as likely invasive. The other six identified species in the Mustard family are non-native species but not listed as invasive or likely invasive. Garlic mustard is the only species in the mustard family known to be toxic to the mustard white (APWG 2025). Excluding garlic mustard, which was present throughout all of Reach 5A

and adjacent areas, other host plants for the mustard white were observed sporadically throughout the Reach 5A floodplains, predominantly within transitional floodplain forest habitats, and within open field habitats located on and adjacent to the floodplain downstream of Holmes Road.

2.2 Ostrich Fern Borer Moth

Summary of Species Life Cycle and Habitat Requirements

The ostrich fern borer moth is a Special Concern Species under MESA (2024). This moth is not formally described in published scientific literature. It is a noctuid moth (Noctuidae family) with bright, orange-yellow forewings overlaid with darker, brownish-orange, sometimes with pink shading towards the outer wing margins. Some individuals are a lighter, more faded yellowish-orange, or a darker, more brownish-orange. The reniform spot is large and white with an orange center; the orbicular spot is white, with two identical, merged spots immediately below. The hind wings are a uniform pinkish-tan. Wingspan is 32-36 mm. The larva has an orange to orangish-brown head and prothorax, and a nondescript, cream-colored body with small black spots and spiracles; it grows to a length of approximately 35 mm (MassDFW 2026).

The ostrich fern borer moth inhabits mature floodplain forest and wooded swamps with ostrich fern (*Matteuccia struthiopteris*) (*ibid*.). The ostrich fern borer moth has a comparatively short flight period, with broods active from late August through September. Eggs overwinter and hatch in the spring. The larvae then bore into and feed on the stems and roots of ostrich fern until they are fully grown and then pupating in August. Threats to this species include aerial insecticides and anything that might impact the growth and survival of its host plant, ostrich fern. In Massachusetts, the ostrich fern borer is known from six towns in Berkshire and western Hampshire and Hampden Counties, including Pittsfield and Lee, Massachusetts (MassDFW 2026).

Ostrich Fern Borer Moth Habitat in Reach 5A

Based on the Species Habitat Mapping provided by MNHESP to date, mapped habitat for the ostrich fern borer moth includes the Reach 5A floodplain from Holmes Road southward to areas just north of the Pittsfield Waste Water Treatment Plant, comprising a total of 171 acres within the 1 mg/kg PCB isopleth and an additional 22 acres within 1,000 feet of the isopleth. Habitats within the mapping limits include riverbank, backwater, open floodplain, and vernal pool habitat types as well as all of Canoe Meadows and floodplains along Sykes and Sackett Brooks.

AECOM did not observe ostrich fern borer moth within the remediation or support areas in Reach 5A during the 2025 surveys (AECOM 2025). However, although surveys were conducted during the flight period for this species, the effort focused on identification and mapping of host plants for this species. The only host plant for the ostrich fern borer moth is the ostrich fern plant, which is a member of the sensitive fern family (Onocleaceae). This host plant was ubiquitous along the upper banks of the Housatonic River and was a dominant plant in the herbaceous layer throughout floodplain forested areas within Reach 5A from the East-West Branch Confluence of the Housatonic River down to the end of Reach 5A.

3. References

AECOM 2025. *Housatonic River Reach 5A - Rare Butterfly and Moth Species Survey Report*. Prepared for General Electric Company. November 17, 2025.

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Attachment A-4: State-Listed Dragonfly Life History and Habitat Use

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Table 2-1. Larval Habitat Summary A4-2

1. Introduction

This attachment to the Rare Species Conservation and Management Plan (Appendix B of the Housatonic River Reach 5A Restoration Plan) provides a focused synthesis of the life history and habitat requirements of state-listed dragonflies in Reach 5A. It describes the physical and biological characteristics of habitats supporting each life stage—from larval development and emergence to adult foraging and dispersal—within the context of the Reach 5A area. This information has been generated primarily from MNHESP summaries at: https://www.mass.gov/info-details/list-of-endangered-threatened-and-special-concern-species#dragonflies

2. Life History and Habitat Descriptions

This section addresses five state-listed dragonfly species identified by MNHESP mapping as occurring or potentially occurring in Reach 5A: brook snaketail (*Ophiogomphus aspersus*), rapids clubtail (*Phanogomphus quadricolor*), riffle snaketail (*Ophiogomphus carolus*), spine-crowned clubtail (*Hylogomphus abbreviatus*), and ocellated darner (*Boyeria grafiana*). For the purposes of habitat description and life history analysis they are organized by life stage corresponding to riverine/larval and terrestrial/adult habitats in Reach 5A.

Section 2.1 addresses larval habitat within the river channel and at the emergence area along the shoreline. This includes the in-channel mosaic of riffles, runs, pools, and associated substrates that support larval development, as well as the gently sloped, well-vegetated shorelines and mid-channel emergent features such as rocks and large woody debris that support emergence from aquatic to terrestrial life stages.

Section 2.2 addresses adult habitat, which spans a broader range of features: riverbank, riparian edge, backwater edge, floodplain edge, and selected open areas. These habitats collectively provide foraging, shelter, dispersal, and reproductive opportunities for adult dragonflies reflecting the species' reliance on both aquatic and adjacent terrestrial environments.

2.1 Larval Life History and Habitats

A summary of the larval habitat of each of the five state-listed dragonfly species is presented in Table 2-1. Descriptions of the habitat and mapped presence in Reach 5A are presented below by species. Across these taxa, larval development may extend across multiple years, and species-level identification is often most reliable at the final instar or from exuviae. Many gomphids require approximately two to four years to reach the final instar, exuviae generally persist for only about one to three weeks, and developmental timing varies with temperature, resource availability, microhabitat conditions, and disturbance from high flows and scouring (Walker 1958; Dunkle 2000; COSEWIC 2018; Suhling et al. 2015; Stahl and Johansson 2024; AECOM 2026).

Table 2-1. Larval Habitat Summary

Species	Habitat Summary
Brook Snaketail	Sand-bottomed streams with intermittent rapids and moderate to swift currents.
Rapids Clubtail	Clear, cold streams with coarse gravel and cobble substrates in riffle sections.
Riffle Snaketail	Clear, cold, fast-flowing streams with riffle habitats and fine gravel or sand substrates.
Spine-crowned Clubtail	Medium to large streams with silty and sandy bottoms.
Ocellated Darner	Clear, shallow, rocky streams and rivers with minimal aquatic vegetation.

Brook Snaketail

Brook snaketail larvae inhabit clear, sand-bottomed stretches of streams and rivers, favoring areas with intermittent rapids and moderate to swift currents where sandy substrates in the main river channel provide well-oxygenated conditions essential for larval development. These habitats are characterized by stable, undisturbed sand and intermittent flow variability, supporting the species' burrowing and feeding requirements throughout the larval stage. MNHESP-mapped habitat for this species extends from the East-West Branch Confluence downstream through most of Reach 5A approximately 4.8 miles to river station 231+100.

Rapids Clubtail

Rapids clubtail larvae are found in clear, cold streams and rivers with coarse gravel and cobble substrates, particularly in sections with rapid features. In Reach 5A, larval habitat is concentrated in the southern portion, where riffle habitats and high-velocity, well-oxygenated water are present. Larvae burrow into coarse substrates and rely on these dynamic, fast water sections for development and feeding, with habitat quality closely tied to substrate composition and flow regime. MNHESP-mapped habitat for this species is in southern Reach 5A where high-velocity, well-oxygenated water is present.

Riffle Snaketail

Riffle snaketail larvae inhabit clear, cold, fast-flowing streams dominated by riffle habitats and fine gravel or sand substrates. In Reach 5A, larval habitat is primarily located in the upstream portion, where these substrates are abundant. Larvae burrow into the riverbed, utilizing riffle habitats for protection and feeding, and depend on high oxygen availability provided by the dynamic flow of these sections throughout their development. MNHESP-mapped habitat is located in upper Reach 5A, although, based on the survey results that were south of this area, the range of this species is considered to encompass the entire Reach 5A (AECOM 2025).

Spine-Crowned Clubtail

Spine-crowned clubtail larvae are associated with medium to large streams and rivers with silty and sandy bottoms, which provide the preferred burrowing substrates for larval development. In Reach 5A, mapped habitat for this species extends from the confluence of the East and West Branches to the southern extent of the Pittsfield Wastewater Treatment Plant; the mapped larval habitat includes the main stem of the river and associated banks used for eclosion.

Ocellated Darner

Ocellated darner larvae occupy clear, shallow, rocky streams and rivers, as well as rocky-bottomed lakes with minimal aquatic vegetation. In Reach 5A, larval habitat encompasses the entire river corridor, with a preference for rocky, shallow sections that provide suitable substrate and flow conditions. Larvae develop among rocks and rely on clean, well-oxygenated water, with habitat quality linked to the presence of rocky

microhabitats and stable hydrology. The mapped habitat for this species extends across the entire Reach 5A river corridor with preference for rocky sections.

2.2 Adult Life History and Habitats

Gomphidae (Brook Snaketail, Rapids Clubtail, Riffle Snaketail, Spine-crowned Clubtail)

The four species in the Gomphidae (clubtail) family exhibit broadly similar adult habitat requirements, relying on a variety of riverbank, riparian edge, floodplain edge, and adjacent upland features (Orlosfske 2024). After emergence, adults use the immediate riverbank and riparian corridor for initial maturation, basking, and foraging. The structurally complex riverbanks of Reach 5A characterized by mature trees, dense shrub thickets, and sparsely vegetated erosional banks provide critical perching, shelter, and hunting sites. Overhanging branches, undercut banks, and large woody debris offer shaded microhabitats and vantage points for prey interception. The floodplain edge, especially where transitional forest or shrub thickets meet open areas, serves as both dispersal corridor and foraging ground, supporting adult movements between riverine and upland habitats. Mature canopy trees and dense shrub layers along the riverbank and floodplain edge are particularly important for adult clubtails, offering both structural refuge and microclimatic moderation (Remsburg and Turner, 2009). These species also use open areas, such as early successional patches, point bars, and will use corridors created by roads and open areas. Such open corridors can facilitate adult dispersal and foraging, especially when bordered by native vegetation.

Ocellated Darner

The adult ocellated darner, while sharing some habitat preferences with the Gomphidae family, is more strongly associated with rocky riverbanks, shallow margins, and adjacent forested floodplain edges. Adults frequently use shaded, rocky banks and overhanging vegetation for roosting and hunting, and they are often observed patrolling both open water and the interface between river and floodplain. The presence of mature trees and structurally diverse riparian vegetation is essential for providing shelter from wind and predators, as well as for thermoregulation. This species is also known to utilize open, sunlit patches along the riverbank and floodplain edge.

3. References

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Attachment B: Wood Turtle Management Plan

Housatonic Rest of River - Reach 5A

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April 29, 2026

Delivering a better world

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Exhibit A – Contractor and Construction Phase Education

1. Introduction

On behalf of the General Electric Company (GE), AECOM has prepared this Wood Turtle Management Plan as an attachment to the Rare Species Conservation and Management Plan (CMP) associated with the remediation and restoration of Reach 5A of the Housatonic River Rest of River (ROR) project in Pittsfield, Massachusetts. Reach 5A includes riverine, riverbank, backwater, other waterbody, floodplain, vernal pool, and associated upland habitats that will be affected by sediment and soil remediation, bank stabilization, and associated support areas including access roads and staging areas.

Wood turtles are semi-aquatic turtles that rely on a seasonal mosaic of instream, riparian, floodplain, and upland habitats. In the Northeast, they overwinter in streams, are generally more aquatic during spring emergence and autumn return to overwintering areas, and may spend weeks to months in adjacent floodplain and upland habitats during the summer active season. Females typically nest in June in open, well-drained sandy or gravelly settings along point bars, banks, floodplain openings, fields, or other nearby uplands (Compton et al., 2002; Jones & Willey, 2021).

The wood turtle is listed as a species of special concern under the Massachusetts Endangered Species Act (MESA). The Massachusetts Natural Heritage and Endangered Species Program (MNHESP) has mapped wood turtle (*Glyptemys insculpta*) species habitat throughout Reach 5A, including the mainstem river corridor and many adjacent floodplain and support areas. As discussed in the Rare Species CMP, the wood turtle has been determined to be subject to a “take” under MESA due to the remediation and supporting activities in Reach 5A.

In accordance with EPA requirements, GE previously prepared a Reach 5A Wood Turtle Standard Operating Procedure (SOP) and conducted reconnaissance and radio-telemetry surveys of this species in 2025. During the course of these surveys, three adult male turtles were captured, fitted with transmitters, and tracked through telemetry observations between April and November of 2025. Those observations showed spring and fall use to be primarily aquatic, summer use to extend into floodplain and upland habitats, and repeated use of large woody debris, root wads, undercut banks, soft-bottom areas, and point-bar or river-margin settings relevant to basking, refuge, nesting, and overwintering functions. These data, together with MNHESP Species Habitat Mapping and the Revised Reach 5A Baseline Restoration Assessment Report (AECOM, 2024), form the technical basis for this management plan.

This Wood Turtle Management Plan establishes procedures to avoid and minimize impacts to wood turtles prior to and during implementation of Reach 5A remediation activities. It should be read together with the Reach 5A Restoration Plan and Rare Species CMP. Those documents address broader mitigation and post-restoration commitments, including phased work and progressive restoration, incorporation of wood-turtle-beneficial habitat features into Natural Channel Design-based river and riverbank restoration, preservation or protection of selected GE-owned properties containing wood turtle habitat, invasive-species management in restored corridors, and seven years of post-restoration telemetry-based monitoring of wood turtle use of restored habitats and habitat features.

This management plan includes the following elements:

- Responsibilities of participating parties, including a designated herpetologist (DH), GE, field biologists, and construction personnel;
- Pre-construction review, survey, telemetry, and work-area planning measures intended to reduce the likelihood of direct impacts to wood turtles;
- Protocols for active-season and inactive-season site preparation within mapped or otherwise suitable wood turtle habitat;
- Construction-period monitoring and encounter response; and
- Contractor education, qualifications and training, and reporting procedures.

This plan is subject to modification as remediation and restoration activities proceed through the five subreaches of Reach 5A.

2. Methods and Responsibilities

For implementation of this management plan, GE will designate a qualified professional as the DH. The DH will be responsible for wood turtle protection measures in Reach 5A, including survey design, radio-telemetry tracking, data management, construction oversight related to wood turtles, and coordination with GE, EPA, and MNHESP – all subject to the overall supervision of GE and its Construction Manager. Because Reach 5A remediation and restoration are expected to proceed in phased annual segments, the DH will also integrate current wood turtle information into annual work planning, sequencing, and adaptive management.

The DH will:

- Maintain or update project-specific standard operating procedures for wood turtle surveys, handling, processing, transmitter attachment and removal, relocation, release, and documentation;
- Coordinate with EPA and MNHESP regarding any approvals, reporting, or consultation needed for implementation of wood turtle protection measures in Reach 5A;
- Provide technical input to the design and construction teams regarding the spatial and temporal distribution of wood turtle use in relation to finalized work areas, access routes, staging areas, and seasonal sequencing;
- Direct pre-construction wood turtle surveys, telemetry tracking, clearance sweeps, and any targeted installation and inspection of turtle exclusion barriers;
- Oversee contractor training regarding wood turtle identification, avoidance, encounter response, and reporting;
- Ensure that any capture, handling, transmitter deployment, or relocation of wood turtles is performed only by authorized personnel operating under the applicable approved protocol and any required agency authorizations; and
- Maintain records of all survey, telemetry, construction-period monitoring, and incident-response activities and prepare summary documentation for regulatory review, including submission of appropriate observations to the MNHESP Heritage Hub online reporting system.

3. Pre-Construction Activities

The pre-construction activities described in this section are intended to reduce the likelihood that wood turtles are present within active work zones when remediation and support activities begin, and to ensure that annual construction planning is informed by the best available information on turtle distribution, seasonal habitat use, and movements.

Pre-construction tasks will include the following:

- Existing Reach 5A wood turtle survey and telemetry results will be reviewed in relation to finalized annual remediation and support-area footprints, access roads, staging areas, and anticipated sequencing.
- Additional wood turtle surveys will be conducted in 2026 and, if warranted, 2027 to further refine active-season use areas and improve targeting of species-protective measures.
- Specific pre-construction visual encounter surveys and clearance sweeps will be conducted within and adjacent to planned work areas and along access routes in mapped or otherwise suitable wood turtle habitat.
- Radio-telemetry tracking of turtles tagged during Reach 5A survey efforts will be continued and transmitters will be deployed on additional turtles captured during pre-construction surveys, as appropriate and consistent with the approved protocol.

- Field delineation or marking will be performed of annual work limits, restricted-access areas, and any site-specific features or habitats identified for special attention during construction planning.
- Wood turtle exclusion barriers will be installed on a case-by-case basis in discrete locations, such as staging areas or other concentrated work zones, where continuous direct oversight is not feasible or where survey and telemetry data indicate elevated risk of turtle-construction interaction.
- Initial coordination meetings will be held among the DH, the Construction Manager, and the remediation contractor to review annual work sequences, sensitive habitat areas, wood turtle protection procedures, and encounter-response protocols.

Any wood turtles encountered during pre-construction surveys will be processed in accordance with the approved SOP, including photo-documentation and recording of basic morphometric information as appropriate, and will be released into suitable habitat outside planned work areas at locations selected by the DH. If an individual is fitted with a transmitter, processing and release locations will be selected to support continued monitoring and to minimize the likelihood of re-entry into active work zones.

3.1 Radio Telemetry

Radio telemetry will continue to serve as a primary tool for understanding wood turtle movements and habitat use in relation to Reach 5A work areas and for informing annual construction planning. The 2025 Reach 5A survey demonstrated the value of telemetry by documenting movements across riverine, riverbank, tributary, floodplain, and upland habitats; identifying overwintering locations; and showing repeated use of large woody debris and other river-margin refuge features. The three tagged turtles showed variable home-range size and made large movements over short time periods, reinforcing the need to evaluate risk at the scale of seasonal movement corridors rather than at isolated point observations alone.

Prior to ground-disturbing activities in mapped or suitable wood turtle habitat, the DH and team will:

- Continue to track turtles tagged during pre-construction surveys in 2025 and 2026 and any additional Reach 5A survey efforts, and fit additional captured turtles with radio transmitters as appropriate under the approved protocol;
- Map and review recent and historical telemetry locations relative to finalized annual remediation areas, access roads, and staging areas, with emphasis on identifying core use areas, travel corridors, nesting areas, and overwintering areas within or proximate to proposed work zones;
- Provide written or mapped summaries of telemetry information to the Reach 5A design and construction teams to support annual finalization of access routes, staging locations, and sequences of work; and
- Use telemetry information to identify locations where additional protection measures may be warranted, such as localized changes in sequencing, enhanced oversight, targeted barrier installation, or more focused surveys prior to disturbance.

Construction planning may be modified based on telemetry results, for example by shifting the timing of work in certain segments, adjusting staging boundaries, or designating areas for focused oversight, in coordination with GE, the Construction Manager, and the remediation contractor and, where necessary, approval by EPA. Telemetry data generated during construction will also inform the broader seven-year post-restoration wood turtle monitoring program described in the Rare Species CMP and Restoration Plan.

3.2 Installation of Turtle Exclusion Barriers

Given the linear extent and complexity of Reach 5A remediation and support areas, continuous exclusion fencing around the full extent of mapped wood turtle habitat is not practicable and would prevent turtles and other wildlife from moving freely across the landscape. Instead, turtle exclusion barriers will be used strategically, on a case-by-case basis, where they provide the greatest benefit and where their installation is feasible without creating additional unnecessary disturbance. Barrier use will be considered in:

- Staging and stockpile areas where heavy-equipment operation and material handling will be concentrated;

- Discrete work zones where construction activities will occur without continuous direct oversight by the DH or trained biological inspectors;
- Access roads and staging areas in wooded area or other areas determined to be sensitive for wood turtles;
- Locations where telemetry or survey data identify repeatedly used travel corridors or high-use areas that coincide with high-intensity construction activities and where physical separation is feasible; and
- Areas where the DH determines that a temporary physical barrier would meaningfully reduce the likelihood of turtle entry into a high-risk workspace, such as extended-duration staging activities, repeated vehicle movements, or constrained access points.

The locations of turtle exclusion barriers will initially be identified in the relevant Supplement Information Packages (SIPs). However, modifications to those barrier locations may be made as turtle movements relative to construction activities are further refined through radio-telemetry tracking and other observational information.

Where barriers are installed, they will consist of silt fence or equivalent material installed along the perimeter of the designated area. The bottom of the barrier will either be toed into the ground or be secured using coir rolls or silt socks so that turtles cannot pass underneath. Stakes or other supports will be installed at appropriate intervals to maintain the barrier in an upright position. Where erosion and sediment controls such as straw bales are needed, they will be placed on the work side of the barrier to reduce the likelihood that turtles could climb over barrier components.

Gate openings or other access points will be designed to provide equivalent protection and will be kept closed when not in active use during the wood turtle active season. The DH or qualified staff will inspect newly installed barriers before the associated area is brought into active use and will identify any deficiencies requiring repair. If a turtle encounter occurs within a fenced area, the DH will evaluate potential entry pathways and may require additional barrier inspections, repairs, or localized changes in work practices.

3.3 Requirements for Active Season (April 1 through October 31) Site Preparation

During the active season, vegetation clearing and other site-preparation activities in mapped or suitable wood turtle habitats will be conducted under direct oversight of the DH or trained biological inspectors. This oversight approach is intended to reduce the likelihood of direct impacts to turtles during vegetation clearing, ground disturbance, access-road use, and establishment of staging areas. Because wood turtle use of aquatic and terrestrial habitats changes through the season, the DH will apply survey methods that reflect both local telemetry results and broader wood turtle survey guidance.

Prior to initiating mowing, grubbing, or ground disturbance within a new work segment during the active season, the DH or trained staff will conduct focused visual surveys along proposed work limits and access routes to locate any wood turtles present.

If barrier fencing is to be installed around a staging or other discrete area, surveys will be conducted immediately prior to installation to remove any turtles from the footprint. Where tagged turtles are known from telemetry to be within or near a planned work area, the DH may adjust the timing of work, conduct more intensive surveys, or temporarily relocate the turtle to suitable nearby habitat outside the work zone, consistent with the approved protocol and any required authorizations.

If a turtle is observed within an active work area and is determined to be within harm's way, work in the immediate vicinity will be temporarily stopped until the turtle can be protected through avoidance, controlled movement away from equipment, or capture and relocation by authorized personnel. Any wood turtles encountered during active-season site preparation will be captured and relocated only by qualified authorized personnel following approved handling procedures. If a turtle is observed outside work areas and access roads and is not within harm's way, it will not be handled unless directed by the DH, to minimize unnecessary disturbance.

3.4 Requirements for Inactive Season (October 31 through April 1) Site Preparation

Wood turtles in Massachusetts typically overwinter in rivers and perennial streams, using features such as undercut banks, woody debris accumulations, root masses, deep pools, and deposits of soft substrate. Full-time submersion typically begins in November and continues through early spring. Chance encounters with turtles in terrestrial habitats (e.g., upland forest, fields, floodplain soils) are unlikely during the inactive season; however, in-channel and near-bank environments may contain overwintering turtles. In Reach 5A, 2025 telemetry documented probable overwintering use of soft-bottom river settings associated with undercut banks, shrub cover, and large woody debris.

Where feasible, some elements of site preparation, such as initial clearing in upland or floodplain areas and limited installation of access routes or staging pads, may be scheduled during the inactive season to reduce the likelihood of turtle encounters in terrestrial habitats. However, when work is proposed in or near riverbanks, backwaters, tributary mouths, or other potential overwintering features during this period, the DH or qualified staff will:

- Review existing telemetry data to identify known or likely overwintering areas within or near the planned work segment;
- Conduct targeted inspections of banks and shallow substrates in the immediate work area, where safe and practicable, to look for overwintering turtles or conditions that indicate high overwintering potential, such as undercut banks, root masses, deep pools, or in-stream woody debris accumulations; and
- Recommend timing, layout, or method adjustments if work is proposed in areas with known or likely overwintering use and avoidance is feasible.

Disturbing turtles during the overwintering period can be fatally stressful to the animal. If an overwintering wood turtle is encountered in a site preparation area during the inactive period, work will stop in the immediate area and a 20-meter buffer zone around the overwintering turtle will be established to protect it from disturbance. EPA will be promptly notified, and MNHESP will be contacted to discuss options for relocation of the animal so that work in the area may be completed.

4. Construction Period Monitoring

Construction-period monitoring encompasses both physical barrier inspections (where barriers are used) and general oversight of work activities in relation to wood turtle protection.

During the construction period:

- The DH and/or trained biological inspectors will be present in the field during key phases of work within mapped or suitable wood turtle habitat, including initial ground disturbance in a new segment, periods of intense activity along access roads, and work in proximity to known turtle use areas based on telemetry or surveys.
- For any area where barrier fencing has been installed, the DH or qualified staff will inspect the barrier at least weekly during the active season and after major storm events, document its condition, and arrange for repairs as needed.
- If a wood turtle is observed within an active work area, work in the immediate vicinity will be temporarily halted and the DH, in coordination with the Construction Manager, will assess appropriate response measures, which may include capture and relocation by authorized personnel, modification of work practices, enhanced monitoring, or adjustment of barrier coverage. Notification will be provided to EPA and MNHESP.
- Any injured or dead wood turtle will be reported to MNHESP. Injured individuals will be transferred to an appropriate wildlife rehabilitation facility, such as Tufts Wildlife Clinic or another MNHESP-approved facility, as directed by MNHESP.

