Pootatuck River Watershed Management Plan

October 2025

Assembled by the Housatonic Valley Association for the Pootatuck River Partners

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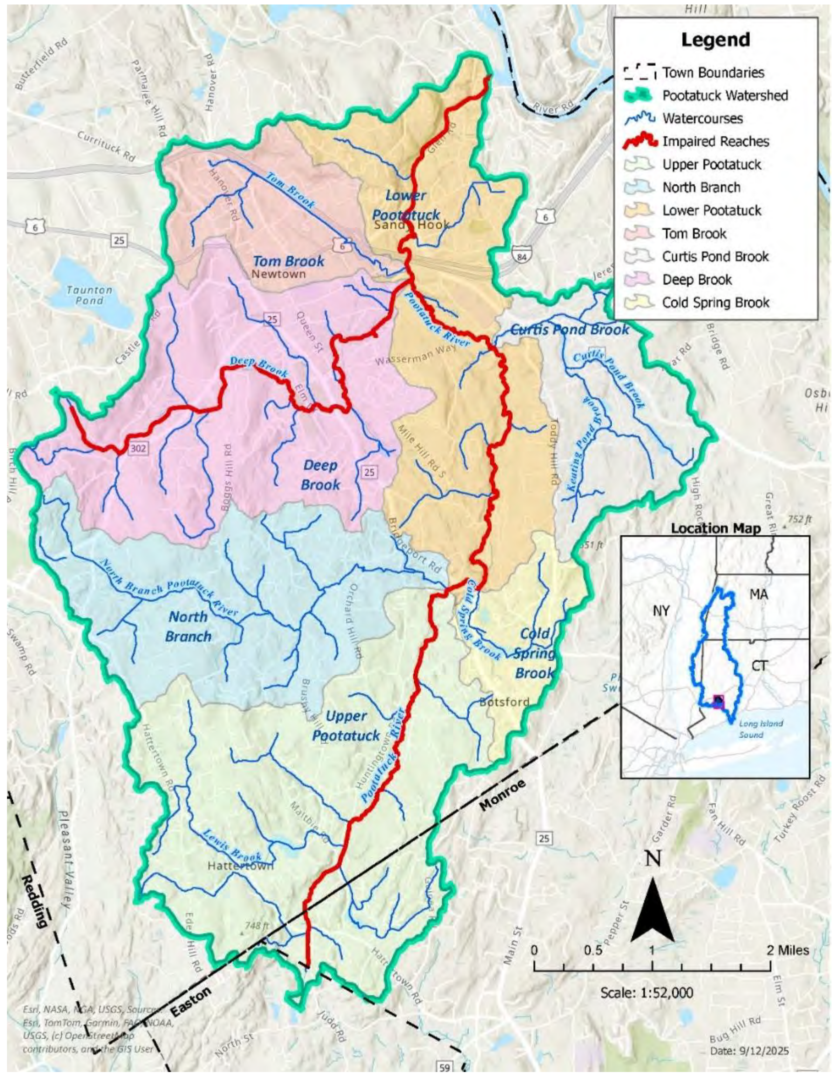
Pootatuck River Watershed Management Plan: Executive Summary

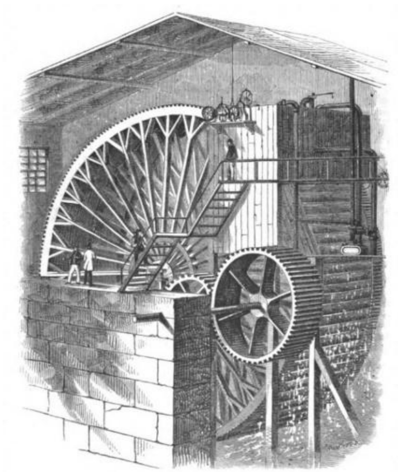
The Pootatuck River Watershed is located in Fairfield County, Connecticut. It flows north from its headwaters in the Towns of Easton and Monroe through the Town of Newtown, where it joins the Housatonic River at Sandy Hook. The waters of the Pootatuck ultimately flow to Long Island Sound. Major tributaries of the Pootatuck include Deep Brook, Tom Brook, Curtis Pond Brook, North Branch Pootatuck, and Cold Spring Brook.

The Pootatuck River has supported people for generations beyond memory, and it continues to be a vital community asset.



Pootatuck River Watershed, Tributaries, and Impaired Reaches

The Pootatuck River has provided fish and game, fertile soil and clean water since humans first came to the watershed. It provided water and energy to fuel industrial activities, which led to the settlement patterns we see today in Newtown. Healthy floodplains and wetlands in the Pootatuck River watershed capture and store floodwaters, reducing the risk of flood damage to property and infrastructure. The watershed recharges an aquifer that provides drinking water for over 3,000 households in Newtown and neighboring communities. The Pootatuck River and its watershed provide opportunities for people to connect with the natural world- streams and public open space in the watershed support a wide variety of outdoor recreation opportunities for residents and visitors.



Water wheel of industrial rubber mill on the Pootatuck River, from an 1859 issue of Scientific American

Non-point source pollution, exacerbated by climate change, threatens the health of the Pootatuck River and its tributaries

The health of the Pootatuck River fluctuates in response to the way people live, work and play in its watershed. Its ability to provide the benefits that residents, businesses and visitors expect is directly influenced by their behavior. While impacts from point sources of pollution (pollution tied directly to industrial operations or waste water treatment plants) have been significantly reduced since the passage of the 1972 Clean Water Act, non-point source pollution from Impervious Cover (roads, parking lots, etc.), residential landscapes, failing septic systems, and other sources continue to impact the Pootatuck River and its tributaries. Pollution from non-point sources has steadily increased as lands in the watershed have been converted to more intensive uses like residential and commercial developments.

Reaches along the Deep Brook tributary, and the entirety of the mainstem Pootatuck River from its headwaters to its confluence with the Housatonic River at Sandy Hook are listed as Impaired for Recreational Uses in the 2024 State of Connecticut Integrated Water Quality Report to Congress. These Impairments are based on observed levels of indicator bacteria (*E. coli*) that exceed CT Water Quality Standards- meaning that people coming into contact with these waters risk exposure to pathogens associated with human and/or animal waste. Pollution in the Pootatuck River is not just a local issue- nutrients (nitrogen and phosphorus) also impact downstream waters, including Lake Zoar and Lake Housatonic (both impoundments of the Housatonic River) and Long Island Sound.

These acute water quality concerns are exacerbated by the effects of climate change. More frequent severe storms and associated large floods have made many stream reaches in the Pootatuck River watershed unstable- meaning these reaches are subject to excessive bank erosion, even after floodwaters recede. Sediment mobilized by this erosion is deposited downstream, which impacts aquatic habitat and water quality. Stream instability also increases flood risk to property and infrastructure. At the same time, periods of drought and associated low flows are becoming more common. Low flows increase water temperatures and concentrate pollutants, with corresponding negative impacts on aquatic organisms.

PRP members in conversation with the public about the draft Pootatuck Watershed Existing Conditions Report.

Collaboration and planning at a watershed scale is essential for reducing non-point source pollution

Non-point source pollution is by nature a difficult issue to tackle. It arises from many different sources and responsible parties. It transcends jurisdictional boundaries, and the specific missions of municipalities, agencies and organizations. In order to address non-point source pollution effectively, a whole-watershed approach that creates a framework for collaboration between diverse stakeholders and engages the public is essential. It is also critical to consider non-point source pollution in the context of other watershed management issues, including but not limited to climate resilience (particularly flood damage prevention), outdoor recreation enhancement, and natural heritage conservation. Layering these objectives with non-point source pollution reduction objectives leads to more robust partnerships, stronger public participation, and a broader constellation of funding opportunities for priority projects and programs.

The Pootatuck River Partners (PRP) assembled in 2020, in recognition of the need to work collaboratively to address non-point source pollution and other watershed management goals. This ad-hoc group is comprised of Town of Newtowm staff, conservation non-profits, representatives from regional and state agencies, and representatives from Aquarion Water Company. The PRP has met regularly since then to discuss watershed management issues, and identify opportunities for collaboration around shared management goals. The PRP served as the Steering Committee for this Pootatuck River Watershed Management Plan (PRWMP). PRP members collectively committed hundreds of hours to assessing the state of the Pootatuck River watershed, articulating a shared Vision for its future, identifying a set of Goals that must be accomplished to realize that Vision, and developing an initial Action Plan to begin work on those

Goals.

At a Watershed Planning “kickoff” meeting held in March of 2020, the PRP selected the following Focus Areas for the Pootatuck River Watershed Management Plan:

- Water Quality Protection and Restoration
- Flood Damage Prevention and Climate Resiliency
- Natural Heritage
- Outdoor Recreation

Characterizing the Pootatuck River Watershed

The Housatonic Valley Association (HVA) and the PRP reviewed over 100 existing references germane to the focus areas chosen by the PRP, including but not limited to local, regional and state planning documents related to land use, natural hazard mitigation and watershed management, water quality studies, and natural resource inventories. Information germane to PRWMP Focus Areas was synthesized and incorporated into a summary of existing research and planning for the Pootatuck River Watershed.

HVA staff and volunteers conduct stream walks along the North Branch Pootatuck River

In addition to this comprehensive review of existing information, HVA assessed over 20 stream-miles in the watershed, using the Unified Stream Assessment (USA) protocol developed by the Center for Watershed Protection. The USA is designed to identify and characterize non-point source pollution impacts and associated restoration opportunities. When assessing restoration opportunities, HVA considered flood risk reduction, recreation enhancement and habitat conservation in addition to non-point source pollution reduction. Following the USA assessments, additional assessments of upland sites were conducted to support restoration project planning.

The summary of existing research and planning and the results of HVA's field investigations were combined as the draft Pootatuck River Watershed Existing Conditions Report (ECR). HVA circulated a draft of the ECR to the PRP, other stakeholders and the public, and incorporated comments received into the final ECR.

Envisioning the Future and Setting Goals

Based on the findings of the Final ECR, PRP members developed the following Vision Statement and Goals for the Watershed:

> *The Pootatuck River watershed is home to healthy lands and waters that support native species and their habitats, clean drinking water, and outdoor recreation opportunities for people of all backgrounds and abilities. The Pootatuck and its tributaries provide essential ecological services, including pollinator habitat, aesthetics, and nutrient cycling for watershed communities. Ensuring functioning floodplains will reduce the risk of damage to property and infrastructure during floods and recharge aquifers. Community officials, government agencies, and other stakeholders work collaboratively to:*
>
> - *Ensure that surface waters are safe for swimming and fishing, and sub-surface waters are safe for drinking.*
> - *Conserve healthy terrestrial and aquatic ecosystems that are resilient and adaptable to our changing climate.*
> - *Create and maintain equitable access to open spaces and waterways that provide opportunities for active recreation (including swimming, fishing, hiking and wildlife-watching), and for immersion in the natural world, reflection, and learning.*
> - *Integrate current and predicted climate change impacts into watershed management decision-making, including local land use and development policies.*
> - *Cultivate love and respect for the Pootatuck River and its watershed in residents and visitors through outreach, engagement, and education.*
> - *Secure funding, technical support and other resources required to achieve and*

maintain our shared Vision for the Pootatuck River watershed.

Water Quality Protection and Restoration Goals

1. All streams in the Pootatuck River watershed consistently meet Connecticut Water Quality Standards based on classification and use goals:

    a. Pollution loading to streams with existing impairments to Recreational and Aquatic Life uses is reduced to remove those impairments.

North Branch Pootatuck River, Town of Newtown

    b. Implement a robust water quality monitoring program that characterizes trends in stream health and informs timely interventions to ensure Water Quality Standards are met as land use and climate conditions change.

2. Drinking water supply continues to be safe and meets all drinking water quality standards.

3. Existing impervious cover connections to storm sewers are characterized to identify opportunities for installing Green Infrastructure or low-impact development (LID) practices; retrofit projects that will result in significant pollution reduction are implemented.

4. Community decision-makers have the resources they need to effectively integrate Green Infrastructure or LID practices into new development and redevelopment.

5. Town staff have the resources they need to effectively implement the requirements of the municipal separate storm sewer systems (MS4) General Permit, including detecting and eliminating illicit discharges to storm sewers and ensuring that

construction projects have adequate erosion and sediment control measures.

6. Riparian buffers of at least 35’ along the Pootatuck River and its tributaries are protected and restored wherever possible in an appropriate and practical manner.
7. Watershed landowners understand how their property management practices can impact water quality and have access to the resources they need to reduce their pollution contributions.
8. Functioning floodplains are protected and restored wherever possible to allow for sediment deposition and removal of pollutants.
9. Dams and barrier culverts are mitigated wherever possible to restore natural flows and reduce pollution arising from impoundments.
10. Wastewater is treated adequately throughout the watershed.

Flood Damage Prevention/Climate Resilience Goals

1. Monitoring of stream temperatures (and other parameters) to understand where areas that are vulnerable or resilient to climate change are located.
2. Green Infrastructure and Low Impact Development strategies are considered and implemented to reduce the impacts of climate change.
3. Targeted flood risk analysis to identify the most effective green and gray infrastructure improvements to reduce flood risk to infrastructure and property, including reconnecting the Pootatuck and its tributaries to natural floodplains and right-sizing bridges and culverts.
4. Watershed residents are educated about the importance of a resilient watershed in the face of climate change.
5. Watershed conservation measures are adaptable to changes in climate and climate related events (storms, drought, reduced snow pack).

Natural Heritage Goals

1. Decision-makers, landowners, developers and the public recognize that the unique natural heritage of the Pootatuck River watershed (geologic history, landscapes,

biodiversity) is essential to the character of the community and should be conserved.

2. Assessments of species and habitats and their conservation needs are characterized to understand their distribution and habitats of conservation concern.

3. Potential impacts to species and habitats of conservation concern are carefully considered in watershed

   management and land-use decision making, using the best available information.

4. Landowners have access to resources for conserving habitat on their property, including managing invasive species, establishing native plants and restoring natural hydrology.

5. Cold-water obligate species such as Eastern Brook Trout are present in the watershed.

6. Dams and barrier culverts are mitigated wherever possible to restore the ability of fish and wildlife to move along stream corridors.

Outdoor Recreation Goals

1. Existing and potential recreational opportunities/access sites are mapped to understand where access enhancement projects are most important; access enhancement projects are implemented.

2. Opportunities to recreate in the watershed are promoted and provided to all watershed residents and visitors, regardless of background or ability.

3. Visitors to recreation access sites become stewards of the Pootatuck River through passive engagement strategies (such as interpretive signage) and active engagement strategies (such as outreach events planned for busy days).

4. Recreation enhancement is integrated into watershed restoration projects wherever possible.

Pootatuck River Action Plan

Once the PRP reached consensus on the Vision and Goals, the next step in the watershed planning process was to identify specific Actions that must be taken to accomplish our Goals. Actions were generally organized as **Construction Projects** (like planting trees along a stream or capturing polluted runoff from a parking lot to filter out pollution- anything where we're putting a shovel in the ground), and **Non-Construction Programs** (such as water quality monitoring or educating youth about the Pootatuck River).

The PRP identified over 25 Actions over the four Focus Areas. The PRP then worked collaboratively to prioritize Actions for implementation based on pollution reduction potential, existing and potential partnerships to support implementation, cost-effectiveness/feasibility and potential to address multiple Goals across the four Focus Areas of the PRWMP.

Construction Projects and Non-Construction Programs identified by the PRP as priority Actions are included below. Note that more expansive descriptions of the highest priority Construction Project (Ram Pasture) and the highest priority Non-Construction Program (River Smart: Engaging Streamside Landowners to Support Riparian Restoration) are included in this Executive Summary; other Actions include a briefer description. More expansive descriptions of these Actions can be found in Section 8 of the PRWMP.

Construction Projects

Ram Pasture Riparian Buffer Enhancement and Goose Exclusion

Focus Areas addressed: **Water Quality, Outdoor Recreation, Climate Resiliency, and Natural Heritage**

Impacts along the stream channel through Ram Pasture

Ram Pasture is located in the heart of Newtown and is an important historic community space. The large lawn offers a great destination for picnics and other recreational activities during the summer and serves as an ice-skating pond in the winter. However, the water bodies in Ram Pasture are experiencing issues related to bacterial loading as a result of Canada Geese, and nutrient loading from stormwater runoff as a result of current management practices. Ram Pasture is currently mowed to the banks of the adjacent stream and pond, which provides an excellent opportunity to improve riparian habitat. Creating a riparian buffer and limiting mowing would reduce the amount of excess bacteria and nutrients entering the stream in Ram Pasture, and ultimately Deep Brook, which is listed as impaired for recreational use by indicator bacteria (*E. coli*). Additionally, there are erosion concerns throughout the stream corridor, resulting in unstable banks and subsequent sediment deposition in the pond. Riparian plantings would be targeted to address areas susceptible to erosion and to limit Canada Goose use of the pond, which in turn would limit bacterial loading. Current preliminary designs include a two-part approach in addressing nutrient, sediment, and bacteria concerns. Part one includes targeted plantings along the stream corridor to establish a riparian buffer to both stabilize the banks of the stream and uptake excess nutrients from runoff. Part two includes establishing offset plant beds staggered along the pond edge to both preserve stream access and views across the waterway for human site users as well as to block sight lines for Canada Geese. This project also provides an opportunity for educational signage about riparian restoration in a popular public location, and for planting events to actively engage the public in watershed restoration and stewardship.

<u>Additional Construction Projects:</u>

Connecticut Department of Transportation Highway Garage: Implementing stormwater retrofits/bioretention systems to address salt, sand, and other pollutants running off the site into Deep Brook.

Head O'Meadow Elementary School: Infiltration Basins/Stream Daylighting to reduce stormwater runoff entering an unnamed tributary that contains a population of wild Eastern Brook Trout.

Country Club Riparian Buffer: Increase riparian buffer along tributary to Deep Brook to reduce nutrient runoff and erosion.

Deep Brook Dam: Removal of Deep Brook Dam to allow for natural stream flow of Deep Brook and full passage for fish and other aquatic organisms.

Sand Hill Plaza: Stormwater Retrofits/Bioretention systems to address the large volume of stormwater runoff from impervious surface (parking lot).

Newtown Transfer Station: Trash cleanup and prevention of trash mobilization from the transfer station into a river channel.

Aquarion Well Field: Improve riparian corridor and instream habitat by removing invasive plant species and replanting
with native species.

Potatuck Club Dams: Removal or mitigation of series of rock dams that prevent fish passage.

Rocky Glen Dam: Removal or mitigation of the first major barrier of the Pootatuck river immediately upstream from the confluence of the Pootatuck and Housatonic River, preventing fish passage.

'Lower' Rocky Glen Dam: Removal or mitigation the second major barrier upstream of the confluence of the Pootatuck and Housatonic River, preventing fish passage (its 'Lower' name is a misnomer).

Non-Construction Programs

River Smart: Engaging Streamside Landowners to Support Riparian Restoration

***Focus Areas addressed:* Water Quality, Natural Heritage, and Climate Resiliency**

Landowners in Newtown and elsewhere in the watershed often own land containing or abutting tributaries to the Pootatuck River. Streamside landowners often maintain turf lawns that are mowed down to the banks of the waterway, leaving very little vegetation to act as a buffer and filter for pollution from fertilizers, pesticides, pet waste and other sources. Turf lawns also have shallow roots, leading to increased erosion along the impacted buffer. Hence, there is a need to engage such streamside landowners to encourage "River Smart" practices and support the implementation of restoration projects with technical and financial assistance. Current challenges include the lack of connections with streamside landowners, limited funding sources to implement projects, and a previous lack of technical support for interested parties. Engaging streamside landowners provides an opportunity to reduce impacts from residential land use, connect landowners with the correct resources for stream corridor management that strengthen the climate resiliency of their properties, and build a sense of stewardship within the community, which all help to address water quality impairments on the Pootatuck River.

Additional Non-Construction Programs:

Pollution Track Down Program: Systematic assessment of the storm sewer system upstream of outfalls flagged as potentially carrying an illicit discharge during USA assessment to identify pollution source and location.

Water Quality Monitoring Program: Establish a program to monitor water quality throughout the watershed, gathering data to understand water quality trends over time.

Education on Proper Septic Maintenance and Practices: Program to educate homeowners on best practices of septic system management to reduce contamination of surface and groundwater.

Wetlands Education Center and/or Program: Development of a center or program to offer easily accessible resources for community members to engage and learn about wetland/watershed conservation.

Land Protection Program: Conservation and preservation of land and natural resources to safeguard their ecological, cultural, recreational, and economic value for present and future generations.

Invasive Species Management Program: Development of comprehensive strategy to address the threats and impacts of invasive species within the Pootatuck River Watershed.

Education on Waste Management and Best Practices for Backyard Farming: Providing educational resources to suburban and backyard farmers to minimize possible negative impacts to the environment.

Work with Town Officials to Place Greater Emphasis on Protection of Watercourses: Ally with Town officials to institute more water protective language and policies such as those in favor of green infrastructure and low-impact development.

Pootatuck Watershed Association volunteers moving trees for Conifer Revetment

Conifer Revetment Program: Use donated Christmas trees to stabilize riverbanks, shorelines, and slopes.

Homegrown National Park Program: Encourage native plants and habitats in residential and suburban areas to support local biodiversity and wildlife.

Municipal Ban on Neonicotinoid pesticides for Non-Agricultural use: Town ban on potent neonicotinoid pesticides that are known to have adverse effects on pollinators.

Winter Water Quality Monitoring: Additional sampling outside of summer sampling to provide a more complete picture of water quality that includes additional metrics such as chloride.

Enhancement of Riparian Buffer and Native Plantings in Utility Right-of-Ways, Particularly those next to Streams: Plant native vegetation in streamside utility right-of-ways to best utilize available space while also allowing access for utilities.

Develop Master Inventory and Plan for Trails and Stream Habitat Improvements along the Pootatuck River from Lower Agricultural Field of Fairfield Hills to Sandy Hook Center: A program to take inventory and develop a comprehensive trail system to identify current trails and areas for new trails.

Advocacate for Municipal and State Tax Credits or Rebates for Reducing Lawn and Increasing Native Plants: Municipal tax credits for reducing lawn and planting native vegetation would incentivize homeowners and property owners to adopt more sustainable landscaping practices.