Exclusion barriers associated with a given staging area or work segment will be removed in consultation with the DH once construction is complete and the area has been stabilized and restored.

It is possible that, during the construction period, there may be some short-term overlap in construction activities with the beginning of the wood turtle overwintering period (i.e., first 2-3 weeks of November). Any work occurring during this period will likely be associated with riverbank and river channel restoration, rather than new in-river or riverbank disturbances. However, to ensure protection of wood turtles preparing to overwinter, wood turtles outfitted with radio-transmitters will be tracked weekly beginning in early to mid-October to identify and pinpoint their overwintering locations. If there is any indication that a turtle may overwinter in an area of the river where remediation/restoration activities are expected, efforts will be made to relocate that turtle prior to doing any work. In coordination with MNHESP, such turtles will be moved to other areas of the river where known overwintering habitats are present, if possible, or temporarily retained in captivity if work is near completion. In the event that an overwintering turtle is nevertheless encountered during this period in an active remediation or restoration area, the steps described at the end of Section 3 will be followed.

Note that remedial construction work is unlikely to begin in a given year prior to the end of the wood turtles' overwintering period, and thus the potential for conflicts with overwintering turtles in early spring is unlikely.

In addition to direct turtle protection, the DH will coordinate as needed with the restoration team on preservation, salvage, replacement, or evaluation of habitat features where practicable and consistent with cap stability and final design.

5. Contractor Education

To further ensure the protection of wood turtles, field and construction personnel, including on-site project engineers, equipment operators, and other employees of the Construction Manager and remediation contractor, will be trained to recognize wood turtles and to understand the conservation practices necessary to avoid or minimize direct impacts during access, site preparation, remediation, and restoration activities. Training will emphasize that only authorized personnel may capture, handle, relocate, or otherwise process wood turtles except under special circumstances described in **Exhibit A**.

Training will be provided before the start of annual work in wood turtle habitat and before installation of any barrier fence associated with a new work area. Additional training will be provided for new remediation contractor personnel or crews that begin work within wood turtle habitat after the initial briefing. Topics will include wood turtle identification; expected habitats and seasonal use patterns in Reach 5A; speed, scanning, and stopping protocols along access roads; work-area limits and barrier requirements; encounter-response procedures; communication and stop-work expectations; and reporting requirements.

A field handout describing wood turtle identification, photographs of representative habitats and turtles, and step-by-step response procedures for turtle encounters will be provided to site supervisors and construction crews and is included in this attachment as **Exhibit A**. (The names and contact information for three qualified biologists will be added to this document before it is distributed.) Tailgate reminders may also be used when work is shifting into new annual segments or into areas with recent telemetry observations.

6. Qualifications and Training

The DH will have, at a minimum, a graduate degree in biology, wildlife ecology, herpetology, or a related natural-resources discipline, or equivalent specialized professional experience, together with at least five years of experience working with state-listed turtle species and implementing field surveys and construction oversight for such species. The DH will be familiar with wood turtle handling, transmitter attachment and tracking, habitat-use interpretation, and encounter-response procedures, and will operate under any applicable approved protocol or MNHESP authorization.

Biologists assisting the DH with surveys, telemetry, exclusion-barrier inspection, and construction-period monitoring will have, at a minimum, a bachelor's degree in biology or a related natural-resources discipline or demonstrated experience working with state-listed turtle species, and documented training by the DH in wood

turtle identification, proper handling and care, telemetry protocols, encounter response, and data collection procedures. Any person directly handling or processing wood turtles must be specifically authorized to do so.

7. Reporting

The DH or qualified staff will maintain standardized field forms and/or digital records for all pre-construction surveys, telemetry tracking events, barrier inspections, and construction-period monitoring visits. These records will include, as applicable, dates and times of surveys, personnel present, survey locations and coverage, turtle observations and locations, transmitter deployment and status, barrier conditions, incidents, corrective actions, and communications with construction management or agencies.

During construction, internal oversight records will be prepared during the active season when work is occurring within mapped or suitable wood turtle habitat. Matters requiring immediate attention, such as turtle encounters in active workspace, barrier breaches, or deviations from protection measures, will be communicated promptly to construction management and documented together with the corrective action taken.

At the end of each year of the Reach 5A project, a summary will be prepared by the DH. That summary will describe, for the subject year, any pre-construction survey and telemetry activities, construction-period monitoring and turtle encounters, telemetry-derived information relevant to the remediation and restoration footprint, any injuries or mortalities and associated corrective measures, and recommendations for refining wood turtle protection measures in subsequent phases of Reach 5A or downstream ROR work. The summary will be included in the annual restoration reports described in Section 13 of the Restoration Plan and referenced in Section 9.3 of the Rare Species CMP.

Consistent with the CMP and the broader Reach 5A post-restoration monitoring framework, post-restoration wood turtle monitoring is expected to include telemetry-based monitoring of tagged turtles for seven years following completion of restoration in each subreach of Reach 5A, as discussed in Section 8.2 of the CMP. Monitoring will be used to document habitat use, movement through restored areas, and apparent use of implemented habitat features. The annual reporting will summarize observations relevant to survivorship, injury, mortality, nesting, and use or avoidance of restored areas and restored habitat features.

8. References

AECOM, 2024. *Revised Housatonic River Reach 5A Baseline Restoration Assessment Report*. Prepared for General Electric Company, Pittsfield, Massachusetts. February 2024.

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Exhibit A – Contractor and Construction Phase Education

Purpose

The wood turtle (*Glyptemys insculpta*) is a Massachusetts state-listed species of Special Concern, and is therefore protected against direct harm to the individual, and against destruction or disturbance of its habitat. The purpose of this document is to provide construction personnel with important information that will help reduce the potential for direct harm to individual wood turtles should they be encountered during construction activities. This includes a basic understanding of wood turtle habitat use, instructions on proper turtle handling and temporary detainment and relocation techniques, contact information of at least three qualified biologists, and representative photographs of the wood turtle to assist in proper identification.

General Overview of Wood Turtle Activity and Habitat Use

Wood turtles in the Northeast use a variety of habitats over the course of the year based on life cycle requirements (e.g., nesting and hibernating) and body temperature regulation. A generalized breakdown of this seasonal habitat use is provided below to give contractors an idea of where chance encounters are most likely to occur given the time of year construction activities are occurring;

- *April and May*. Wood turtles are just emerging from hibernation and are typically found within the river or on the adjacent riverbanks and floodplains, usually near the river (i.e., typically within 100 feet). They would be found basking on logs, in dense woody shrub cover, or meandering on the floodplain.
- *June through September*. Wood turtles are typically observed feeding in successional fields, hayfields and forests. They can also be seen in riparian wetlands such as wet meadows, bogs, and beaver ponds. The majority of wood turtle nesting activity occurs in June in areas which provide sandy and/or gravelly substrate (including point bars, cutbanks, sand and gravel bars, and open sand and gravel pits).
- *October through March*. Wood turtles typically spend winters hibernating in flowing rivers and perennial streams. In October, the turtles start to make their way back to the rivers and streams with full-time submersion in the water starting in November. Overwintering occurs in muddy banks, stream bottoms, deep pools, in-stream woody debris, and abandoned mammalian bank-burrows.

Methods

Below is a step-by-step process that shall be followed in the event of a wood turtle observation.

1) If a turtle is observed, first determine if the individual is within harm's way. If the individual is observed outside of exclusion zones (i.e., outside of the work area and access roads), then the turtles should not be handled to minimize disturbance and prevent altering their behavior.
2) When a turtle is determined to be within harm's way, or does not already have a radio-transmitter glued to its shell, it should be captured and temporarily detained until the designated herpetologist has been notified and can perform standard data collection and turtle relocation.
3) When handling a turtle, grasp it firmly by the sides of the carapace (top shell). Wood turtles are typically shy and will typically retract into their shell. If the turtle does not retreat into its shell, be cautious of the turtle's head, mouth and feet. Although wood turtles typically do not bite, they certainly are capable of doing so. In addition, they have very sharp claws and powerful legs for digging, which can scratch the skin.
4) Captured turtles may be placed into a small tub or cooler if necessary. Turtles can easily die from overheating. Therefore, this tub **MUST** be placed in a cool shaded area out of direct sunlight, indoors or out. Outdoor shaded areas must be persistent, that is, make sure that the tub is not in an area that will BECOME sunny later in the day. In addition, fresh vegetation (e.g., leaves, tall grass cuttings) and water **SHALL** be placed into the tub for cover and hydration.
5) Within one hour of capturing a wood turtle, one of the three qualified biologists listed below **SHALL** be notified.

Contact Information for Qualified Biologists

Name _____	Name _____	Name _____
Work No. _____	Work No. _____	Work No. _____
Cell No. _____	Cell No. _____	Cell No. _____
Email _____	Email _____	Email _____

Attachment C: Use of Native Plant Trust Program

Housatonic Rest of River - Reach 5A

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April 29, 2026

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1. Introduction

As discussed in the General Electric Company's (GE's) Rare Species Conservation and Management Plan (CMP), GE has determined that the remediation and supporting activities in Reach 5A of the Housatonic Rest of River (ROR) would result in a "take" of several state-listed plant species under the Massachusetts Endangered Species Act (MESA). Those species are bristly buttercup, wapato, hairy wild rye, Frank's lovegrass, matted spike-sedge, great blue lobelia, and possibly Tuckerman's sedge.

Frank's lovegrass, matted spike-sedge, and great blue lobelia were confirmed to occur in river-margin and bank habitats that overlap anticipated remedial areas in Reach 5A. Bristly buttercup and Tuckerman's sedge were observed only in spatially discrete locations, and the presence of both wapato and hairy wild rye could not be confirmed. However, all four of these species are conservatively considered subject to a take because mapped habitat or potentially suitable habitat could be affected by project activities and because bristly buttercup is an annual plant that can germinate almost anywhere in the floodplain when conditions are suitable. The Tuckerman's sedge "take" determination is tentative and subject to final refinement of work limits and habitat specific avoidance opportunities. This species occurs in only one location, a vernal pool that is subject to remediation. However, the extent of remediation within the pool and the remediation approach have not been finalized and it may be possible to avoid direct impacts to this occurrence.

As further discussed in the Rare Species CMP, GE's proposed measures to minimize and mitigate impacts to these species include use of and coordination with the Native Plant Trust (NPT) to assist with collection and propagation of affected state-listed plants where avoidance is not practicable or certain. The NPT program extends from pre-construction minimization of impacts to long-term conservation measures. This appendix describes the NPT program, acknowledging its comprehensive aspect from pre-construction through restoration and beyond, as the focus of achieving a long-term net benefit for the listed plant species subject to a "take".

In addition to use of NPT for rare plant species conservation measures, GE anticipates use of NPT program for the collection and propagation of host plants for the state-listed mustard white butterfly and the ostrich fern borer moth. Although these two lepidopteran species were not observed during 2025 surveys of Reach 5A, host plants for both of these species were documented within and adjacent to anticipated remediation and support areas, and it is anticipated that remediation and support activities will remove or disturb host plants in floodplain and riverbank settings. Since the presence of both species is assumed to be consistent with presence of host plants, removal of host plants is assumed to result in a "take" of these species. Accordingly, use of the NPT program is proposed to ensure replacement of host plants within the affected work areas. Because the host plants are relatively common native species (not rare in Massachusetts), NPT proceeds somewhat differently than it does for rare species, as described herein.

Although the final NPT scope is still being finalized, this assessment reflects GE's current proposed approach and is presented here as the working framework for rare plant conservation, lepidopteran host plant preservation, and long-term net benefit to the state-listed plant species and lepidopteran species in Reach 5A.

2. Overview of Native Plant Trust Program

NPT is the nation's oldest plant conservation organization (founded as the New England Wildflower Society) and focuses exclusively on conserving and promoting New England's native plants through seed banking, propagation, habitat restoration, population monitoring, and reintroduction efforts.

Key relevant aspects of the programs and services offered by NPT include the following:

- **Rare Plant Seed Bank** — NPT maintains one of the region's premier *ex situ* conservation collections, prioritizing seeds from the ~389 globally or regionally rare New England species (including many state-listed plants). Seeds are collected under strict sustainable guidelines, cleaned, dried, and stored long-term at -18°C at Nasami Farm in Whately, Massachusetts, with periodic viability testing and re-collection as needed. The program follows best practices developed by the Center for Plant Conservation (CPC) to preserve genetic diversity against threats like habitat loss.
- **Propagation and Contract Growing at Nasami Farm** — This 75-acre nursery grows New England native plants from sustainably wild-collected local-ecotype seed. It emphasizes genetic diversity (avoiding clones common in traditional nurseries), organic methods, and no systemic pesticides. NPT offers contract propagation for restoration projects, producing plugs or other material suitable for planting in other areas.
- **Restoration Accelerator** — NPT also runs the Restoration Accelerator program for large-scale seed processing, cleaning, and climate-controlled storage to support habitat restoration. This program provides seed-processing services and climate-controlled storage space (cold-dry room and long-term freezer) and seed-increase plots for native plant growers that need to clean and store large quantities of seed. This program is focused more on locally sourced, seed-grown native species than only rare plant species. It supports large-volume needs for restoration while avoiding over-collection from wild populations. It operates as part of the Northeast Seed Network (https://www.northeastseednetwork.org), which sets regional standards for ethical, ecotypic (locally adapted) seed work.
- **New England Plant Conservation Program (NEPCoP) and Habitat Restoration** — NPT leads collaborative networks of scientists and volunteers for rare-plant monitoring, seed collection, habitat management, and reintroductions/augmentations. It provides locally sourced seed and plants for large restoration projects (e.g., post-Hurricane Sandy coastal work, public-land habitat enhancement) and develops ecotypic seed mixes for broader landscape use.

GE's proposed use of NPT aligns directly with these services. Where avoidance of state-listed plants is not practicable, GE proposes contracting with NPT for collection, handling, off-site propagation, seed banking, and eventual re-establishment as part of both minimization and long-term mitigation/net-benefit measures. In addition, GE proposes to use the Restoration Accelerator program for the preservation of the affected lepidopteran host plants.

3. Use of NPT Program for Rare Seed Banking and Propagation

3.1 Key Elements of NPT Seed Banking Protocols

NPT follows strict, sustainable guidelines aligned with CPC best practices for conventional seed banking. These guidelines ensure that collections do not harm wild populations while maximizing long-term viability and genetic representation. Key elements of the NPT seed collection and banking program are as follows:

1. Prioritization and Permissions

- Priority is given to species with few remaining locations, those declining rapidly, or lacking protection.
- All collections require appropriate state and/or federal permits or approvals (e.g., from Massachusetts Natural Heritage and Endangered Species Program [MNHESP] for state-listed plants) and explicit landowner permission.
- Collections target healthy, well-established populations to capture local ecotypes and genetic diversity.

2. Seed Collection Guidelines (Maternal Line Approach)

NPT uses detailed written protocols for rare plant seed collection (covered in its 2025 training materials for plant conservation volunteers). Core rules include the following:

- 10% Rule: Collect no more than 10% of the available ripe seeds from any individual plant and no more than 10% of the overall population's seed output in a single season. This prevents damage to reproductive potential. (CPC recommends the same limit, with collections ideally spaced across years—e.g., no more than five of 10 years.)
- Maternal Line Collections: For the first 50 plants (genets/genetically distinct individuals) at a site, use a separate glassine envelope or container for seeds from each mother plant. This preserves family-level genetic diversity and allows tracking of provenance.
- Focus collections on mature, viable seeds from multiple unrelated individuals (ideally aiming for seeds from at least 50 mother plants per population and multiple populations across a species' range).
- Randomize selection (collecting not just the largest or most productive plants) and document details thoroughly (location, date, population size, habitat, etc.).
- For annual or short-lived species (relevant to some Housatonic River plants like bristly buttercup or Frank's lovegrass), use extra caution due to population variability year-to-year.

These rules align with broader CPC guidance to aim for ~3,000+ seeds per population where feasible, while never exceeding sustainable limits.

3. Post-Collection Processing

- Seeds are cleaned (removing chaff, debris) and dried under controlled cool, dry conditions to reach an optimal moisture content (typically targeting equilibrium with <25% relative humidity at storage temperature).
- Processing occurs in dedicated facilities, such as the seed-processing building at Nasami Farm (NPT's 75-acre nursery in Whately, MA), which also supports the Restoration Accelerator program for larger-scale native seed handling (described below).

4. Storage

- Orthodox seeds (for most temperate species that tolerate drying and freezing) are stored in a freezer at -18°C (or colder, e.g., -20°C).
- Storage includes primary collections at the Garden in the Woods facility in Framingham, MA, with backup in a new large walk-in freezer for redundancy.
- The rare seed bank is managed separately by NPT staff; common native seeds for restoration use different (but related) processing/storage pathways via the Restoration Accelerator.

5. Viability Monitoring and Maintenance

- At regular intervals (typically every 5–10+ years, depending on species), subsamples undergo germination/viability testing.
- If viability declines, NPT may re-collect seeds from the wild population (following the same 10% guidelines) or use banked material for propagation/reintroduction.
- The long-term goal is to maintain seed viability for decades or centuries as a safeguard against catastrophic loss in the wild, with potential for augmentation or re-establishment.

While NPT applies its applies its core seed banking protocols described above (e.g., the 10% and maternal line collection rules, etc.) uniformly across rare New England species, species-specific variations arise due to differences in life history (annual vs. perennial), seed physiology (orthodox, intermediate, or recalcitrant behavior), habitat requirements, dormancy mechanisms, and collection/processing needs. Most temperate New England wetland, river-margin, and floodplain plants, including the rare plants listed for Reach 5A, produce orthodox seeds that tolerate drying to low moisture content (<12%) and freezer storage. This makes them suitable for conventional banking. Variations still exist in collection timing, cleaning methods, dormancy breaking for propagation, and re-establishment strategies, as described below.

- Orthodox seeds (most common here): These are dried and frozen at -18°C, and have long viability (decades+ with testing/re-collection). Annual plants (e.g., some lovegrasses or spike-sedges) may warrant extra caution in collection volume because populations fluctuate yearly and depend heavily on current seed production.
- Dormancy and germination: Many seeds require cold moist stratification (e.g., 30–150+ days) or specific light/temperature cues. Wetland/aquatic species often need light exposure or wet conditions for germination and may benefit from double dormancy (cold-warm-cold cycles).
- Collection adjustments: Timing aligns with seed maturity (often mid-to-late summer for these species). For small or mat-forming plants, collections emphasize multiple small harvests. Perennials allow repeated collections over years; annuals prioritize preserving local genetics for prompt re-use.

3.2 Application of NPT Program to Rare Plant Conservation in Reach 5A

Use of NPT's protocols for the conservation of the affected state-listed plant species in Reach 5A includes the following in order to provide both immediate genetic safeguarding and material for reestablishment of plant communities:

- Seeds will be collected prior to disturbance from impacted Reach 5A populations, following the 10% and maternal-line rules to preserve local genetics without harming remaining plants.
- Seeds will be cleaned (e.g., removing chaff, perigynia on sedges) at Nasami Farm.
- Banked seeds will be used to support off-site propagation at Nasami Farm, with seed production for annual plants like Frank's lovegrass or matted spike-sedge and plug production for perennials).
- Planting will be tied to restored habitats based on habitat suitability (e.g., sandy point bars for Frank's lovegrass, depositional river margins for spike-sedge), rather than immediate uniform planting.
- Broader ecotypic seed mixes (from common project-area plants) will use similar sustainable collection/processing standards.

This approach emphasizes genetic diversity and site-specific conditions, which supports the plan's long-term net-benefit requirements under MESA.

3.2.1 Species-Specific Notes for Reach 5A Rare Plant Species

The following information draws from general CPC/NPT-aligned practices and available propagation data for these or closely related taxa:

- **Frank's lovegrass (*Eragrostis frankii*)** — This is an annual grass that inhabits river margins and sandbars. The small, fine seeds of this species mature quickly in summer. Related *Eragrostis* species germinate readily after light cold moist stratification (e.g., 14 days) or direct sowing. Banking will emphasize maternal lines due to annual variability. Propagation will focus on seed production for later reestablishment in sandy river margin and point-bar habitats.

- **Matted spike-sedge (*Eleocharis intermedia*)** — This is a small annual plant forming dense tufts on muddy/mucky river margins or emergent marshes. Tiny achenes mature in mid-to-late summer. Since this is an annual plant without rhizomes, collections are conservative. Related Eleocharis species are typically orthodox; germination may require light and moist conditions. Banking will store achenes after cleaning. Propagation will focus on seed production for later reestablishment in restored depositional river-margin settings.
- **Hairy wild rye (*Elymus villosus*)** — This is a perennial tufted grass that inhabits well-drained floodplain forests/meadows. Seeds (with awns/glumes) are orthodox. Related Elymus plants (e.g., Canada wild rye) often need 30–60 days cold moist stratification for reliable germination. This plant will be harvested in summer when it is mature but before heavy shattering. Maternal-line collections will preserve genetic diversity. Propagation will occur via plugs or seeds for later reestablishment in restored floodplain habitats.
- **Bristly buttercup (*Ranunculus hispidus*, including varieties)** — This is a short-lived perennial plant (sometimes behaving annually in floodplains) with achenes. Seeds often require 30–60+ days cold stratification. Buttercup achenes are orthodox but may need light or specific moisture conditions. Collection will occur from discrete floodplain occurrences; processing will involve cleaning achenes. Propagation will occur via seeding or division for reestablishment in suitable moist conditions, noting the species' ability to germinate opportunistically.
- **Wapato (*Sagittaria cuneata*)** — This is a perennial aquatic/emergent plant with tubers (turions) and achenes. Seeds exhibit double (physiological) dormancy, often requiring a cold-warm-cold cycle (e.g., 150+ days total stratification or two winters) and light exposure on muddy substrates. Achenes are orthodox but slow to germinate (up to two years in some cases). Banking is viable after cleaning/drying. Propagation often uses tubers for faster results, but seed banking supports genetic diversity. For application to Reach 5A, propagation will occur via either or both techniques for later re-establishment of the wapato plants in restored backwaters or shallow-water habitats.
- **Great blue lobelia (*Lobelia siphilitica*)** — This is a perennial plant that inhabits moist riverbanks/lowlands. Tiny seeds are orthodox and often need light to germinate (surface sowing); some sources note the need for 60 days cold moist stratification, while others indicate that he plant will germinate without such stratification if fresh. This plant is easy to propagate from seed. Collection of seeds will occur in late summer/fall. NPT will bank seeds and produce plugs for later riverbank/lowland floodplain planting.
- **Tuckerman's sedge (*Carex tuckermanii)*** — This is a perennial sedge found in a vernal pool in Reach 5A. Achene-in-perigynium structures are orthodox. Many Carex plants require cold moist stratification (often 60–120+ days or dormant seeding) and can be slow to germinate. Processing will involve removing perigynia for cleaner storage. Propagation will occur via seeding (stratified) or division for later reestablishment (if necessary) in suitable wetland/vernal pool conditions.

3.2.2 Seed Collection, Propagation, and Planting

Under the proposed scope, NPT will handle pre-disturbance collections, seed banking, and off-site propagation at Nasami Farm for the seven subject state-listed species, plus ecotypic mixes from common plants. Propagation of annuals like Frank's lovegrass and matted spike-sedge will emphasize seed production, and propagation of perennials will focus on production of plugs.

Planting will be habitat-specific (e.g., after creating sandy point bars or depositional margins) and integrated with invasive control and seven-year monitoring to enable reestablishment of the subject plant species along the Housatonic River. Planting will be conducted either directly by NPT (if appropriate contractual provisions can be worked out) or by a separate qualified planting contractor retained by GE. Because some species depend on re-creation of specific physical habitat conditions before they can be successfully re-established, such re-planting will not be implemented as a uniform planting program across all species or habitats. For example, re-establishment of matted spike-sedge is expected to follow restoration of appropriate depositional river-margin settings rather than immediate replacement into freshly restored areas lacking the hydrologic and geomorphic conditions that the species requires.

Likewise, installation of propagated plant material will be tied to the development of appropriate restored habitat conditions, rather than to a single construction milestone.

4. Use of the NPT Program for Rare Lepidopteran Host Plant Conservation in Reach 5A

For the host plants of the mustard white butterfly and ostrich fern borer moth within affected areas where avoidance is not practicable, GE proposes pre-disturbance collection of local plant material as part of the NPT program to reduce direct losses of host-plant resources.[1] Depending on the species and plant form, this will include collection of seed, rhizomes, or other propagules, and potentially transplanting of suitable perennial host plants where feasible for re-establishment in restored areas. This host plant process will be implemented as an additional component of the NPT program. As noted above, because these host plants are common native plants (not rare in Massachusetts), NPT will route the work through the Restoration Accelerator program using Northeast Seed Network standards for ecotypic material. This includes site-specific collection from Reach 5A, processing/storage, amplification, and replanting to support the state-listed lepidopterans where avoidance is impracticable.[2]

Mustard white host plants documented to occur in Reach 5A include 13 species of the mustard family (Brassicaceae). These 13 species (e.g., *Cardamine pratensis* [cuckoo flower], *C. pensylvanica* [Pennsylvania bittercress], *Barbarea vulgaris* [yellow rocket], *Alliaria petiolata* [garlic mustard], *Hesperis matronalis* [dame's-rocket], *Rorippa sylvestris*, *Turritis glabra*, etc.) all produce orthodox seeds (i.e., seeds that tolerate drying to low moisture and subfreezing storage). Standard Restoration Accelerator protocols apply to these species, with only minor species-level variations. Invasive species such as garlic mustard will not be included. NPT has indicated direct experience propagating *Cardamine* species and related Brassicaceae in nursery settings.

The host plant for the ostrich fern borer moth, ostrich fern (*Matteuccia struthiopteris*) is abundant in the floodplain of the Housatonic River and prominent locations have been mapped during the 2025 surveys. Like all ferns, the ostrich fern does not produce seeds but rather reproduces via spores (on separate fertile fronds) and vegetatively via rhizomes. Accordingly, seed-banking protocols do not apply. Instead, it is anticipated that NPT will utilize rhizome collection from Reach 5A impact areas and subsequent rhizome division to produce the necessary ostrich fern plant material for use during restoration. The Restoration Accelerator is suited to handle this approach for increasing the plant material necessary for restoration of floodplain forest and bank habitats where this fern is sporadically abundant.

In summary, the collection of host plant propagation materials for mustard white and ostrich fern borer moth in the Reach 5A floodplain is proposed under the NPT Restoration Accelerator program. Such plant source material is relatively common in Reach 5A and locations have been documented for collection. The processing/storage/amplification/replanting of this source material will follow standard protocols and is anticipated to be highly successful. NPT's approach ensures genetic appropriateness, minimizes wild depletion, and aligns directly with objectives and expectations for Reach 5A restoration and habitat enhancement.

[1] Although the monarch butterfly is not a state-listed species and has only been proposed for federal listing, milkwood plants, which are host plants for the monarch butterfly, will be protected and/or relocated prior to remediation, and milkweed plugs have been included in restoration planting plans to promote the growth of milkweeds and thus provide mitigation for potential impacts on the monarch butterfly. NPT will likely not be used for milkweed propagation, as this species is readily available from multiple sources.

[2] It is noted again that GE's use of the NPT program is still in the formative stage, and is subject to further scope development and execution of formal agreement(s). In addition, as noted above for the state-listed plant species program, replanting of the lepidopteran host plants will be conducted either directly by NPT (if appropriate contractual provisions can be worked out) or by a separate qualified planting contractor.

Appendix C: Invasive Species Control Plan

Housatonic Rest of River – Reach 5A

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April 29, 2026

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Attachment A

Reach 5A Invasive Species - Map Sheets 1-11

1. Introduction

GE's Revised Restoration Performance Objectives and Evaluation Criteria (RPOEC) Report (Arcadis and AECOM, 2024) stated that a specific Invasive Species Control Plan would be included in the Restoration Plan for each Remediation Unit. This Invasive Species Control Plan (ISCP or Plan) has been developed for Reach 5A to align with the remediation and restoration activities planned for Reach 5A. It is provided as Appendix C to the Reach 5A Restoration Plan. The Plan integrates habitat-specific invasive species management strategies for targeted invasive plants within the remediation and restoration footprint, staging areas, and access roads, including an associated 25-foot buffer zone associated with these project components (collectively referred to as the Project Areas), as well as the treatment of all Japanese knotweed regardless of location within Reach 5A. The Plan is designed to ensure that efforts to control invasive plants are conducted prior to or in tandem with soil and sediment excavation, capping, and habitat restoration. In addition, the Plan incorporates a seven-year post-remediation monitoring period and an adaptive response component, which includes follow-up control measures should they be needed. In consideration of the distribution and frequency of invasive species across Reach 5A habitats, the physical and ecological impacts of remediation activities, and proven species-specific control methods, this Plan outlines a comprehensive approach to invasive species management before, during, and after remediation activities.

Invasive plant species were evaluated in Reach 5A using established state, federal, and regional invasive species lists. Invasive plants were defined as those listed as "invasive" or "likely invasive" by the Massachusetts Invasive Plant Advisory Group (MIPAG) and those identified by the U.S. Army Corps of Engineers (USACE) New England District and the Invasive Plant Atlas of New England (IPANE).

The invasive species assessment integrated available information (including aerial photographic interpretation and site-specific base mapping) with field verification conducted in conjunction with riverine, riverbank, backwater, floodplain and vernal pool habitat surveys. Invasive plant occurrence was ranked by relative foliage cover by stratum; discrete contiguous infestations exceeding 50% cover were documented by global positioning system (GPS) where practicable; and extensive groundcover species (e.g., goutweed and garlic mustard) were documented by presence where mapping was impractical.

Native plants are foundational in forming a healthy and productive ecosystem. Re-establishing native plant communities provides ecological benefits by preserving biodiversity of and habitat for other native species such as large numbers of insect species, including moths, butterflies, bees, and other pollinators, birds and mammals. The primary goals of the ISCP are the following:

- Reduce existing invasive populations to ecologically acceptable thresholds in treated areas;
- Prevent further spread of invasive plants;
- Restore plant communities to a state where native plants are the dominant component; and
- Monitor treatment results and adapt management actions accordingly.

As a result of habitat assessments and surveys, invasive plant species were recorded across all habitat types, with the most comprehensive dataset collected in 2022–2023. Collectively, site-specific surveys documented one invasive tree species (Norway maple), eight invasive shrub species, one invasive woody vine (Asian bittersweet), and 14 invasive herbaceous species. The invasive species recorded are described in Section 12 of the Restoration Plan. Invasive plant proliferation on the riverbanks and floodplain is recognized as a significant factor negatively affecting existing habitat and plant community conditions of Reach 5A and its control provides an opportunity to improve habitat functions through site restoration provided that control measures are successfully applied.

The goal of the ISCP is to control and prevent the re-establishment and spread of identified invasive species, minimize ecological impacts associated with invasive plants, and support the recovery of native

plant communities. This will be accomplished by controlling identified invasive plants within treatment areas by means of a combination of herbicide applications supported by other control methods, such as mechanical removal (e.g., grubbing), mowing and cutting, and biological means, as necessary and appropriate. Controlling invasive species is intended to ensure that the existing ecosystem is not further compromised by the colonization and spread of these invasive species, post remediation.

Invasive plants reduce the natural functions of the ecosystem by competing with native species for light, nutrients, and water. They can also change habitat structure and value, adversely affecting native seed production, altering hydrologic regimes in wetlands, and providing substandard resources for native wildlife. This ISCP is designed to manage species based on their degree of invasiveness, location, prevalence within subject plant communities, and in concurrence with habitat-specific remedial activities. Implementation of this Plan will help to ensure that restoration goals, including the re-establishment of native plant communities, are given the best chance of success over the long term, and will allow native plants to undergo natural successional processes to provide enhanced ecological functions compared to present conditions.

2. Reach 5A Existing Habitat Types and Plant Community Conditions

Reach 5A includes approximately 409 acres of habitat. The area contains approximately 39 acres of riverine habitat and 50,000 linear feet of riverbanks associated with the Housatonic River; four acres of backwater habitat; three acres of Other Waterbodies (e.g., Sykes Brook and Sackett Brook); 302 acres of floodplain wetland habitat (including vernal pools); and 55 acres of upland floodplain habitat, of which approximately 31 acres is managed/disturbed habitat (i.e., agriculture and cultural grasslands). Invasive plant species have been documented in all of these Reach 5A habitats.

These habitats are described in detail in the Reach 5A Restoration Plan, as well as in GE's Final Remedial Design/Remedial Action Work Plan for Reach 5A. However, a brief description of each habitat cover type is also provided below, with particular reference to the invasive species aspects, for completeness in this Plan and to aid individuals in implementing this Plan.

2.1 Riverine Habitat

The Housatonic River in Reach 5A includes two primary flowing water habitat designations, as defined by the Massachusetts Division of Fisheries and Wildlife (Swain and Kearsley, 2000): medium-gradient stream (MGS) and low-gradient stream (LGS). Extending approximately 4.6 river miles, the total riverine habitat (riverbed) in Reach 5A is approximately 39 acres, of which approximately 25 acres are classified as MGS and approximately 14 acres as LGS. Since the entire riverbed in Reach 5A will be remediated and restored, treatments for invasive aquatic plants in the river itself are not proposed.

2.2 Riverbank Habitat

Riverbanks in Reach 5A generally range in height from three to seven feet, with some areas of higher vertical banks ranging from eight to 12 feet. This habitat type supports different plant communities as described below.

Riverbank Floodplain Forest: Floodplain forest areas along riverbanks are generally dominated by mature canopy trees such as silver maple (*Acer saccharinum*), box elder (*Acer negundo*), green ash (*Fraxinus pennsylvanica*), and eastern cottonwood (*Populus deltoides*). The midstory and shrub layers commonly include silky dogwood (*Cornus amomum*), gray dogwood (*Cornus racemosa*), and common elderberry (*Sambucus canadensis*). The herbaceous layer is composed of native riparian forbs and grasses.

Riverbank Shrub Thicket: Shrub-dominated riverbank communities are present on lower banks and recently stabilized areas. These areas are characterized by dense stands of willows (*Salix* spp.), red-osier dogwood (*Cornus sericea*), silky dogwood (*Cornus amomum*) and other wetland shrubs.

Riverbank Herbaceous Plant Community: Herbaceous plant communities on riverbank areas typically consist of herbaceous riparian fringes occurring along low bench bank areas and adjacent frequently inundated margins. Vegetation includes native sedges (*Carex* spp.), rushes (*Juncus* spp.), and wetland grasses, along with forbs adapted to seasonal flooding.

All the above plant communities occurring on riverbank habitats currently support populations of several invasive plant species, including one of the most invasive and ecologically damaging, Japanese knotweed. Planned remediation activity in riverbank areas, consisting of excavation and removal of contaminated sediment and rebuilding of the banks with clean material, is anticipated to remove most of the invasive plants.

2.3 Backwater Habitat

Reach 5A contains six designated backwaters covering a total area of 3.9 acres, with individual backwaters ranging from approximately 0.04 to 2 acres. These backwaters consist largely of deep marsh habitat, with some smaller areas of shallow marsh. All six backwater areas in Reach 5A will require remediation. For three of the backwaters, remediation will involve sediment removal and capping (BW 5A-2, BW5A-4 and BW5A-5; two others will be subject to sediment removal and backfilling (BW5A-3 and BW5A-6). For BW5A-1 (located in Core Area 1 habitat), only a small portion will be subject to removal and capping, with the remaining area remediated by the application of an activated carbon-based amendment.

Similar to the riverbed habitat areas, the majority of the backwater habitats will be dredged and capped or dredged and backfilled and these actions are anticipated to remove any invasive aquatic species which may be present. However, unlike the riverbed habitat areas, which will not receive plantings as part of restoration, backwater habitats will be replanted with aquatic submerged and emergent plantings designed to restore and enhance habitat value.

2.4 Other Waterbody Habitat

In Reach 5A, five features were identified as Other Waterbodies: the outlet from Morewood Lake (known as Wampenum Brook), the Intermittent Side Channel, West Pond, Sackett Brook, and the Lower Sykes Brook confluence. As described in the Final RD/RA Work Plan, no remediation is required in Wampenum Brook or Sackett Brook. West Pond and the Lower Sykes Brook confluence are subject to sediment remediation. The Intermittent Side Channel is being disconnected from the main river channel and filled. This latter area will be restored with native floodplain vegetation, forming a forested wetland floodplain with a native shrub thicket.

2.5 Floodplain and Vernal Pool Habitats

Reach 5A includes approximately 370 acres of floodplain habitat, defined by the area between the riverbanks and the 1 millligram per kilogram (mg/kg) PCB isopleth, which approximates the 10-year floodplain. Most of this area (approximately 85%) consists of wetland community types. Floodplain wetlands in Reach 5A are composed of seven plant community cover types. Forested wetland habitats comprise the largest component of the floodplain, totaling approximately 167 acres, with transitional floodplain forest the dominant wetland cover type at approximately 147 acres, followed by high terrace floodplain forest (11 acres) and red maple swamp (nine acres). An additional 147 acres of other floodplain wetland communities include shrub swamp (64 acres), wet meadow (24) acres, and shallow and deep emergent marshes (46 and 13 acres, respectively).

Floodplain upland community types account for approximately 45 acres and occur primarily along the outer margins of the floodplain. These upland habitats include approximately 26 acres of cultural grassland, 4.4 acres of agricultural fields, 14 acres of upland forest cover types, and approximately 0.6 acre of developed/disturbed cover. The floodplain also includes approximately 11.6 acres of open water associated with small ponds and beaver impounded areas of Sykes and Sackett Brooks in Canoe Meadows. Reach 5A also contains 59 seasonally wet depressions that meet the MNHESP criteria for certification as vernal pools.

As with the riverbank plant communities noted above, all floodplain habitats currently support populations of several invasive plant species, including stands of the highly invasive and damaging Japanese knotweed. Planned remediation activity in floodplain areas, consisting of excavation and removal of contaminated sediment and habitat restoration with clean material, is anticipated to remove most of the invasive plants. Detailed planting plans for these habitats, which will be implemented as part of the restoration of the affected floodplain areas, are provided in the Restoration Plan.

3. Invasive Plant Species Control

3.1 Invasive Species Identification and Management

Invasive species identification and assessment in Reach 5A integrated available information (including aerial photographic interpretation and site-specific base mapping) with field-based verification conducted in conjunction with floodplain and vernal pool habitat surveys. Invasive plant species were evaluated in Reach 5A using established state, federal, and regional invasive species lists. As noted above, invasive plants were defined as those listed as “invasive” or “likely invasive” by the MIPAG and those identified by the USACE New England District and by the IPANE. As a result of this assessment, a total of 25 invasive plants were identified and are listed in Table 3-1 below.

Table 3-1. Invasive Plant Species Observed in Reach 5A

Layer	Common Name	*Scientific Name*	Status[1]	Occurrence*
Tree	Norway maple	*Acer platanoides*	AB	FP
Shrub	Japanese barberry	*Berberis thunbergii*	ABC	FP; VP
	Autumn olive	*Elaeagnus umbellata*	ABC	FP
	Burning bush	*Euonymus alatus*	ABC	FP; B; VP
	Glossy buckthorn	*Frangula alnus*	ABC	FP; VP
	Border privet	*Ligustrum obtusifolium*	D	FP; B; VP
	Morrow's honeysuckle	*Lonicera morrowii*	AB	FP; B; VP
	European buckthorn	*Rhamnus cathartica*	ABC	FP; B; VP
	Multiflora rose	*Rosa multiflora*	ABC	FP; VP
Woody Vine	Asiatic bittersweet	*Celastrus orbiculatus*	ABC	FP; B: VP
Herbs	Bishop's goutweed	*Aegopodium podagraria*	AB	FP; B
	Garlic mustard	*Alliara petiolata*	AB	FP; B
	Spotted Knapweed	*Centaurea stoebe*	ABC	FP
	Japanese knotweed	*Fallopia japonica*	ABC	FP; B
	Gill-over-the-ground	*Glechoma hederacea*	B	B
	Dame's-rocket	*Hesperis matronalis*	AB	FP

Layer	Common Name	*Scientific Name*	Status[1]	Occurrence*
	Yellow iris	*Iris pseudacorus*	AB	FP; B: BW; VP
	Moneywort	*Lysimachia nummularia*	A	FP; BW; VP
	Purple loosestrife	*Lythrum salicaria*	ABC	FP; BW
	Water forget-me-not	*Myosotis scorpioides*	D	FP; B; BW; VP
	Eurasian water-milfoil	*Myriophyllum spicatum*	AB	FP; BW; R
	Reed canary grass	*Phalaris arundinacea*	ABC	FP; B; BW; VP
	Common reed	*Phragmites australis*	ABC	FP; VP
	Curly pondweed	*Potamogeton crispus*	AB	BW; R
	Water chestnut	*Trapa natans*	ABC	BW

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

* Occurrence Codes: FP=Floodplain; B=Bank; BW=Backwater; R=River; VP=Vernal Pool

Of the 25 invasive plants identified within Project Areas, 15 have been identified for control measures based on factors such as degree of invasiveness, potential for negatively impacting plant communities over the long-term and existing prevalence with specific habitats. In addition, due to its highly invasive nature, proclivity to outcompete native vegetation, and tendency to form monotypic stands to exclusion of all native vegetation, Japanese knotweed has been identified for eradication wherever it occurs within Reach 5A. The full species list identified for invasive vegetation treatments is identified in Table 3-2.

Table 3-2. Invasive Plant Species Identified for Treatment within Reach 5A

Common Name	*Scientific Name*	Status[1]	Occurrence*
Japanese barberry	*Berberis thunbergii*	ABC	FP; VP
Autumn olive	*Elaeagnus umbellata*	ABC	FP
Burning bush	*Euonymus alatus*	ABC	FP; B; VP
Glossy buckthorn	*Frangula alnus*	ABC	FP; VP
Border privet	*Ligustrum obtusifolium*	D	FP; B; VP
Morrow's honeysuckle	*Lonicera morrowii*	AB	FP; B; VP
European buckthorn	*Rhamnus cathartica*	ABC	FP; B; VP
Multiflora rose	*Rosa multiflora*	ABC	FP; VP
Asiatic bittersweet	*Celastrus orbiculatus*	ABC	FP; B: VP
Bishop's goutweed	*Aegopodium podagraria*	AB	FP; B
Garlic mustard	*Alliara petiolata*	AB	FP; B
Japanese knotweed	*Fallopia japonica*	ABC	FP; B
Purple loosestrife	*Lythrum salicaria*	ABC	FP; BW
Reed canary grass	*Phalaris arundinacea*	ABC	FP; B; BW; VP
Common reed	*Phragmites australis*	ABC	FP; VP

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

* Occurrence Codes: FP=Floodplain; B=Bank; BW=Backwater; R=River; VP=Vernal Pool

A description of each of the invasive plants identified in Table 3-2 along with potential treatment methods is provided in Section 3.2. The terrestrial invasive plant species listed in Table 3-1 but not specifically identified for treatment in Table 3-2 (i.e., gill-over-the-ground, dame's-rocket, yellow iris, moneywort, spotted knapweed and water forget-me-not) are anticipated to be incidentally removed as part of soil and sediment removal associated with remedial activity.

All areas subject to soil removal for remediation will be subject to re-vegetation as part of site restoration. Twenty-five-foot buffer zones around remediation and restoration areas, which will be treated for invasive plants but are not subject to soil removal as part of remediation, are expected to be re-seeded with a cover crop to aid soil stabilization, suppress re-growth of invasive species and encourage growth of native species remaining in such areas. If it is determined based on monitoring that conditions specific to invasive plants warrant additional restoration plantings, the area will be restored with native plantings suitable for observed soil and growing conditions. This determination will be made by GE with the input of an environmental scientist based upon the prevailing conditions, as they evolve over time through the treatment process.

The map sheets provided in Attachment A depict known locations of invasive plants throughout Reach 5A and can be used to guide management actions. In addition, during the 2026 growing season, a survey of the entirety of Reach 5A will be implemented to ensure that all Japanese knotweed areas have been identified and are shown on updated ISCP mapping, so they can be properly targeted for eradication. During this same 2026 survey, areas of common reed (phragmites), which occur within all Project Areas, will also be mapped for future treatments.

3.2 Invasive Species Description and Potential Treatment Protocols

This section describes each of the invasive plants identified in Table 3-2 and potential/preferred treatment protocols. However, those responsible for implementing this Plan are not bound to use these protocols, and invasive species control contractors have flexibility to utilize alternate treatment options with which they have documented success. The invasive plant treatment methodologies described below will be implemented within remediated and restored areas, staging areas, access roads and the associated 25-foot buffer and, with the exception of Japanese knotweed and common reed, are not proposed for the entirety of Reach 5A.

3.2.1 Japanese Barberry

Japanese barberry is a thorny, deciduous shrub introduced from Asia that has become invasive in many parts of North America. It forms dense thickets in forests, pastures, roadsides, and displaces native vegetation by altering soil chemistry. It also creates favorable habitat for ticks by providing a habitat with a suitable microclimate. Effective control of the species requires an integrated management approach combining mechanical removal, herbicide application, and adaptive, long-term monitoring.

For dense infestations and forest understory areas, cut stump herbicide treatments (Glyphosate or Triclopyr) are recommended for this species. The process generally consists of the following steps.

1) Cut stem close to ground.
2) Immediately apply concentrated herbicide to stump.
3) If berries remain on the plant at the time of cutting, take the cut material off-site for disposal.

As with control of many invasive plants, the most effective time for chemical control of Japanese barberry is late summer through early fall, when plants are transporting nutrients from above ground to their roots, this timing maximizes herbicide impacts on root systems. As noted above, if berries are present on the plants at the time of cutting, the plant material should be properly disposed of off-site.

Japanese barberry should be treated wherever it is observed within Project Areas.

3.2.2 Autumn Olive

Autumn olive is a fast-growing, nitrogen-fixing shrub introduced for erosion control and wildlife habitat. It aggressively invades forests, old fields, roadsides, and disturbed sites, forming dense thickets that outcompete native vegetation. It spreads by prolific seed production (bird-dispersed) and can resprout vigorously after cutting.

Effective control requires an integrated, multi-year approach which combines cutting and simultaneous application of herbicide such as Glyphosate or Triclopyr. Cut-stump treatment in late summer or early fall provides the highest success rate for established shrubs, while foliar or basal bark applications can be effective for smaller infestations. If berries are present on the plants at the time of treatment, the plant material should be properly disposed of off-site.

Autumn olive should be treated wherever it is observed within Project Areas.

3.2.3 Burning Bush

Burning bush, also known as winged euonymus, is a deciduous ornamental shrub that has become invasive in forests, woodlands, and natural areas. It spreads by bird-dispersed seed and forms dense understory thickets that suppress native vegetation and tree regeneration. Because it readily resprouts after cutting, effective management requires an integrated, multi-year approach.

Effective control combines cutting and simultaneous application of herbicide such as Glyphosate or Triclopyr. Cut-stump treatment in late summer or early fall provides the highest success rate for established shrubs, while foliar or basal bark applications can be effective for smaller infestations. If berries are present on the plants at the time of treatment, the plant material should be properly disposed of off-site.

Winged euonymus should be treated wherever it is observed within Project Areas.

3.2.4 Glossy Buckthorn

Glossy buckthorn is an invasive plant that can present as a shrub or small tree. The species colonizes wetlands, forest edges, riparian corridors, and disturbed sites and produces abundant berries. It tolerates shade and resprouts aggressively following cutting. Therefore, successful control requires the two-pronged combination approach of mechanical removal and targeted herbicide application.

Initiated in late summer through early to mid-fall, a typical control methodology consists of an integrated, multi-year approach combining cutting and simultaneous application of herbicide such as Glyphosate or Triclopyr. If berries are present on the plants at the time of treatment, cut plant material should be properly disposed of off-site.

Glossy buckthorn should be treated wherever it is observed within Project Areas.

3.2.5 Border Privet

Border privet is an invasive deciduous shrub commonly found in forests, old fields, roadsides, and riparian areas. It also produces abundant berries, which bird and other animals eat and subsequently spread seed. The species can resprout vigorously after cutting and effective control often requires an integrated, multi-year management strategy.

As with other woody shrubs, control measures for this species are best initiated in late summer through early to mid-fall, and the typical control methodology consists of an integrated, multi-year approach combining cutting and simultaneous application of herbicides such as Glyphosate or Triclopyr. If berries are present on the plants at the time of treatment, the plant material should be properly disposed of off-site.

Border privet should be treated wherever it is observed within Project Areas.

3.2.6 Morrow's Honeysuckle

Morrow's honeysuckle is an invasive deciduous shrub commonly found in forests, old fields, roadsides, and riparian areas. Its leaves emerge in early spring and it retains foliage late into fall, giving it a competitive advantage over native plants. It also produces abundant berries, which bird and other animals eat and subsequently spread seed. The species can resprout vigorously after cutting and effective control often requires an integrated, multi-year management strategy.

As with other woody shrubs in the Project Areas, control measures for this species are best initiated in late summer through early to mid-fall, and the typical control methodology consists of an integrated, multi-year approach combining cutting and simultaneous application of herbicides such as Glyphosate or Triclopyr. If berries are present on the plants at the time of treatment, the plant material should be properly disposed of off-site.

Morrow's honeysuckle should be treated in the locations shown on the maps in Attachment A and wherever it is observed within Project Areas.

3.2.7 European Buckthorn

European buckthorn (also known as common buckthorn) is a highly invasive shrub or small tree that colonizes forests, woodland edges, prairies, and other disturbed areas. Its leaves appear early in spring and are retained late into fall, giving it a competitive advantage over native plants. It produces abundant berries, with seeds dispersed by birds. This invasive plant forms dense understory thickets that suppress native plants.

Initiated in late summer through early to mid-fall, a typical control methodology consists of an integrated, multi-year approach combining cutting and simultaneous application of herbicide such as Glyphosate or Triclopyr. If berries are present on the plants at the time of treatment, cut plant material should be properly disposed of off-site.

European buckthorn should be treated in the locations shown on the maps in Attachment A and wherever it is observed within Project Areas.

3.2.8 Multiflora Rose

Multiflora rose is an aggressive, thorny, perennial shrub that invades pastures, forest edges, roadsides, and other natural areas. Its seeds spread when its abundant berries are consumed by birds and small mammals and subsequently dispersed, and by rooting at cane tips when they come in contact with the soil surface. Established plants form dense thickets that restrict access, outcompete native vegetation, and hinder the establishment of native plants.

As with many invasive shrubs, multiflora rose can be controlled using a cut stump chemical treatment approach implemented in the late summer or early fall. Using this method, shrubs are cut close to the ground surface and herbicide such as Glyphosate or Triclopyr is immediately applied to the cut stump.