Implementing the Pootatuck River Watershed Management Plan

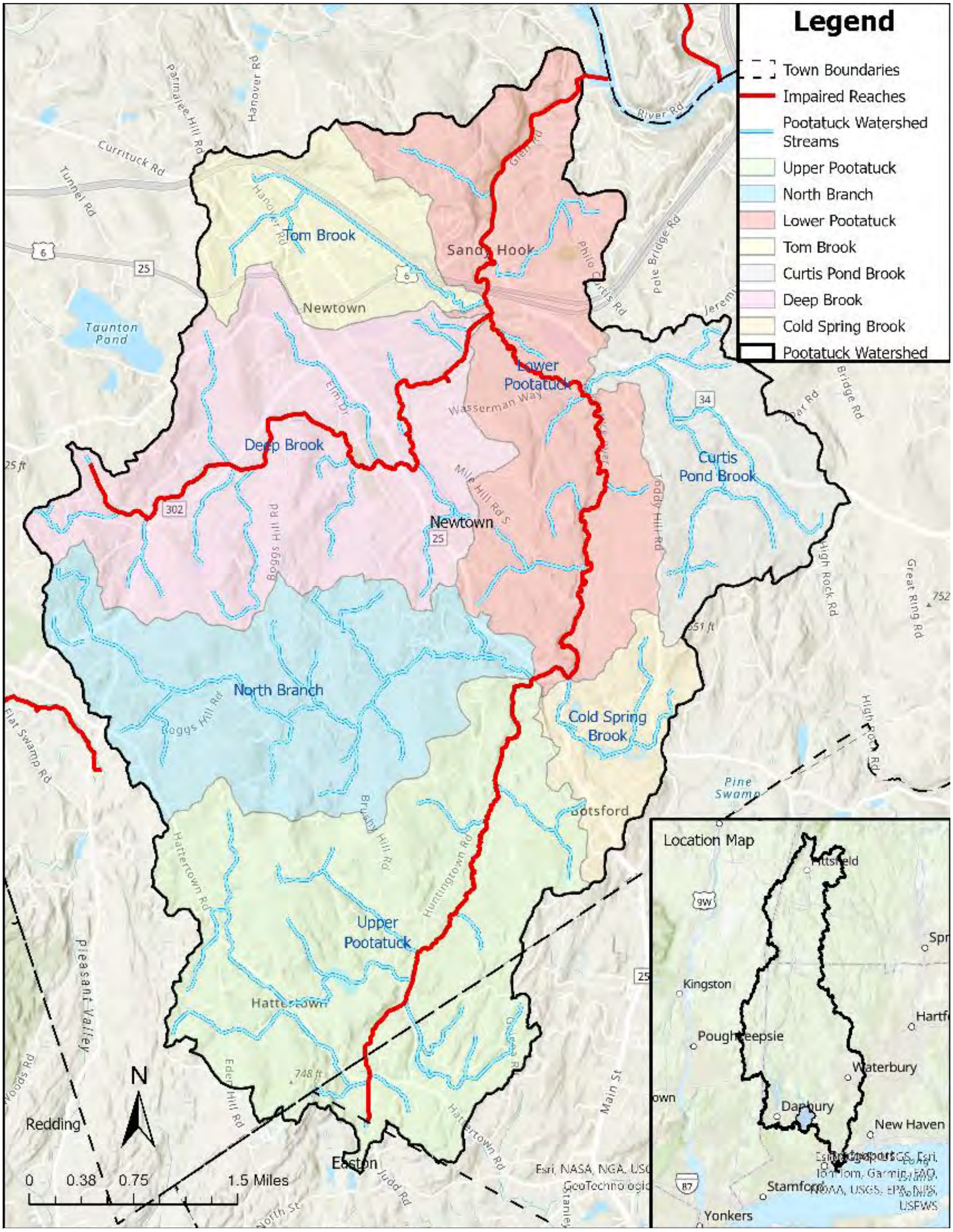
This document represents the intention of people living and working in the Pootatuck River watershed to achieve a shared Vision that restores and protects all the values the River can provide, for people and the natural world. It is our road map toward a Pootatuck River that supports healthy, climate-resilient lands and waters, native species and their habitats, clean drinking water, and outdoor recreation welcoming for people of all backgrounds and abilities.

While a huge amount of hard work and careful thinking on the part of PRP members, other stakeholders and the public went into this document, our work is really just beginning. The role of the PRP now shifts to facilitating implementation of the Actions identified above (described in more detail in Section 8). This work will require continued collaboration between PRP members and other stakeholders, engaging specific landowners and the general public, and securing the funds and technical resources necessary to support each Action.

Implementing the initial set of Actions we have identified will help us achieve our Goals and move us toward our shared Vision for the future of Pootatuck River. We will also need to evaluate the degree to which our Actions are achieving our Goals, and periodically update the Action Plan based on that evaluation to ensure we are always making positive progress towards our Vision.

This part of the Watershed Planning process is referred to as Adaptive Management. The PRP will meet annually to review the Action Plan, track effectiveness of Actions that have been implemented, add new Actions as new issues and opportunities related to the Focus Areas of the PRWMP come to light, and re-evaluate priorities. It's time to get busy! If you want to learn more about how you can help, please visit PootatuckWatershed.org

1. Watershed Plan Context



The Pootatuck River watershed, major sub-watersheds and Impaired reaches

1.1 Introduction

The Pootatuck River Watershed (PRW) is in Fairfield County, Connecticut. Most of the basin drains the Town of Newtown. The headwaters of the Pootatuck also include portions of Town of Monroe and Town of Easton. Deep Brook, Tom Brook, Curtis Pond Brook, North Branch Pootatuck, and Cold Spring Brook are major tributaries of the Pootatuck. The waters of the Pootatuck and its tributaries are confluent with the Housatonic River at Sandy Hook, and ultimately flow to Long Island Sound.

While there have been significant improvements in Pootatuck River water quality since the 1972 Clean Water Act[1] (CWA), primarily through the management of "point sources" of water pollution, the PRW still faces ongoing challenges from non-point source (NPS) water pollution-exacerbated by the effects of climate change. The CWA defines point sources of pollution as "any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged" directly into a waterbody.[2]

NPS pollution originates from a broad area rather than a single, identifiable pipe or discharge point. Sources include but are not limited to polluted stormwater runoff from developed areas and agricultural areas, illicit discharges to storm sewer systems, and failing septic systems. NPS pollution can carry pathogens, nutrients, heavy metals, deicing agents, sediment, trash and other pollutants into surface waters. Because if its diffuse nature, NPS pollution is more difficult to manage than point-source pollution. Watershed-Based Planning that includes relevant stakeholders, assesses pollution sources on the landscape, and identifies strategic interventions to reduce that pollution is an approach for tackling the challenges presented by NPS pollution.

Additionally, climate change has brought extreme weather events, including more frequent and intense storms, localized and regional major floods, more frequent drought and overall elevated ambient air temperatures, which exacerbate NPS pollution and increase risk to public health, property, infrastructure and the environment.

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[1] US EPA, "Summary of the Clean Water Act."

[2] US EPA, "Clean Water Act Section 502: General Definitions."

Non-point and point source pollution along with elements of the water cycle

To tackle these complicated problems, the Pootatuck River Partners (PRP) came together in 2020. This group includes local government, state and regional agencies, and non-profit conservation groups. The PRP evolved out of the work of several local partners to restore and protect the Pootatuck River watershed, including the Pootatuck Watershed Association, Candlewood Valley Chapter of Trout Unlimited, Newtown Forest Association, and the Town of Newtown.

The PRP works together to identify shared watershed management concerns and address them through collaboration, resource-sharing and communication with stakeholders and the public. The PRP recognized that Watershed-Based Management Planning is a framework that supports detailed characterization of the watershed, consensus on management priorities, public and stakeholder engagement, and prioritization of specific management actions.

The PRP secured funding through the Clean Water Act's Section 319 non-point source grants program to complete a Watershed-Based Plan for the Deep Brook tributary. Subsequently, additional funding was secured from the Long Island Sound Futures Fund[3] to expand Watershed-Based Planning to the entire Pootatuck River watershed.

This Pootatuck River Watershed Management Plan (PRWMP) is meant to provide a road map towards achieving the Goals and realizing the Vision for the future of the watershed developed by the Pootatuck River Partners, with stakeholder and public input. Removing three Impairments that the CT Department of Energy and Environmental Protection (CT-DEEP) identified for certain uses of particular stretches of Pootatuck waterways is central to the analysis and Action planning incorporated into this document. A water body is considered 'Impaired' when it does not meet Connecticut Water Quality Standards (WQS) based on empirical water quality and/or biological data, and that water body's classification and associated use goals.

One of these Impairments is for Aquatic Life Uses of Meeker Brook, a tributary to Deep Brook that was documented to support Eastern Brook Trout during fish community assessments in the 1990s. This Impairment is suspected to have been caused by a series of heating oil spills from the Fairfield Hills area during 2003, 2004, and 2013. Two Impairments are for Recreational Use of Deep Brook and the mainstem Pootatuck River, including swimming, wading or any activities that may lead users to come into contact with surface water.

The recreational Impairments on Deep Brook and the mainstem Pootatuck are based on observation of elevated levels of *Escherichia coli* (*E. coli*), a bacterium which indicates the presence of untreated human waste and/or waste from domestic or wild animals. In the case of Deep Brook, CT-DEEP has developed a Total Maximum Daily Load (TMDL) that quantifies the amount by which *E. coli* concentrations must be reduced to remove the Impairment and make the waters of Deep Brook safe for contact recreation. More details about the Deep Brook TMDL are below in section 3.3. This Management Plan uses the Environmental Protection Agency (EPA) Nine Elements of Watershed-Based Planning to create an approach for meeting the *E. coli* load reductions identified in the Deep Brook TMDL. A TMDL has not been developed for mainstem Pootatuck reaches, however the Actions identified in Section 8 are expected to lead to *E. coli* load reductions.

[3] The National Fish and Wildlife Foundation manages LISFF in collaboration with and major funding from the U.S. EPA through the Long Island Sound Study (LISS), and additional funding from other federal agencies and private partners.

The PRWMP is also identifies opportunities to reduce non-point sources of nutrients (phosphorus and nitrogen) that are likely degrading waterbodies downstream from the Pootatuck River, including the Lake Zoar and Lake Housatonic impoundments of the Housatonic River and Long Island Sound.

The State of Connecticut issues a Municipal Separate Storm Sewer System (MS4) General Permit that regulates urbanized stormwater systems as point sources. The State requires communities that contain "Urbanized Areas" (determined by the United States Census) that discharge stormwater via a separate storm sewer system to surface waters to follow the guidelines of its MS4 General Permit.

While all three municipalities in the Pootatuck River watershed are MS4 communities, this Pootatuck River Watershed Management Plan (PRWMP) is distinct from their obligations under the MS4 General Permit. The PRWMP and the Actions described in Section 10 -meant to accomplish the Goals and achieve the Vision for the watershed developed collaboratively by the Pootatuck River Partners- do not arise from any statutory responsibility on the part of watershed municipalities.

1.2 - EPA's Nine Elements of Watershed-Based Planning

A watershed plan is a guide to mobilize communities toward improved water quality and other watershed management goals.[4] Such plans proceed through a non-regulatory, voluntary approach to protect and restore water quality through reductions of NPS pollution, before it enters surface water or a stormwater system.

The Watershed-Based Planning (WBP) process developed by the Environmental Protection Agency (EPA) entails seven major steps that result in nine elements that comprise a WBP. The EPA has outlined this structured framework for WBP in the *Handbook for Developing Watershed Plans to Restore and Protect Our Waters*. These elements and steps serve as comprehensive guidelines for developing effective plans that address water quality and resource management at the watershed level.[5] The nine minimum elements and seven minimum steps are intended to ensure that the contributing causes and sources of NPS pollution are identified, key stakeholders are

[4] EPA, *Handbook for Developing Watershed Plans to Restore and Protect Our Waters*.

[5] New York State Department of Environmental Conservation.

involved in the planning process, and restoration and protection strategies are identified that will address water quality concerns.[6]

In 2020, a group of conservation nonprofits, Town of Newtown staff, federal, state, and regional agencies and Aquarion Water Company staff came together to form the Pootatuck River Partners (**Step 1**). The PRP gathered existing planning and research to help inform the Pootatuck Watershed Existing Conditions Report (ECR), a document that outlines the state of the Pootatuck Watershed today (**Step 2**). Based on the findings in the ECR, the PRP collaboratively articulated a Vision for the future of the watershed, and a set of Goals that must be achieved to realize that Vision, which were informed by stakeholder and public comment (**Step 3**). The ECR, Vision and Goals informed the Action Plan, which articulates specific construction projects and non-construction programs that further watershed planning goals (**Step 4**). The next steps are to put the outlined recommendations into action through implementation (**Step 5**); measure the progress of those Actions in reducing pollution loads and improving water quality (**Step 6**); and, make adjustments as necessary to the Action Plan to ensure we're making the most effective progress towards achieving our goals (**Step 7**).

The seven steps described above result in a WBP that contains the following nine elements:

1. **Impairment:** This element identifies the causes and sources of pollution as necessary to address pollutant load reductions required for rectifying impairments and achieving water quality goals.
2. **Load Reduction:** This element estimates the expected pollutant load reductions resulting from the management measures proposed.
3. **Management Measures:** Descriptions of non-point source (NPS) pollution management measures required to achieve the estimated pollutant load reductions.
4. **Technical and Financial Assistance:** An estimate of the technical and financial resources needed as well as potential sources and authorities that will support plan implementation.
5. **Public Information and Education:** An information and education component aimed at enhancing public understanding and engagement in the selection, design, and implementation of NPS management measures.

[6] Mika et al., "Evolution and Application of Urban Watershed Management Planning."

6. **Schedule:** An expedited schedule outlining the implementation of NPS management measures.
7. **Milestones:** Descriptions of interim, measurable milestones for gauging the extent to which NPS management measures or other controls get implemented.
8. **Performance:** Criteria to evaluate the achievement of loading reductions over time, progress towards attaining water quality standards (WQS), and in cases of no such achievement and progress then criteria to evaluate any needs to revise the plan or a related Total Maximum Daily Load (TMDL) of pollutants.
9. **Monitoring:** A monitoring element to assess the effectiveness of implementation efforts over time.

The following table serves as a guide to help readers navigate the EPA Nine Elements of Watershed Planning within the various sections of the PRWMP.

1	**Impairment**	Pootatuck Watershed impairments are described in Section 3, Water Quality Protection and Restoration; and TMDLs included as Appendix A.
2	**Load Reduction**	Pollutant load reduction requirements are in described in Section 3, Water Quality Protection and Restoration; and in TMDLs included as Appendix A. Pollutant load reduction estimates are included with Construction Projects in Section 8, Action Plan.
3	**Management Measures**	Management measures are included in Section 8, Action Plan.
4	**Technical and Financial Assistance**	Anticipated Technical and Financial Assistance needs are included in Section 8, Action Plan.
5	**Public Information and Education**	Section 1.3 describes the public participation and outreach elements of this planning process, and the extensive comments received are included in Section 9. Section 8, Action Plan, includes details about future public engagement.
6	**Schedule**	Schedules for priority Actions, milestones for those Actions and deliverables (e.g. performance measures) are included in Section 8, Action Plan.
7	**Milestones**	
8	**Performance**	

9	**Monitoring**	Monitoring conducted to support the PRWMP is described in Section 3, Water Quality Protection and Restoration; and TMDLs included as Appendix A. Section 8, Action Plan, includes details about future monitoring.

1.3 Pootatuck River Watershed Management Plan Development Process

Pootatuck community members at a public meeting held to review the draft PWR Existing Conditions Report in January 2024

Stakeholder and Public engagement was a critical part of this planning process. In March of 2020, a PRWMP "kickoff" meeting was held to develop a basic understanding of NPS pollution issues and the watershed planning process for PRP members. During this meeting, other potential focus areas of the planning process aside from water quality were discussed. The PRP chose to add Climate Resilience, Outdoor Recreation and Natural Heritage as focus areas of the PRWMP. After the initial kickoff meeting, the PRP met regularly to guide the development of the PRWMP.

The PRP gathered and synthesized existing research and planning related to each of the chosen focus areas. This effort helped to identify and prioritize Actions that reduce NPS pollution, while addressing other focus areas of the PRWMP. Water quality and temperature data collected by the Pootatuck Watershed Association (PWA), Town of Newtown, and the Candlewood Valley Chapter of Trout Unlimited (CVTU) over the past ten years provided valuable insight into pollution hotspots and sources.

The synthesis of existing research and planning was used to inform strategies and locations for field assessments. Field assessments were conducted by HVA with support from Town of Newtown staff, volunteers from the Pootatuck Watershed Association and other PRP members.

The synthesis of existing research and planning and field assessments were combined as a draft Existing Conditions Report (ECR), which was shared for stakeholder and public review in January of 2024. Comments received were addressed in the final ECR, which is incorporated into this PRWMP.

Based on the findings in the ECR, the PRP worked collaboratively to articulate a Vision for the future of the watershed and a set of Goals that must be achieved to realize this Vision. The PRP met on multiple occasions to craft the Vision and Goals, including a meeting to brainstorm initial ideas, a workshop to wordsmith the first vision and goal statements, and a meeting to approve the final versions. The Vision and Goals then informed identification, development and prioritization of Construction Projects and Non-Construction Programs included in the PRWMP Action Plan (Section 8).

The ECR, the Vision and Goals and the Action Plan were combined to create the draft Pootatuck River Watershed Management Plan. This was then circulated to the PRP and other stakeholders. Comments on this draft were addressed in the final version of PRWMP (this document).

2. WATERSHED CHARACTERISTICS

2.1 Geography

The Pootatuck River Watershed, covering an area of 26.1 square miles, is situated in northern Fairfield County, Connecticut (CT). The Pootatuck River mainstem originates near the Monroe-Newtown border and flows in a northerly direction through the Town of Newtown[7]. Approximately 10.6 miles of the Pootatuck River mainstem flow through Newtown. The major tributaries of Deep Brook, Tom Brook, Curtis Pond Brook, North Branch Pootatuck, and Cold Spring Brook are confluent with the Pootatuck River along its northerly run to the confluence with the Housatonic River at Sandy Hook. While the majority of its drainage area falls within the town boundaries of Newtown, small portions of Easton and Monroe also contribute to this watershed.

2.2 Geology and Soils

The geological characteristics of the Pootatuck River Watershed (PRW) resemble those of other watersheds in Connecticut and, on a broader scale, New England. The watershed features narrow valleys formed in bedrock, a common trait in glaciated valleys. The valley walls are composed of glacial till, a mixture of unsorted clay, silt, sand, gravel, and boulders, which overlays the

[7] Carlson et al., "Hydrogeology and Numerical Simulation of the Unconsolidated Glacial Aquifer in the Pootatuck River Basin, Newtown, Connecticut."

underlying bedrock. Within the Pootatuck River basin, three primary rock units are identified: bedrock, glacial till, and glacial deposits.

The foundational bedrock serves as the structural base of the basin and is predominantly composed of gneiss and schist. In Newtown specifically, the prominent bedrock formation is the Brookfield Gneiss, characterized by its dark and light rock with significant foliation. These metamorphic bedrock formations are prevalent throughout the region, resulting from the accumulation of landmasses along the Northeast coast, which contributed to the formation of the local mountains and hills.

Around 10-15,000 years ago, during a period of glaciation, the area was covered by an ice sheet. As the ice sheets gradually retreated, they sculpted valleys into the bedrock and deposited layers of sediment, known as glacial till, on top of the bedrock layer. This till comprises a mix of various-sized particles, creating a diverse substrate. Additionally, the melting ice sheets transported sediment and gave rise to glacial deposits primarily consisting of sands and gravels in the valley bottoms, shaping the geological makeup of the PRW[8].

[8] Carlson et al.

2.3 The Hydrologic Cycle and Watersheds

The quantity of water present on Earth remains constant over time, which means that while it changes form regularly, there is no creation or destruction of water[9]. We can directly observe water's movement in its various forms in our daily lives. For instance, we witness land flooding

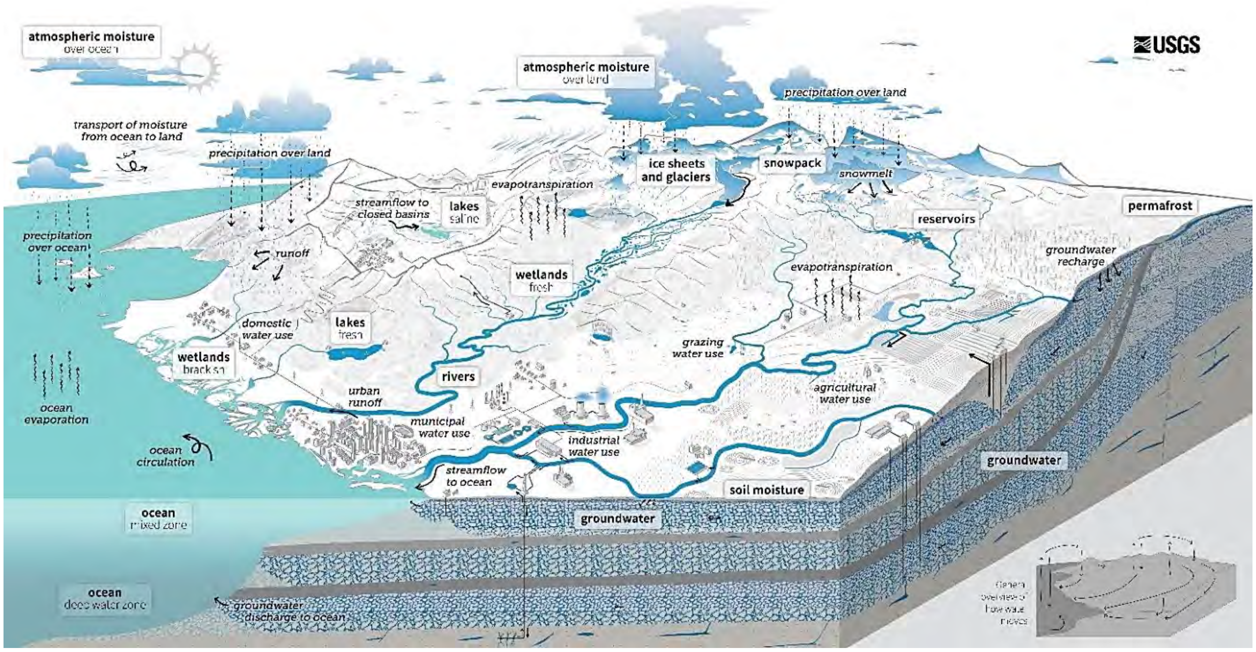

Figure 2. The water cycle (USGS, 2022)

and watch previously water-rich areas become dry. These fluctuations in visible surface water in our immediate surroundings indicate changes in water storage. Water is stored in different "reservoirs," including the atmosphere, oceans, lakes, rivers, soils, snow and glaciers, and underground reserves[10]. The capacity of these reservoirs to store water varies over both space and time.

The hydrologic cycle featured in Figure 2 above is a conceptual model that illustrates how water moves among these reservoirs through processes like evaporation, precipitation, and flow. The oceans serve as Earth's largest reservoir, containing about 97% of all water. The remaining 3% constitutes the planet's freshwater, with approximately 78% of it stored as ice and 21% as groundwater.[11]

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[9] Oki, Entekhabi, and Harrold, "The Global Water Cycle."
[10] Koutsoyiannis, "Revisiting the Global Hydrological Cycle."
[11] Koutsoyiannis.

Water undergoes a phase change when it enters the atmosphere, transitioning from a liquid state (through processes like evaporation and transpiration) or a solid state (through sublimation) into a gaseous form known as water vapor[12]. Once in the atmosphere, this water vapor rises and cools. During the cooling process, water vapor molecules adhere to tiny particles in the air and condense, forming water droplets that collectively create clouds. When these droplets become sufficiently heavy, they return to the Earth's surface as precipitation, which can take the form of rain, snow, dew, fog or hail.

All bodies of water have a finite area of land that drains into them, determined by the surrounding topography. These topographic and hydrological systems are most commonly referred to as watersheds (but are also referred to as drainage basins or catchments). The amount of runoff that reaches a water body, the pollution that runoff carries, and the rate at which it reaches the water body is influenced mainly by soil, land use and vegetative cover characteristics of its watershed.