Distinct proposed treatment areas for this species are shown in the maps in Attachment A. However, multiflora rose should be treated wherever observed within the Project Areas, as described for other woody shrubs.

3.2.9 Asiatic Bittersweet

Asiatic bittersweet is an aggressive, woody vine that invades habitats such as forests, fields, roadsides, and riparian areas. As it climbs and spreads, it can girdle trees, outcompete native vegetation, and expand rapidly through bird-dispersed seeds and root suckering. It is known to resprout vigorously after cutting, due to its extensive root system. Therefore, a chemical control component, using Glyphosate or Triclopyr, is typically required for effective eradication.

Eradication of Asiatic bittersweet requires a targeted herbicide approach, combined with mechanical cutting. Cut-stump treatment in late summer or early fall provides the highest success rate for established

vines, while foliar or basal bark applications can be effective for smaller infestations. If berries are present on the vines at the time of treatment, the plant material should be properly disposed of off-site.

Asiatic bittersweet should be treated in the locations shown on the maps in Attachment A and wherever it is observed in Project Areas.

3.2.10 Bishop's Goutweed

Bishop's goutweed is a fast-spreading, rhizomatous herbaceous, perennial plant. Effective control requires persistence due to the ability of even small rhizome fragments to regenerate. Chemical treatments using a broad-spectrum herbicide such as Glyphosate is the recommended methodology for managing this plant. For this invasive, successful treatment may require multiple chemical applications over one or more growing seasons.

After allowing the plants to grow to a height of 6-10 inches, in spring or early fall, the herbicide would be applied directly to foliage. Additional herbicide treatments every three to four weeks, or the following growing season, may be required based on the timing of initial application, and if regrowth appears.

Proposed treatment areas for Bishop's goutweed include portions of the Project Areas, such as staging areas, access roads, and the 25-foot buffers. Where this species occurs within specific remediation areas, no chemical application is proposed, as it is assumed that removing the top one foot of soil in the remediation areas will be sufficient to control this species in those areas.

3.2.11 Garlic Mustard

Garlic mustard is an invasive biennial herb that dominates areas with its relentless seed dispersal and allelopathic interference with surrounding plants. Successfully eradicating this plant requires eliminating its seed dispersal abilities and disabling dispersed seeds from germinating successfully. Combining physical removal with specific herbicide treatments destroys garlic mustard and nullifies its reproductive capabilities. Disturbing soil can worsen garlic mustard infestations by improving conditions for its disturbance-adapted seeds to germinate. Exact treatment procedures depend on the size of the garlic mustard population being targeted but generally follow the strategy below.

1) Apply an herbicide suitable for the surrounding vegetation (either Triclopyr or Glyphosate) in April to both first- and second-year plants or, alternatively remove garlic mustard by hand in areas with few plants and/or cut/mow dense populations.
2) Note and monitor where garlic mustard was removed and avoid spreading soils from these areas to other locations.
3) Apply pre-emergent herbicide (Pendimethalin) to suppress growth from previously dispersed seeds before snowfall the following November and/or in March.
4) Revisit garlic mustard growth sites to treat any emerging plants in April, either removing, cutting, or applying Glyphosate or Triclopyr to the plants.
5) Repeat steps 3 and 4 as needed and begin replanting natives once emerging garlic mustard becomes sparse.

Proposed treatment areas for garlic mustard include areas of access roads and staging areas, along with the 25-foot buffer extending from these areas and the 25-foot buffer extending from remediation areas, as shown on the maps in Attachment A. Remediation areas themselves are not proposed for treatment. It is assumed that removing the top one foot of soil in remediation areas will be sufficient to control this species in those areas.

3.2.12 Japanese Knotweed

With rhizome depths of up to 10 feet, Japanese knotweed is exceedingly difficult to eradicate. Successful eradication, which can take years to accomplish, typically consists of a combination of herbicide

application and cutting, repeatedly implemented at different times of the year, in successive years. A typical eradication scenario is presented below.

1) Apply a broad-spectrum herbicide (e.g. Glyphosate or similar) on foliage after flowering in late summer or early fall. This results in the plants translocating herbicide from the foliage to the rhizomes and will weaken the rhizome network.
2) Repeat cutting of foliage in the following growing season(s) to continue to weaken the plants, combined with annual herbicide treatment, until eradicated.

Digging into the soil to eradicate knotweed is not recommended in most scenarios due to the potential for rhizomes fragmenting, spreading, and resprouting. Due to the aggressive nature of this invasive plant, GE is committed to attempting to completely eradicate it from the Project Areas. If treatment areas for this plant were limited to remediation and associated areas, recolonization of these areas over time is highly likely.

Proposed treatment areas for Japanese knotweed are shown on the maps in Attachment A. However, this species should be treated wherever it occurs within Reach 5A. As noted above, a survey of the entirety of Reach 5A will be implemented to ensure that all Japanese knotweed areas have been identified and are shown on updated ISCP mapping so they can be targeted for eradication.

3.2.13 Purple Loosestrife

Purple loosestrife is a perennial wetland plant that aggressively invades marshes, wet meadows, shorelines and other wet areas. It can produce high seed quantities (up to 2-3 million seeds per mature plant annually), forms dense monocultures, and displaces native wetland vegetation. Dependent on density, effective control measures often require an integrated, multi-year management approach.

While ecological benefits are likely to result from keeping this plant in check, purple loosestrife does not typically occur at densities that preclude the growth of native plants to an excessive degree. Therefore, for managing this invasive, and depending on availability, biological controls consisting of the release of beetles from the genus Galerucella should be utilized. The presence of these beetles in Reach 5A has been previously documented. Therefore, in order to bolster the existing population of Galerucella beetles in Reach 5A, additional numbers of these beetles should be released on purple loosestrife plants throughout Reach 5A annually for a period of seven years.

Galerucella calmariensis and *Galerucella pusilla* are leaf-feeding beetles used as biological control agents specifically for purple loosestrife. They were introduced to North America in the 1990s after extensive host-specificity testing demonstrated that they primarily feed on purple loosestrife. The goal of releasing the beetles is not to eradicate this plant but to exert sufficient herbivory pressure such that its vigor, abundance, and fecundity are significantly diminished and that it does not expand its footprint within the Project Areas beyond the areas shown on the maps in Attachment A.

Release sites for this beetle within the Project Areas would be determined in the field at the time of release and should be concentrated in areas with the highest density of purple loosestrife observed at the time of release.

3.2.14 Reed Canary Grass

Reed canary grass is a tall, coarse, perennial cool-season grass that thrives in wet, marshy areas. Growing three to nine feet tall, it is highly invasive and forms dense monocultures that displace native vegetation.

This wetland grass can be effectively controlled by combining cutting with herbicide applications. Cutting in mid-summer, allowing the grass to revegetate to a height of eight to 12 inches, and applying a broad spectrum herbicide such as Glyphosate can combine to effectively deplete nutrient reserves in the roots and improve herbicide uptake. Revegetating with native sedges, rushes, and wetland grasses is a critical aspect of this approach.

Distinct proposed treatment areas for this species are shown on the maps in Attachment A. However, this species should be treated wherever it is observed within the overall Project Areas.

3.2.15 Common Reed

Common reed (phragmites) is a tall, perennial grass that aggressively invades wetlands, shorelines, roadside ditches, and other wet areas. It spreads long distances through seed production and transport and locally through expansion of extensive rhizome networks. This plant frequently forms dense monocultures that displace native vegetation.

Herbicide application has been shown to be the most effective approach for established infestations of this invasive plant. As with many other invasive plants, a late summer or early fall application of a broad-spectrum herbicide such as Glyphosate is recommended for control. In late summer and early fall, phragmites plants are translocating nutrients to their rhizomes; it is this downward flow of nutrients that also facilitates herbicide transport, making timing of application of critical importance.

Distinct proposed treatment areas for this species are shown on the maps in Attachment A. However, common reed should be treated wherever it is observed within the overall Project Areas. As noted above, a survey of the entirety of Reach 5A will be implemented to ensure that all common reed areas can be targeted for eradication.

4. Best Management Practices to Prevent the Spread of Invasive Plants

Best management practices (BMPs) designed to prevent the spread of invasive plants will be implemented throughout all stages of the project, including planning, remediation, and restoration. The goals of implementing the BMPs described below are to minimize the spread of existing invasive populations, and to prevent introduction of invasive plant species and seeds into restored areas and associated buffers. Combined with the monitoring and adaptive response activities described in the next section, utilizing the BMPs will maximize the opportunity to protect native plant communities and restoration success. As previously discussed, remediation and restoration areas, staging areas, and access roads, have all been provided with an associated 25-foot buffer zone. By treating invasives in this buffer zone, an additional line of defense has been incorporated into efforts dedicated to preventing invasive plants entering remediated and restored areas. Additional measures are described below.

4.1 Site Access and Hygiene Protocols

To prevent the spread of invasive species, it is critical that remediation and restoration equipment must arrive on-site clean and free of visible soil, invasive plant material, and debris. To achieve that goal, measures designed to reduce the risk of spreading invasive plant material will be implemented at all project entry points, including access roads and staging areas. Hygiene protocols should be implemented as a matter of protocol prior to personnel and equipment entry into remediation and restoration areas. These measures will include:

- Posting signage indicating the need to follow invasive species prevention protocols;
- Installation and use of boot brush stations at all project entry points for all personnel entering the site; and
- Required cleaning of all tools, equipment and vehicles, including tires and undercarriage.

There are several methodologies that may be deployed for cleaning equipment and vehicles including:

- Dry cleaning/physical removal using wire brushes, brooms, shovels, or scrapers to remove packed mud and debris;

- Compressed air using an air compressor with an extension wand to remove dry soil; and
- High-pressure washing (with water) all surfaces, including undercarriages, wheels, and tracks, to remove mud, dry soil and other debris.

Equipment cleaning and associated activities will take place in an area with a hard surface or otherwise in areas where potential run-off will not enter remediation and restoration areas and accumulated sediment and debris can be controlled, collected, and disposed of. Cleaning will occur prior to vehicles entering the Project Areas and before vehicles move from one project location to another. All personnel engaged or proximal to equipment cleaning activities will also utilize appropriate personal protective equipment (PPE), including eye and hearing protection, safety toe footwear, hardhat, gloves, and safety/reflective vest, at a minimum.

Additionally, the designated cleaning area will be monitored to ensure that no invasive plants germinate in that area. If invasive plants are observed within the washing station areas, the plants will be physically removed and properly disposed of at an approved, off-site location, along with accumulated sediment and debris.

4.2 Material Control Protocols

To prevent the introduction of invasive plant material from entering Project Areas from outside sources, strict controls will be implemented for all imported materials, including soil, sediment, fill, rock, logs, sediment and erosion control material, mulch, compost, restoration plantings, seed mixes and all other material which may potentially contribute to the spread or introduction of invasive plants. Where practicable, only certified weed-free materials will be permitted in Project Areas, and all material will be visually inspected for invasive plants and/or plant material prior to admittance into Project Areas. Inspections will verify the certification documentation (if applicable) and absence of visible invasive plant fragments, seeds, or other contamination. Any materials suspected of contamination will be rejected and removed from the site immediately.

All seed mixes and other plantable material for restoration and stabilization will be certified weed-free and sourced from reputable suppliers, with a preference for locally adapted native species (ecotypic) appropriate for the restoration goals. Mulch (e.g., straw, wood chips) will be visually free of weeds and of the seeds, roots, or rhizomes of invasive species. No hay will be utilized for any purpose. All imported soil, compost, fill, and other material will be physically inspected, visually weed-free, and visually free of invasive plant material, including seeds, rhizomes, and root fragments.

Inspection records, material certification (where applicable), and records of rejected deliveries, if any, will be documented and maintained as part of overall project documentation processes.

5. Invasive Species Monitoring and Adaptive Responses

The ISCP's invasive plant monitoring and adaptive response approach, which has been developed in accordance with and is consistent with the RPOEC Report, provides a structured, science-based framework to help ensure the long-term success of restored plant communities by proactively addressing invasive species threats over a seven-year period. These qualitative measures are designed to systematically detect, quantify, and track invasive plant species over time, allowing for early identification of emerging issues and trends, in conjunction with the ability to respond quickly with additional treatment measures. While the monitoring will be primarily qualitative, a threshold of 10% relative abundance (or no greater than documented reference-site conditions where applicable), as provided in the RPOEC Report, will be applied to function as the threshold over which additional invasive treatments would be initiated. By maintaining invasive plant cover at or below this criterion, these measures establish a clear ecological guideline that informs management decisions. When this threshold is exceeded, timely and targeted response actions, consisting of strategic herbicide treatments, will be implemented to prevent further spread and minimize ecological impacts. If needed, chemical treatments will be combined with

supplemental plantings to contribute to the re-establishment of native plant communities. Collectively, these efforts are intended to support the sustained establishment of native plant communities, enhance ecosystem resilience, and promote the recovery of functional, self-sustaining habitats, which in turn will benefit native wildlife.

5.1 Invasive Species Monitoring

For monitoring invasive plant species within the Project Areas, a hybrid qualitative and quantitative monitoring approach will be employed. Such an approach focuses on observing and describing ecological conditions using professional judgment, rather than relying on detailed numerical measurements specific to fixed vegetation plots. This approach emphasizes visual assessment, pattern recognition, and ecological interpretation to evaluate whether invasive species are affecting restored areas.

Qualitative monitoring will involve systematic field observations conducted by trained ecologists who will assess restored site conditions and plant communities based on experience and standardized descriptors. Instead of measuring exact percent cover or frequency of individual plants using standard vegetation monitoring plots, which can skew monitoring results by collecting data on limited areas, observers will evaluate restored habitats by assessing relative abundance, distribution patterns, and ecological impact of invasive species in the context of habitat types.

Key elements to this approach will include visual estimates of invasive species abundance and invasive plant spatial distribution patterns, assessment of the ecological impacts of observed invasive species, and assessment of the overall health and appearance of restored plant communities. These measures will be combined with photographic documentation from fixed, repeatable points facing the same direction. Recreating photographs from the same vantage point will provide visual records over time, helping track changes in vegetation structure and potential invasive spread.

Using the hybrid methodology, visual estimates of invasive species abundance will be categorized using the following descriptive cover classes:

- Absent;
- Rare (isolated individuals);
- Occasional (scattered patches);
- Common (frequent throughout portions of the site); and
- Dominant (visually prominent or forming large patches).

Spatial distribution patterns specific to invasive plants will be documented to record how invasive plants are distributed using the following categories:

- Isolated individuals;
- Small patches;
- Expanding colonies; and
- Widespread.

Ecological assessment of invasive species will be evaluated to measure impacts to restored habitats using the following categories:

- Minimal impact (no noticeable suppression of native species);
- Moderate impact (localized competition with natives); and
- High impact (displacing or preventing native establishment).

The general condition of restored native plant communities will be assessed using the following categories:

- Healthy and diverse;
- Establishing but patchy; and
- Stressed or declining.

Monitoring will be initiated in the year following habitat restoration in each subreach and will continue for a period of seven years, as specified in the RPOEC Report. The parameters associated with the methodology described above will be recorded on project-specific data forms (to be provided in the applicable Supplemental Information Packages) for inclusion in annual monitoring reports. Annual reports on invasive species monitoring and control efforts will be included in the annual reports on restoration activities, as described in Section 13 of the Restoration Plan. These reports will include a summary of monitoring actions taken, existing conditions, a list of native and invasive species observed, general health of plant communities, and maps of observed invasive species, as well as recommendations for the following growing season. After seven years, if site-specific monitoring documents restored habitats with less than 10% overall coverage of invasive species (or less than reference-site conditions where applicable), excluding buffer zones, monitoring will be considered complete and no further action will be taken.

This qualitative monitoring approach provides a practical, experience-based method for tracking invasive plants. The method supports adaptive responses by enabling quick, informed decisions based on observed ecological conditions rather than strict numerical analysis. Should the monitoring activities described above determine that additional invasive plant treatments are necessary, adaptive responses will be implemented as described below.

5.2 Adaptive Responses

Should invasive plants make up greater than 10% of the plant communities and habitat types monitored (or more than reference-site conditions where applicable), responses will be implemented. The nature of the actions taken will be dictated by the prevalence of invasive species observed. In general, using the 10% criterion, if invasive plants constitute 10% or less of the documented plant community in a given restored area, no action will be necessary. For areas with invasive species constituting between 11% and 25%, targeted chemical treatments for invasives and additional native plantings will be proposed. For areas with 26% or greater coverage by invasive species, intensive chemical treatment, combined with additional native plantings and a potential reassessment of site conditions and restoration protocols will be proposed. Any such proposals will be included in the annual restoration reports described in Section 5.1.

Throughout the seven-year monitoring period, the adaptive response strategy will continue to be informed by monitoring results, identification of invasive and other emerging threats to restored areas and the effectiveness of the corrective actions taken. If invasive plant species persist in restored areas above the applicable criterion after seven years, soil conditions, site hydrology and other site characteristics will be reassessed as needed. Consideration will also be given to using alternative native seed mixes, increasing planting densities, and modifying restoration practices, as appropriate.

Conversely, documentation of no new invasive species, invasives at or below the applicable threshold, a reduction in the overall percent coverage of invasive plants over time, increased percent coverage of native plants over time, and habitat structural development will all be indicators of successful restoration efforts.

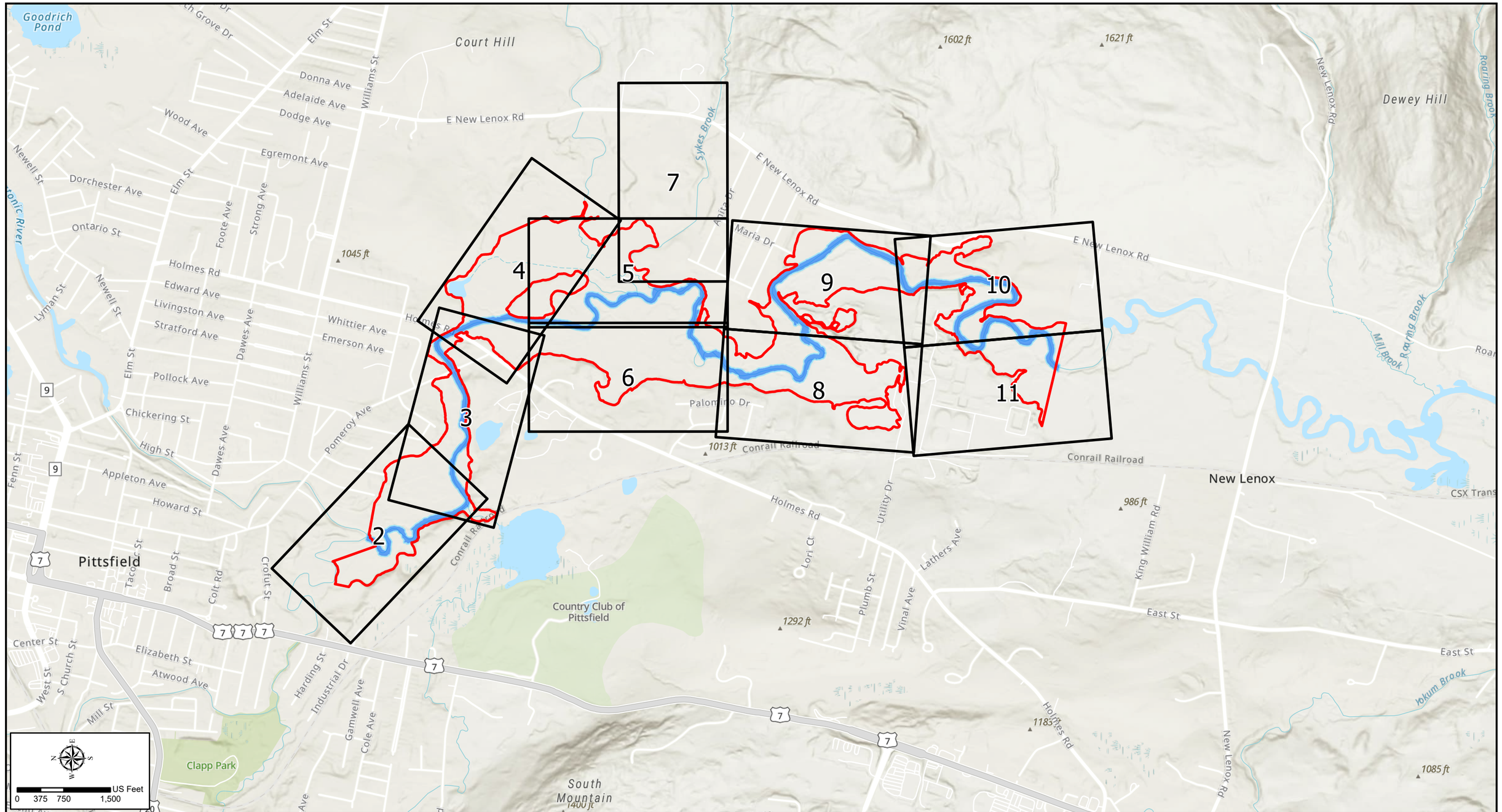
6. References

Arcadis and AECOM, 2024. Revised Restoration Performance Objectives and Evaluation Criteria Report. Prepared for General Electric Company, Pittsfield, Massachusetts. April 2024.

Swain, P.C., and J.B. Kearsley, 2000. *Classification of the Natural Communities of Massachusetts*. Massachusetts Division of Fisheries and Wildlife, Westborough, Massachusetts.

Attachment A

Reach 5A Invasive Species - Map Sheets 1-11



INDEX MAP

Legend

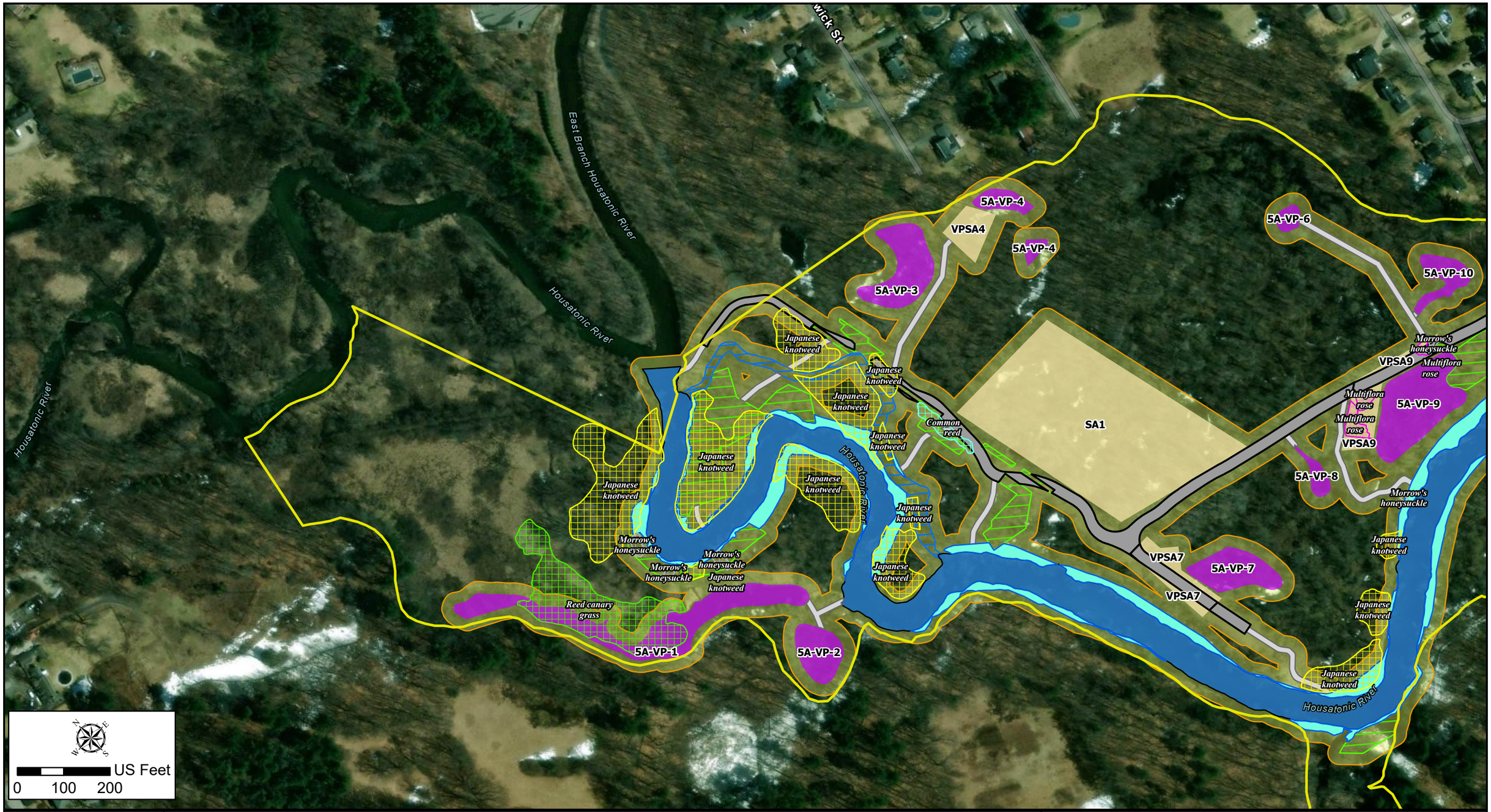
- Reach 5A Isopleth Limit
- Housatonic River
- Mapsheets

Overview Map
Reach 5A Invasive Species
Housatonic River - Pittsfield, MA

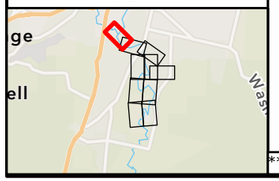
SCALE	DATE	PROJECT NO.
1:18,000	4/20/2026	60670015

AECOM

Map Sheet 1 of 11



INDEX MAP



Legend

- R5A Isopleth Limit
- 25-Foot Buffer from Project Areas
- Backwater Remediation Areas
- Floodplain Remediation Areas
- Primary Access Roads
- River Sediment Removal
- Riverbank Remediation Areas
- Secondary Access Roads
- Staging Area
- Vernal Pool
- Common reed
- Japanese knotweed
- Morrow's honeysuckle
- Multiflora rose
- Reed canary grass

**Note, some treatment areas are located in regulated wetlands and proximal to waterbodies therefore chemical control methods of invasive species in these areas may be subject to local, state, and/or federal law.

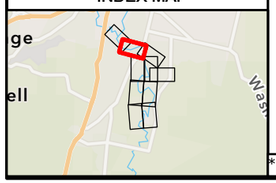
Detail Map
Reach 5A Invasive Species
Housatonic River - Pittsfield, MA

SCALE	DATE	PROJECT NO.
1:2,400	4/20/2026	60670015

AECOM

Map Sheet 2 of 11

INDEX MAP



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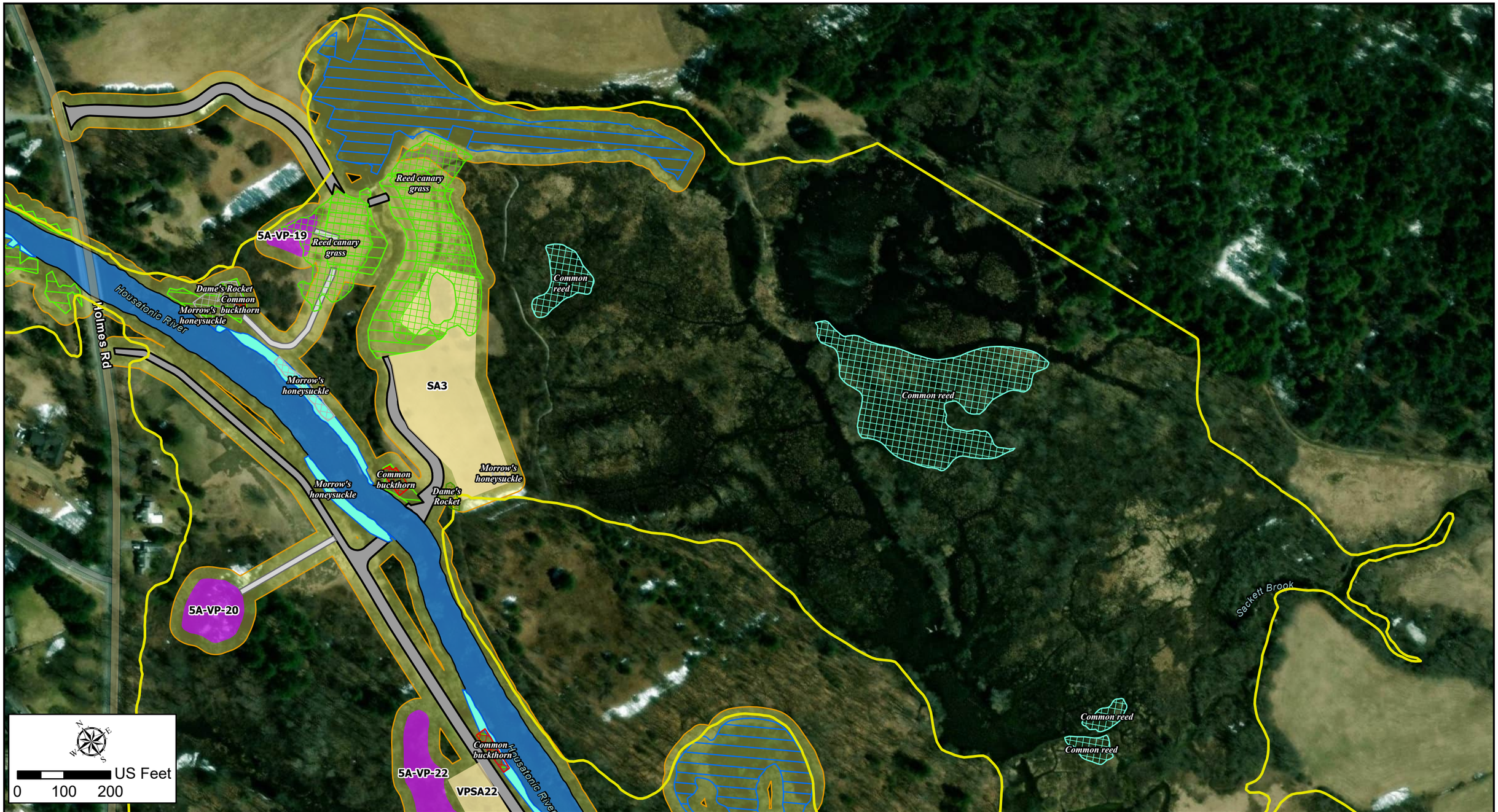
Housatonic River - Pittsfield, MA

SCALE	DATE	PROJECT NO.
1:2,400	4/20/2026	60670015

AECOM

Map Sheet 3 of 11



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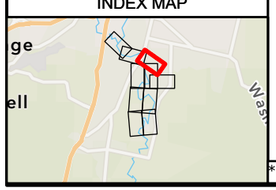

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Housatonic River - Pittsfield, MA

SCALE	DATE	PROJECT NO.
1:2,400	4/20/2026	60670015

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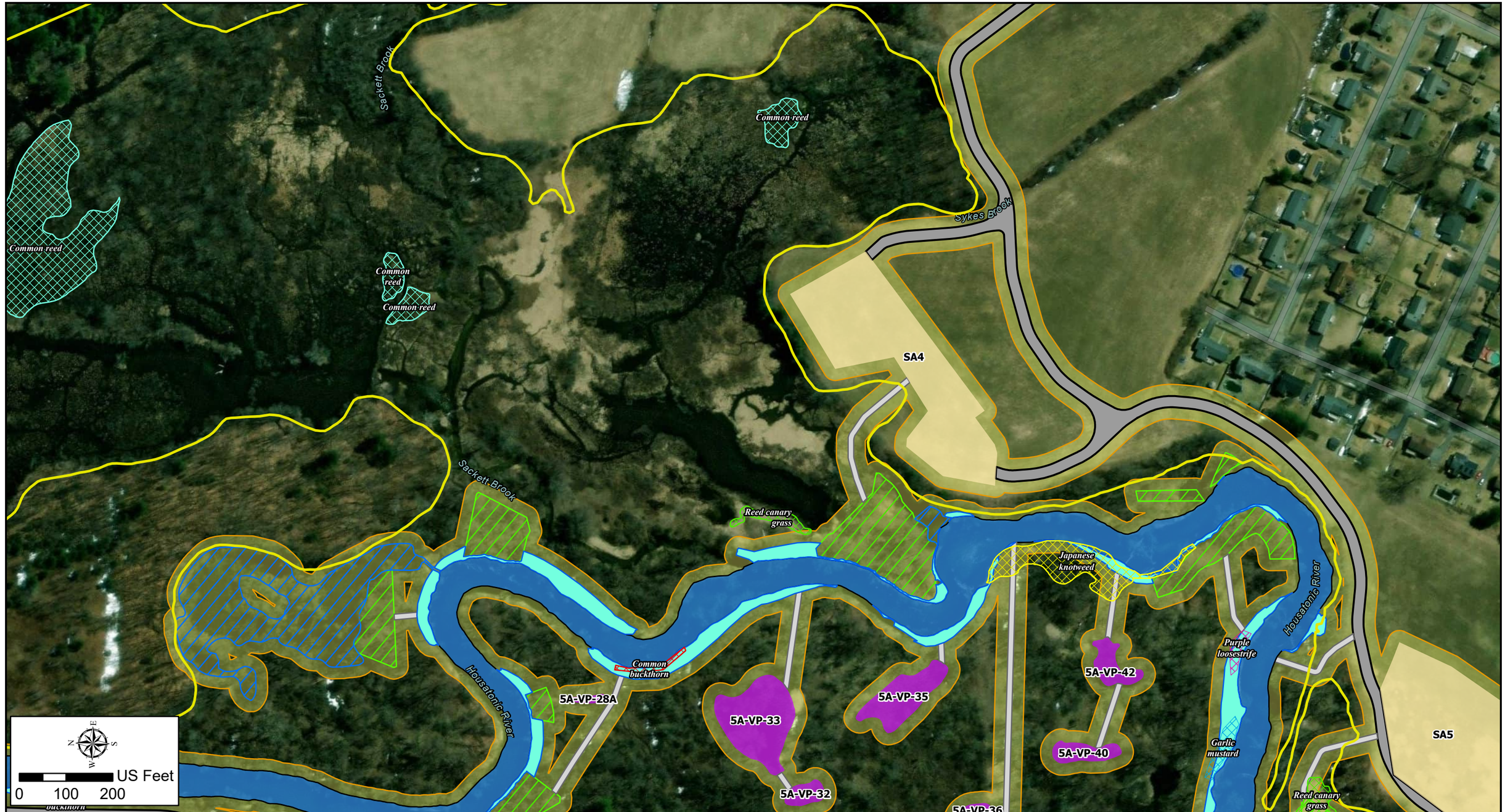
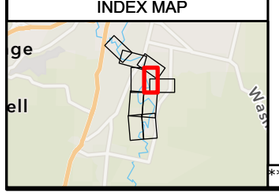


INDEX MAP



Legend

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Detail Map
Reach 5A Invasive Species
Housatonic River - Pittsfield, MA

SCALE	DATE	PROJECT NO.
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AECOM

Map Sheet 5 of 11

Common buckthorn
VPSA22
5A-VP-22
Oriental bittersweet
5A-VP-27
VPSA27
5A-VP-26
5A-VP-32
5A-VP-36
SA5
Purple loosestrife
Reed canary grass
Japanese knotweed
Japanese knotweed
Japanese knotweed
Japanese knotweed
Japanese knotweed
Japanese knotweed
5A-VP-50
Purple loosestrife
Japanese knotweed
Purple loosestrife
Holmes Rd
Holmes Rd
N
E
S
W
US Feet
0 100 200

INDEX MAP

Legend

- R5A Isopleth Limit
- 25-Foot Buffer from Project Areas
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Detail Map
Reach 5A Invasive Species
Housatonic River - Pittsfield, MA

SCALE	DATE	PROJECT NO.
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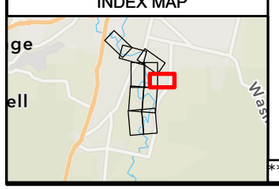
AECOM

Map Sheet 6 of 11

INDEX MAP



Legend

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Detail Map

Reach 5A Invasive Species

Housatonic River - Pittsfield, MA

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AECOM

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SA5

5A-VP-50

5A-VP-49A

Japanese knotweed

Purple loosestrife

Japanese knotweed

Housatonic River

Japanese knotweed

Purple loosestrife

Japanese knotweed

Purple loosestrife

Japanese knotweed

5A-VP-54

5A-VP-52

Reed canary grass

5A-VP-55

5A-VP-57

VPSA54

VPSA54

VPSA54

VPSA57

VPSA57

Japanese knotweed

Japanese knotweed

Japanese knotweed

Japanese knotweed

Japanese knotweed

Japanese knotweed

Japanese knotweed

5A-VP-65

5A-VP-64

Common reed

Common reed

Spotted knapweed

Spotted knapweed

SA6

Morrow's honeysuckle

Oriental bittersweet

Spotted knapweed

Spotted knapweed

Spotted knapweed

Spotted knapweed

Dame's Rocket

Spotted knapweed

N

E

S

W

US Feet

0 100 200

INDEX MAP

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Detail Map

Reach 5A Invasive Species

Housatonic River - Pittsfield, MA

SCALE	DATE	PROJECT NO.
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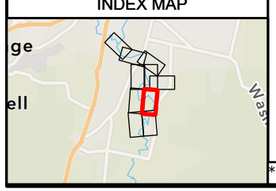
Map Sheet 8 of 11

INDEX MAP



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Housatonic River - Pittsfield, MA

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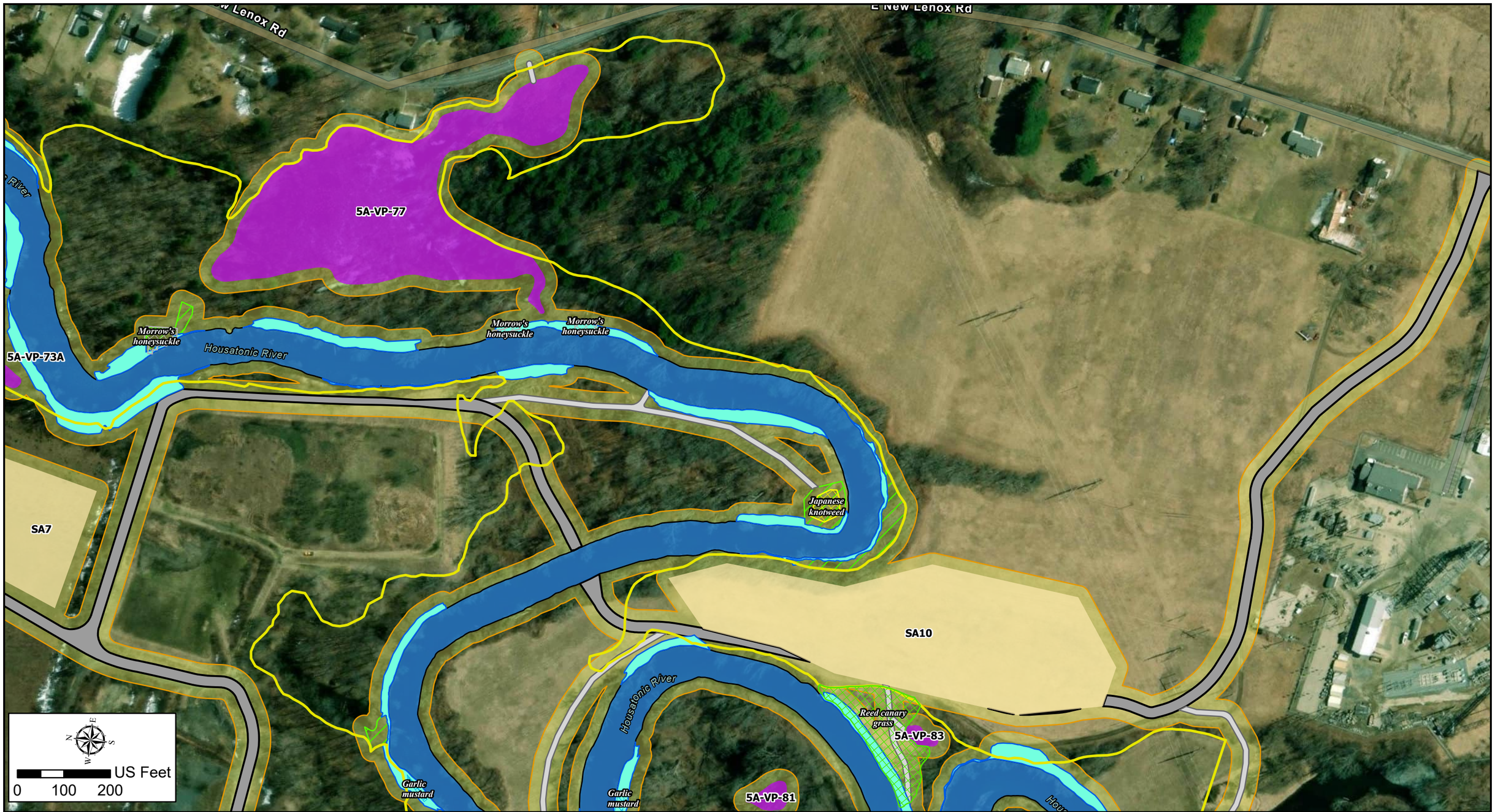

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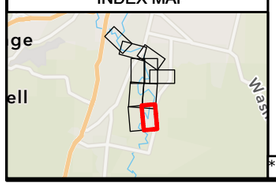

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Detail Map
Reach 5A Invasive Species
Housatonic River - Pittsfield, MA

SCALE	DATE	PROJECT NO.
1:2,400	4/20/2026	60670015

AECOM

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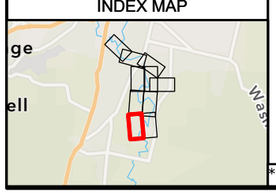
INDEX MAP



Legend

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Detail Map
Reach 5A Invasive Species
Housatonic River - Pittsfield, MA

SCALE	DATE	PROJECT NO.
1:2,400	4/20/2026	60670015

AECOM

Map Sheet 11 of 11

Appendix D: Restoration Planting Drawings

Plans are provided under separate cover or via a link

Housatonic Rest of River – Reach 5A

Prepared for:

General Electric Company
Pittsfield, MA

Prepared by:

AECOM
250 Apollo Drive
Chelmsford, MA 01824

April 29, 2026

Delivering a better world

Appendix D: Restoration Planting Drawings

Housatonic Rest of River – Reach 5A

Prepared for:

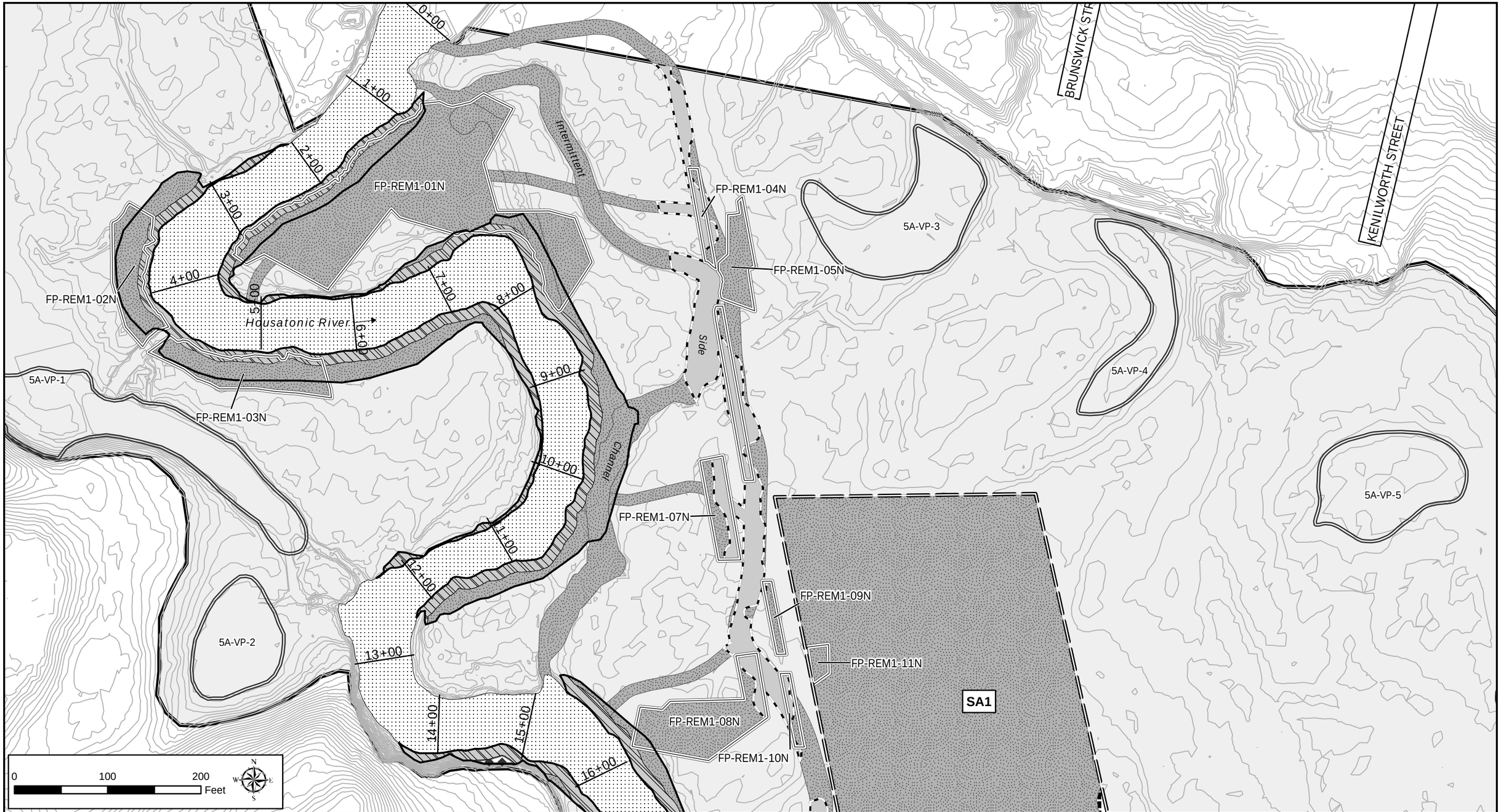
General Electric Company
Pittsfield, MA

Prepared by:

AECOM
250 Apollo Drive
Chelmsford, MA 01824

April 29, 2026

Delivering a better world



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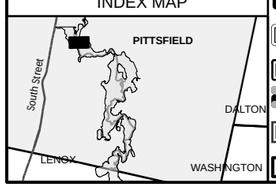


- Reach 5A
- Floodplain Removal Disposal Areas
- Temporary Staging Areas
- 5A-VP-13
- Vernal Pools Requiring Future Remediation
- Remediation Riverbank Impacts

Planting Areas by Habitat Cover Type
(See Sheets 23 to 25 for Planting Tables)

- Cultural grassland (CGL)
- Deep emergent marsh (DEM)
- High-terrace floodplain forest (HTTF)
- Moderately alkaline lake/pond (MALP)
- Shallow emergent marsh (SEM)
- Stream (STR)
- Shrub swamp (PSS)
- Wet meadow (WMD)
- Transitional floodplain forest (TFF)
- Upland Forest (UPLF)
- Existing Access Road
- Live Stakes

Reach 5A Restoration Planting Drawings
Housatonic River - Pittsfield, MA

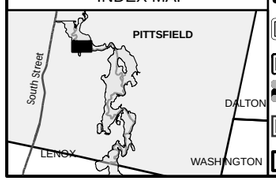
SCALE	DATE	PROJECT NO.
1:1,200	4/22/2026	60778161

AECOM

Figure D-1

Map Sheet 1 of 25

INDEX MAP



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Reach 5A Restoration Planting Drawings
Housatonic River - Pittsfield, MA

SCALE	DATE	PROJECT NO.
1:1,200	4/22/2026	60778161

AECOM

Figure D-2

Map Sheet 2 of 25

CHESTER STREET

REVILLA TERRACE

5A-VP-10

5A-VP-8

FP-REM1-13N

5A-VP-9

FP-REM1-14N

See Sheet 22 for Details on VP-13

FP-REM1-15N

5A-VP-13

5A-VP-16

5A-VP-15

5A-VP-15A

5A-VP-14

FP-REM1-17N

FP-REM1-16N

5A-VP-12

Housatonic River

26+00

29+00

30+00

32+00

33+00

36+00

37+00

38+00

40+00

41+00

42+00

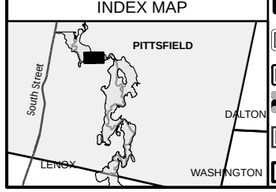
43+00

44+00

0 100 200 Feet

N W E S

INDEX MAP



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Reach 5A Restoration Planting Drawings
Housatonic River - Pittsfield, MA

SCALE	DATE	PROJECT NO.
1:1,200	4/22/2026	60778161

AECOM

Figure D-3

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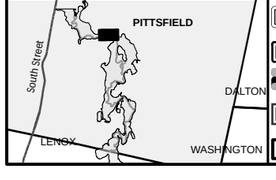