2.4 Land Use/Land Cover

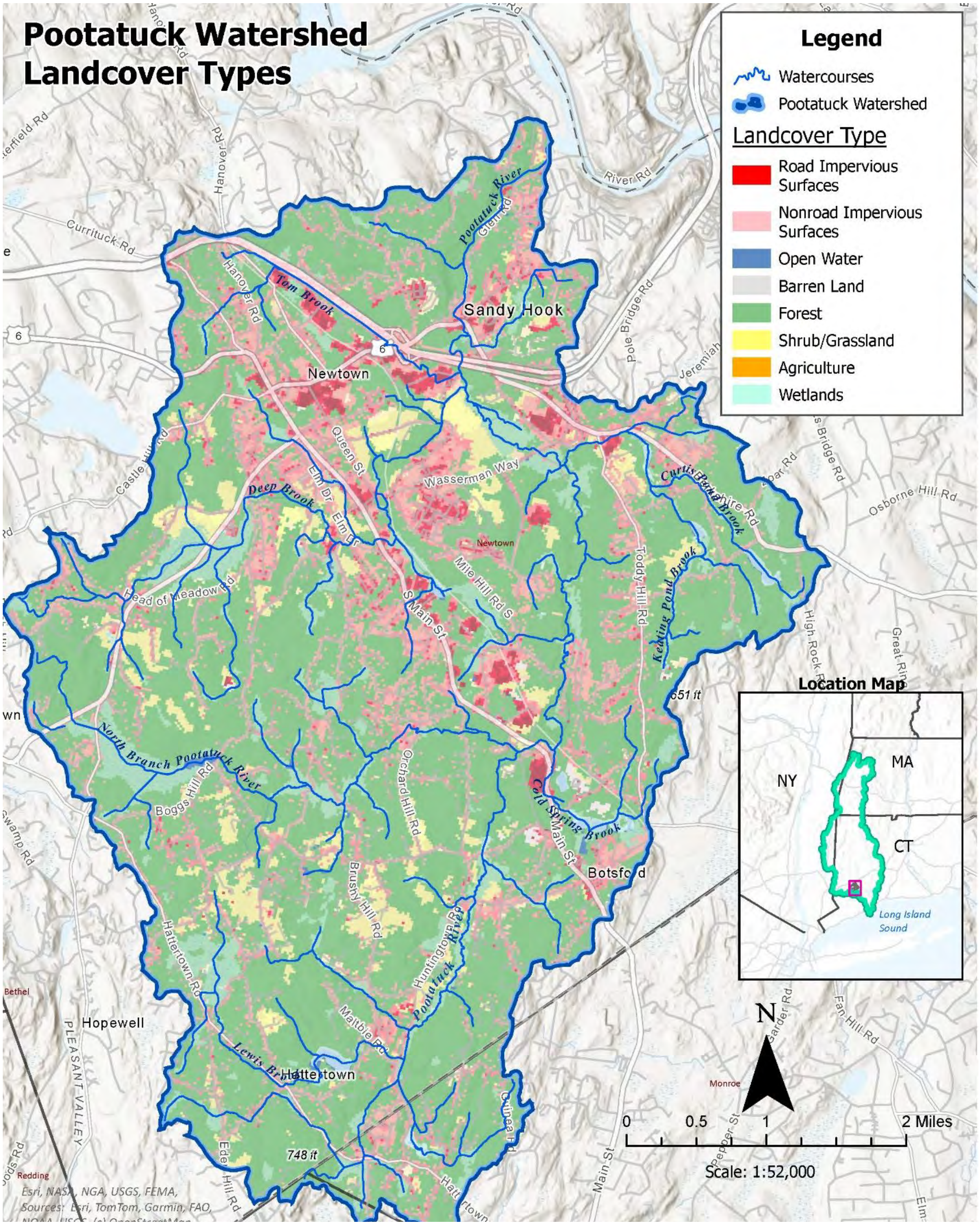
"Land use" is the term used to describe the ways that people live, work and play on the landscape. "*Land Cover*" refers to other elements that cover the landscape that are minimally modified by people, such as surface water and forests. When siting and design of land use is not carefully considered, these uses can have negative impacts on water quality. Water quality, and the ability of surface waters to support their use goals, tends to decline in proportion to upstream development.

Runoff from precipitation flowing over the landscape and washing pollutants into nearby surface water is a key source of NPS pollution. NPS pollution can also come from sanitary sewage disposal issues (e.g., failing septic systems or connections between sanitary sewers and storm sewers); stream instability (excessive erosion/deposition) caused by land use changes, channel modifications and/or large floods; and atmospheric deposition. Please note that this list is not exhaustive. Examples of NPS pollution include but are not limited to:

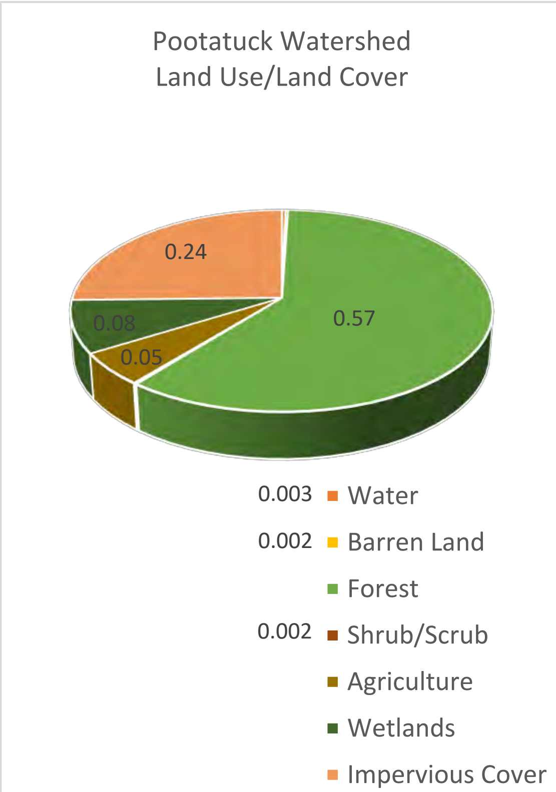
- Fertilizers, herbicides and insecticides from agricultural lands and residential areas such as lawns;
- Hydrocarbons (oil and gas), grease, and heavy metals from urban runoff;

[12] Yang, Yang, and Xia, "Hydrological Cycle and Water Resources in a Changing World."

- Sediment from improperly managed construction sites, crop and forest lands, and eroding streambanks;
- Salt from road, parking-lot and sidewalk de-icing agents;
- Bacteria and nutrients from livestock, pet wastes, and faulty septic systems;
- Mercury from upwind power generation.



Map 1. Pootatuck River Watershed Land Use / Land Cover



PRW Land Use/Land Cover

Map 1 above displays land use/land cover in the Pootatuck River Watershed, derived from the 2021 National Land Cover Dataset maintained by the United State Geological Survey.[13] Approximately 57% of the PRW is forested, approximately 8% is wetlands, approximately 5% is agricultural, including pasture and row crops. Historically, agriculture was a much larger proportion of land use in the PRW, but agricultural lands have steadily been converted to residential and commercial land uses. Like many communities in Connecticut, Newtown has transitioned from a primarily rural community to a primarily suburban community.

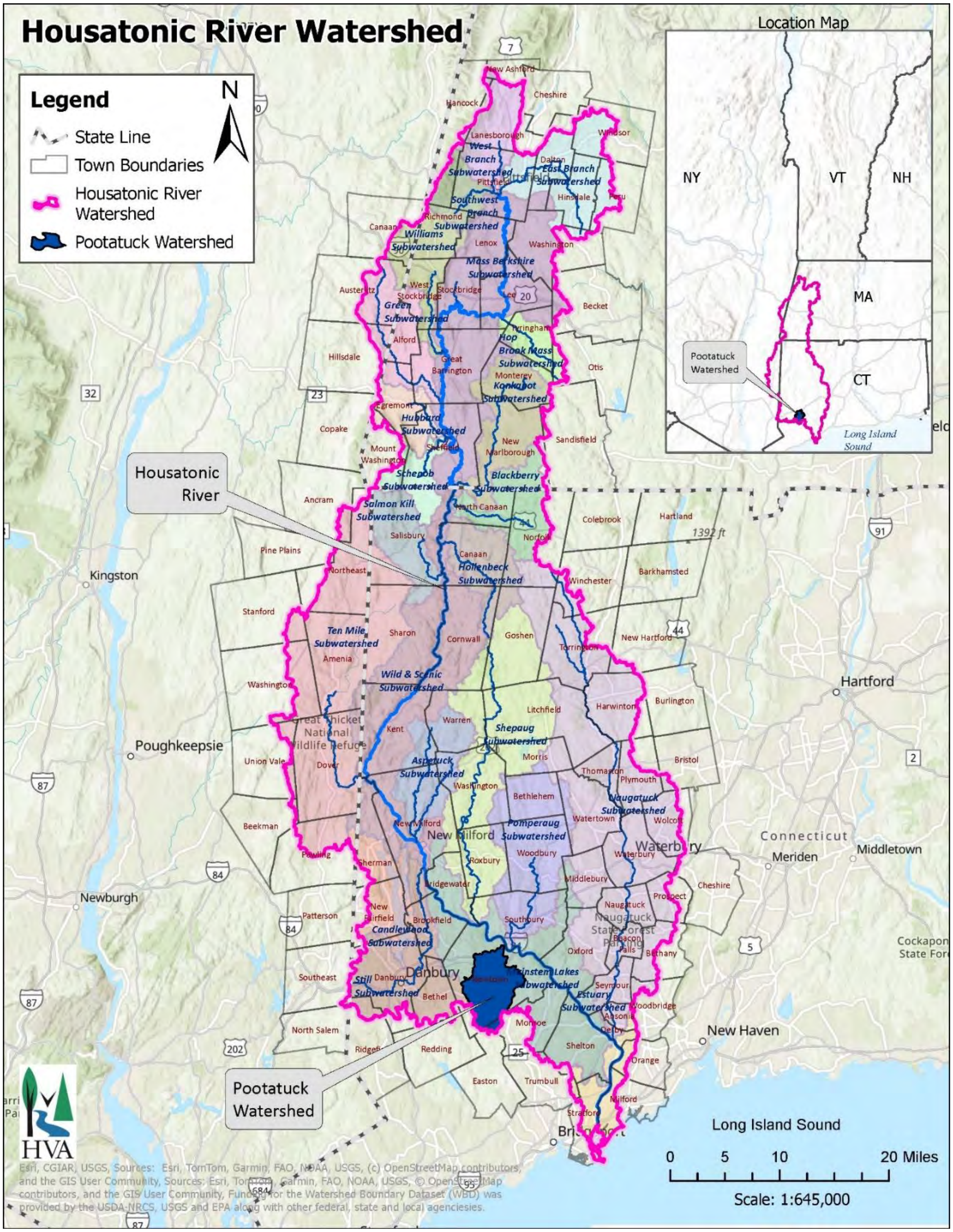
2.5 The Pootatuck River, Housatonic River and Long Island Sound

The Housatonic River watershed drains approximately 1,948 square miles. From its headwaters north of Pittsfield, Massachusetts, it flows south through Berkshire County (MA), Litchfield County (CT) and Fairfield County (CT), gathering water from tributaries in Columbia County (NY), Dutchess County (NY) and New Haven County (CT) along the way. The waters of the Housatonic join Long Island Sound at Town of Milford/Town of Stratford. The Housatonic watershed encompasses all or part of 83 towns.

One of those Fairfield County tributaries is the Pootatuck River. Restoring water quality in the Pootatuck is important not just locally, but also for downstream waters- particularly Lake Zoar and

[13] U.S. Geological Survey (USGS) Earth Resources Observation and Science (EROS) Center. 2021.

Lake Housatonic, impoundments of the Housatonic that experience Harmful Algae Blooms due primarily to phosphorus loading. The Pootatuck flows directly into Lake Zoar. The waters of the Pootatuck ultimately reach Long Island Sound, where nitrogen loading has led to hypoxic events that negatively impact aquatic species.



Housatonic River Watershed, Major Sub-Watersheds and Long Island Sound

3. WATER QUALITY PROTECTION AND RESTORATION

3.1 Water Quality Parameters and Pollution Sources

This section describes physical, chemical and biological parameters that are used to assess water quality, and includes general information about pollutant sources.

3.1.1 Impervious Cover

Impervious cover (IC) refers to surfaces such as pavement or buildings, which collect pollutants from vehicles and other sources, concentrate stormwater runoff and in many situations deliver that polluted runoff directly to surface waters. Pollutants in stormwater runoff include but aren't limited to hydrocarbons, heavy metals, nutrients, bacteria, and sediment[14]. CT DEEP has conducted studies that highlight the relationship between IC and water quality, which are the basis for the 2015 "Connecticut Watershed Response Plan for Impervious Cover" and the "Town of Newtown Water Quality and Stormwater Summary".[15] CT DEEP has determined that streams tend to not support Life Use goals when IC covers 12% of total watershed area.[16] Given the well-documented relationship between IC and water quality impacts, IC can be a useful proxy for identifying areas where restoration efforts are needed.

IC connected to streams by storm sewers- known as Directly Connected Impervious Areas (DCIAs) - tend to contribute more pollution than IC not connected in this way. DCIA is defined as "impervious area with a direct hydraulic connection to a storm drainage system or a waterbody via continuous paved surfaces, gutters, drainpipes, or other conventional conveyance and detention structures that do not reduce runoff volume."[17] DCIAs can include streets, sidewalks, driveways, parking lots, and roof tops. An isolated impervious area that drains to a pervious area, allowing runoff to percolate through the soil profile before reaching surface water, would not be considered a DCIA. It is important to note that while IC has been mapped approximately through remote sensing in the PRW, DCIA has not been mapped

[14] Town of Newtown, "Clean Water and Storm Water Management Plan." 2021.

[15] CT DEEP, "Connecticut Watershed Response Plan for Impervious Cover." 2015
[16] CT DEEP, "Factsheet: Town of Newtown Water Quality and Stormwater Summary"
[17] CT DEEP, "Connecticut Stormwater Quality Manual," p. 26.

comprehensively. Disconnecting DCIAs can help reduce the effective percentage of IC in a watershed, and lead to re-attainment of Aquatic Life Use goals.

Based on analysis of the 2021 National Land Cover Dataset maintained by the United State Geological Survey, approximately 24% of the entire PRW is under Impervious Cover. However, IC is distributed heterogeneously across the landscape and varies in its connection to surface water and pollutant load contribution as described above. IC density varies between the major sub-watersheds of the Pootatuck, with corresponding variations in impact to tributary and mainstem health. For example, a site on a headwater tributary may have a very low effective percentage of IC in the watershed draining to it, while a site lower in the watershed may have a much higher effective percentage of IC draining to it. Section 3.4 below describes each of the major Pootatuck sub-watersheds in more detail.

While IC is not the sole cause of Impairments in the PRW, reducing effective IC within the basin - addressing DCIA in particular- is a critical general Action that will lead to improvements in water quality and support the attainment of Use Goals for Recreation and Aquatic Life.

3.1.2 Indicator Bacteria

Escherichia coli (*E. coli*) is a type of bacteria that is commonly present in the gastrointestinal tracts of all warm-blooded animals, including humans, livestock, and wildlife. While *E. coli* itself is not necessarily harmful, the presence of *E. coli* in surface water may indicate the presence of other pathogens that can pose health risks to humans and wildlife.

E. coli in water bodies can become elevated due to various sources, including human-generated wastewater, agricultural runoff, and the activities of wildlife such as beavers and waterfowl.

3.1.3 Nutrients

The two nutrients most commonly measured in water quality monitoring are nitrogen and phosphorus. At normal levels, these nutrients are essential for biological growth, but they can be detrimental to water quality when present in excess.

The most common forms of nitrogen in streams are ammonia (NH_3) and nitrate (NO_3). Ammonia concentration that exceeds 1.0 mg/L and nitrate levels above 0.10 mg/L indicate human impact such as from sewage, fertilizers from residential and agricultural stormwater runoff or atmospheric deposition of nitrogen from gas emissions. Consequently, even in small quantities, nitrogen can lead to harm such as toxins for humans and/or animals through algal blooms, eutrophication, and a reduction in dissolved oxygen levels within aquatic ecosystems.

Phosphorus is commonly found as phosphate (PO_4). Plants take up phosphate from water and convert to organic phosphorus. Phosphate will have an impact on aquatic life at concentrations above 0.05 mg/L and as low as 0.01 mg/L. Phosphate is often the limiting factor for aquatic plant growth. Therefore, even in small amounts it can cause harm such as toxins for humans and/or animals through algal blooms, eutrophication, and a depletion of dissolved oxygen levels. For this reason, the EPA recommends keeping phosphate levels below 0.1 mg/L in flowing streams and less than 0.05 mg/L in stagnate water such as lakes, ponds, and reservoirs. Phosphate can originate from various sources, including sewage, animal waste, fertilizers, detergents, disturbed land, anticaking agents (such as those found in road salt), and stormwater runoff from urbanized landscapes. These sources play a pivotal role in the phosphorus cycle and can contribute to water quality issues when not properly managed.[18]

3.1.4 Dissolved Oxygen

Dissolved oxygen (DO) is the amount of oxygen dissolved in water and available to aquatic organisms. When dissolved oxygen is too low, aquatic organisms cannot survive. Thus, it is an important measurement of water quality. DO comes primarily from atmospheric exchange or as a byproduct from aquatic plant photosynthesis.[19] The depletion of oxygen in surface waters can be caused by several factors. Below here is how each of several factors contribute to oxygen depletion.

1. Increases in Organic Matter: When organic matter such as leaves, plant debris, or other organic substances enters a water body, it can serve as a food source for bacteria. As these bacteria break down the organic matter through decomposition, they consume dissolved oxygen in the process. This increased microbial activity can lead to a decrease in oxygen levels, especially in areas with a high input of organic material.

2. Decay from Sewage: Sewage or wastewater contains organic materials, including human and organic waste. When sewage is discharged into surface waters without proper treatment, the

[18] Grady, "Effects of Land Use on Quality of Water in Stratified-Drift Aquifers in Connecticut."

[19] YSI, Inc, "Dissolved Oxygen Measurement in Water."

organic matter in sewage undergoes decomposition by bacteria. This decomposition consumes oxygen, leading to a reduction in oxygen levels in the water. This is particularly harmful to aquatic life and can result in oxygen-deprived "dead zones."

3. Excess Algal Growth: Excess algal growth, often referred to as an algal bloom, can occur due to an abundance of nutrients like nitrogen and phosphorus in the water[20]. Algae are photosynthetic organisms that produce oxygen during the day. However, at night or when the algal bloom dies and decomposes, it consumes oxygen. If the rate of oxygen consumption exceeds the rate of oxygen production through photosynthesis, it can lead to oxygen depletion in the water.

4. Lack of Flow: Stagnant or slow-moving water bodies are more susceptible to oxygen depletion because they have limited contact with the atmosphere. Flowing water, on the other hand, can naturally replenish oxygen through aeration.

5. Warming Waters: Elevated water temperatures, often caused by factors like climate change or the absence of sufficient buffer zones upstream (which can help regulate water temperature), can reduce the capacity of water to hold dissolved oxygen. As water temperatures rise, the ability of water to hold oxygen decreases, potentially leading to decreased DO levels.

Decreased DO levels in surface waters can contribute to fish kills and the death of other aquatic organisms[21]. When oxygen levels drop below a critical threshold, it can have severe consequences for the health of aquatic ecosystems.

3.1.5 pH

The pH of water is the measure of acidity and is measured on a scale ranging from 0 (highly acidic) to 14 (highly alkaline). It quantifies the concentration of hydrogen ions in the water, indicating whether a solution is acidic (low pH), neutral (pH 7), or alkaline (high pH). Aquatic life thrives in healthy freshwater systems with a pH between 6.5 and 8.0. While the geology underlying water bodies can also influence their pH, environments outside this range can stress or kill aquatic life.

Acid rain is closely related to changes in water pH and is a result of atmospheric deposition. Acid rain occurs when pollutants from various sources, primarily emissions from burning fossil fuels and industrial activities, are released into the atmosphere. These pollutants include sulfur dioxide

[20] Curry and Wilson, "Effect of Sewage-Borne Phosphorus on Algae."

[21] Kramer, "Dissolved Oxygen and Fish Behavior."

(SO_2) and nitrogen oxides (NO_x). Once in the atmosphere, these compounds can undergo chemical transformations, forming acidic compounds such as sulfuric acid (H_2SO_4) and nitric acid (HNO_3).

Environmental regulations have made significant strides in reducing the impacts of acid rain, yet it remains an ongoing concern with repercussions for waterways and aquatic ecosystems. Additionally, the legacy effects of past acid deposition continue to affect water bodies, even as emissions have been reduced.

3.1.6 Turbidity

Turbidity measures the clarity of a water sample or how much material (sediment, algae, pollution, microbes etc.) is suspended in the sample. It is measured by the amount of sunlight that passes through a sample of water, in Nephelometric Turbidity Units (NTUs). The higher the NTUs, the less light passes through the water. Turbidity can be caused by soil erosion from eroding banks, agriculture or construction, stormwater runoff, and sometimes failing septic systems. Each of these turbidity sources involves solids (e.g., pet droppings, leaves and grass clippings, litter, sediments) being transported through the liquid water. High turbidity blocks or absorbs sunlight, reducing the ability of plants to photosynthesize and grow, thus harming the food source for fish and other aquatic life. Moreover, suspended solids can clog fish gills, smother fish eggs, and suffocate the organisms that fish eat.

3.1.7 Chloride

Chloride is found in salts such as sodium chloride, calcium chloride, or magnesium chloride. Some common sources of chloride in the environment include:

1. *Winter Road Salting:* During the winter months, road maintenance crews commonly use salt (generally sodium chloride or calcium chloride) to de-ice roads and highways. When the snow and ice melt, the salt can be washed into nearby water bodies and riparian soil profiles, elevating chloride levels in these waters.

2. *Geologic Formations:* Chloride ions can naturally occur in geological formations and can be leached into groundwater and surface water over time.

3. *Agricultural Runoff:* The use of fertilizers and manure in agriculture can contribute chloride to nearby water bodies through runoff, especially when excessive amounts of chloride-containing fertilizers are applied.

4. Industrial Wastewater: Industrial processes may generate wastewater that contains chloride ions as a byproduct. When not properly treated or managed, this industrial wastewater can discharge chloride into waterways.
5. Effluent from Wastewater Treatment Plants: Wastewater treatment plants often receive sewage containing chloride from various sources, including household products and industrial discharges. While treatment plants are designed to remove many contaminants, chlorides are not typically removed.

Road salt was first used in New Hampshire in 1938 and quickly became a popular solution to deicing winter roads[22]. Rock salt—sodium chloride (NaCl)—is the most common salt used in Connecticut for the removal of snow and ice. It easily dissolves with snowmelt and ends up in nearby road ditches, culverts, and streams[23] as well as groundwater through infiltration[24].

Chloride is detrimental to freshwater ecosystems, as it can be acutely toxic, and can lead to acidification and increased mobilization of metals. EPA guidance indicates that stream ecology is impacted when the four-day average concentration of chloride exceeds 230 mg/L, or a one-hour average concentration exceeds 860 mg/L more than once every three years.

Chloride can alter the composition of riparian and wetland plant communities, giving a competitive advantage to more salt tolerant invasive species. It can interfere with the natural mixing of lakes and alter or inhibit microbial communities, which remove nitrate and impact water quality[25]. Chloride in groundwater can interrupt healthy reproduction of plants and increase mortality by interrupting the ion exchange in plant root systems[26].