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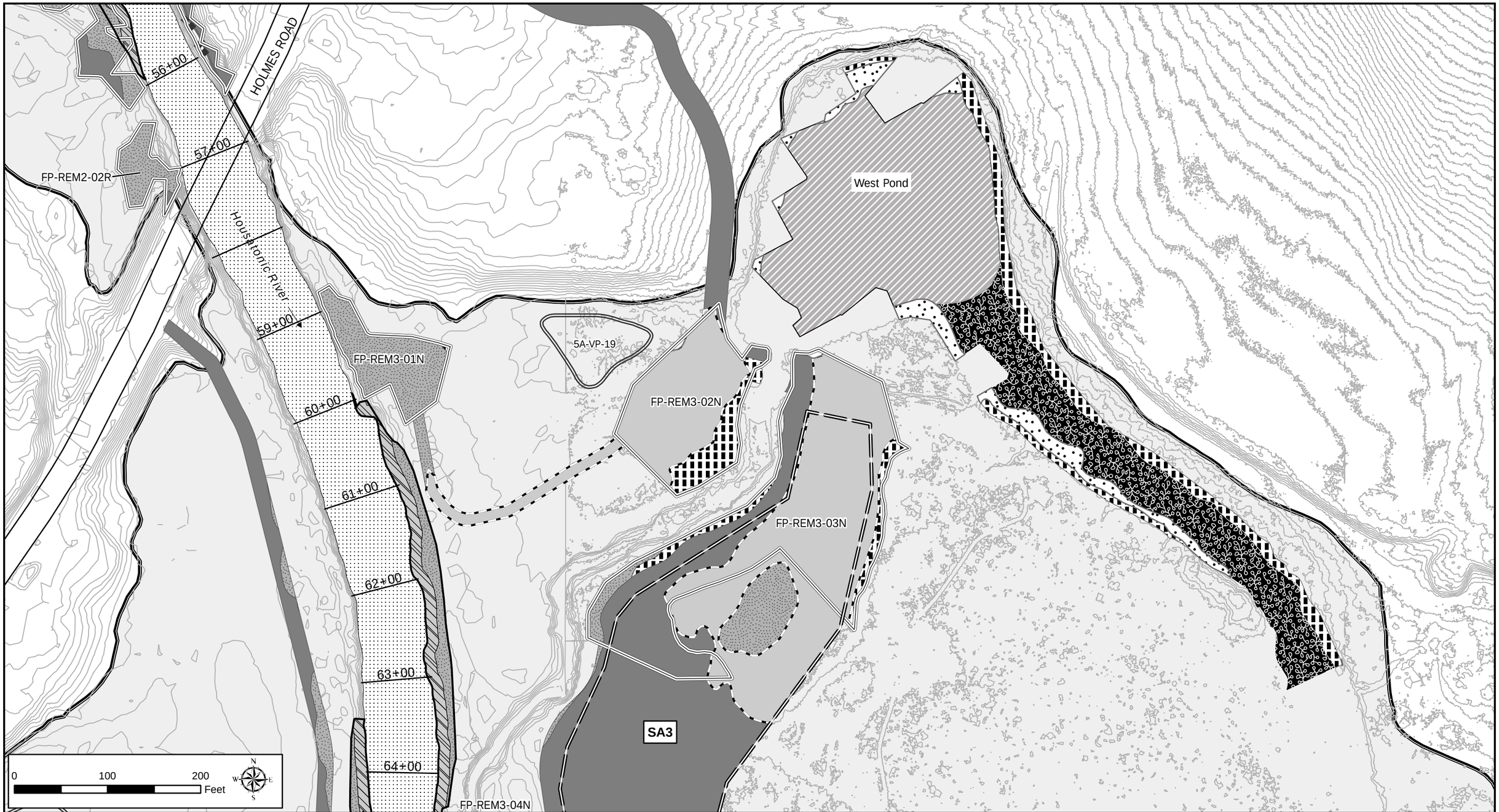
Reach 5A Restoration Planting Drawings
Housatonic River - Pittsfield, MA

SCALE	DATE	PROJECT NO.
1:1,200	4/22/2026	60778161

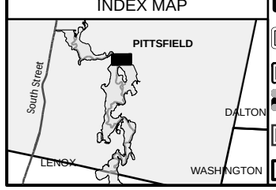
AECOM

Figure D-4

Map Sheet 4 of 25



INDEX MAP



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Reach 5A Restoration Planting Drawings
Housatonic River - Pittsfield, MA

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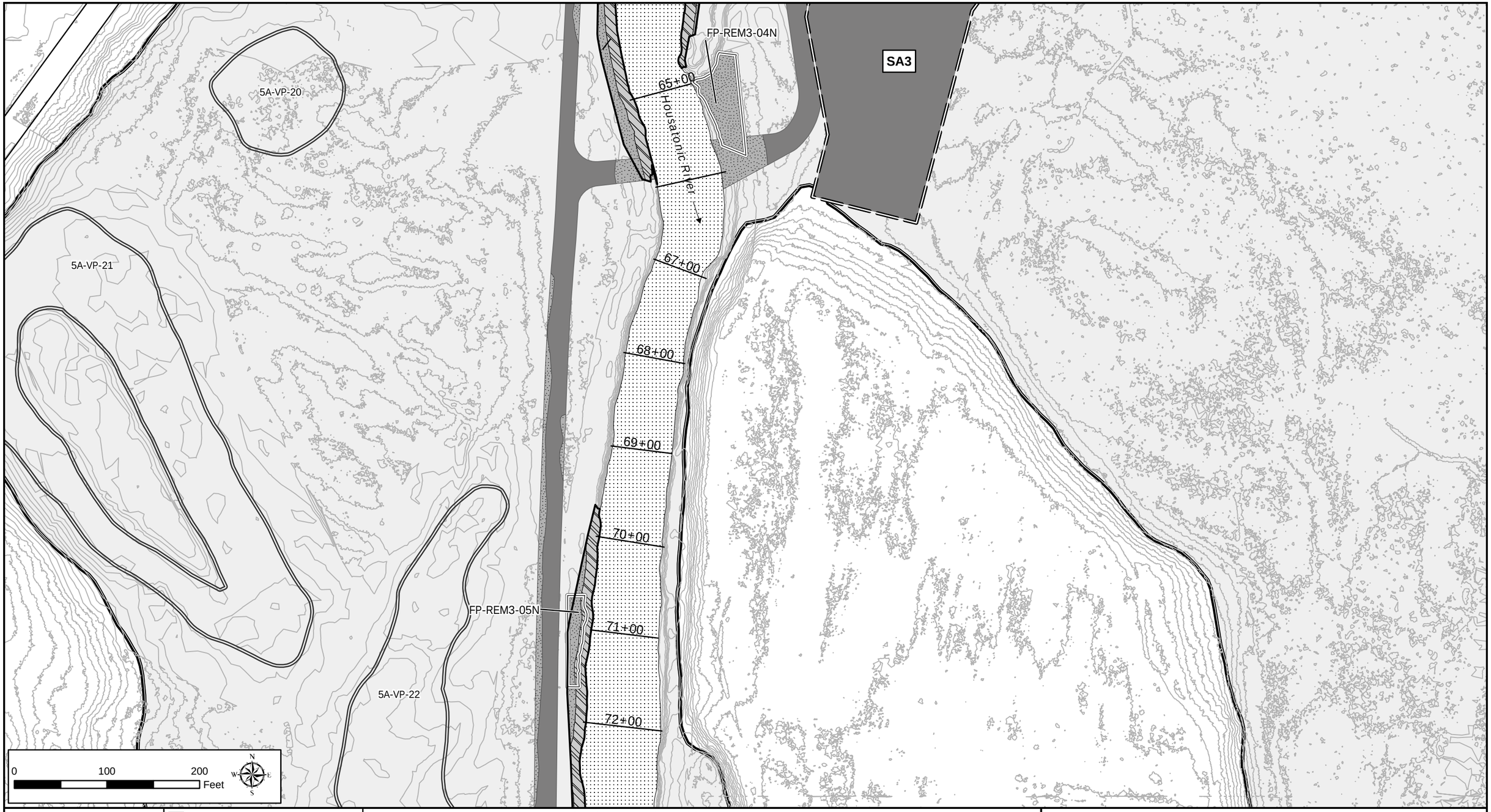
AECOM

Figure D-5

Map Sheet 5 of 25



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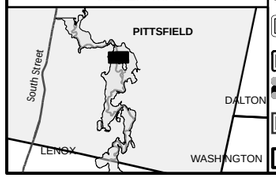

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Figure D-6

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INDEX MAP

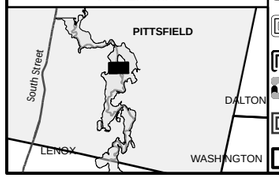

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Figure D-7

Map Sheet 7 of 25

5A-VP-28A

89+00

90+00

91+00

Housatonic River

Sackett Brook

93+00

5A-VP-33

94+00

5A-VP-32

95+00

96+00

FP-REM4-01N

5A-VP-35

97+00

Lower Sykes Brook

SA4

98+00

99+00

0 100 200 Feet

N W E S

INDEX MAP

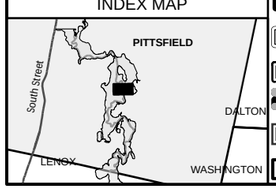

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Figure D-8

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INDEX MAP

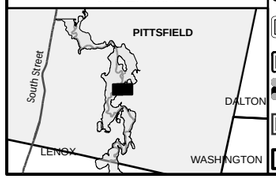

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Figure D-9

Map Sheet 9 of 25

FP-REM4-08N
BW5A-2
FP-REM4-05N
FP-REM4-07N
FP-REM4-06N
FP-REM4-09N
FP-REM4-12N
FP-REM4-11N
FP-REM4-13N
FP-REM4-10N
5A-VP-50
BW5A-4
BW5A-3
SA5
Housatonic River
115+00
116+00
117+00
119+00
120+00
121+00
122+00
123+00
124+00
125+00
126+00
112+00
113+00
114+00
0 100 200 Feet
N
W E
S

INDEX MAP

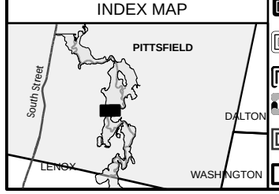

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Figure D-10

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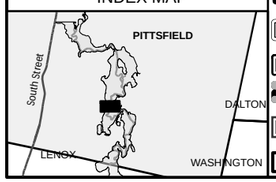
FP-REM4-12N
FP-REM4-11N
125+00
5A-VP-50
FP-REM4-10N
BW5A-4
126+00
FP-REM4-13N
BW5A-3
5A-VP-49A
SA5
127+00
FP-REM4-14R
128+00
129+00
Housatonic River
130+00
5A-VP-52
132+00
5A-VP-54
FP-REM4-16N
133+00
5A-VP-59A
FP-REM
0
100
200
Feet
N
W
E
S

INDEX MAP



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Reach 5A Restoration Planting Drawings
Housatonic River - Pittsfield, MA

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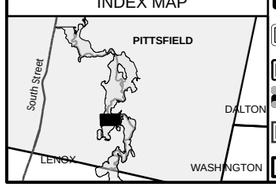
Figure D-11

Map Sheet 11 of 25

INDEX MAP



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Reach 5A Restoration Planting Drawings
Housatonic River - Pittsfield, MA

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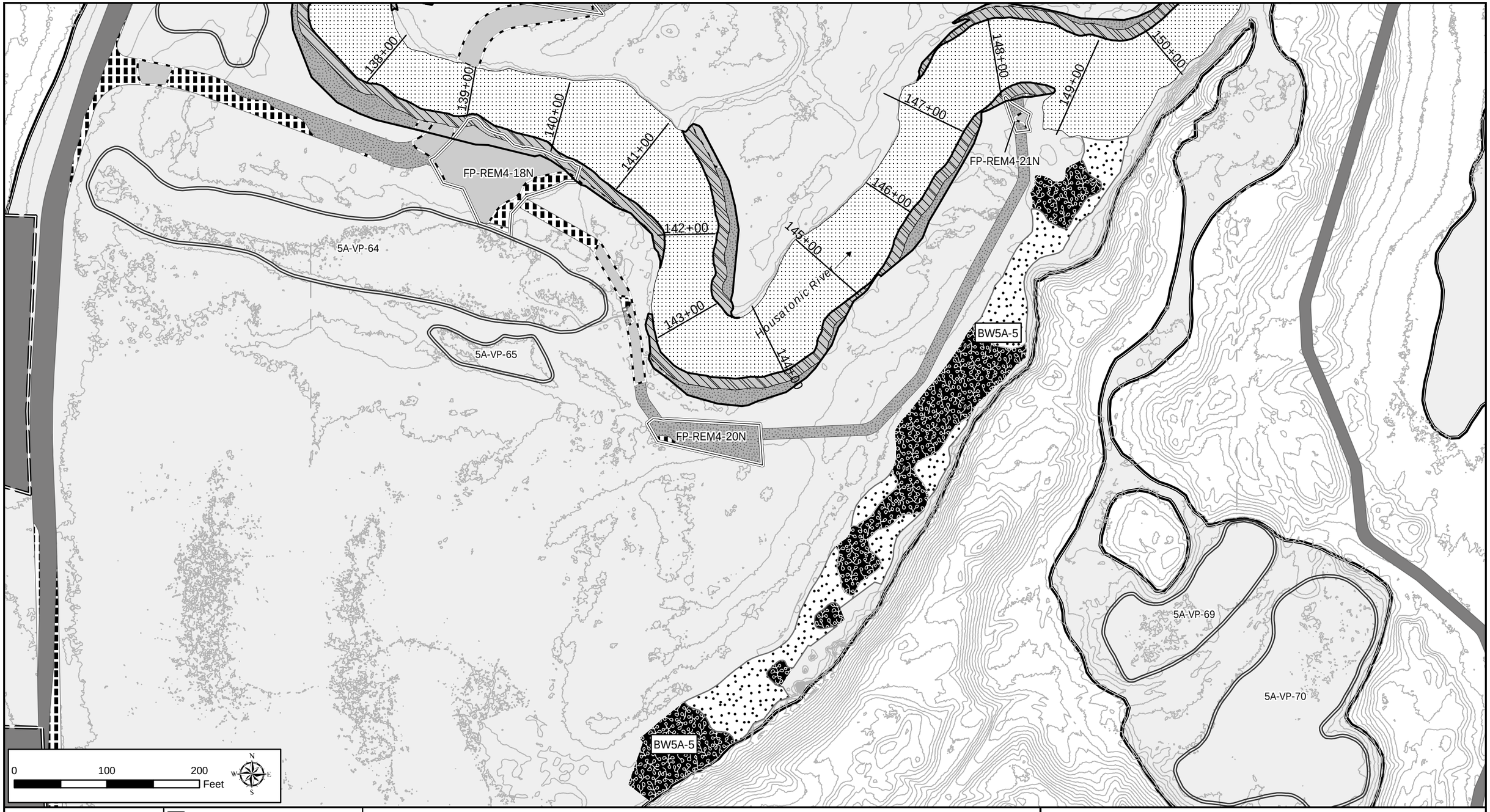
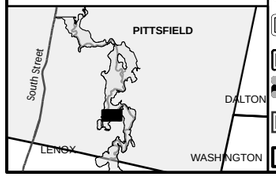
Figure D-12

Map Sheet 12 of 25



INDEX MAP



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Reach 5A Restoration Planting Drawings
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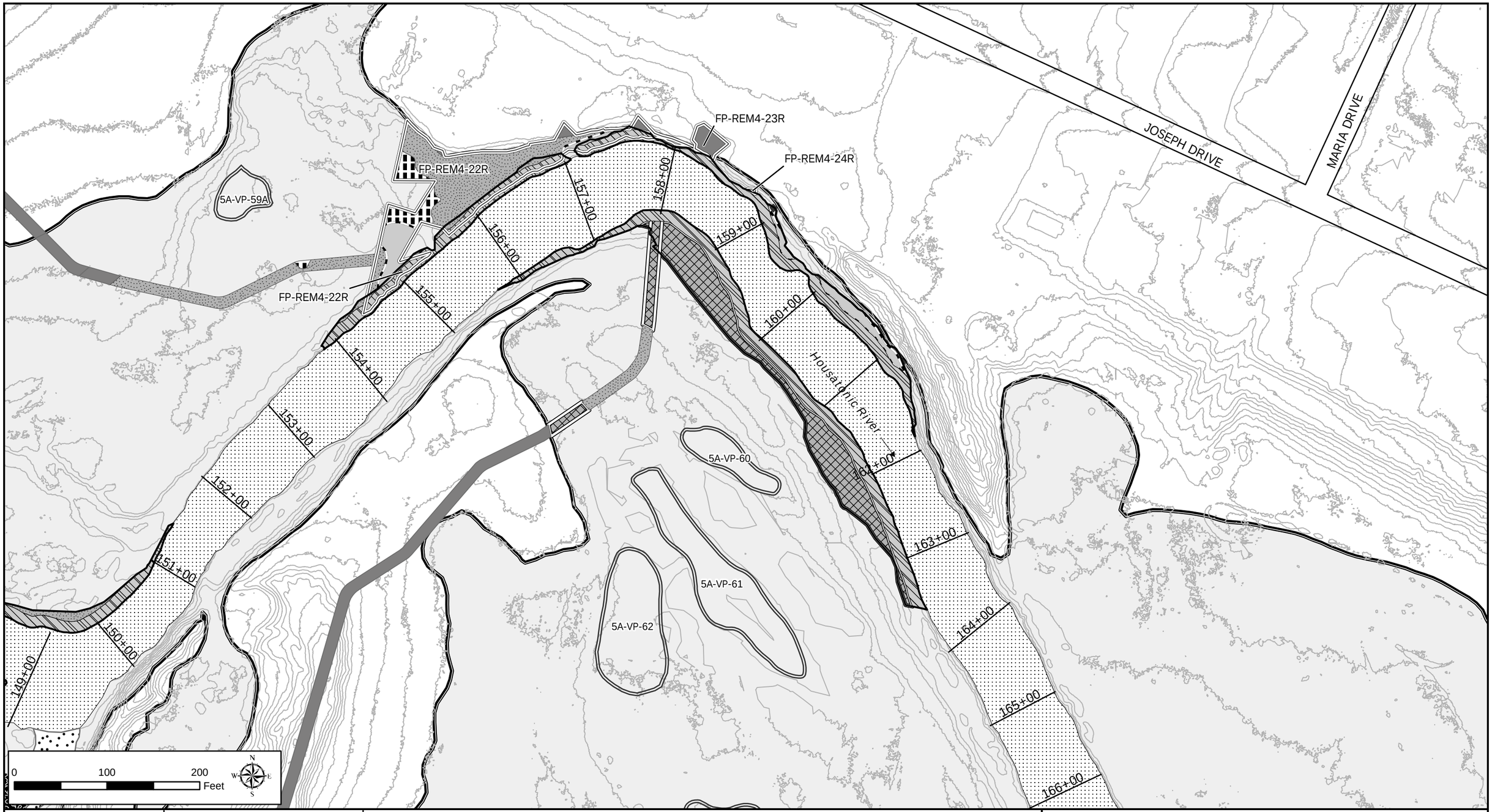
Figure D-13

Map Sheet 13 of 25



INDEX MAP

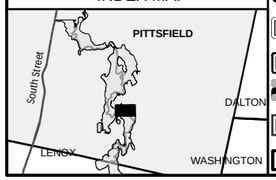


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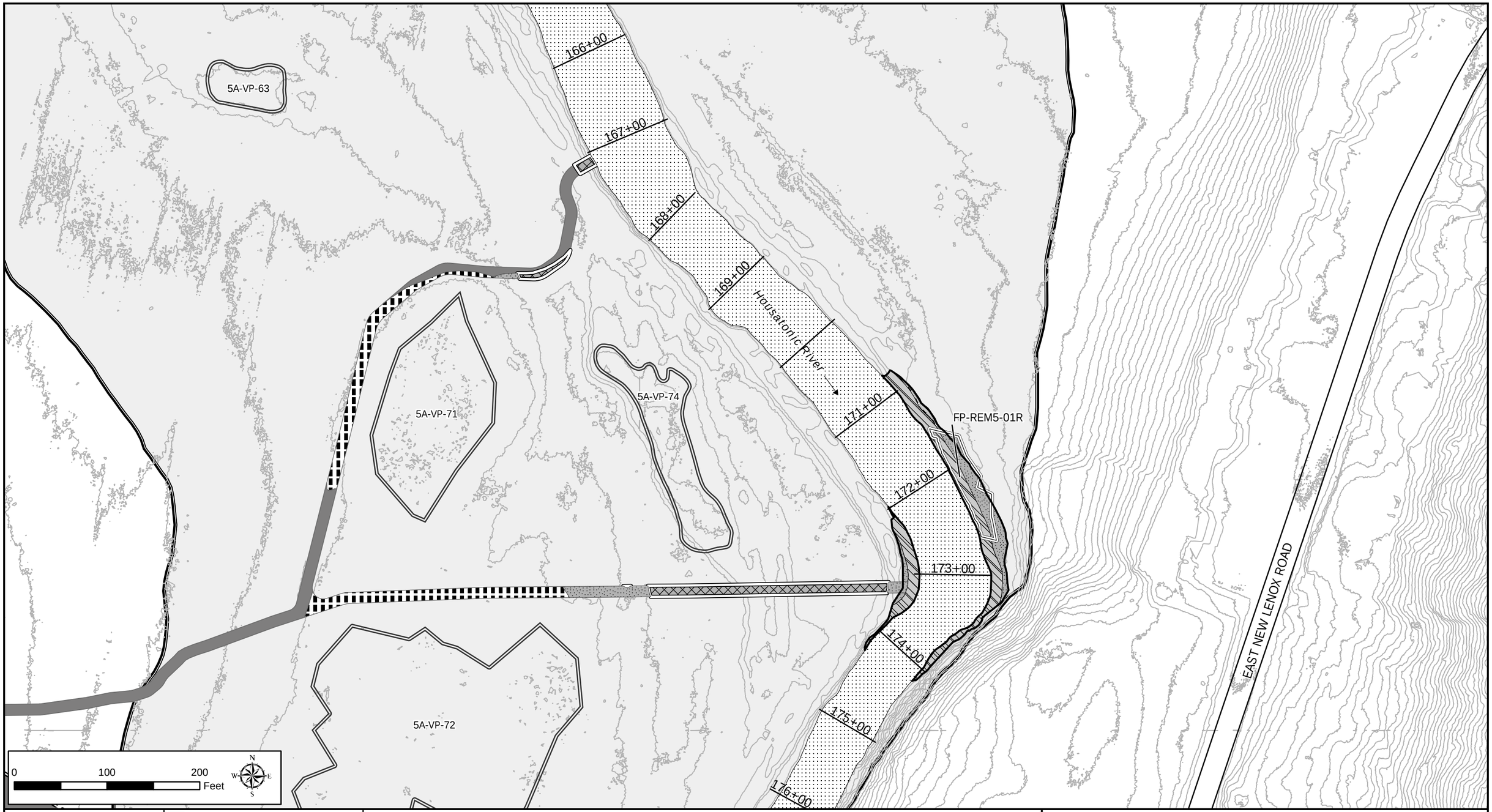
Figure D-14

Map Sheet 14 of 25



INDEX MAP

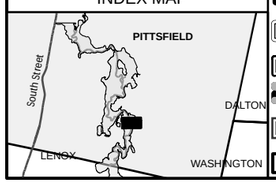


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Figure D-15

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SA7

5A-VP-73

5A-VP-73A

FP-REM5-02R

176+00

177+00

178+00

179+00

180+00

181+00

182+00

183+00

184+00

185+00

187+00

Housatonic River

EAST NEW LENOX ROAD

0 100 200 Feet

N W E S

INDEX MAP

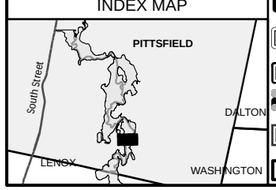

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Figure D-16

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188+00
189+00
190+00
191+00
192+00
194+00
195+00
196+00
217+00
216+00
FP-REM5-03N
5A-VP-77
Housatonic River
EAST NEW LENOX ROAD
0
100
200
Feet
N
W
E
S

INDEX MAP

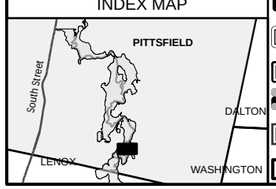

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Figure D-17

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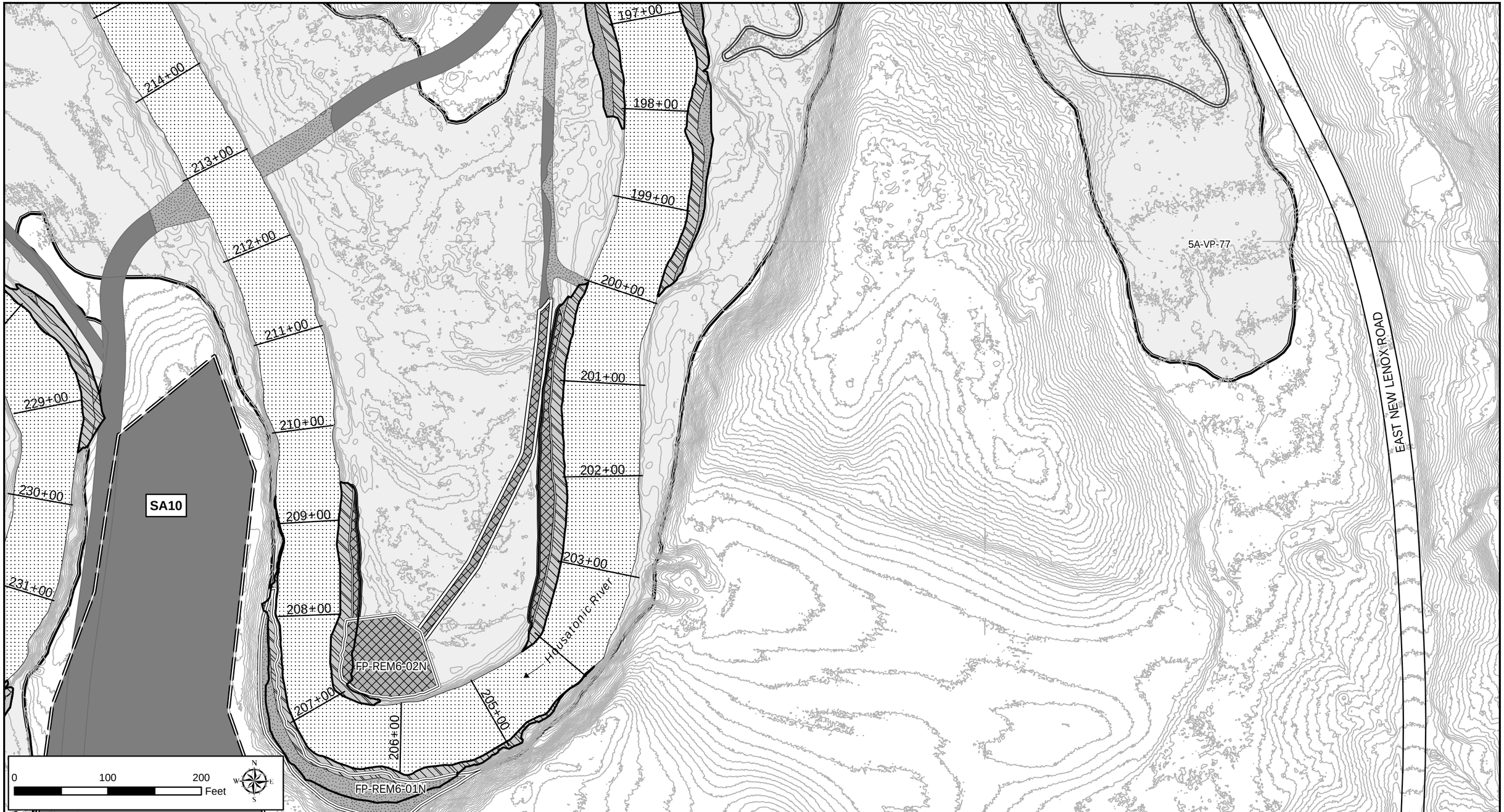

INDEX MAP

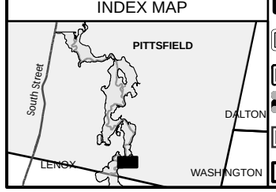

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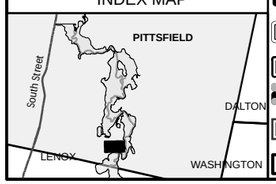
Figure D-18

Map Sheet 18 of 25

INDEX MAP



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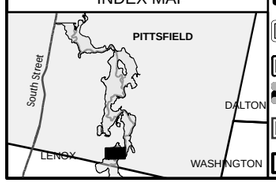
INDEX MAP



- Reach 5A
- Floodplain Removal Disposal Areas
- Temporary Staging Areas
- 5A-VP-13
- Vernal Pools Requiring Future Remediation
- Remediation Riverbank Impacts

Planting Areas by Habitat Cover Type
(See Sheets 23 to 25 for Planting Tables)

- Cultural grassland (CGL)
- Deep emergent marsh (DEM)
- High-terrace floodplain forest (HTTF)
- Moderately alkaline lake/pond (MALP)
- Shallow emergent marsh (SEM)
- Stream (STR)
- Shrub swamp (PSS)
- Wet meadow (WMD)
- Transitional floodplain forest (TFF)
- Upland Forest (UPLF)
- Existing Access Road
- Live Stakes

Reach 5A Restoration Planting Drawings
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Figure D-20

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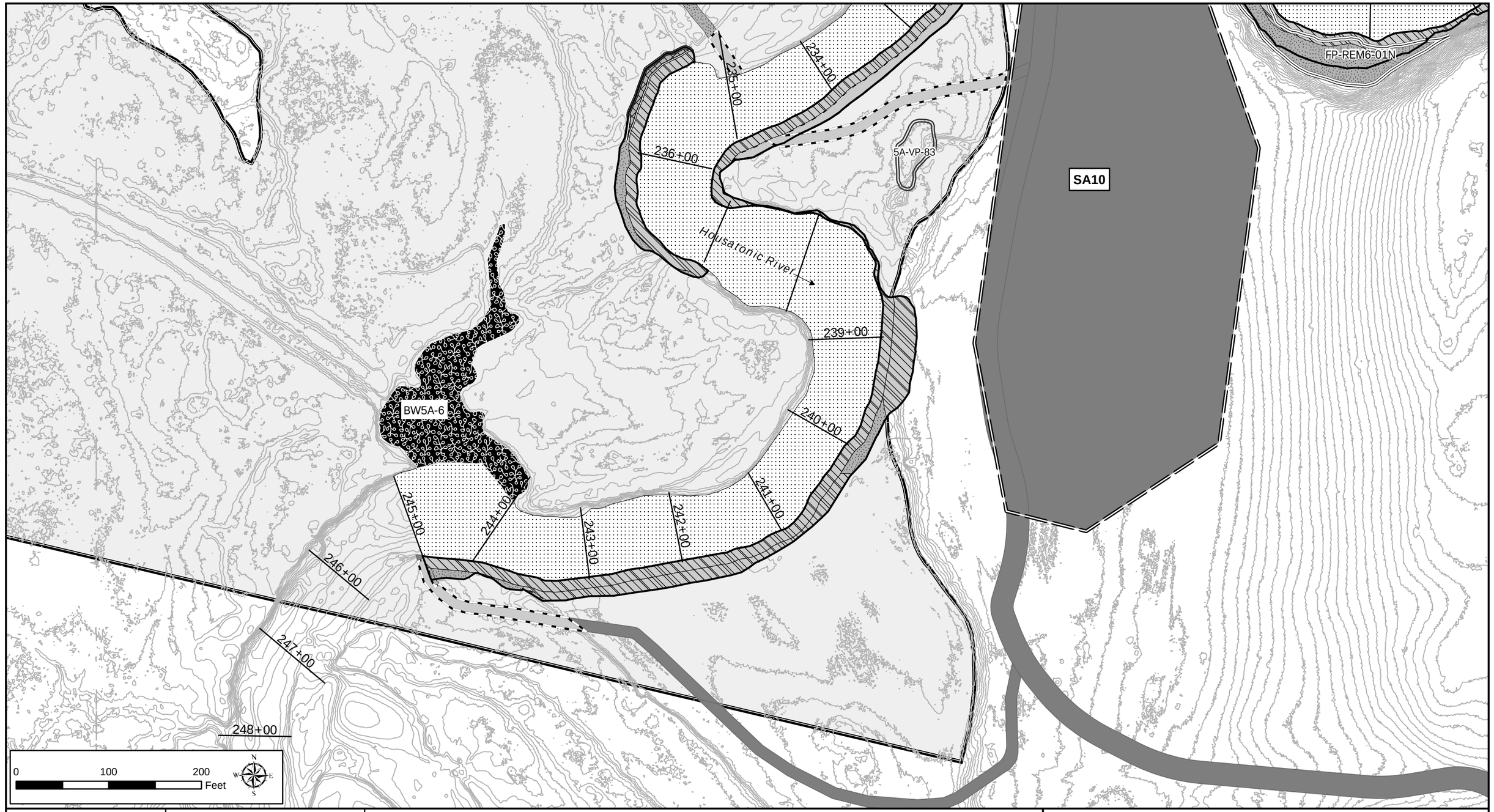
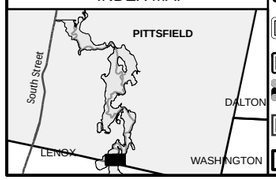


INDEX MAP



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Planting Areas by Habitat Cover Type
(See Sheets 23 to 25 for Planting Tables)

- Cultural grassland (CGL)
- Deep emergent marsh (DEM)
- High-terrace floodplain forest (HTTF)
- Moderately alkaline lake/pond (MALP)
- Shallow emergent marsh (SEM)
- Stream (STR)
- Shrub swamp (PSS)
- Wet meadow (WMD)
- Transitional floodplain forest (TFF)
- Upland Forest (UPLF)
- Existing Access Road
- Live Stakes

Reach 5A Restoration Planting Drawings
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Figure D-21

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Common Winterberry (9)

Black Elderberry (5)

American Elm (3)

Silver Maple (7)

Silky Dogwood (13)

Boxelder maple (5)

0 100 200 Feet

N W E S

INDEX MAP

Floodplain Removal Disposal Areas

5A-VP-13

Remediation Riverbank Impacts

Planting Areas by Habitat Cover Type
(See Sheets 23 to 25 for Planting Tables)

Stream (STR)

Transitional floodplain forest (TFF)

Deep emergent marsh (DEM)

Shallow emergent marsh (SEM)

Live Stakes

Reach 5A Restoration Planting Drawings
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Figure D-22

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Table 6-1. Planting table for portions of BW5A-1 subject to dredge and cap activities.

Cover type	Scientific Name	Common Name	Size	Total Num Plantings
Transitional Floodplain Forest (0.01 acres)				
Shrubs[1]	*Ilex verticillata*	Common Winterberry	18 to 24”	4
	Sambucus nigra	Black Elder	18 to 24”	6
Trees[2]	*Acer negundo*	Boxelder maple	18 to 24”	3
	Acer saccharinum	Silver maple	18 to 24”	1
			Total Pounds Needed	
Seed Mix[3]	*NEWP WetMix*		1	
Deep Emergent Marsh (0.13 acres)				
Herbaceous[4]	*Nuphar variegata*	Spatterdock	2” plug	33
	Schoenoplectus tabernaemontani	Softstem Bulrush	2” plug	20
	Ludwigia palustris	Marsh Purslane	2” plug	53
	Pickerelweed	Pontederia cordata	2” plug	33

1. Shrubs 8' OC spacing for a total of 681 shrubs / acre.
2. Trees planted 12'OC (303 trees per acre).
3. Seeding rate of 18 pounds / acre.
4. Two-inch plugs planted 6' OC (total 1050 plants / acre).

Table 6-2. Planting table for portions of BW5A-2 subject to dredge and cap activities.

Cover type	Scientific Name	Common Name	Size	Total Num Plantings
Shallow and Deep Emergent Marsh (0.29 acres)				
Herbaceous[1]	*Sagittaria latifolia*	Broad-Leaf Arrowhead	2” plug	147
	Sparganium americanum	American Bur-Reed	2” plug	176
	Leersia oryzoides	Rice Cut Grass	2” plug	73
	Alisma subcordatum	American Water-Plantain	2” plug	117
	Schoenoplectus tabernaemontani	Softstem Bulrush	2” plug	73
	Ludwigia palustris	Marsh Purslane	2” plug	88
	Nuphar variegata	Spatterdock	2” plug	123
			Total Pounds Needed	
Seed Mix[2]	*NEWP WetMix*		5	

1. Two-inch plugs planted 4' OC (total 2720 plants / acre).
2. Seed mix distributed evenly along shallow margins of the backwater. Seeding rate of 18 pounds / acre.

Table 6-3. Planting table for portions of BW5A-3 subject to dredge and backfill activities.

Cover type	Scientific Name	Common Name	Size	Total Num Plantings
Shallow and Deep Emergent Marsh (0.18 acres)				
Herbaceous[1]	*Sagittaria latifolia*	Broad-Leaf Arrowhead	2” plug	109
	Sparganium americanum	American Bur-Reed	2” plug	90
	Leersia oryzoides	Rice Cut Grass	2” plug	90
	Alisma subcordatum	American Water-Plantain	2” plug	54
	Schoenoplectus tabernaemontani	Softstem Bulrush	2” plug	45
	Ludwigia palustris	Marsh Purslane	2” plug	58
	Nuphar variegata	Spatterdock	2” plug	73
			Total Pounds Needed	
Seed Mix[2]	*NEWP WetMix*		2	

1. Two-inch plugs planted 4' OC (total 2720 plants / acre).
2. Seed mix distributed evenly along shallow margins of the backwater. Seeding rate of 18 pounds / acre.

Table 6-4. Planting table for portions of BW5A-4 subject to dredge and cap activities.

Cover type	Scientific Name	Common Name	Size	Total Num Plantings
Shallow and Deep Emergent Marsh (0.06 acres)				
Herbaceous[1]	*Sagittaria latifolia*	Broad-Leaf Arrowhead	2” plug	40
	Sparganium americanum	American Bur-Reed	2” plug	35
	Leersia oryzoides	Rice Cut Grass	2” plug	29
	Alisma subcordatum	American Water-Plantain	2” plug	17
	Schoenoplectus tabernaemontani	Softstem Bulrush	2” plug	14
	Ludwigia palustris	Marsh Purslane	2” plug	21
			Total Pounds Needed	
Seed Mix[2]	*NEWP WetMix*		1	

1. Two-inch plugs planted 4' OC (total 2720 plants / acre).
2. Seed mix distributed evenly along shallow margins of the backwater. Seeding rate of 18 pounds / acre.

Table 5-1. Preliminary Bank Restoration Seed Mix.

Scientific Name	Common Name	Percent in Mix
Lolium multiflorum	Annual Ryegrass	20%
Schizachyrium scoparium	Little Bluestem	20%
Elymus canadensis	Canada Wild Rye	16%
Panicum virgatum	Switchgrass	10%
Agrostis perennans	Autumn Bentgrass	8%
Tridens flavus	Purple Top	8%
Coreopsis lanceolata	Lanced Leaved Coreopsis	5%
Agrostis scabra	Ticklegass (Rough Bentgrass)	4%
Elymus virginicus	Virginia Wild Rye	4%
Penstemon digitalis	Tall White Beard Tongue	3%
Monarda fistulosa	Wild Bergamot	2%

Notes: ERNMX-181 Seeding Rate: 30 pounds per acre, or 1 pound per 1,000 SF or comparable
Total area of riverbank remediation and grading associated with NCD is approximately 11.6 acres, requiring 41.6 pounds of seed.

Table 6-5. Planting table for portions of BW5A-5 subject to dredge and cap activities.

Cover type	Scientific Name	Common Name	Size	Total Num Plantings
Shallow Emergent Marsh (0.47 acres)				
Herbaceous[1]	*Sagittaria latifolia*	Broad-Leaf Arrowhead	2” plug	427
	Sparganium americanum	American Bur-Reed	2” plug	332
	Leersia oryzoides	Rice Cut Grass	2” plug	261
	Alisma subcordatum	American Water-Plantain	2” plug	190
	Eleocharis palustris	Spike Rush	2” plug	261
	Pickerelweed	Pontederia cordata	2” plug	190
			Total Pounds Needed	
Seed Mix[2]	*NEWP WetMix*		4	
Deep Emergent Marsh (0.55 acres)				
Herbaceous[3]	*Nuphar variegata*	Spatterdock	2” plug	274
	Schoenoplectus tabernaemontani	Softstem Bulrush	2” plug	164
	Ludwigia palustris	Marsh Purslane	2” plug	137

1. SEM Plugs planted ~3' OC (total 3500 plants per acre).
2. Seed mix distributed evenly along shallow margins of the backwater. Seeding rate of 18 pounds / acre.
3. DEM Plugs planted ~6' OC (total 1050 plants per acre).

Table 6-6. Planting table for portions of BW5A-6 subject to dredge and backfill activities.

Cover type	Scientific Name	Common Name	Size	Total Num Plantings
Shallow Emergent Marsh (0.03 acres)				
Herbaceous[1]	*Sagittaria latifolia*	Broad-Leaf Arrowhead	2” plug	23
	Peltandra virginica	Arrow Arum	2” plug	18
	Leersia oryzoides	Rice Cut Grass	2” plug	20
	Eleocharis palustris	Spike Rush	2” plug	16
	Alisma subcordatum	American Water-Plantain	2” plug	14
			Total Pounds Needed	
Seed Mix[2]	*NEWP WetMix*		1	
Deep Emergent Marsh (0.32 acres)				
Herbaceous[3]	*Nuphar variegata*	Spatterdock	2” plug	113
	Schoenoplectus tabernaemontani	Softstem Bulrush	2” plug	65
	Potamogeton pectinatus	Sago Pondweed	tubers	97
	Ludwigia palustris	Marsh Purslane	2” plug	65

1. SEM Plugs planted ~3' OC (total 3500 plants per acre).
2. Seed mix distributed evenly along shallow margins of the backwater. Seeding rate of 18 pounds / acre.
3. DEM Plugs planted ~6' OC (total 1050 plants per acre).

Table 5-2. Bank Restoration Planting List.

	Scientific Name	Common Name	Size	Quantity #/acre	Total Num Live Stakes
		Lower Riverbank (6.5 acres)			
Live Stakes	*Cornus racemosa*	Gray Dogwood	2-3 foot	2200	14,740
	Cornus stolonifera	Red-osier Dogwood	2-3 foot	3200	21,440
	Salix discolor	Pussy Willow	2-3 foot	3000	20,100
	Salix sericea	Silky Willow	2-3 foot	500	3,350
	Salix interior	Sandbar Willow	2-3 foot	1200	8,040
	Salix purpurea	Purpleosier Willow	2-3 foot	800	5,360
		Transitional Floodplain Forest (3.6 acres)			
Shrubs	*Amelanchier canadensis*	Shadbush	18 to 24”	52	186
	Cornus amomum	Silky dogwood	18 to 24”	80	286
	Sambucus canadensis	Elderberry	18 to 24”	52	186
	Vaccinium corymbosum	Highbush blueberry	18 to 24”	40	143
	Viburnum dentatum	Arrowwood	18 to 24”	38	136
	Spiraea alba	White Meadowsweet	18 to 24”	20	72
	Ilex verticillata	Common Winterberry	18 to 24”	20	72
Trees	*Acer negundo*	Boxelder maple	3-4’	100	358
	Acer saccharinum	Silver maple	3-4’	50	179
	Tilia americana	American linden	3-4’	50	179
	Quercus bicolor	Swamp white oak	3-4’	25	89
	Populus deltoides	Eastern cottonwood	3-4’	100	358
	Ulmus americana	American elm	3-4’	40	143
	Carpinus caroliniana	American hornbeam	3-4’	40	143
	Platanus occidentalis	American sycamore	3-4’	30	107
		High Terrace Floodplain Forest (0.49 acres)			
Shrubs	*Carpinus caroliniana*	Ironwood	18 to 24”	60	29
	Viburnum dentatum	Arrowwood	18 to 24”	40	20
Shrubs	*Viburnum lentago*	Nannyberry	18 to 24”	65	32
	Hamamelis virginiana	Witch-hazel	18 to 24”	25	12
Trees	*Acer saccharum*	Sugar maple	3-4’	40	20
	Betula alleghaniensis	Yellow birch	3-4’	20	10
	Quercus bicolor	Swamp white oak	3-4’	20	10
	Platanus occidentalis	American sycamore	3-4’	30	15
	Tilia americana	American linden	3-4’	60	29
		Wet Meadow (0.56 acres)			
Shrubs	*Cornus amomum*	Silky dogwood	18 to 24”	10	6
	Rosa palustris	Swamp rose	18 to 24”	2	1
	Sambucus canadensis	Elderberry	18 to 24”	5	3
	Spiraea latifolia	Meadowsweet	18 to 24”	5	3
	Ilex verticillata	Winterberry	18 to 24”	5	3
				Total Pounds Needed	
Seed Mix	*NEWP WetMix*			10	

1. Live stakes to be planted at a density of 2-foot on center (10,890 stakes per acre)
2. Transitional floodplain forest: Shrubs 12x12 spacing for a total of 302 shrubs / acre. Trees planted on 10X10-foot grid (436 trees / acre).
3. High terrace floodplain forest: Shrubs 16x16 spacing for a total of 170 shrubs / acre. Trees planted on 10X10-foot grid (436 trees / acre).
4. Wet meadow: Shrubs planted on 40X40-foot grid (27 shrubs / acre). Seeding rate of 18 pounds / acre.
5. Forested uplands: Shrubs 12x12 spacing for a total of 302 shrubs / acre. Trees planted on 10X10-foot grid (436 trees / acre)

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Table 7-1. Planting table for Intermittent Side Channel (E-OWB1) restoration.

Cover type	Scientific Name	Common Name	Size	Total Num Plantings
Transitional Floodplain Forest (0.4 acres)[1]				
Herbaceous	*Matteuccia struthiopteris*	Ostrich fern	Pot / plug	60
	Onoclea sensibilis	Sensitive fern	Pot / plug	25
	Parathelypteris noveboracensis	New York fern	Pot / plug	60
	Cardamine concatenata	Cut-leaved toothwort	2" plug	401
	Cardamine diphylla	Two-leaved toothwort	2" plug	273
Shrubs	*Amelanchier canadensis*	Shadbush	18 to 24"	25
	Cornus amomum	Silky dogwood	18 to 24"	48
	Sambucus canadensis	Elderberry	18 to 24"	21
	Viburnum dentatum	Arrowwood	18 to 24"	19
	Spiraea alba	White Meadowsweet	18 to 24"	8
Trees	*Acer negundo*	Boxelder maple	3-4'	40
	Acer saccharinum	Silver maple	3-4'	20
	Tilia americana	American linden	3-4'	20
	Quercus bicolor	Swamp white oak	3-4'	10
	Populus deltoides	Eastern cottonwood	3-4'	40
	Ulmus americana	American elm	3-4'	16
	Carpinus caroliniana	American hornbeam	3-4'	16
	Platanus occidentalis	American sycamore	3-4'	12
			Total Pounds Needed	
Seed Mix	*Habitat Specific mix*		7	
Wet Meadow (0.1 acres)[2]				
Herbaceous	*Onoclea sensibilis*	Sensitive fern	Pot / plug	24
	Thelypteris palustris	Marsh fern	Pot / plug	12
	Cardamine pensylvanica	Pennsylvania Bittercress	2" plug	4
	Asclepias incarnata	Swamp Milkweed	2" plug	6
	Verbena hastata	Blue Vervain	2" plug	2
Shrubs	*Cornus amomum*	Silky dogwood	18 to 24"	2
	Sambucus canadensis	Elderberry	18 to 24"	1
	Ilex verticillata	Winterberry	18 to 24"	1
			Total Pounds Needed	
Seed Mix	*NEWP WetMix*		2	

1. Transitional floodplain forest
Six-inch pots (#1 container) or 2" plugs (if available) planted 3' OC, in three 0.025-acre patches per acre (total 362 plants / acre). Plugs planted 18" OC, in three 0.025-acre patches per acre (total 1688 plants / acre).
Shrubs 12x12 spacing for a total of 302 shrubs / acre. Trees planted on 10X10-foot grid (436 trees / acre).
Seeding rate of 18 pounds / acre.

2. Wet meadow
Six-inch pots (#1 container) or 2" plugs (if available) planted 3' OC, in three 0.025-acre patches per acre (total 362 plants / acre). Plugs planted 6' OC, in three 0.025-acre patches per acre (total 120 plants / acre). Shrubs planted on 40X40-foot grid (27 shrubs / acre). Seeding rate of 18 pounds / acre.

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Table 7-2. Planting table for West Pond (OWB-WP) restoration area.

Cover type	Scientific Name	Common Name	Size	Total Num Plantings
Shrub Swamp (0.23 acres)				
Shrubs[1]	*Ilex verticillata*	Common Winterberry	18 to 24"	23
	Cornus amomum	Silky Dogwood	18 to 24"	45
	Alnus incana	Speckled Alder	18 to 24"	36
	Sambucus nigra	Black Elder	18 to 24"	23
	Salix discolor	Pussy Willow	18 to 24"	27
Trees[2]	*Ulmus americana*	American Elm	18 to 24"	3
	Acer rubrum	Red Maple	18 to 24"	3
			Total Pounds Needed	
Seed Mix[3]	*NEWP WetMix*		4	
Shallow Emergent Marsh (0.16 acres)				
Herbaceous[4]	*Sagittaria latifolia*	Broad-Leaf Arrowhead	2" plug	136
	Sparganium eurycarpum	Broad-Fruit Bur-Reed	2" plug	192
	Leersia oryzoides	Rice Cut Grass	2" plug	152
	Alisma subcordatum	American Water-Plantain	2" plug	80
Deep Emergent Marsh (0.60 acres)				
Herbaceous[5]	*Nuphar variegata*	Spatterdock	2" plug	150
	Schoenoplectus tabernaemontani	Softstem Bulrush	2" plug	120
	Potamogeton pectinatus	Sago Pondweed	tubers	179
	Ludwigia palustris	Marsh Purslane	2" plug	179

1. Shrubs 8x8 spacing for a total of 681 shrubs / acre.
2. Trees planted on 40X40-foot grid (27 trees / acre).
3. Seeding rate of 18 pounds / acre.
4. SEM Plugs planted ~3' OC (total 3500 plants / acre).
5. DEM Plugs planted ~6' OC (total 1050 plants / acre).

Table 8-1. Planting tables for floodplain remediation areas (including access and staging) located within Transitional Floodplain Forests

Cover type	Scientific Name	Common Name	Size	Total Num Plantings
Transitional Floodplain Forest (15.8 acres)				
Herbaceous[1,2]	*Matteuccia struthiopteris*	Ostrich fern	Pot / plug	2,363
	Onoclea sensibilis	Sensitive fern	Pot / plug	977
	Parathelypteris noveboracensis	New York fern	Pot / plug	2,363
	Cardamine concatenata	Cut-leaved toothwort	2" plug	9,452
	Cardamine diphylla	Two-leaved toothwort	2" plug	7,089
	Lepidium virginicum	Poorman's-Pepper	2" plug	4,537
	Turritus glabra	Tower Mustard	2" plug	5,514
Shrubs[3]	*Amelanchier canadensis*	Shadbush	18 to 24"	819
	Cornus amomum	Silky dogwood	18 to 24"	1,260
	Sambucus canadensis	Elderberry	18 to 24"	819
	Vaccinium corymbosum	Highbush blueberry	18 to 24"	630
	Viburnum dentatum	Arrowwood	18 to 24"	599
	Spiraea alba	White Meadowsweet	18 to 24"	315
	Ilex verticillata	Common Winterberry	18 to 24"	315
Trees[4]	*Acer negundo*	Boxelder maple	3-4'	1,575
	Acer saccharinum	Silver maple	3-4'	788
	Tilia americana	American linden	3-4'	788
	Quercus bicolor	Swamp white oak	3-4'	394
	Populus deltoides	Eastern cottonwood	3-4'	1,575
	Ulmus americana	American elm	3-4'	630
	Carpinus caroliniana	American hornbeam	3-4'	630
	Platanus occidentalis	American sycamore	3-4'	473
			Total Pounds Needed	
Seed Mix[5]	*Habitat specific mix*		284	

1. Six-inch pots (#1 container) or 2" plugs (if available) planted 3' OC, in three 0.025-acre patches per acre (total 362 plants / acre).
2. Plugs planted 18" OC, in three 0.025-acre patches per acre (total 1688 plants / acre).
3. Shrubs 12x12 spacing for a total of 302 shrubs / acre.
4. Trees planted on 10X10-foot grid (436 trees / acre).
5. Seeding rate of 18 pounds / acre.