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[22] Kelly and Weathers, “Road Salt: The Problem, The Solution, and How to Get There.”

[23] Szklarek, Górecka, and Wojtal-Frankiewicz, “The Effects of Road Salt on Freshwater Ecosystems and Solutions for Mitigating Chloride Pollution - A Review.”

[24] Kukucka, “Private Well Impacts from Road Salt Applications.”

[25] Kaushal et al., “Increased Salinization of Fresh Water in the Northeastern United States.”

[26] Cassanelli and Robbins, “Effects of Road Salt on Connecticut’s Groundwater: A Statewide Centennial Perspective.”

These impacts persist beyond the salinity spikes that occur at the time of application and during snowmelt. Concentrations of chloride in surface waters are sometimes higher in the summer, possibly due to upwelling of contaminated groundwater, and/or high concentrations of chloride in soils adjacent to roads and parking lots.

Additionally, chloride impacts private wells and public drinking water sources. Since 2013, CT DEEP has seen an increase in salt-related complaints concerning private water supplies[27]. High chloride concentrations in drinking water supplies can exacerbate hypertension and related cardiovascular problems.

3.1.8 Temperature

Stream temperature has a significant impact on aquatic ecology. High temperature generally increases solubility of solids and decreases solubility of gases. Among other dynamics, change in temperature affects movement of molecules, fluid dynamics and the metabolic rate of aquatic organisms. Chemical water quality worsens with rising temperature, namely dissolved oxygen levels drop and algal blooms occur more frequently. Algal blooms reduce dissolved oxygen further, can clog fish gills, and produce toxins harmful to animals and humans[28]. Finally, warmer waters also make fish more vulnerable to parasites and diseases.

A number of factors influence stream temperatures~~:~~ including watershed land use, groundwater recharge, stream profile (i.e. depth and complexity), riparian buffer canopy density, flow velocity that can be impacted by dams, culverts or other impoundments, and air temperature[29]. Stream temperature data throughout the northeast has been compiled into the Spatial Hydro-Ecological Decision System (SHEDS) Stream Temperature Database. This dataset presents the data collected by 81 organizations at 7,612 monitoring stations through the Interactive Catchment Explorer (ICE) online application[30]. With ambient air temperature rising due to climate change, the temperature of surface waters will rise also. By 2100, climate change models predict air temperatures to rise

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[27] Kukucka, "Private Well Impacts from Road Salt Applications."

[28] Climate Central, "In Hot Water: How Warming Waters Are Stressing Fish and the Fishing Industry."

[29] Climate Central.

[30] Spatial Hydro-Ecological Decision System, "Interactive Catchment Explorer."

between 2.0ºC (with low emissions scenario) and 4.8ºC (with high emissions scenario)[31]. An ICE model predicts that with an increased air temperature rise of 2ºC the average stream temperature will rise by 1.4ºC to an average of 20.4ºC during the summers on the PRW (68.7ºF).

Cold water species such as native Eastern Brook Trout (*Salvelinus fontinalis*) require thermal refuges with colder water to survive during warm summer months. Brook Trout cannot survive in stream temperatures above 25ºC and prefer temperatures less than 20ºC. If stream temperature rises to 20.4ºC many Brook Trout and other cold-water obligate populations of fish will likely decrease as fish experience stress and are forced to adapt. These fish species adapt when they find colder water, move north, change the timing of migration and spawning, and/or alter predator-prey ranges and interaction[32].

3.1.9 Benthic Macroinvertebrates

Biological monitoring programs with the primary objective to evaluate the health of surface waters through the analysis of benthic macroinvertebrate communities were initiated in Connecticut during the mid-1970s.[33] Benthic macroinvertebrates—animals that have no backbone, can be observed with the naked eye, and spend all or part of their lives living on the bottom—have varying sensitivities to water quality impacts. They also are generally unable to travel long distances in response to habitat changes and lack the ability to detect non-chemical impacts (e.g., siltation and thermal changes), so their ability to avoid pollution is limited.[34] The composition of the benthic macroinvertebrate community at a given site reflects long-term trends in water quality. Sites with episodic or chronic water quality impacts will support fewer organisms that are sensitive to pollution and more organisms that are tolerant of pollution.

Hence, benthic macroinvertebrate assessment provides a valuable indicator of the overall health of a site that may be difficult to capture with water chemistry sampling, especially when researchers may not have the opportunity to visit a site regularly. Individual water chemistry samples deliver a static snapshot of conditions at the instant the sample was taken that might not

[31] Climate Central, "In Hot Water: How Warming Waters Are Stressing Fish and the Fishing Industry."

[32] Climate Central, "In Hot Water: How Warming Waters Are Stressing Fish and the Fishing Industry."

[33] CT DEEP, "Ambient Benthic Macroinvertebrate Community Monitoring."

[34] New York State Department of Environmental Conservation Division of Water. Biological Monitoring of Surface Waters in New York State, 2019:6.

reflect the range of impacts any site experiences over time, which benthic macroinvertebrates do indicate with these their more dynamic assessments.

In Connecticut, sampling for benthic macroinvertebrates as indicators of water quality is conducted between September 15th and November 30th annually as a precaution to represent worst-case water quality conditions. The samples collected are preserved then brought back to the laboratory for ‘subsampling’ in a nested process that entails randomly selecting 200 organisms for more detailed analysis as a final sampling procedure.[35]

Metrics of a benthic macroinvertebrate community are used in Connecticut to determine whether a section of stream supports or does not support the designated use goal for aquatic life as established by the State’s Water Quality Standards (WQS) and are regionally calibrated to account for variations in aquatic systems according to the field conditions of each different state. In Connecticut, such benthic analytical metrics used to assess water quality include calculations of two numbers for the macroinvertebrate structure of each site sampled:

- a macroinvertebrate multimetric index (MMI) as a composite score generated from several macroinvertebrate-based indices of water quality with the score of a site ranging on a scale from 0 to 100, in which generally a MMI value greater than 48 points indicates good water quality and a MMI score of less than 43 is indicative of poor water quality;
- a biological condition gradient (BCG) tier as an illustration of the relationship between the amount of a biological, chemical or physical stress on an environment and its effect on biological communities. Each site is assigned to an integer tier value on a scale from 1 to 6, in which a Tier 1 value indicates good or completely natural water quality and a Tier 6 is indicative of water quality that is poor or completely dysfunctional due to human disturbance. The model attempts to mimic how trained environmental professionals would rank data on any biological (macroinvertebrate) community through a common or universal language for comparison no matter what, how, where or when their evidence is evaluated as in the cases of data on different forms of life (e.g., other biological data such as fish or diatom communities), different methods of data collection, and even evidence from different ecological systems.

[35] CT DEEP, “Ambient Benthic Macroinvertebrate Community Monitoring.”

3.2 Water Quality Governance

In 1967, the Connecticut legislature passed "An Act Concerning the Elimination of Pollution of the Waters of the State". This CT legislation informed the federal Clean Water Act (CWA), which was enacted in 1972.[36] The CWA made point source (end-of-pipe) pollution discharges into navigable waters without a permit illegal through the National Pollutant Discharge Elimination System (NPDES).[37]

In addition to the NPDES, the CWA contains provisions meant to restore polluted waters of the United States. The CWA spells out two-step process to achieve this goal- water bodies are assessed and characterized, and plans "to restore the water body's integrity" are developed for water bodies that are found to be polluted[38] This responsibility falls primarily on States and Tribes, who are required to adopt Water Quality Standards (WQS) and revise them periodically; regularly assess waters in their jurisdiction to understand where WQS are not being met; and take action to ensure waters not meeting WQS are restored. Connecticut's WQS guide surface water regulation and management across the state.

State WQS consider intended uses (e.g., drinking, swimming, fishing), which are used to assign water quality classifications (use goals) for surface water, groundwater, and coastal/marine surface waters. A review of the State WQS is conducted every three years by governing state agencies.[39]

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[36] CT DEEP, "Connecticut Clean Water Accomplishments 1967-1977."

[37] US EPA, "Summary of the Clean Water Act."

[38] River Network, *The Clean Water Act Owner's Manual*, p. 124.

[39] CT DEEP, "Connecticut Water Quality Standards."

Connecticut Inland Freshwater Classifications

Class	Designated Use	Discharges Allowed
AA	Existing or proposed drinking water supply; fish and wildlife habitat; recreational use (may be restricted); agricultural and industry supply	Discharges from public or private drinking water treatment systems, dredging and dewatering, emergency and clean water discharges
A	Potential drinking water supply; fish and wildlife habitat; recreational use; agricultural and industrial supply and other legitimate uses including navigation	Discharges from public or private drinking water treatment systems, dredging and dewatering, emergency and clean water discharges
B	Recreational use; fish and wildlife habitat; agricultural and industrial supply and other legitimate uses including navigation	Same as A as well as discharges from industrial and municipal wastewater treatment facilities that practice best available treatment methods and best management practices. Other discharges allowed with a National Pollutant Discharge Elimination System (NPDES) permit (Connecticut General Statute Section 22a-430).

3.2.1 Stormwater Regulated by CT General Permit for Municipal Separate Storm Sewer Systems

The State of Connecticut issues a General Permit for Municipal Separate Storm Sewer Systems (MS4 GP) that regulates non-point sources of pollution discharged into state waters through urban stormwater systems as if they were point sources. Communities that contain areas designated as "Urbanized Areas" (determined by the United States Census) that discharge stormwater via a separate storm sewer system to surface waters of the state are required to follow the guidelines of the MS4 GP. The Towns of Newtown, Easton and Monroe are MS4 communities. Under the MS4 GP, communities must develop a Stormwater Management Plan that includes six minimum control measures:

1. Public Education and Outreach- Municipalities are required to provide educational material about
   stormwater to four audiences (residents, industry, commercial, and construction). The purpose of the educational material is to provide the targeted audience information about stormwater and how their actions may impact it.
2. Public Participation – Municipalities are required to at least annually provide an opportunity for the public to participate in the development/implementation of their Stormwater Management Program (SWMP). Notices must comply with state public notice requirements.

3. Illicit Discharge Detection and Elimination – Municipalities are required to find and eliminate sources of non-stormwater from their storm sewer system. The permit requires a proactive rather than a reactive approach. Municipalities are expected to systematically look in their system for non-stormwater sources and remove them.
4. Management of Construction Site Runoff – Municipalities are required to have an ordinance for management of stormwater discharges from construction sites that disturb one or more acres of land. Their ordinance should include requirements for projects to implement sediment and erosion control practices as well as requirements for site plan review.
5. Management of Post Construction Site Runoff (New Development and Redevelopment) – Municipalities are required to address stormwater runoff from new development and redevelopment that disturb one or more acres of land. The goal of this measure is to try to management stormwater where it falls and retain it on site. This control measure encourages the use of low impact design techniques and requires the retention or treatment of runoff on site using green infrastructure practices.
6. Good Housekeeping in Municipal Operations – Municipalities are required to implement good housekeeping practices in municipal operations such as vehicle maintenance, open space, buildings and infrastructure. The permit requires at least annual street sweeping and optimization of catch basin cleaning. Development of pollution prevention plans are required at waste management facilities and maintenance garages not already regulated by another NPDES permit.

The PRW is almost entirely within the Town of Newtown's jurisdiction; consequently, their activities under the MS4 GP are important for restoring and protecting water quality. Their 2021 "Clean Water and Stormwater Management Plan" articulates Newtown's approach to meeting requirements under the six minimum control measures. While the Actions included in Section 8 are complementary to Newtown's work to meet their obligations under the MS4 GP, it is important to note that these Actions go above and beyond those obligations.

3.2.2 State of Connecticut Water Quality Reporting/Total Maximum Daily Load Development

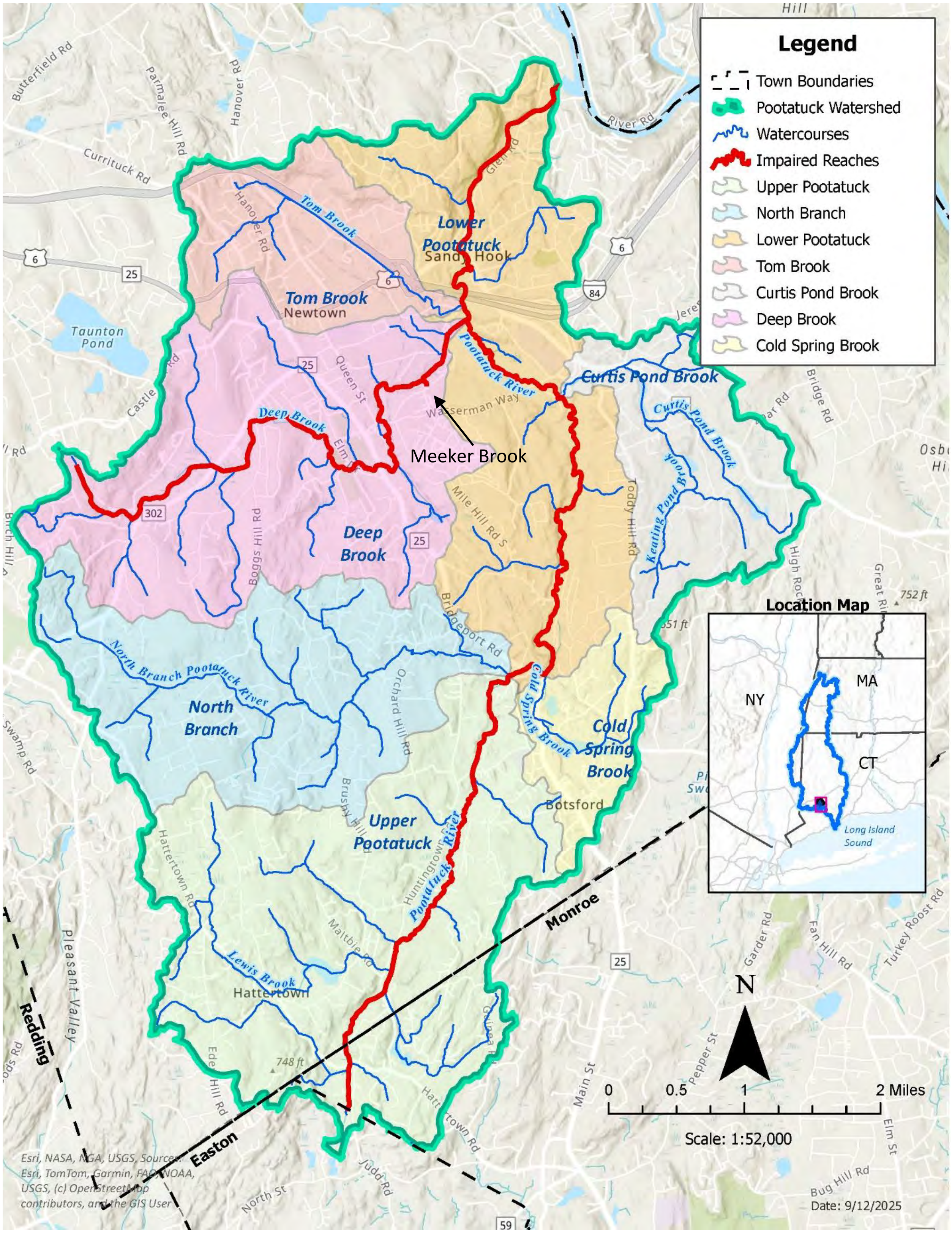
Under Section 305(b) of the CWA, the State of Connecticut is required to monitor and assess surface waters, and submit a report on this research to Congress via the Environmental Protection Agency (EPA) biennially. Section 303(d) of the CWA requires that Connecticut (and other states) develop a list of water bodies under their jurisdiction that do not meet WQS and cannot support their designated uses, set priorities for restoring those waters, and report that information to EPA/Congress biennially. Connecticut combines their Section 305(b) and Section 303(d) reports to EPA/Congress into an Integrated Water Quality Report (IWQR).

The 2022 State of Connecticut IWQR lists the entire mainstem Pootatuck River and reaches along the Deep Brook main stem as Impaired for Recreational Uses. Meeker Brook, a tributary of Deep Brook, is listed as Impaired for Aquatic Life Uses. These Impairments are discussed in more detail under sub-watershed descriptions in Section 3.4.

Stream segments within the PRW included on Connecticut's 2022 303(d) list are included in the table below:

Waterbody Segment ID	Waterbody Name	Location	Miles	Aquatic Life	Recreation
CT6019-00_01	Deep Brook (Newtown)-01	Mouth at confluence Pootatuck River (south side of I84, near exit 10), US to HW at Deep Brook Pond outlet dam (parallel to Head of Meadow Road), Newtown.	5.25	Fully Supporting	Not Supporting
CT6019-00-trib_01	Unnamed tributary Deep Brook (Newtown)-01	Mouth Deep brook US to HW near Old Farm Rd, Newtown. Locally called Meeker Brook, between Town salt storage lot and old mill.	0.07	Not Supporting	Not Assessed
CT6019-02_01	Unnamed tributary Deep Brook 6019-02 (Newtown)-01	Mouth at confluence Deep Brook DS (north) Head Of Meadow Road crossing, US (south) to HW past Head Of Meadow School, parallel to east along Shepard Hill Road (north of Sugar Hill Road intersection), Newtown.	1.6	Fully Supporting	Not Assessed
CT6020-00_01	Pootatuck River-01	From mouth at confluence with Housatonic River (west bank, DS of Walnut Tree Hill Road crossing), US to confluence with Newtown WPCF outflow (just DS of confluence with Deep Brook, US of I84 crossing), Newtown.	2.44	Fully Supporting	Not Supporting
CT6020-00_02	Pootatuck River-02	From confluence with Newtown WPCF outflow (just	8.39	Fully Supporting	Not Supporting

		DS of confluence with Deep Brook, US of I84 cossing), Newtown, US to headwaters at unnamed pond (parallel to Judd Road), Easton.			



Impaired Stream Reaches in the PRW.

When a water body is identified as Impaired, states are tasked with developing a Total Maximum Daily Load (TMDL) Analysis for the pollutant(s) responsible for the Impairment. The TMDL quantifies reductions in pollutant loads necessary for the water body to meet its use goals.

3.3 Water Quality Monitoring

CT-DEEP administers a number of water quality monitoring programs statewide. The River and Stream Water Quality Monitoring and Lake and Pond Water Quality Monitoring programs conducted by CT-DEEP staff help Connecticut evaluate the impact of pollution and effectiveness of pollution control programs, track water quality trends, explore water quality problems, investigate community complaints, and provide data for the biennial Integrated Water Quality Report (IWQR) to EPA.

CT DEEP's community-based science programs provide training, equipment and quality control to volunteers monitoring water quality. The Riffle Bioassessments by Volunteers (RBV) program supports volunteer collection of benthic macroinvertebrate samples, which are used primarily to identify healthy sites along smaller streams. The Volunteer Stream Temperature Monitoring Network (V-STeM) works with local volunteers to deploy in-situ temperature loggers between May and October each year. The data collected by RBV and VSTeM volunteers are used to inform CT DEEP water quality assessments, help develop state water temperature standards, identify cold-water habitat, and determine the impact of non-point source (NPS) pollution mitigation projects.

V-STeM data is also uploaded to the Spatial Hydro-Ecological Decision System (SHEDS) Stream Temperature Database administered by the US Geological Survey, which uses the data to refine cold-water habitat distribution predictive models. The Candlewood Valley Chapter of Trout Unlimited has collected data under both the RBV and V-STeM programs for many years.

3.3.1 Harbor Watch Water Quality Study in the Pootatuck River Watershed

Harbor Watch, a non-profit dedicated to improving water quality and ecosystem health in Connecticut and a PRP member, conducted a water quality study of the PRW during the years 2017, 2018, and 2019. This research was conducted in accordance with a Quality Assurance Project Plan approved by CT-DEEP and EPA. Harbor Watch sampling locations are included in subwatershed maps in Section 3.4, below.

Over the course of those three years, Harbor Watch conducted sampling approximately twice per month from May through September. Grab samples were evaluated for *E. coli* (MPN/100mL) at the Harbor Watch laboratory, which is certified for this testing by the CT Department of Public Health. Dissolved Oxygen (DO), Temperature, and other parameters were evaluated in the field.

The data collected by Harbor Watch were shared with CT DEEP and included in the 2022 Connecticut IWQR to Congress.

Harbor Watch water quality monitoring sampling locations

Site Name	Latitude	Longitude	Site location notes	Town
Pootatuck 6	41.33469	-73.29826	Mountainside Drive	Monroe
Pootatuck 4	41.36009	-73.28211	Meadow Brook Road	Newtown
Pootatuck 3	41.38355	-73.26919	Turkey Hill Road	Newtown
Pootatuck 2	41.42292	-73.28190	Rocky Glen State Park	Newtown
Pootatuck 1	41.43745	-73.27017	Walnut Tree Hill	Newtown
Deep 4	41.39217	-73.32881	Head of Meadow Road	Newtown
Deep 3	41.40242	-73.31227	Boggs Hill Road	Newtown
Deep 2	41.39755	-73.29807	Elm Drive	Newtown
Deep 1	41.40980	-73.28536	Old Farm Road	Newtown

CT DEEP's water quality standards (WQS) specify that (1) the geometric mean for *E. coli* should be less than 126 MPN/100mL over the course of 8 sampling events during a single sampling season (May-September), and (2) the single sample maximum for *E. coli* should not exceed 576 MPN/100mL. *E. coli* geometric means at all sites monitored by Harbor Watch on the Pootatuck River and Deep Brook exceeded WQS for at least one sampling season; *E. coli* geometric means at six sites exceeded WQS for all three sampling seasons included in this study.

E. coli (MPN/100mL) geometric means over 2017-2019 sampling seasons. Red highlights indicate values above WQS

Site	2017 Geomean	2018 Geomean	2019 Geomean
Pootatuck 6	197	290	193
Pootatuck 4	191	320	190
Pootatuck 3	129	219	95
Pootatuck 2	126	179	186
Pootatuck 1	62	195*	119
Deep 4	369	353	443
Deep 3	182	283	166
Deep 2	232	297	353

Deep 1	94	125	159

*(*During 2018, there was construction at Pootatuck 1, which only allowed for 5 days of data collection at this location while the other sampling sites had 10 days of data collection)*

CT DEEP's WQS specify that DO should not fall below 5 mg/L at any time to support healthy aquatic ecosystems. Table 5 below summarizes the DO data collected by Harbor Watch. 23 out of 264 measurements recorded dissolved oxygen concentrations falling below the 5 mg/L threshold. Sites *Pootatuck 6* and *Deep Brook 3* exhibited the highest percentage of sampling events where DO levels fell below 5 mg/L. These sites are situated in areas where the river's flow tends to slow down, which is likely a contributing factor to the lower DO concentrations observed.

Dissolved Oxygen data from Harbor Watch 2017-2019 WQ study. Red highlights indicate values below WQS.