Table 8-2. Planting tables for floodplain remediation areas (including access and staging) located within High-Terrace Floodplain Forests

Cover type	Scientific Name	Common Name	Size	Total Num Plantings
High-Terrace Floodplain Forest (0.51 acres)				
Herbaceous[1,2]	*Adiantum pedatum*	Northern maidenhair fern	Pot / plug	31
	Matteuccia struthiopteris	Ostrich fern	Pot / plug	62
	Onoclea sensibilis	Sensitive fern	Pot / plug	51
	Polystichum acrostichoides	Christmas fern	Pot / plug	41
	Caulophyllum thalictroides	Blue cohosh	2" plug	180
	Erythronium americanum	Trout-lily	2" plug	231
	Solidago flexicaulis	Zigzag goldenrod	2" plug	148
	Carex pensylvanica	Pennsylvania Sedge	2" plug	308
Shrubs[3]	*Carpinus caroliniana*	Ironwood	18 to 24"	31
	Viburnum dentatum	Arrowwood	18 to 24"	21
	Viburnum lentago	Nannyberry	18 to 24"	33
	Hamamelis virginiana	Witch-hazel	18 to 24"	13
Trees[4]	*Acer saccharum*	Sugar maple	3-4'	21
	Betula alleghaniensis	Yellow birch	3-4'	10
	Quercus bicolor	Swamp white oak	3-4'	10
	Platanus occidentalis	American sycamore	3-4'	15
	Tilia americana	American linden	3-4'	31
			Total Pounds Needed	
Seed Mix[5]	*Habitat specific mix*		9	

1. Six-inch pots (#1 container) or 2" plugs (if available) planted 3' OC, in three 0.025-acre patches per acre (total 362 plants / acre).
2. Plugs planted 18" OC, in three 0.025-acre patches per acre (total 1688 plants / acre).
3. Shrubs 16x16 spacing for a total of 170 shrubs / acre.
4. Trees planted on 10X10-foot grid (436 trees / acre).
5. Seeding rate of 18 pounds / acre.

Table 8-3. Planting tables for floodplain remediation areas (including access and staging) located within Shrub Swamp habitats

Cover type	Scientific Name	Common Name	Size	Total Num Plantings
Shrub Swamp (1.1 acres)				
Herbaceous[1,2]	*Matteuccia struthiopteris*	Ostrich fern	Pot / plug	159
	Onoclea sensibilis	Sensitive fern	Pot / plug	95
	Osmundastrum cinnamomeum	Cinnamon fern	Pot / plug	64
	Thelypteris palustris	Marsh fern	Pot / plug	64
	Cardamine pensylvanica	Pennsylvania Bittercress	2" plug	42
	Asclepias incarnata	Swamp Milkweed	2" plug	64
	Eupatorium perfoliatum	Boneset	2" plug	21
Shrubs[3]	*Amelanchier canadensis*	Shadbush	18 to 24"	42
	Cephalanthus occidentalis	Buttonbush	18 to 24"	42
	Cornus amomum	Silky dogwood	18 to 24"	212
	Rosa palustris	Swamp rose	18 to 24"	53
	Salix discolor	Pussy willow	18 to 24"	85
	Sambucus canadensis	Elderberry	18 to 24"	53
	Spiraea latifolia	Meadowsweet	18 to 24"	53
	Vaccinium corymbosum	Highbush blueberry	18 to 24"	42
	Viburnum dentatum	Arrowwood	18 to 24"	42
	Rhododendron viscosum	Swamp azalea	18 to 24"	32
	Ilex verticillata	Winterberry	18 to 24"	64
Trees[4]	*Acer rubrum*	Red maple	3-4'	15
	Salix nigra	Black willow	3-4'	13
			Total Pounds Needed	
Seed Mix[5]	*NEWP WetMix (or similar approved)*		19	

1. Six-inch pots (#1 container) or 2" plugs (if available) planted 3' OC, in three 0.025-acre patches per acre (total 362 plants / acre).
2. Plugs planted 6' OC, in three 0.025-acre patches per acre (total 120 plants / acre).
3. Shrubs 8x8 spacing for a total of 681 shrubs / acre.
4. Trees planted on 40X40-foot grid (27 trees / acre).
5. Seeding rate of 18 pounds / acre.

Table 8-4. Planting tables for floodplain remediation areas (including access and staging) located within Wet Meadow habitats

Cover type	Scientific Name	Common Name	Size	Total Num Plantings
Wet Meadow (4.0 acres)				
Herbaceous[1,2]	*Matteuccia struthiopteris*	Ostrich fern	Pot / plug	483
	Onoclea sensibilis	Sensitive fern	Pot / plug	554
	Thelypteris palustris	Marsh fern	Pot / plug	396
	Cardamine pensylvanica	Pennsylvania Bittercress	2" plug	158
	Asclepias incarnata	Swamp Milkweed	2" plug	237
	Verbena hastata	Blue Vervain	2" plug	79
Shrubs[3]	*Cornus amomum*	Silky dogwood	18 to 24"	40
	Rosa palustris	Swamp rose	18 to 24"	8
	Sambucus canadensis	Elderberry	18 to 24"	20
	Spiraea latifolia	Meadowsweet	18 to 24"	20
	Ilex verticillata	Winterberry	18 to 24"	20
			Total Pounds Needed	
Seed Mix[4]	*NEWP WetMix (or similar approved)*		79	

1. Six-inch pots (#1 container) or 2" plugs (if available) planted 3' OC, in three 0.025 -acre patches per acre (total 362 plants).
2. Plugs planted 6' OC, in three 0.025-acre patches per acre (total 120 plants).
3. Shrubs planted on 40X40-foot grid (27 shrubs / acre).
4. Seeding rate of 18 pounds / acre.

Table 8-5. Planting tables for floodplain remediation areas (including access and staging) located within Forested Upland habitats.

Cover type	Scientific Name	Common Name	Size	Total Num Plantings
Forested Uplands (0.65 acres)				
Herbaceous[1]	*Onoclea sensibilis*	Sensitive fern	Pot / plug	39
	Parathelypteris noveboracensis	New York fern	Pot / plug	78
	Dennstaedtia punctilobula	Hay-Scented Fern	Pot / plug	119
Shrubs[2]	*Amelanchier canadensis*	Shadbush	18 to 24"	33
	Corylus americana	American hazelnut	18 to 24"	53
	Hamamelis virginiana	American witch hazel	18 to 24"	46
	Viburnum acerfolium	Maple Leaf Viburnum	18 to 24"	65
Trees[3]	*Prunus serotina*	Black cherry	3-4'	52
	Pinus strobus	Eastern white pine	3-4'	65
	Ostrya virginiana	Hop-hornbeam	3-4'	39
	Quercus rubra	Northern red oak	3-4'	65
	Acer saccharum	Sugar maple	3-4'	26
	Betula populifolia	Gray Birch	3-4'	37
			Total Pounds Needed	
Seed Mix[4]	*Habitat Specific mix*		5	

1. Six-inch pots (#1 container) or 2" plugs (if available) planted 3' OC, in three 0.025 -acre patches per acre (total 362 plants / acre).
2. Shrubs 12x12 spacing for a total of 302 shrubs / acre.
3. Trees planted on 10X10-foot grid (436 trees / acre).
4. Seeding rate of 18 pounds / acre.

Table 9-1. Planting table for 5A-VP-13.

Cover type	Scientific Name	Common Name	Size	Total Num Plantings[1]
Trees and Shrubs (0.08 acres)				
Shrubs[2]	*Ilex verticillata*	Common Winterberry	18 to 24"	9
	Cornus amomum	Silky Dogwood	18 to 24"	13
	Sambucus nigra	Black Elder	18 to 24"	5
Trees[3]	*Ulmus americana*	American Elm	18 to 24"	3
	Acer negundo	Boxelder maple	18 to 24"	5
	Acer saccharinum	Silver maple	18 to 24"	7
			Total Pounds Needed	
Seed Mix[4]	*NEWP WetMix*		1	
Shallow and Deep Emergent Marsh (0.22 acres)				
Herbaceous[5]	*Sagittaria latifolia*	Broad-Leaf Arrowhead	2" plug	45
	Sparganium americanum	American Bur-Reed	2" plug	56
	Alisma subcordatum	American Water-Plantain	2" plug	34
	Ludwigia palustris	Marsh Purslane	2" plug	18

1. Placement of aquatic emergent plugs, woody shrub, and trees will be directed by the supervising wetland scientist or otherwise specified in the SIP.
2. Shrubs planted around pool edges at ~8' OC for a total of 681 shrubs / acre .
3. Trees planted around pool edges at ~12' OC for a to tal of 303 trees / acre .
4. Seed mix distributed evenly along shallow margins of the pool. Seeding rate of 18 pounds / acre.
5. Plugs planted 8' OC (total 680 plants per acre) .

PLANTING SPECIFICATIONS

1. ALL WORK WILL FOLLOW THE CONSTRUCTION SEQUENCE DEFINED IN APPENDIX B OF THE REACH 5A RD/RA WORKPLAN. TOPSOIL PLACEMENT AND PLANTING WILL BE PERFORMED UNDER DIRECT SITE SUPERVISION BY A DESIGNATED WETLAND SCIENTIST. FOLLOW-UP MONITORING OF THE PLANTINGS PROPOSED IN THE PLANS WILL BE PERFORMED AS DESCRIBED IN THE HOUSATONIC RIVER REACH 5A RESTORATION PLAN AND RESTORATION CORRECTIVE MEASURES COORDINATION PLAN.
2. PRIOR TO THE START OF SITE WORK, ALL SEDIMENTATION AND EROSION CONTROL FENCING WILL BE INSTALLED BY THE CONTRACTOR AS NEEDED. AN ADEQUATE SUPPLY OF REPLACEMENT EROSION CONTROL MATERIALS WILL BE AVAILABLE ON SITE FOR EMERGENCY PURPOSES. EROSION CONTROL STRUCTURES WILL BE INSPECTED ON A REGULAR BASIS AND MAINTAINED IN GOOD ORDER UNTIL ALL EXPOSED SOILS ARE VEGETATED AND STABLE.
3. THE PLANTING PLAN PROVIDED FOR THE RESTORATION AREAS SHALL NOT BE DEVIATED FROM WITHOUT THE APPROVAL OF THE DESIGNATED WETLAND SCIENTIST. IT IS RECOGNIZED THAT NOT ALL SPECIES MAY BE AVAILABLE AT THE TIME OF PLANTING AND SUBSTITUTIONS ARE ALLOWED WITH APPROVAL OF THE WETLAND SCIENTIST.
4. SEED MIXES WILL BE BROADCAST AT THE APPROPRIATE RATES THROUGHOUT THE RESTORATION AREAS TO CREATE AN HERBACEOUS GROUNDCOVER LAYER. SEED MIXES MUST BE APPROVED BY THE WETLAND SCIENTIST.
5. SEED SHOULD ALWAYS BE PLACED ON BARE SOIL AND LIGHTLY RAKED OR ROLLED TO ENSURE PROPER SOIL-SEED CONTACT.
6. TREES, SHRUBS, AND HERBACEOUS PLANTS WILL BE SIZED AS SPECIFIED ON THE PLANTING TABLES. PLANT MATERIAL WILL BE INSPECTED WHEN PICKED UP AT THE NURSERY, AS WELL AS UPON DELIVERY TO THE SITE. THE PLANTING SEASON WILL BE IN THE SPRING FROM APRIL 1 THROUGH JUNE 30, AND FALL FROM AUGUST 15 THROUGH DECEMBER 15.
7. THE FOLLOWING PLANTING PROTOCOL WILL BE FOLLOWED: 1) THE PLANTING CONTRACTOR SHALL MAINTAIN THE ORIGINAL GRADE OF ROOT FLARE AFTER BEING TRANSPLANTED FROM THE NURSERY; 2) THE TREE/SHRUB PIT SHALL BE BACKFILLED WITH A PLANTING SOIL MIXTURE OF LOAM, COMPOST, AND PEAT MOSS; 3) A TEMPORARY EARTH SAUCER WILL BE MADE TO RETAIN MOISTURE OVER THE ROOT BALL; 4) PLANT MATERIAL WILL BE IMMEDIATELY WATERED.
8. ADDITIONAL EROSION CONTROL MATTING SHALL BE PLACED ON DISTURBED AREAS AS NEEDED, OR AT THE DIRECTION OF THE WETLAND SCIENTIST.
9. FOLLOWING COMPLETION OF THE WORK ANY EROSION CONTROLS THAT WERE INSTALLED AS NEEDED, MUST BE REMOVED ONCE STABILIZATION HAS BEEN ACHIEVED.

Note: Planting and seeding quantities presented in these tables are based upon the project lay-out and work activities as anticipated at the time of this plan preparation. Final quantities may vary from the amounts indicated herein based upon subsequent changes in project work limits. This is especially true for areas downstream of Pomeroy Avenue (i.e., downstream of the first subreach work area).

Reach 5A Restoration Planting Drawings
Housatonic River - Pittsfield, MA

SCALE	DATE	PROJECT NO.
1:1,200	4/22/2026	60670015

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Appendix E - Restoration Corrective Measures Coordination Plan
Housatonic River Rest of River – Reach 5A

Prepared for General Electric Company

April 29, 2026

Delivering a better world

Appendix E
Restoration Corrective Measures Coordination Plan
Housatonic River Rest of River – Reach 5A

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April 29, 2026

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1. Introduction and Requirements

The Revised Final Permit Modification issued by the United States Environmental Protection Agency (EPA) to the General Electric Company (GE) for the Rest of River (ROR) (Revised Final Permit) and the Final Revised Statement of Work for the ROR Remedial Action (SOW) require GE to submit a Restoration Corrective Measures Coordination Plan (RCMCP), as well as a Restoration Plan for each ROR Remediation Unit (RU). Those documents also specify the requirements for the RCMCP. The Final Revised SOW provides that the RCMCP for a given RU may be submitted either as a stand-alone plan (concurrently with the Restoration Plan) or as part of the Restoration Plan for that RU. For Reach 5A, GE has developed the required RCMCP and, with EPA concurrence, is providing that plan as an appendix to the Restoration Plan for Reach 5A.

This RCMCP is a coordination document that describes how restoration will be implemented in coordination with the remedial actions in Reach 5A[1] to phase disturbance, support progressive recovery, and reduce the magnitude and duration of habitat disruption to the extent feasible and consistent with remediation requirements. To avoid undue repetition, this RCMCP does not repeat specific design details contained in the Reach 5A Final Remedial Design/Remedial Action (RD/RA) Work Plan or in the Reach 5A Restoration Plan, but provides a high-level summary of the required coordination items and cross-references to those other plans for the implementation details. This RCMCP will serve as the coordination plan applicable to all remediation-related work areas within Reach 5A, including associated support areas (e.g., temporary access roads, staging/laydown areas, and other temporary work zones needed to implement the remedy and restoration).

As provided in Section II.B.1.c of the Revised Final Permit and Section 4.3.3.5 of the Final Revised SOW, the RCMCP is required to address the following:

- **Integration of restoration with remediation** (e.g., locations of access roads and staging areas, harvesting/salvage for later restoration use, habitat-layer characteristics, bank stabilization methods, bed/bank interface construction);
- **Timing/phasing of remedial activities;**
- **Identification of restoration specialists and their roles and responsibilities;**
- **Specification of pre-construction preparation requirements to minimize habitat impacts** (e.g., protective/exclusion measures; propagation/material preparation; monitoring/relocation/propagation where applicable; delineation/flagging of species occurrences and vernal pool boundaries); and
- **Specification of protocols to be implemented prior to and during construction to minimize impacts to threatened, endangered, and other state-listed species** (collectively referred to as rare species) and habitats (e.g., seed-banking, transplanting, wildlife exclusion barriers, turtle tracking, and related measures).

This RCMCP addresses each of these requirements by identifying how restoration-remediation coordination will be implemented in Reach 5A and by cross-referencing the controlling technical documents where detailed requirements, habitat- and species-specific measures, and construction procedures are provided. Most of these specified requirements are addressed in the Final RD/RA Work Plan and/or the Restoration Plan for Reach 5A, and the sections below cross-reference to the appropriate section(s) of those plans to avoid repetition.

[1] The Revised Final Permit generally uses the term “Corrective Measures” to refer to the remediation activities that comprise the ROR Remedial Action. This RCMCP generally uses the term remediation or remedial activities to refer to those required activities.

2. Integration of Restoration with Remediation

Remediation and support activities in Reach 5A will disturb riverine, riverbank, backwater, Other Waterbody, and floodplain work areas. As described in the Final RD/RA Work Plan and the Restoration Plan, restoration has been and will continue to be considered during remedy design and execution, rather than being deferred until remediation is complete. As discussed in those documents, restoration has been considered and will function as an implementation constraint for work-area planning, access and staging layout, material handling, grading and stabilization, and seasonal sequencing. The following paragraphs describe further how, in practical terms, remediation-restoration coordination will be implemented across three operational areas.

First, integrated phasing and controls have been and will continue to be used to coordinate access, staging, sequencing, and restoration material management to avoid or minimize impacts to sensitive resources and restoration features where practicable. For example, the locations of access and staging routes have been developed through coordination between engineers and scientists to identify the least impact practicable alternatives, including avoiding large mature trees. This coordinated approach will continue throughout remediation and restoration construction activities, with contractor input and others as needed.

Second, coordination will include implementation of pre-construction readiness measures that must be completed before ground disturbance begins in a work area. These measures include delineation and protection of sensitive resources, installation and verification of protective/exclusion measures, and completion of any additionally required rare species surveys or other pre-construction actions identified in the Restoration Plan or to be identified in the future SIPs. These readiness measures will serve as measures completed before disturbance begins. In addition, suitable native materials identified during pre-construction surveys will be preserved for restoration reuse where feasible and consistent with the Final RD/RA Work Plan and Supplemental Information Packages (SIPs).

Third, during construction, coordination measures will be used to maintain work-area limits, implement applicable avoidance/minimization measures, and document the transition from remediation to restoration. Completed work areas will be stabilized in a timely manner to facilitate transition to the restoration phase. Restoration construction activities will be initiated only after the applicable coordination prerequisites have been satisfied and documented, consistent with the Final RD/RA Work Plan and future SIPs. For riverine and riverbank work areas, this includes coordination of grading, cap/habitat layer placement, bank treatments, and Natural Channel Design-based transitions. For backwater, Other Waterbody, floodplain, and vernal pool work areas, this includes completion of surface preparation, implementation of invasive species controls (if required), and any other prerequisites needed to begin restoration installation. These measures are described in the habitat-specific sections of the Restoration Plan.

3. Timing/Phasing of Remedial Activities

Remedial and restoration activities in Reach 5A will be implemented in phases by subreach and work area, as described in Sections 1 and 18.1 of the Final RD/RA Work Plan. Work will be sequenced so that only an approximate one-mile subreach of Reach 5A is under active disturbance at a given time, progressively restoring completed areas as work advances. The phased five-year sequencing of work, with prompt restoration of areas affected by remediation, will help limit impacts to a smaller portion of Reach 5A at a given time.

Construction will occur within approved seasonal windows, which will be identified in the applicable SIPs. Where practicable, work will be scheduled to avoid direct disturbance to wildlife during sensitive periods, such as nesting and breeding seasons. For example, tree clearing will be conducted during the winter period to avoid active-season roosting impacts to rare bat species, and riverine and bank work will have additional provisions during the winter months to avoid hibernating wood turtles. Seasonal construction

limitations and species-specific work windows will be defined in the applicable SIPs and species-protection procedures, consistent with the Final RD/RA Work Plan and Restoration Plan.

4. Identification of Restoration Specialists and their Roles and Responsibilities

The Reach 5A project organization is described in Section 6 of the Final RD/RA Work Plan, entitled Project Management Structure and Communications. Restoration will be coordinated through the Construction Manager, as identified in the Final RD/RA Work Plan, with input as needed from qualified restoration specialists assigned to support resource protection, constructability review, and verification of work-area conditions. Restoration specialists will support pre-construction planning, work-area verification, implementation of protection measures, and restoration readiness reviews, as applicable to the work being performed. Their role is to provide technical support for resource protection, restoration constructability, material suitability, and transition from remediation to restoration, consistent with the Restoration Plan and related species/resource protection procedures, as summarized in Table 1. Specific restoration specialists will be identified in the Reach 5A remediation SIPs.

Table 1. Restoration Specialist Roles and Responsibilities

Restoration Specialist	Role	Responsibilities
Herpetologist	Wood Turtle and Other Reptile Protection	Wood turtle clearance sweeps, construction oversight, habitat preservation and reconstruction oversight
Aquatic Scientist	Aquatic Habitat Restoration	Technical oversight for restoration of riverine, backwater, and Other Waterbody habitats, including habitat-layer placement, channel reconstruction, structural habitat features, aquatic/shoreline vegetation, and restoration of aquatic habitats; support for field verification and post-restoration monitoring.
Botanist	Rare Plant and Tree Species Protection, Invasive Species Control	Rare plant surveys, identification, plant/seed collection, relocation, and replanting oversight; rare invertebrate host plant protection; invasive plant species pre-construction mapping, prevention, treatment sequencing and habitat-specific controls; post-restoration monitoring and adaptive management.
Wetland / Vernal Pool Scientist	Vernal Pool and Wetland Restoration	Confirmation of boundaries and pre-construction conditions for the vernal pools to be remediated as part of the Reach 5A remediation; support for work planning, documentation of vegetation/organic material and woody debris for habitat replication; oversight of restoration of vernal pool and wetland microtopography/habitat features, and mitigation of impacts to wetlands outside the work areas.
Other Qualified Restoration Specialists	Ecological Technical Support	Support for pre-construction planning, work-area verification, implementation of protection measures, and restoration-readiness reviews, as applicable to the work being performed

5. Specification of Pre-Construction Preparation Requirements

Prior to initiating construction in an area, measures will be implemented to minimize ecological impacts. These measures are detailed in the habitat-specific sections of the Restoration Plan (Sections 4.3, 5.3, 6.3, 7.3, 8.3, and 9.3) and, for rare species, in Section 11 of that plan and the Rare Species Conservation and Management Plan (CMP) that is Appendix B to the Restoration Plan. Pre-construction preparation requirements include protective and exclusion measures, pre-construction surveys, delineation of sensitive resources, and native plant protection measures.

More specifically, where required by the Restoration Plan or CMP, pre-construction activities will include updated surveys or clearance checks for rare species, seed collection/propagation/transplanting measures, and salvage or segregation of suitable topsoil, organics, woody material, or other natural materials for reuse. For example, pre-construction surveys will be conducted in affected habitats to assess rare species presence, wood turtle exclusion barriers will be installed in high-risk areas such as staging zones, and vernal pool boundaries will be confirmed and flagged. Habitat features to be avoided, protected, or salvaged to the extent practicable will be identified, such as mature riparian trees along access routes, large woody debris, boulders, and other structural elements that contribute to cover, basking, refuge, emergence, or overwintering functions. Seeds and/or other plant material from state-listed plants will be collected and managed, including seed banking and off-site propagation in coordination with the Native Plant Trust (NPT) for later re-establishment in restored or otherwise suitable habitats, as described in the Use of Native Plant Trust Program (Attachment C to the Rare Species CMP).

6. Specification of Protocols to be Implemented Prior to and during Construction to Minimize Impacts to Threatened, Endangered, or State-Listed Species and Their Habitats

Measures to be implemented prior to and during construction to minimize impacts to rare species and their habitats are described in the associated Rare Species CMP. In general, these measures include limiting active disturbance footprints to the minimum practicable area; sequencing work so that only a portion of Reach 5A is under active disturbance at a given time; progressively restoring completed areas as work advances; conducting pre-construction review of updated rare-species information; and implementing species-specific field controls such as screening, exclusion, work-area marking, and construction oversight where warranted. Construction field personnel will also be trained in rare species awareness as described in the CMP.

Other measures to be implemented prior to and during construction to minimize impacts to rare species will include: clearance sweeps and telemetry-informed management of wood turtles in affected habitats; relocating any wood turtles encountered in active areas in accordance with the Wood Turtle Management Plan (Attachment B to the Rare Species CMP); installing exclusion fencing or other field controls where occurrences of state-listed plants have been confirmed; and re-locating state-listed plants to suitable habitats outside of impact areas. Measures for state-listed dragonflies and lepidopterans will be

implemented through the phased approach to remediation and restoration, limiting impacts to a portion of the habitat at a given time and supporting recolonization as restored areas become available. For rare lepidopterans, impact minimization will also rely on limiting the extent and duration of host-plant loss at any one time.[2]

[2] Although not required to be included in the RCMCP, it is noted that pre-construction and during-construction measures to minimize impacts to non-rare species habitats and wildlife are described in the habitat-specific sections of the Restoration Plan.

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