	Minimum recorded value	**# of sampling events**	**% of sampling events less than 5 mg/L**
Pootatuck 6	1.97	30	20%
Pootatuck 4	3.36	30	7%
Pootatuck 3	2.46	30	3%
Pootatuck 2	8.05	30	0%
Pootatuck 1	7.94	24	0%
Deep B. 4	3.1	30	3%
Deep B. 3	1.93	30	43%
Deep B. 2	6.12	30	0%
Deep B. 1	8.2	30	0%

3.3.2 Unified Stream Assessment/Unified Subwatershed and Site Reconnaissance

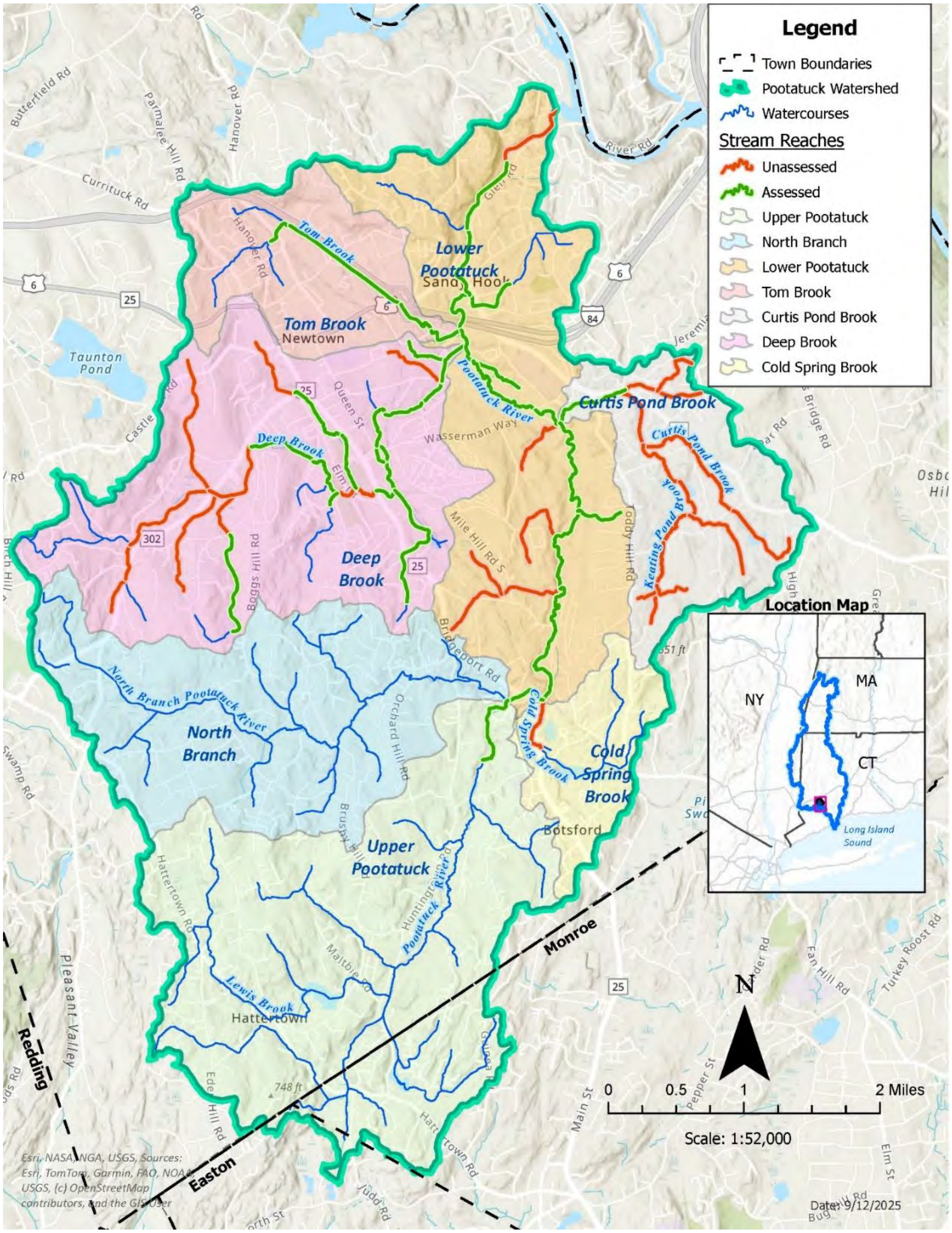
HVA staff and volunteers conduct USA assessments

HVA conducted field assessments within the Pootatuck River watershed, using the Unified Stream Assessment (USA) and Unified Subwatershed and Site Reconnaissance (USSR) protocols developed by the Center for Watershed Protection. The Unified Stream Assessment (USA) is a continuous stream walk designed to identify and characterize impacts and potential opportunities for restoration. This protocol was developed specifically for urban watersheds, however HVA has modified the protocol to include impacts seen in areas with less development and record areas with the potential for recreation enhancement. During the USA field assessments, HVA staff and volunteers conducted surveys of prioritized impaired reaches of the Pootatuck River and its tributaries, documenting data on reach conditions, potential impacts, and areas suitable for restoration.

Assessed reaches were chosen based on presence of Impairments and input from the PRP. Approximately 20 stream miles were assessed to support the PRWMP. Reaches delineated and assessed are shown below.

The USSR provides a framework for assessing and prioritizing upland sites with potential for restoration projects, particularly stormwater retrofits. In general, sites assessed with the USSR method were chosen based on stormwater outfall data collected during the USA. USSR data was used to develop Construction Projects included in Section 8.

During these field assessments, HVA staff and volunteers collected data related to the condition of reaches and sites, potential sources of NPS pollution, and restoration project potential. The USA and USSR methods are described in the Quality Assurance Project Plan developed for the PRWMP, which is included as Appendix A.



Unified Stream Assessment- Reaches Delineated/Assessed

Stream impacts assessed during the USA include Stormwater Outfalls, Utilities, Trash and Debris, Stream Crossings, Severe Erosion, Impacted Buffers, Channel Modifications, Dams, Recreation, Agriculture and Miscellaneous. For each identified impact, multiple photos were taken, and precise location data were collected using a Trimble GeoXT handheld GPS unit. Additionally, an overall assessment of conditions along each reach was recorded, including factors such as average bank stability, in-stream habitat, riparian vegetation, floodplain connectivity, access for management activities, flow characteristics, and substrate composition.

Descriptions of the impacts assessed during the USA are included below.

1. **Stormwater Outfalls:** Outfalls documented include all discharge pipes and open channels draining to the stream. If an outfall is actively flowing (these assessments took place at least 48 hours after the most recent rainfall) or displays suspicious characteristics such as an unusual odor, color, suds or excessive vegetation at the outlet, the effluent was tested for ammonia nitrogen and surfactants. This approach is meant to flag outfalls that may be carrying illicit discharges for further investigation and potential pollution trackdown surveys. Excessive erosion at the outlet is also documented.
2. **Utilities:** Utility assessments in the stream corridor focus on exposed pipes or conduit. Any issues or concerns related to these utilities were documented.
3. **Trash and Debris:** The presence of trash and debris was recorded if its accumulation is significant. Generally, trash accumulations beyond what would fill the bed of a pickup truck are recorded. These are often encountered in the form of "trash racks" that accumulate behind woody debris.
4. **Stream Crossings:** Assessments of stream crossings (bridges and culverts) followed the protocol developed by the North Atlantic Aquatic Connectivity Collaborative (NAACC). This protocol was substituted for the standard USA stream crossing assessment, as it is consistent with the approach used by HVA and other partners across the watershed. NAACC assessments provide details about each crossing and its structural characteristics, and provide an understanding of the degree to which each structure is a barrier to fish and wildlife movement. More information about NAACC is available at www.streamcontinuity.org.
5. **Channel Modifications:** This category documents significant modifications to natural channel morphology, such as straightening or rip-rap that extends more than ten feet along the bank.
6. **Severe Bank Erosion:** Bank erosion is recorded if the observed conditions are significantly worse than the average level of erosion observed throughout the entire reach.

7. **Impacted Buffers:** Riparian areas lacking a vegetated buffer zone at least 25' in width comprised of mostly of native plants were documented. This assessment also records riparian areas where the buffer is mostly or entirely comprised of invasive plants.
8. **Dams:** Dams encountered were documented, including height, condition and estimated impoundment area.
9. **Recreation:** This addition to the standard USA protocol documents formal and informal access points to the stream to inform recreational use planning.
10. **Agriculture:** This addition to the standard USA protocol documents impacts from farms that are not captured under other impact assessments, such as livestock access to the stream.
11. **Miscellaneous:** This category encompasses all other impacts that did not fit within the defined categories.

HVA staff and volunteers record outfall data (Left) and road-stream crossing data (Right).

USA data was made accessible to the PRP, other stakeholders and the public through an online mapping tool. This tool displayed the locations of impacts observed, and allowed users to view assessment data and photos for each impact interactively. This tool was used extensively in facilitated conversations to support project development and prioritization.

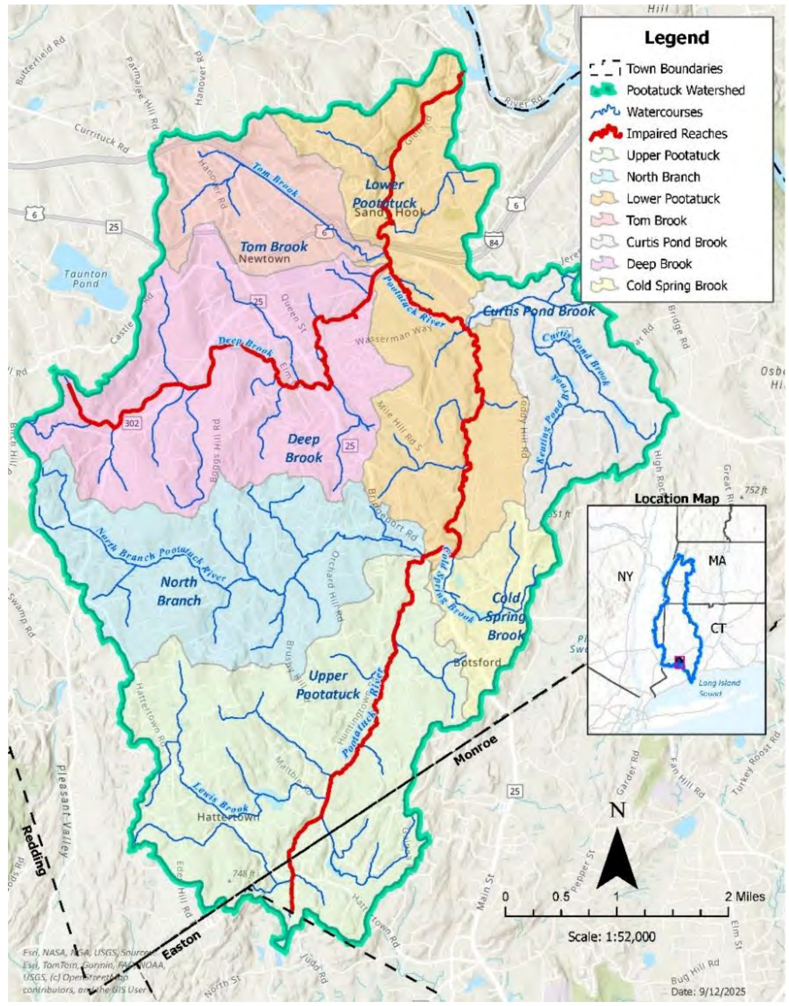
Sites prioritized by the PRP as strong candidates for restoration (with input from the public and other stakeholders) were targeted for more detailed assessment.

3.4 Pootatuck River Sub-Watersheds

The Pootatuck River Watershed (PRW) covers an area of 26.1 square miles, most of this falling within the Town of Newtown. The headwaters of the PRW also include portions of two other municipalities, Town of Monroe and Town of Easton. The PRW includes seven major sub-watersheds. Each of these is described in more detail below.

3.4.1 Deep Brook

The Deep Brook subwatershed drains approximately 5.35 square miles of the PRW. The headwaters of Deep Brook originate in wooded wetlands on the eastern side of Newtown. Deep Brook is popular for a range of recreational activities, including wading, fishing, and wildlife observation. The Deep Brook watershed encompasses densely developed areas in the center of Newtown and several agricultural areas. These land uses have the potential to influence water quality (refer to Map 7 below for details).



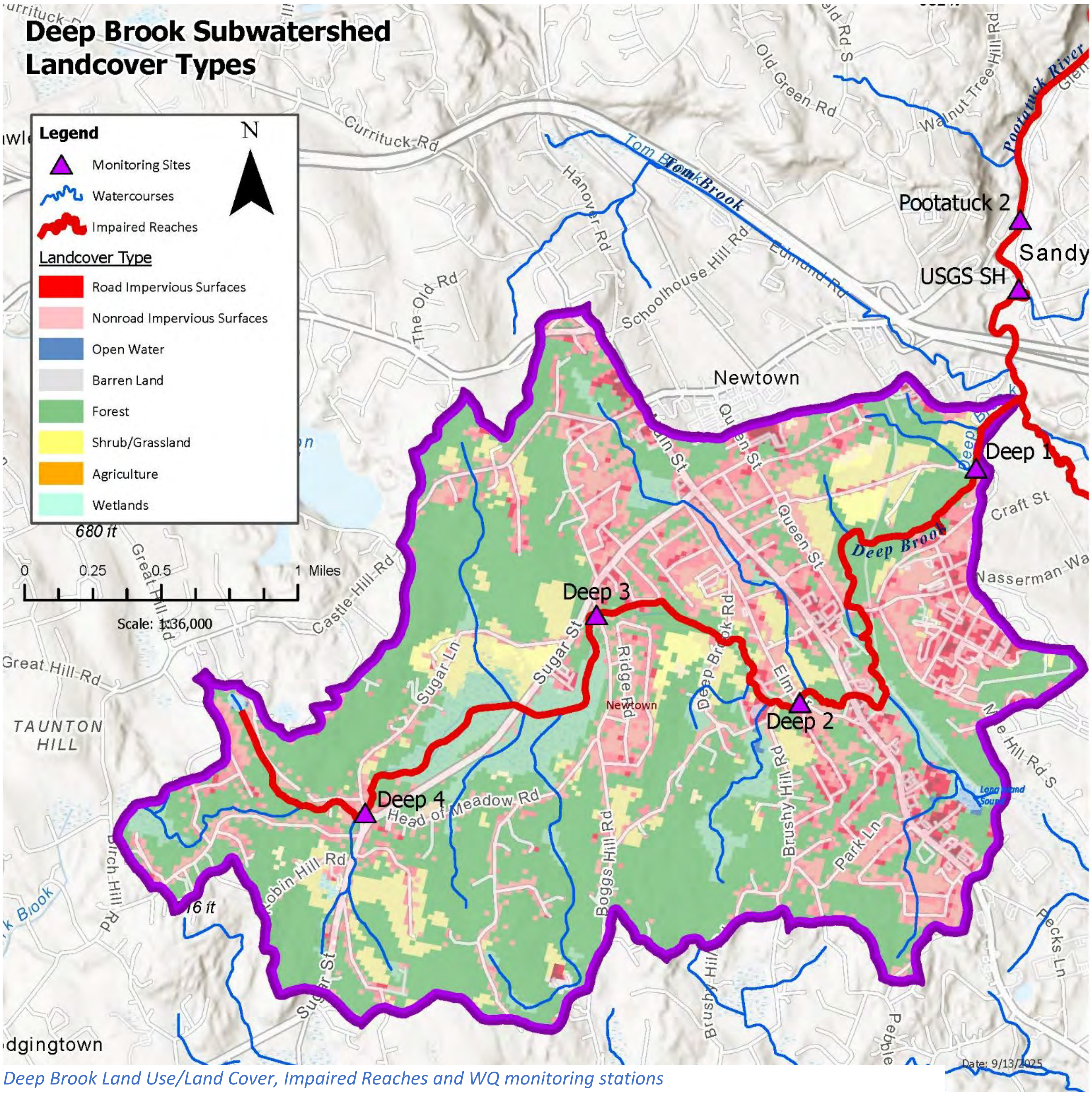
Pootatuck River Sub-Watersheds.

Deep Brook is listed as Impaired for Recreational Uses in the State of Connecticut's 2022 Integrated Water Quality Report, due to concentrations of *E. coli* that exceed WQS.[40] Deep Brook was first included on Connecticut's 303(d) list in the 2010 IWQR, due to elevated levels of *E. coli.* It has been included in biennial IWQRs since then.

A Total Maximum Daily Load Analysis for Recreational Uses of the Deep Brook Sub-Regional Basin (Deep Brook TMDL) was approved in 2012.[41] Figure 3 from the Deep Brook TMDL (included below) shows the location of the sampling site used to determine if Deep Brook was

[40] CT DEEP, "Integrated Water Quality Report to Congress". 2022.
[41] CT DEEP, "A Total Maximum Daily Load Analysis for Recreational Uses of the Deep Brook Sub-Regional Basin". 2012. This document is also included as Appendix II.

meeting WQS for *E. coli*, and to calculate *E. coli* load reductions necessary to meet WQS. A 34% reduction in *E. coli* concentrations (MPN/100mL) is required to meet WQS.



Deep Brook Land Use/Land Cover, Impaired Reaches and WQ monitoring stations

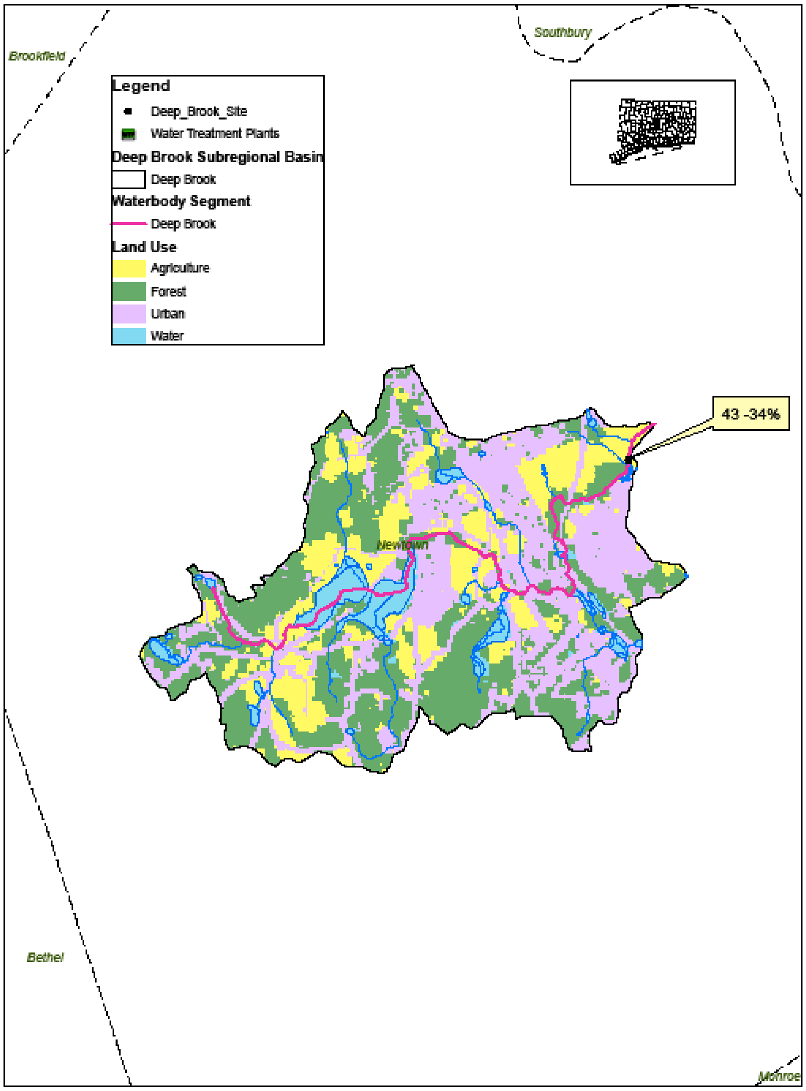


Figure 3: Deep Brook Regional Basin Land Use and TMDL % Reduction Map

N 0 0.5 1 2 Miles

Map Data: DEEP
Map Created: August 2010

Suspected sources of *E. coli* are described in the Deep Brook TMDL as unspecified urban stormwater, failing septic systems, illicit connections to storm sewers, animal waste and other sources that remain unidentified.

The water quality study conducted by Harbor Watch over the 2017-2019 sampling seasons indicates that Deep Brook is still consistently exceeding WQS for *E. coli*, based on the geometric mean. The Harbor Watch assessment confirms the data collected by CT-DEEP to support the Deep Brook TMDL, as well as data collected by Town of Newtown, PWA, and CVTU over 20 years of monitoring.[42]

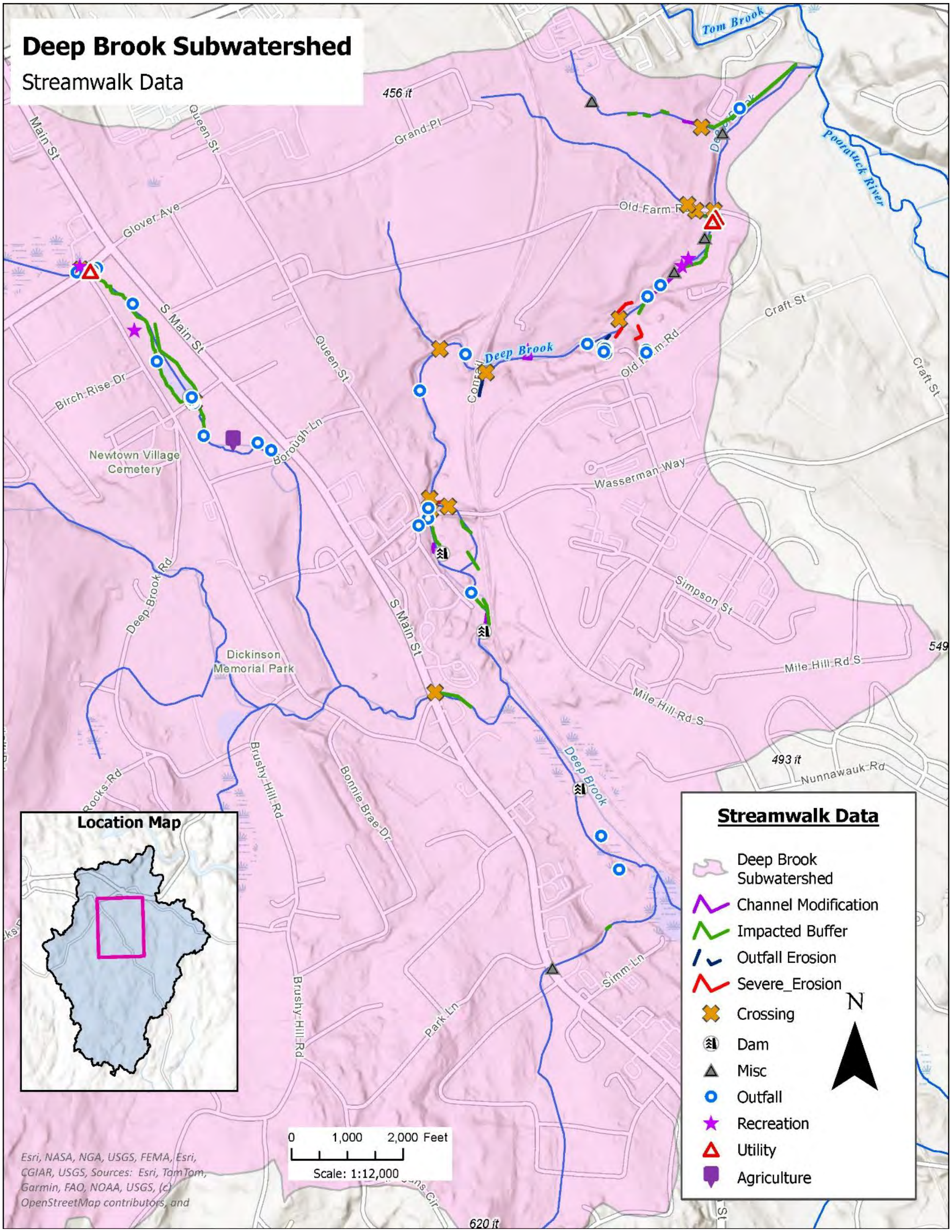
The TMDL for Deep Brook requires a 34% reduction in indicator bacteria levels at the mouth of Deep Brook. The Deep Brook TMDL recommends that a watershed-based plan for the Deep Brook

[42] Monitoring conducted by Town of Newtown, PWA, and CVTU used CT-certified laboratories, but was not conducted using a CT-DEEP/EPA approved Quality Assurance Project Plan. While this data may not be deemed entirely suitable for making regulatory decisions, it can help inform future research and watershed management efforts.

Basin be developed to achieve the load reductions required to meet WQS. The PRWMP encompasses Deep Brook. Section 8 includes Construction Projects and Non-Construction Programs that will reduce *E. coli* loading to Deep Brook.

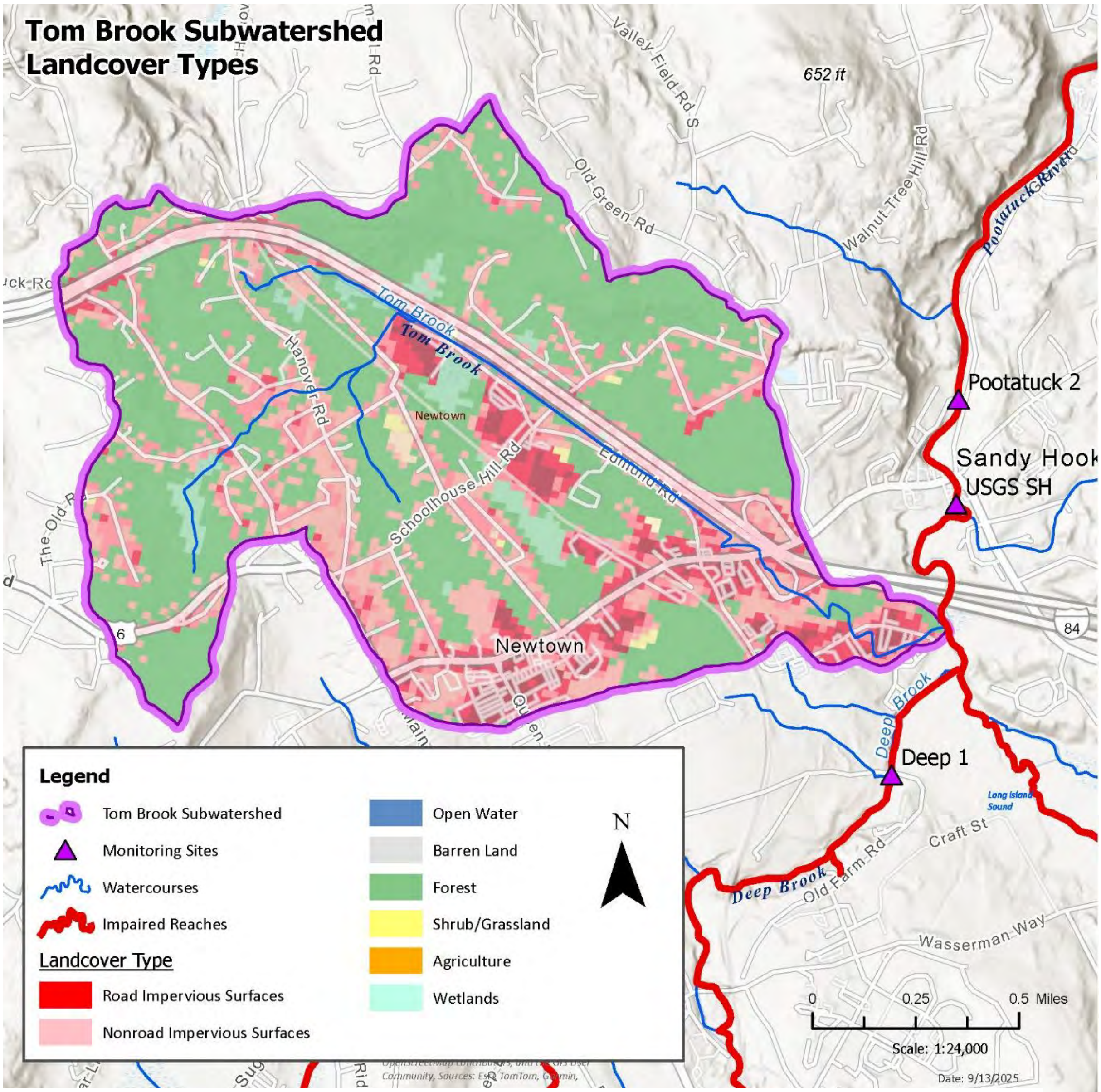
PWA and CVTU's in-situ temperature monitoring included the Class 1 Wild Trout Management Area along the Deep Brook main stem, and the tributary known as Meeker Brook. The data collected in these areas shows that Meeker Brook could be a possible thermal refuge for trout and other cold-water obligate aquatic species in the summer, which is especially important as ambient air temperature rises in response to climate change.

Given Impairments for Recreational Uses and Aquatic Life Uses, extensive streamwalks using the USA protocol were conducted to identify pollution sources and potential restoration projects in the Deep Brook watershed.



Deep Brook Watershed Stream Corridor Impacts

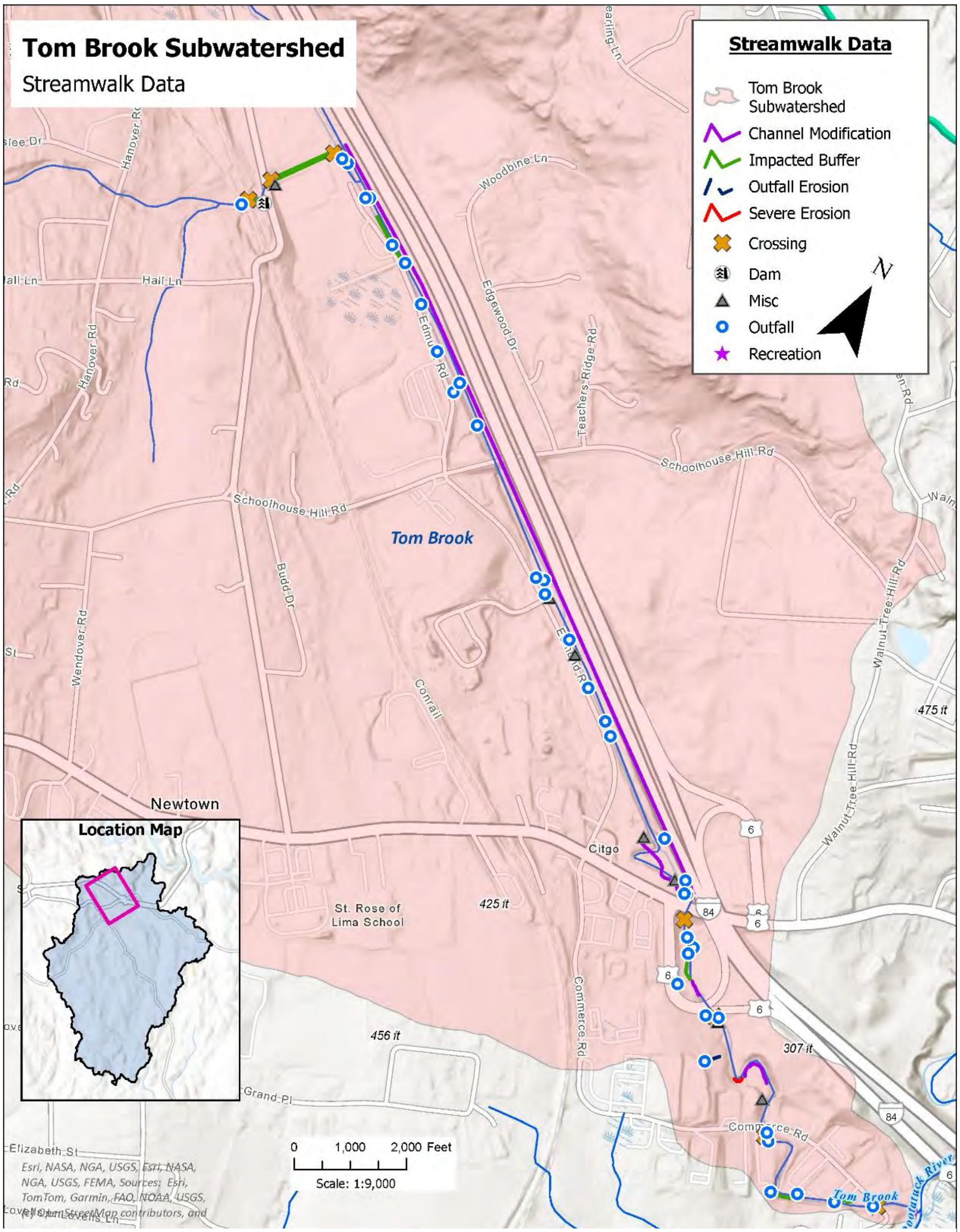
3.4.2 Tom Brook



Tom Brook Watershed Land Use/Land Cover and Impaired Reaches.

Tom Brook is a tributary situated in the northern sector of the Pootatuck River Watershed, encompassing an area of 1.87 square miles. The Tom Brook watershed includes Interstate 84 and significant dense development- 15.5% of the watershed is under impervious cover. Interstate 84 is heavily salted during winter storms, and likely contributes significant amounts of other pollutants in stormwater runoff.

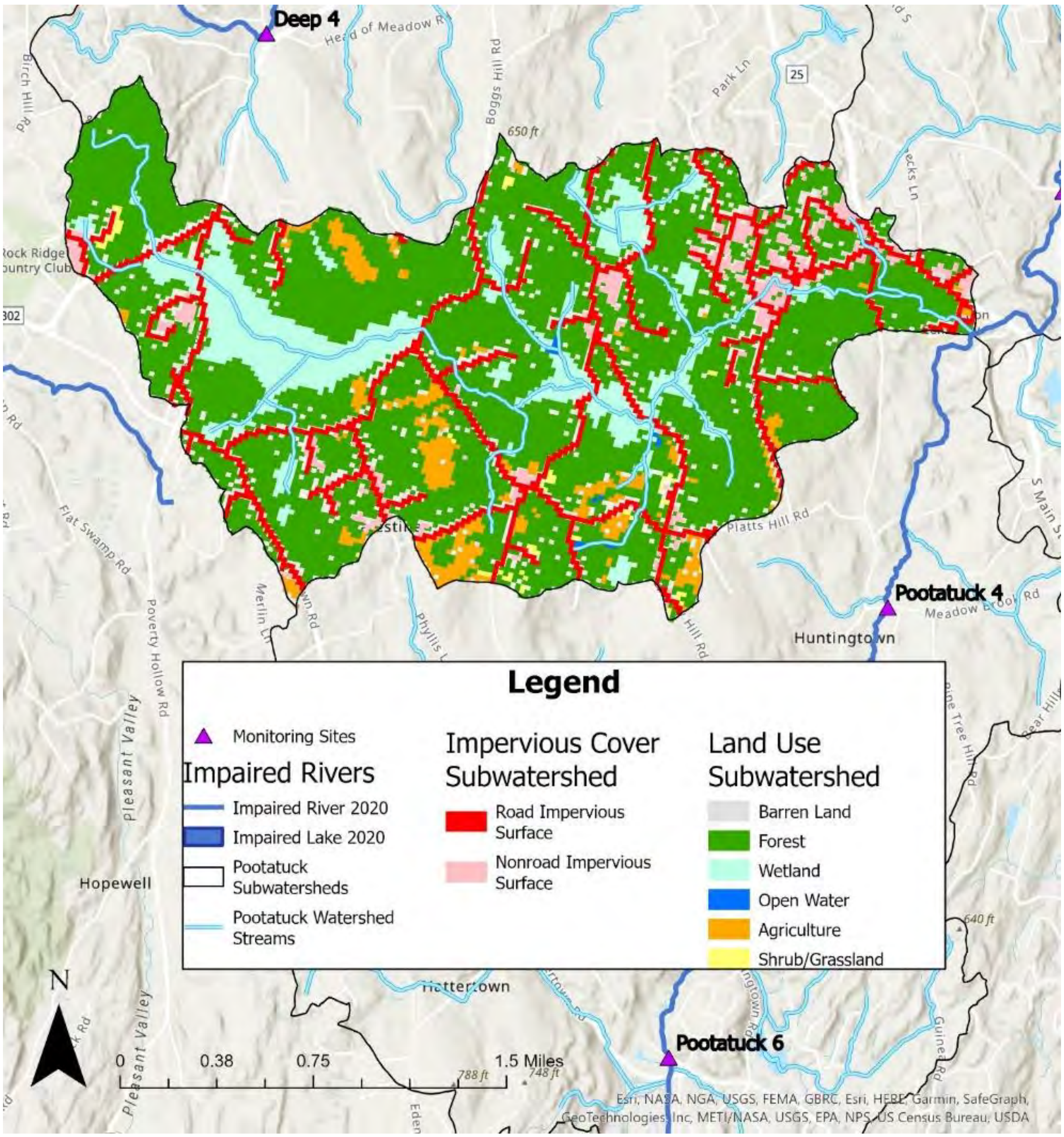
Housatonic Valley Association (HVA) has conducted several streamwalks along Tom Brook. Their findings note the presence of many stormwater outfalls, providing additional evidence of stormwater-related challenges and the possible occurrence of illicit discharges. Preliminary examination of hydrographs from USGS flow gauges above and below the Tom Brook/Pootatuck River confluence (Berkshire Road and Sandy Hook Center gauges) indicate much more rapid flow changes below Tom Brook, suggesting that there are significant amounts of stormwater runoff coming from this stream.



Deep Brook Watershed Stream Corridor Impacts

Although water quality data to support regulatory action (addition to the 303 (d) list) has not been collected from Tom Brook, land use/cover, observation during USA streamwalks and data from USGS flow gauges indicate that it is likely not meeting WQS.

3.4.3 North Branch Pootatuck



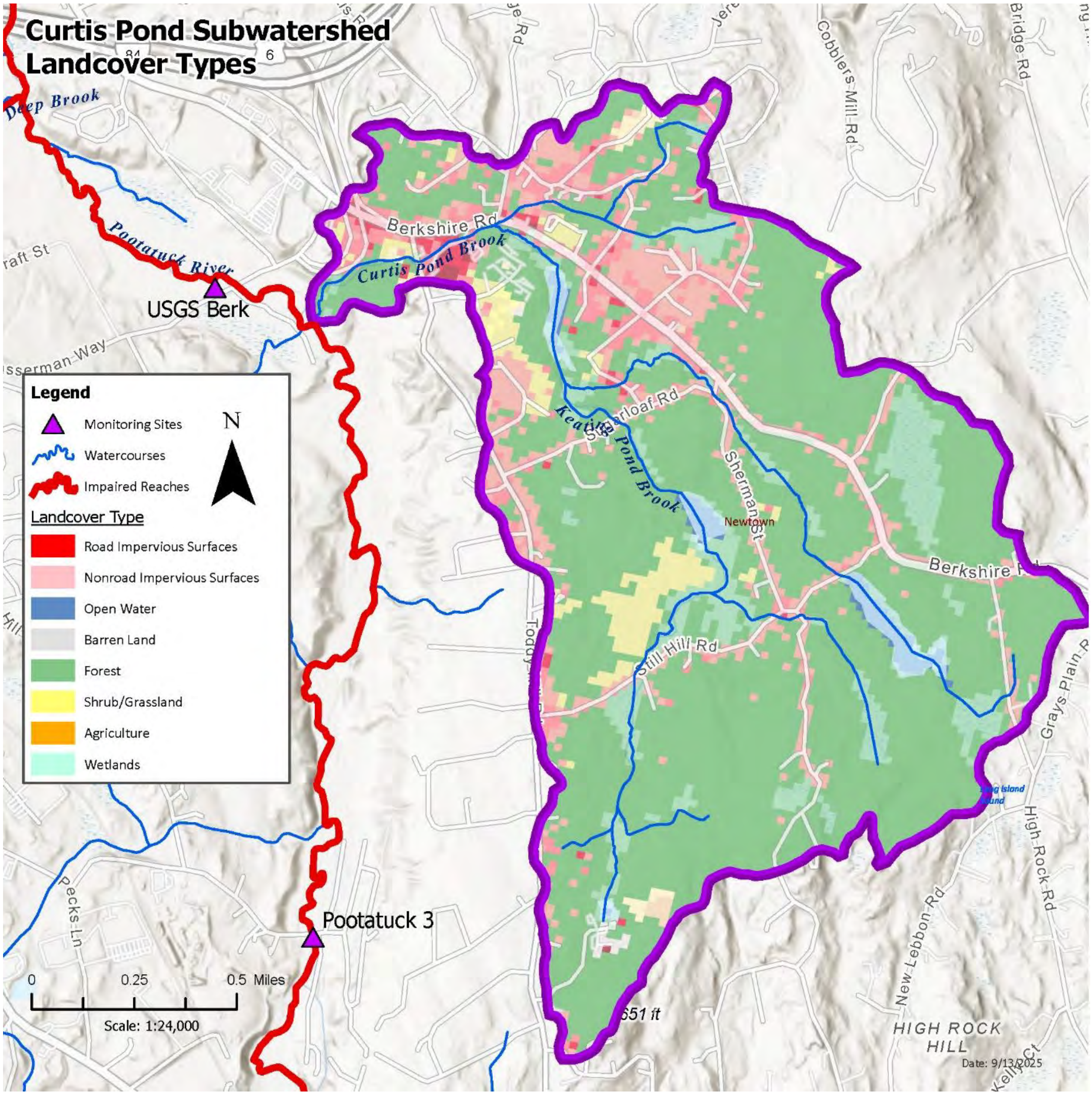
North Branch Pootatuck River Watershed Land Use/Land Cover.

The North Branch Pootatuck River is situated in the western sector of the PRW, covering an area of 4.13 square miles. Approximately 2.2% this sub-watershed is under IC based on GIS analysis, as depicted above.

The low percentage of IC within this sub-watershed indicates a relatively low likelihood of issues related to stormwater runoff. It is important to note that a very small portion of the North Branch Pootatuck watershed falls within the South Main Street aquifer protection area, where the North Branch converges with the Mainstem Pootatuck.

Streamwalks were not conducted in the North Branch Pootatuck sub-watershed as part of the planning process, however this sub-watershed should be included in future assessments. The combination of low development and a significant expanse of forested land along the river makes this sub-watershed particularly promising for conservation and restoration efforts.

3.4.4 Curtis Pond Brook



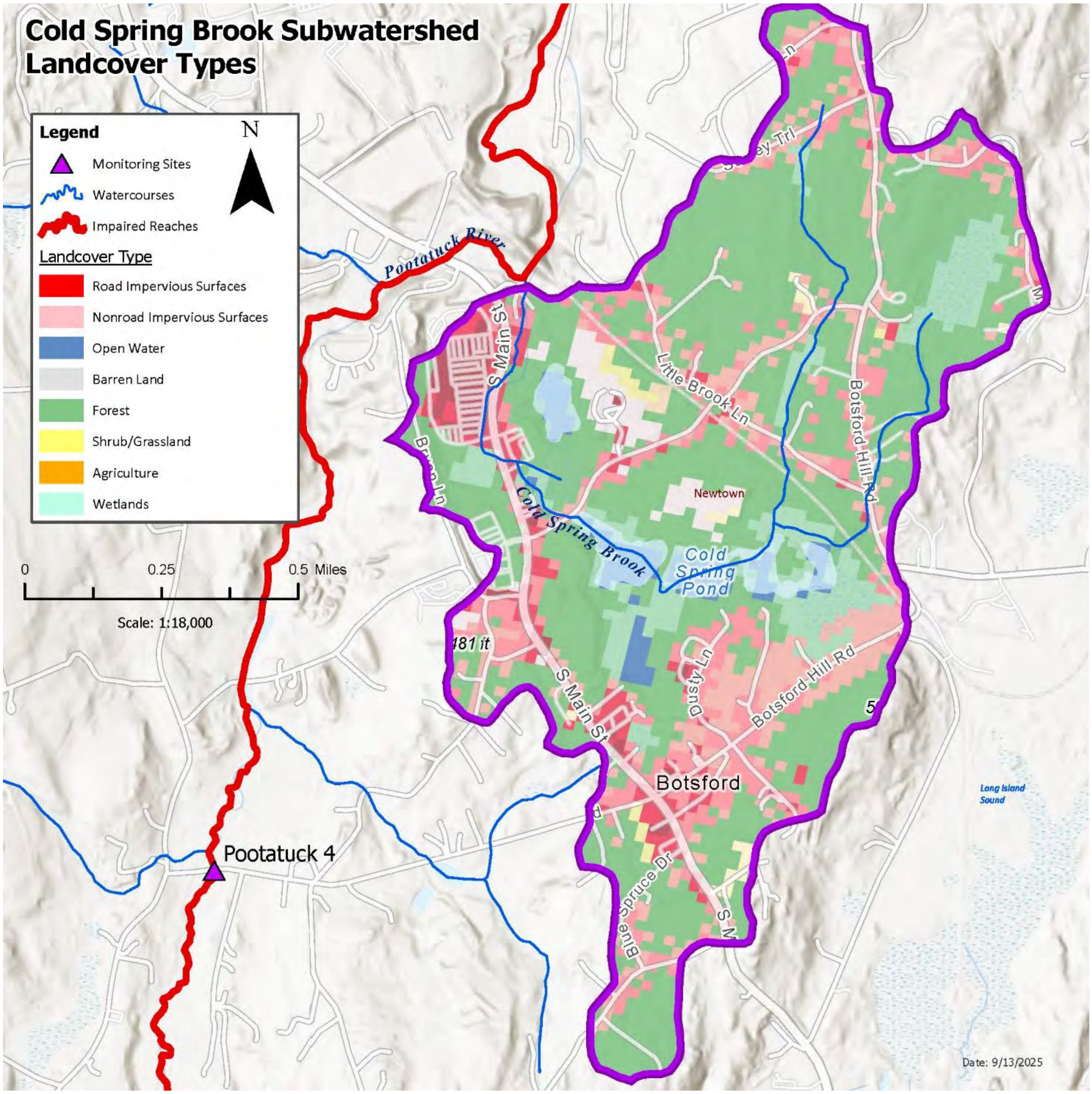
. Curtis Pond Brook Watershed Land Use/Land Cover

The Curtis Pond Brook watershed is located in the northeastern segment of the Pootatuck watershed and drains approximately 2.17 square miles, as illustrated in Map 11. Additionally, Keating Pond Brook contributes to Curtis Pond Brook's flow in the northern region of the watershed.

Within the Curtis Pond Brook watershed, approximately 4% of land is under IC. IC is predominantly concentrated near the confluence of Curtis Pond Brook with the Pootatuck River.

Upstream reaches are mostly forested. A streamwalk was conducted along Curtis Pond Brook, starting from the confluence with the Mainstem Pootatuck River and extending upstream to the Berkshire Road crossing.

3.4.5 Cold Spring Brook



Cold Spring Brook Watershed Land Use/Land Cover

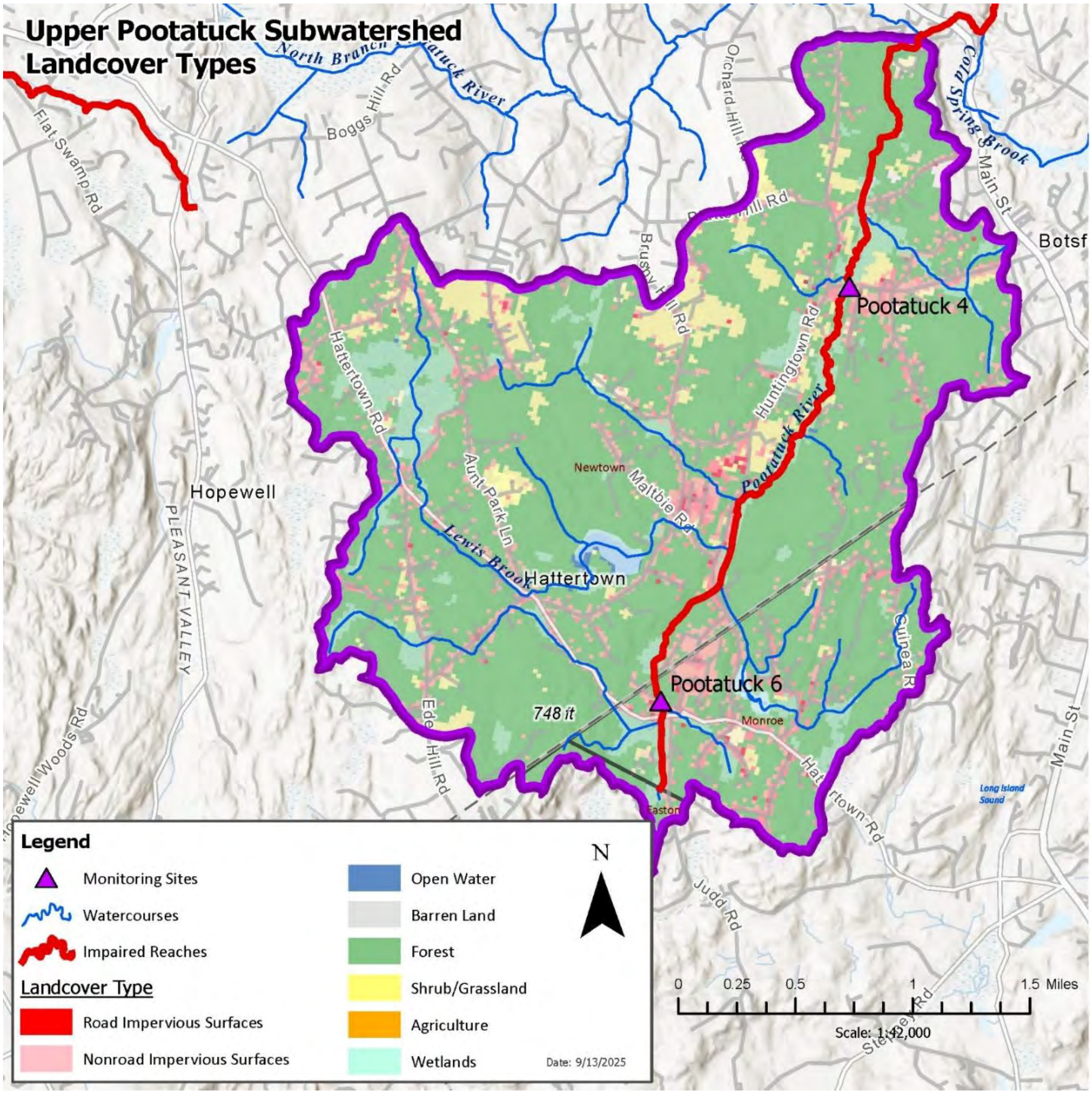
The Cold Spring Brook sub-watershed, situated in the southeastern part of the PRW, encompasses an area of approximately 1.12 square miles as depicted above. The western and southern regions of this sub-watershed host dense development, including commercial centers with expansive parking lots that are directly connected to surface waters. Approximately 9% of this sub-watershed is under IC, meaning it is approaching the 10%-12% IC tipping point where more pronounced impacts to water quality and intended Uses are expected.

A portion of this sub-watershed falls within the South Main Street aquifer protection area[43]. In this area, the landscape has been significantly developed, Including IC that impedes infiltration and aquifer recharge. The Cold Spring Brook watershed also includes several sizable ponds and associated wetlands.

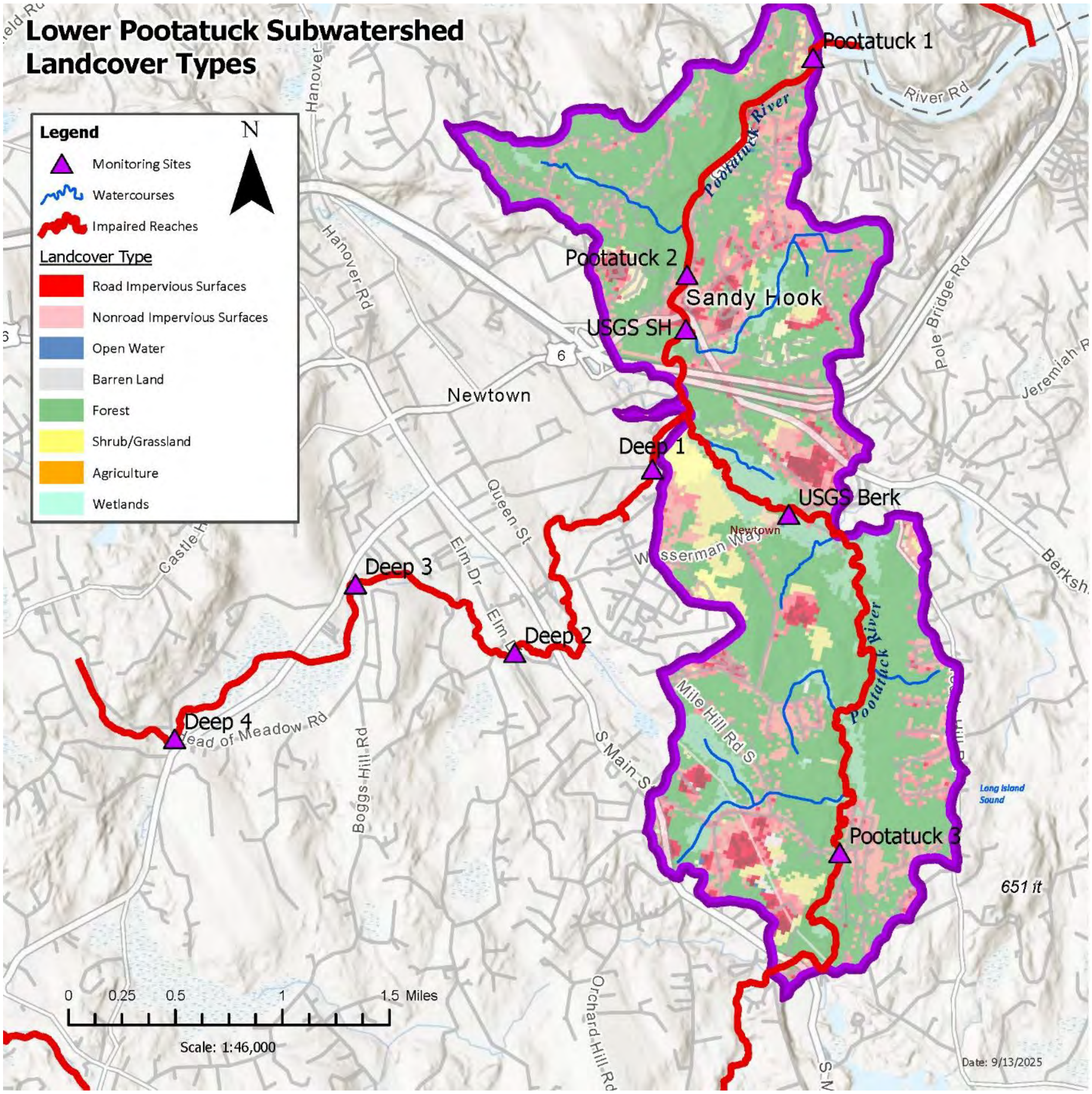
Streamwalks were not conducted in the Cold Spring Brook sub-watershed. Assessing stream reaches flowing through developed areas within this sub-watershed is an important future Action for watershed management, described in Section 8.

[43] CT DEEP, "Newtown Aquifer Protected Areas."

3.4.6 Mainstem Pootatuck



Upper Pootatuck Mainstem Land Use/Land Cover, Impaired Reaches and WQ Monitoring Stations

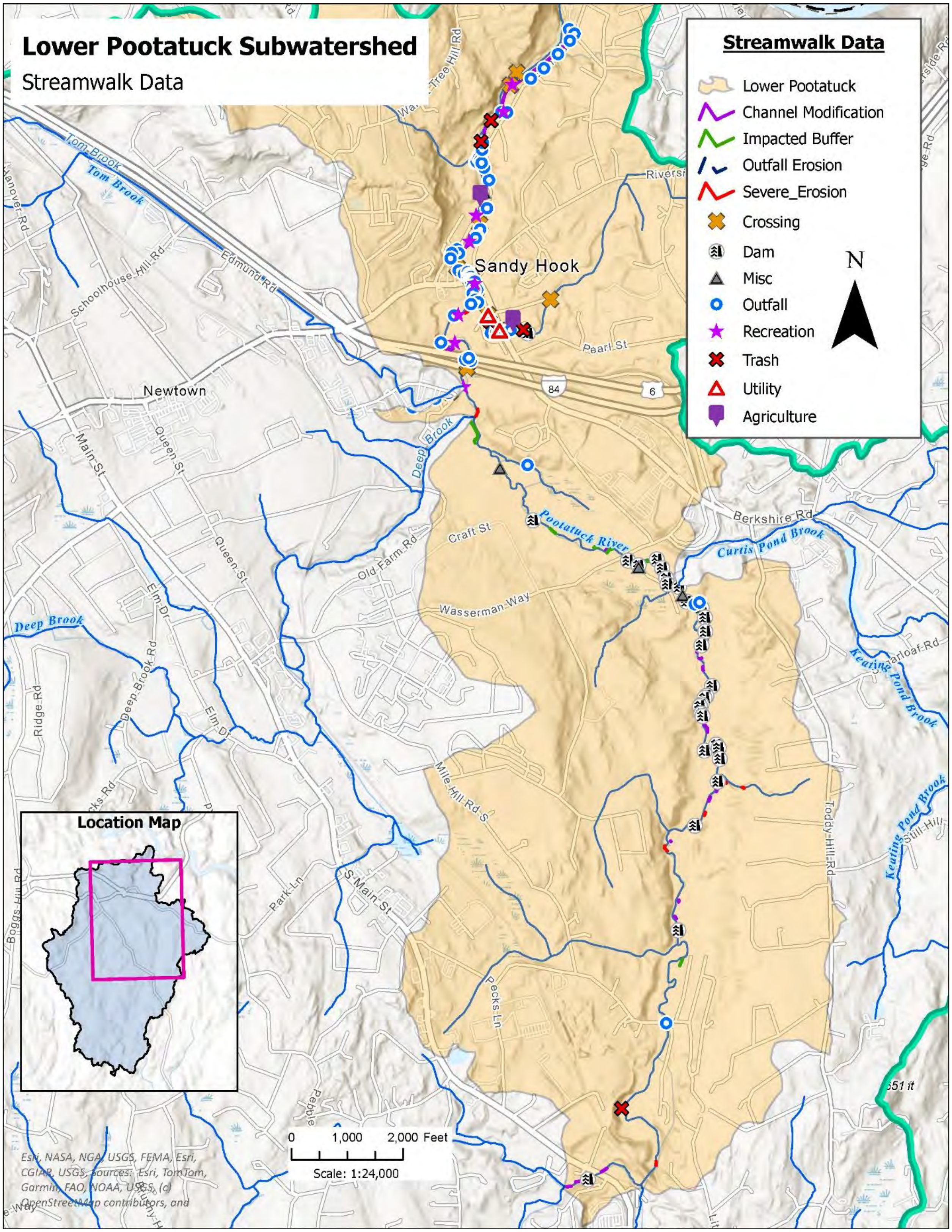


Lower Pootatuck Mainstem Land Use/Land Cover, Impaired Reaches and WQ Monitoring Stations

The Mainstem Pootatuck River, divided into upper and lower sections for assessment and analysis purposes, drains approximately 10.6 square miles of the PRW. It begins near the Monroe-Newtown border and flows north through Newtown, ultimately confluent with the Housatonic River at Sandy Hook. The Mainstem Pootatuck River is a critical historical, cultural, recreational and environmental resource for the Town of Newtown. It offers numerous recreational opportunities, including fishing, hiking along riverside trails, wildlife observation and paddling along the lower reaches.

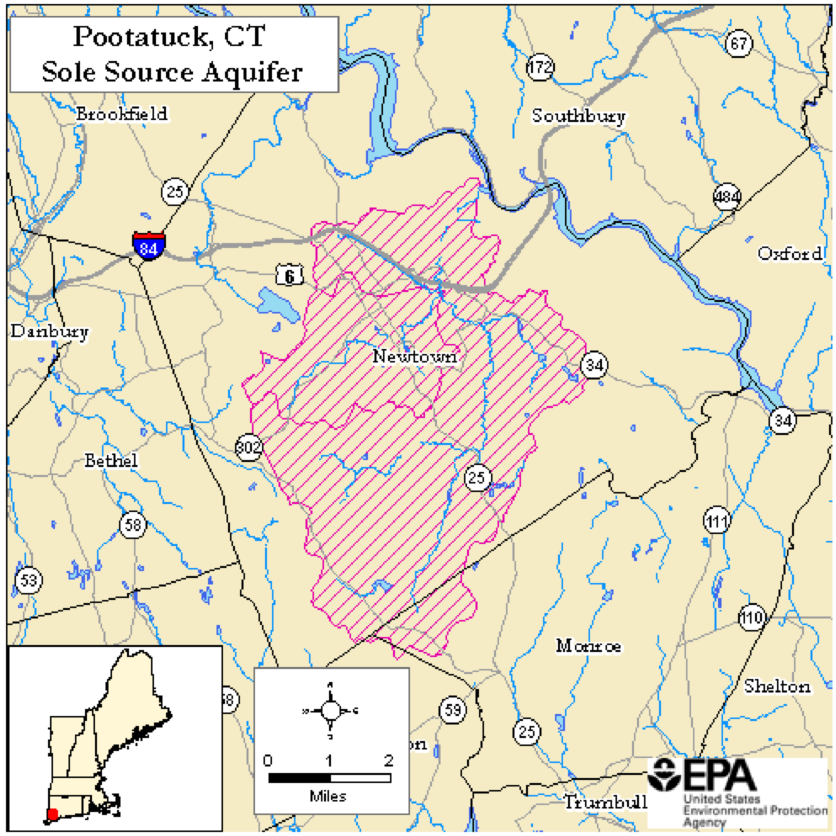
As of the 2022 CT Integrated Water Quality Report to Congress, stream reaches covering the entire Mainstem Pootatuck River are listed as Impaired for Recreational Uses due to indicator bacteria (*E. coli*) concentrations that exceed WQS. A TMDL including *E. coli* load reduction estimates necessary for re-attaining support for Recreational Uses has not been developed for the Mainstem Pootatuck, however this PRWMP includes Actions aimed at reducing *E. coli* and other pollutant loads to Impaired reaches along the Pootatuck mainstem.

Given Impairments for Recreational Uses, extensive streamwalks using the USA protocol were conducted to identify potential pollution sources and potential restoration projects along the Lower Pootatuck River Mainstem subwatershed. USA Streamwalk data are depicted below.



Lower Pootatuck Mainstem Stream Corridor Impacts

3.5 Aquifers and Drinking Water



Pootatuck Sole Source Aquifer

CT DEEP defines an aquifer as "any geologic formation capable of yielding significant quantities of water to wells."[44] Primary management concerns for water sourced from aquifers are quantity (the amount of water available for users) and quality (the pollutants present that may require treatment before use). Groundwater quantity and quality are influenced by land use.

The US EPA Sole Source Aquifer (SSA) Program has designated the Pootatuck Aquifer as an SSA under Section 1424 (e) of the 1974 U.S. Safe Drinking Water Act (SDWA).[45] SDWA defines 'sole source aquifer' as one where: "The aquifer supplies at least 50 percent of the drinking water for its service area" and "[t]here are no reasonably available alternative drinking water sources should the aquifer become contaminated."[46] Under SDWA, the EPA not only designates each SSA as a singular source of drinking water, but also establishes its federal jurisdictional review boundaries for any development projects located within the aquifer that receive federal funding. "The review area includes the area overlying" the SSA and "may also include the source areas of streams that flow into the SSA's recharge zone."[47]

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[44] CT DEEP, "Connecticut's Aquifers."

[45] US EPA, "EPA Region 1 Sole Source Aquifer Program."

[46] US EPA, "Overview of the Drinking Water Sole Source Aquifer Program."

[47] US EPA.

Approximately 3,000 households rely on the Pootatuck SSA for their drinking water.[48] Protection of water quality and quantity in the Pootatuck aquifer is a critical public health concern. In addition to the water quality issues arising from land use discussed above, water quantity concerns include:

- consumer withdrawals of groundwater
- impervious land cover preventing groundwater recharge
- more frequent droughts

The Pootatuck SSA is a source for Aquarion Water Company (a PRP member) to supply water to central Newtown, Mount Pleasant Road, Sandy Hook Center, and South Main Street. The Town of Newtown also draws water from the Pootatuck SSA for the Fairfield Hills campus and the Garner Correctional Institution.[49]

While inhabitants of the PRW have long sourced their drinking water from a groundwater supply out of two wellfields within the basin, since 2019 they have also derived their public drinking water from recently interconnected public water supplies out of three surface-water reservoirs elsewhere in Fairfield County: the Saugatuck, Easton and Aspetuck Reservoir systems that are beyond the scope of this PRWMP in a Greater Bridgeport System.[50] The aquifer share of these distinct water sources is pumped from stratified drift deposits—also known as sand-and-gravel deposits—then the water is stored and disinfected before being delivered to homes and other sites.

The Town of Newtown designated those two wellfields as parts of Aquifer Protection Districts (APDs) then the State of Connecticut established them as parts of two Aquifer Protection Areas (APAs). In response to a petition from State Representative Mae Schmidle of the 106th District of Connecticut, the U.S. EPA designated them as part of a combined Sole Source Pootatuck Aquifer.

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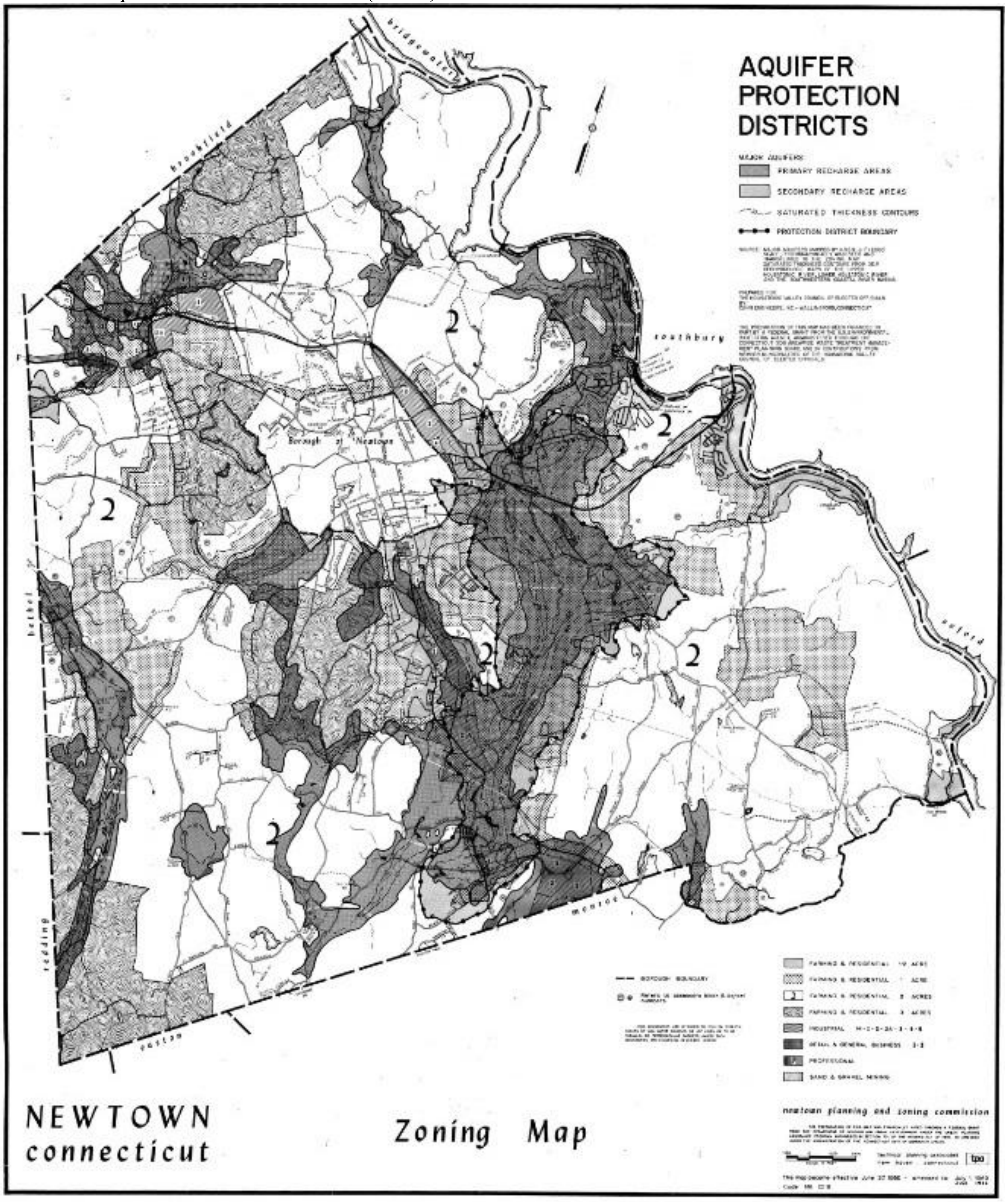
[48] Carlson et al., "Hydrogeology and Numerical Simulation of the Unconsolidated Glacial Aquifer in the Pootatuck River Basin, Newtown, Connecticut." See Harrall - Michalowski Associates, "Analysis of Open Space Conservation Subdivisions"; Western Connecticut Council of Governments (formerly Housatonic Valley Council of Elected Officials), "Housatonic Valley Regional Plan of Conservation and Development." See also: Gorosko, "Pootatuck Aquifer Gets Another Layer of Environmental Protection."

[49] Gorosko, "Pootatuck Aquifer Gets Another Layer of Environmental Protection." See: Keough, "Sole Source Aquifer Designation for the Pootatuck Aquifer, Connecticut," page 11057.

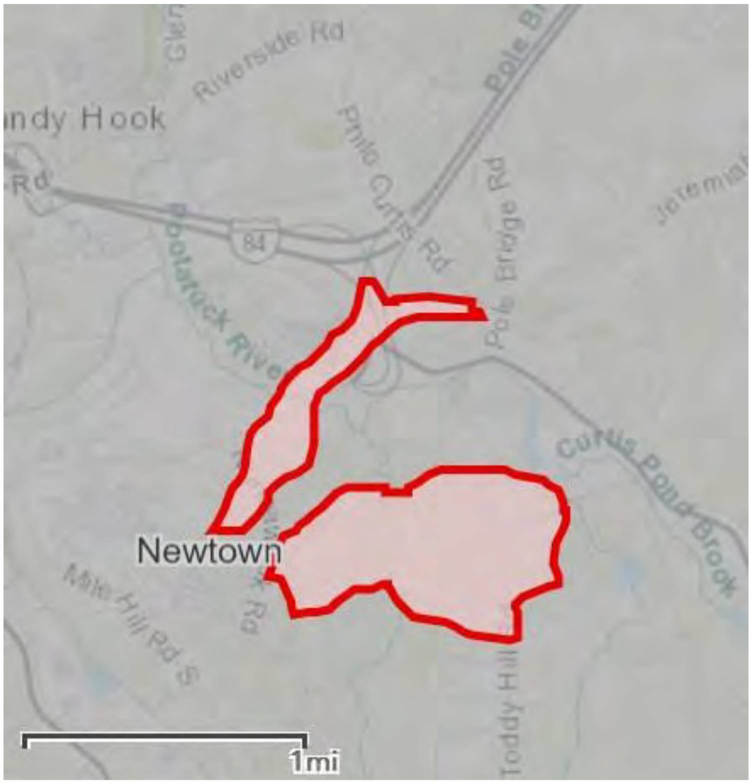
[50] Sibley to Pinto et al., "Re: Current Estimate or Number of Users Who Rely on Pootatuck Aquifer for Their Drinking Water," February 9, 2024. On drinking water quality from these surface waters: Aquarion Water Company, "2019 Water Quality Report: Greater Bridgeport System PWS ID#: CT0150011."

As shown in the map below, the Town of Newtown designated APDs that overlap with the drainage basin of the Pootatuck River.

Newtown Aquifer Protection Districts (APDs)[51]

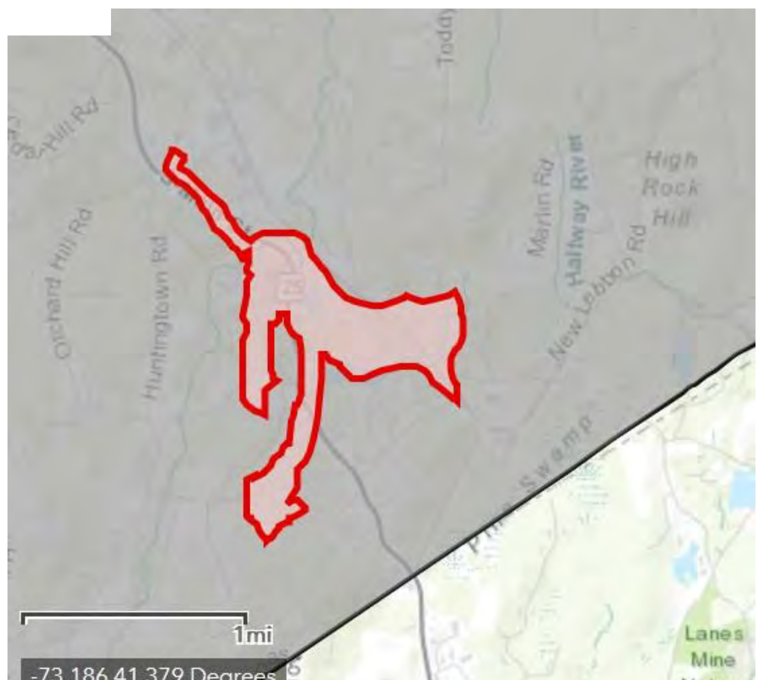


[51] Cahn Engineers, Inc., "Aquifer Protection Districts."



Fairfield Hills Aquifer Protection Area

The CT DEEP Groundwater Classification data categorizes the PRW as supporting both GA and GAA groundwater classifications, which are defined below.[52]



South Main Street Aquifer Protection Area

[52] Newtown Conservation Commission and Milone and MacBroom, Inc., "Town of Newtown Natural Resource Inventory," p. 30, 33.

CT DEEP Groundwater Classifications in Pootatuck River Watershed

Value	Definition of designated uses
GA	Existing private and potential public or private supplies of water suitable for drinking without treatment; baseflow for hydraulically connected surface water bodies.
GAA	Existing or potential public supply of water suitable for drinking without treatment; baseflow for hydraulically connected surface water bodies.

Under the State of Connecticut Aquifer Protection Program, the wellfields were mapped to Level B standards at the turn from the late 1980s to the early 1990s, then mapped to Level A standards during the 2010s. Aquifer maps charted at Level B depict preliminary aquifer recharge areas and areas that contribute to public water supplies. Aquifer maps charted at Level A such as those shown for each of the Pootatuck APAs in maps 15 and 16 below are based on detailed hydrogeologic analysis of aquifer recharge areas and of areas that contribute to public water supplies. As has been the case of most groundwater mapping projects submitted to the CT DEEP for the 80 towns where State APAs are located, Pootatuck aquifer areas mapped at Level A have turned out to be smaller than those preliminarily mapped at Level B.[53]

Whereas the state aquifer protection program designates lands and surface waters relatively close to the wellheads of public water supplies into its areas, the Newtown aquifer protection program designates lands and surface waters that extend farther outwardly from the wellheads into its districts, which cover a town geographic area approximately five times wider than those of the APAs.[54]

Aquarion Water Company maintains a wellfield that supplies public water from an area off South Main Street. It also supplies public water from a wellfield that is currently owned by the Town of Newtown near the former campus of Fairfield Hills Hospital and current Town facilities.

3.5.1 Drinking Water Threats and Protection

A reason why groundwater contamination and scarcity are more serious threats than usual for community members in the drainage basin is due to the Pootatuck Aquifer's "relatively high

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[53] Newtown Conservation Commission and Milone and MacBroom, Inc., p. 34; CT DEEP, "Connecticut's Aquifer Protection Area Program Municipal Manual," p. 19; CT DEEP, "Aquifer Protection Area Program;" CT DEEP, "Water Quantity."

[54] Gorosko, "Pootatuck Aquifer Gets Another Layer of Environmental Protection."

permeability and its shallow water table."[55] The "wellfields are located within stratified drift deposits consisting of alluvial floodplains with both hydric and nonhydric soil designations."[56] Indeed, "more than half of the water pumped from the aquifer's wells comes from the Pootatuck River."[57] Recharge directly from precipitation is the most substantial source of groundwater for sub-watersheds located in upstream headwater areas, whereas stream inflows from surface waterways are the largest source of aquifer water for sub-watersheds located in downstream sites and near the main stem of the Pootatuck River.[58] While the percentage of aquifer water that recharges directly from precipitation has ranged from 20 to 62 percent between different parts of the watershed, the share of groundwater that comes from surface waterways or stream inflows has ranged from 38 to 80 percent across such sub-watersheds.[59] The estimated recharge of the Pootatuck aquifer has averaged 16 inches per year for the entire watershed and ranged from 1 to 28 inches per year for each of the basin's different sub-watersheds.[60] Two of the wellfields in the Pootatuck aquifer have been estimated to be most responsive or sensitive to recharge: well number 2 overlapped with the sub-watershed of Cold Spring Brook and well number 8 spread across four overlaid sub-watersheds—Curtis Pond Brook, Deep Brook, the Lower Pootatuck, and North Branch.[61] Overall, "increases in the amount of impervious surface from future development will reduce and redistribute recharge to the groundwater system. A simulation of future development scenarios showed a decrease in the simulated base flow in the main stem of the Pootatuck River

[55] Quote attributed to a staff person with the Town of Newtown in Gorosko, "Pootatuck Aquifer Gets Another Layer of Environmental Protection."

[56] Newtown Conservation Commission and Milone and MacBroom, Inc., "Town of Newtown Natural Resource Inventory," p. 33.

[57] Carlson et al., "Hydrogeology and Numerical Simulation of the Unconsolidated Glacial Aquifer in the Pootatuck River Basin, Newtown, Connecticut," p. 1.

[58] Carlson et al. p. 66 and 80.

[59] Carlson et al. p. 80.

[60] Carlson et al. p. 79.

[61] Carlson et al. p. 64-65.

and in all of the 26 simulated subbasins, with some of the subbasins showing a decrease in the aquifer of more than 20 percent when new development had 85 percent impervious area."[62]

While the municipal aquifer regulations that Newtown has instituted apply only to proposed activities, those that the State of Connecticut has established also regulate some existing activities. The town's aquifer rules prohibit land uses that can contaminate groundwater and "also regulate certain other land uses that may have the potential to contaminate groundwater."[63] The state regulations restrict development of certain new land use activities that use, store, handle or dispose of hazardous materials as well as "require existing regulated land uses to register and follow best management practices."[64]

To achieve the greatest public health protection, groundwater throughout the PRW must be protected. The APA off South Main Street has a protection area of approximately 336 acres and the APA at Fairfield Hills has a protection area that spans approximately 370 acres.[65]

Based on the U.S. EPA designation of the combined Pootatuck Sole Source Aquifer, any projects proposed for construction or modification within this PRW aquifer review area that seek federal financial assistance are subject to EPA review for the purpose of a reduction in the risk of the projects contaminating groundwater.[66]

Albeit with all the due outdating caution of a dozen years that have passed since 2011 when the Town of Newtown—another PRP member—published a major Natural Resource Inventory, the report is still worth referencing at length where it also reviews how Connecticut regulations at the State level have been applied to the APAs in the overlapping federal Pootatuck Aquifer:

> "As required by the Safe Drinking Water Act Amendments of 1996, DPH [(the CT Department of Public Health)] and DEEP have completed source water assessments for all

[62] Carlson et al.

[63] Gorosko, "Pootatuck Aquifer Gets Another Layer of Environmental Protection."

[64] Gorosko.

[65] Newtown Conservation Commission and Milone and MacBroom, Inc., "Town of Newtown Natural Resource Inventory," p. 33.

[66] Newtown Conservation Commission and Milone and MacBroom, Inc., p. 36; US EPA, "Overview of the Drinking Water Sole Source Aquifer Program."

public water supplies in the State of Connecticut. Assessments were completed for the [South Main Street] and Fairfield Hills wellfields in the past few years, and Source Water Assessment Reports were published in 2004. As stated in the reports, the assessments can be used to target and implement enhanced source water protection measures such as inspections, land use regulations, land acquisitions, septic system maintenance, and education.

The [South Main Street] wellfield has a ‘low’ rating for environmental sensitivity (indicating that the source water area is not sensitive) based on proper well construction and the absence of contaminants; a "moderate" rating for potential risk factors (indicating that the source water area has low risk) based on the amount of developable land in the source area and the presence of potential contaminant sources; and a ‘high’ rating for source protection needs based on the fact that the 200-foot sanitary radius around each well is not fully controlled, although local aquifer protection regulations are in place. The overall susceptibility is ‘moderate.’

The main listed strength is that local aquifer protection regulations are in place. Recommendations of the source water assessment report include completing the Level A mapping [that has since been completed as mentioned above], monitoring commercial and industrial activities, working with local officials to ensure that only low-risk development occurs in the source water area, and acquisition of open space in the source water area.

The Fairfield Hills wellfield has a ‘low’ rating for environmental sensitivity (indicating that the source water area is not sensitive) based on proper well construction and the absence of contaminants; a ‘low’ rating for potential risk factors (indicating that the source water area has low risk) based on the amount of developable land in the source area and the presence of potential contaminant sources; and a "moderate" rating for source protection needs based on the fact that less than 10% of the land in the source area is preserved open space, although local aquifer protection regulations are in place. The overall susceptibility is ‘low.’

The main listed strengths are that local aquifer protection regulations are in place and that commercial and industrial land uses comprise less than 10% of the source area.

> Recommendations of the source water assessment report include completing the Level A Mapping [that has since been completed as mentioned above], monitoring commercial and industrial activities, working with local officials to ensure that only low-risk development occurs in the source water area, and acquisition of open space in the source water area."[67]

Among the attributes of the PRW that the Town of Newtown inventoried as important are how its GA/GAA groundwater serves as the source for public supply wells and how several of its impaired surface waterbodies contribute to public water supply areas.[68] The Newtown Inventory highlights the APAs as important features of the PRW; recommends that both of them be protected through such best management practices as sound engineering and low-impact development; and also recommends that public water supply watershed lands be protected through acquisition, regulation and/or restriction.[69] Indeed, the Inventory deems it as important for the Town of Newtown to "regulate development within these APAs for long-term protection of ground water quality and production" as well as recommends that "any proposed development within these zones should be designed using Low Impact Development (LID) practices."[70]

According to a 2021 Water Quality Report that the Aquarion Water Company publicizes, the Newtown "water has been tested for more than 100 compounds that are important to public health. Only 16 of these were detected, all of which were below the amounts allowed by state and federal law. Most of these compounds are either naturally occurring or introduced as treatment to improve water quality. Monitoring frequency varies from daily to once every nine years per EPA regulation, depending on the parameter. [Aquarion's] testing encompasses the full range of regulated inorganic, organic and radiological compounds and microbiological and physical parameters."[71]

In 2019, Aquarion Water Company voluntarily began a program testing water for six among a wider set of chemicals called per- and polyfluoroalkyl substances (PFAS) in its 72 public water

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[67] Newtown Conservation Commission and Milone and MacBroom, Inc., "Town of Newtown Natural Resource Inventory.", p. 34-36.

[68] Newtown Conservation Commission and Milone and MacBroom, Inc., p. 31.

[69] Newtown Conservation Commission and Milone and MacBroom, Inc., p. 32.

[70] Newtown Conservation Commission and Milone and MacBroom, Inc., p. 33.

[71] Aquarion Water Company, "2021 Water Quality Report: Newtown System PWS ID#: CT0970011."

systems across Connecticut. As detailed in Table 9 below, test results for the Newtown system that provides most of the public water supply in the PRW have shown PFAS concentrations ranging as follows at points of entry where samples were collected after treatment—as water enters the distribution system before the first customer.

- For each among six chemicals tested: from not detected to 5 parts per trillion (ppt) on any one of the three sample locations tested—Newtown Wells, Sandy Hook Wells #1/#3/#10 or Sandy Hook Wells #7/#12A/#13/#14;
- For the cumulative or combined sum across the six chemicals tested: from 3ppt out of Sandy Hook Wells #1/#3/#10 through 8 ppt out of Sandy Hook Wells #7/#12A/#13/#14 to 18 ppt out of Newtown Wells.

These results were all initially well below the advisory maximum limits of 70 ppt that the guidelines of the Connecticut Department of Public Health (DPH) and the U.S. EPA had advised until April 26 and June 25 of 2024 when an EPA rule raised regulatory standards through a process of policymaking change which the federal agency had previously announced as forthcoming since at least September of 2023 and estimated to be completed earlier—by the end of 2023.[72] There have also been current processes concerned with PFAS at the state level.

Table 9. Newtown PFAS Sampling Results in Parts per Trillion (ppt) at Points of Entry[73]

Sample Location	PFOA	PFOS	PFHpA	PFHxS	PFNA	PFBS	Combined sum of 6 PFAS tested
Newtown Well	5	5	3	2	Not detected	3	18
Sandy Hook Wells #1/#3/#10	Not detected	Not detected	Not detected	Not detected	Not detected	3	3
Sandy Hook Wells #7/#12A/#13/#14	4	Not detected	2	Not detected	Not detected	2	8

Table 10. U.S. EPA-Proposed and Final PFAS National Primary Drinking Water Regulation[74]

Compound	**Proposed MCLG**	**Proposed MCL (en-forceable levels)**	**Final MCLG**	**Final MCL (enforceable levels)**
PFOA	Zero	4.0 parts per trillion (also expressed as ng/L)	Zero	4.0 parts per trillion (ppt) (also expressed as ng/L)

[72] Aquarion Water Company; "PFAS National Primary Drinking Water Regulation; Correction."
[73] Aquarion Water Company, "2021 Water Quality Report: Newtown System PWS ID#: CT0970011."
[74] US EPA, "Per- and Polyfluoroalkyl Substances (PFAS) Proposed PFAS National Primary Drinking Water Regulation."

PFOS	Zero	4.0 ppt	Zero	4.0 ppt
PFNA	1.0 (unitless) Hazard Index	1.0 (unitless) Hazard Index	10 ppt	10 ppt
PFHxS			10 ppt	10 ppt
PFBS				
HFPO-DA (commonly referred to as GenX Chemicals)			10 ppt	10 ppt
Mixtures containing two or more of PFHxS, PFNA, HFPO-DA, and PFBS			1 (unitless) Hazard Index	1 (unitless) Hazard Index

Table 9 and the ‘proposed’ columns of Table 10 above show how 33%- six (6) of these eighteen (18) test results would exceed Maximum Contaminant Levels (MCLs) and/or Maximum Contaminant Level Goals (MCLGs) of a PFAS National Primary Drinking Water Regulation that the U.S. EPA proposed during the period from March of 2023 until April of 2025. Until April 26 of 2024, this proposed PFAS regulation did not require any actions while it had not yet been finalized—although at the time of proposal the EPA had anticipated finalizing it by the end of 2023.

The cells highlighted by the color red in Table 9 and the ‘final’ columns of Table 10 above also show how 28% as in four (4) of these eighteen (18) test results have recently been regulated as probably exceeding Maximum Contaminant Levels (MCLs) and/or Maximum Contaminant Level Goals (MCLGs) of the PFAS National Primary Drinking Water Regulation that the U.S. EPA ruled to become effective from June 25 of 2024 on. Starting on this date, compliance with MCLs began to be “determined by running annual averages at the sampling point.”[75]

The Environmental Working Group (EWG) also reports on EPA assessments of the two APA sources’ compliance with legally-mandated, health-based federal standards for drinking water. While the EWG verifies both wellfields to have been consistently complying with these standards in the most recent assessments (from April 2019 to March 2021), it also reports that:

- twelve (12) of fifteen (15) contaminants detected in the drinking water out of the South Main Street APA from 014 to 2019 exceeded the EWG’s health guidelines;[76] and

[75] US EPA.
[76] Environmental Working Group (EWG), “Aquarion Water Company of CT - Newtown System.”

- seven (7) of eleven (11) contaminants detected in the drinking water out of the Fairfield Hills APA from 2017 to 2019 exceeded the EWG's health guidelines.[77]

According to reports from EWG, each of the twelve most concerning contaminants in the South Main Street wellfield are carcinogenic. Four of these contaminants have exceeded its health guidelines: total trihalomethanes (TTHMs, by 171 times), bromodichloromethane (by 79 times), dibromochloromethane (by 45 times), and haloacetic acids (HAA5, by 28 times).[78]

The EWG also reports six of the most concerning contaminants in the Fairfield Hills wellfield to be carcinogenic and the seventh one to be harmful to the brain and nervous system. The three such contaminants that the EWG reports exceeded its health guidelines are: haloacetic acids (HAA5, by 24 times), total trihalomethanes (TTHMs, by 9.2 times), and bromodichloromethane (by 8.8 times).[79]

One well-characterized source of groundwater contamination is an EPA-designated Superfund site that has been the subject of a remediation effort led by the State of Connecticut, over a period of several years.[80] This contamination is related to a factory operated by Noranda Metal Industries, a Canada-based mining business. This operation polluted a part of the Newtown APD. The site is located between rather than within the two state APAs in the PRW.[81]

Two rounds of remediation have been conducted since 1989 to clean up a chronic release of trichloroethylene (TCE) at this site, released during "the 1950s and 1960s through a hole positioned in the floor of the Noranda factory, which led to an underlying dry well" at a riparian location that drains down to the "Mile Hill Road South wetland, which in turn is drained by a

[77] Environmental Working Group (EWG), "Fairfield Hills."
[78] Environmental Working Group (EWG), "Aquarion Water Company of CT - Newtown System."
[79] Environmental Working Group (EWG), "Fairfield Hills."

[80] US EPA, "Noranda Metal Industries ERH–Biostimulation–Bioaugmentation–Technical Impracticability Waiver–Monitored Natural Attenuation"; US EPA, "Superfund Site Information: Noranda Metal Industries (EPA ID: CTD052708450)"; Gorosko, "Noranda Cleanup Will Take Ten Years or More--Firm Comes to Grips with Its Legacy of Industrial Pollution"; *Our Sole Source: Protecting Our Town's Water*.
[81] See Gorosko, "Noranda Cleanup Will Take Ten Years or More--Firm Comes to Grips with Its Legacy of Industrial Pollution"; Cahn Engineers, Inc., "Aquifer Protection Districts"; CT DEEP, "Connecticut Aquifer Protection Areas: Interactive Map."

stream" that is an unnamed tributary to Deep Brook.[82] Being a volatile organic compound similar to a dry-cleaning fluid, the TCE was used as a degreasing solvent during the metal-cleaning phases of the property's manufacturing processes then released untreated. These TCE releases are estimated to have amounted to hundreds of gallons, creating a contaminated industrial site that has impacted an adjacent wetland, and groundwater.[83] Groundwater contamination from this site is estimated to have spread in a plume underlying around 15 acres- so, spreading beyond the 12-acre property of the former facility.[84]

While remediation of the Noranda Metal Industries site is critical and underway, there is likely a multi-causal array of groundwater pollution sources in the PRW. A better understanding of these sources is essential for effective management of drinking water quality, and protection of public health. Ideas for additional source investigation gleaned from this planning process are described below.

Long-term toxic impacts from the historical sites of Newtown's feldspar and mica mines,[85] where contaminants might have percolated the groundwater given how studies show that "hazardous chemicals, such as mercury, crystalline silica, carbon monoxide, diesel or hydrocarbon fumes, cyanide, and mica, associated with mining are harmful to health."[86]

The historic use of mercury to produce hats in the Hattertown part of Newtown from approximately 1800 until at least 1856 may raise similar prospects for further applied research that could be pursued by the PRP.[87]

A more recent and better known potential source of groundwater contamination has been located across the road—namely, Glen Road—from the lower mainstem Pootatuck River at a segment

[82] Gorosko, "Noranda Cleanup Will Take Ten Years or More--Firm Comes to Grips with Its Legacy of Industrial Pollution." See the location relative to the unnamed tributary to Deep Brook through CT DEEP, "Connecticut Aquifer Protection Areas: Interactive Map."
[83] Gorosko, "Noranda Cleanup Will Take Ten Years or More--Firm Comes to Grips with Its Legacy of Industrial Pollution." On how the Pootatuck aquifer is particularly integrated with and thereby vulnerable to its watershed's wetlands, see page 51 of Carlson et al., "Hydrogeology and Numerical Simulation of the Unconsolidated Glacial Aquifer in the Pootatuck River Basin, Newtown, Connecticut."
[84] See US EPA, "Noranda Metal Industries ERH–Biostimulation–Bioaugmentation–Technical Impracticability Waiver–Monitored Natural Attenuation"; Gorosko, "Noranda Cleanup Will Take Ten Years or More--Firm Comes to Grips with Its Legacy of Industrial Pollution."
[85] Connecticut Humanities, "Newtown - Connecticut History."
[86] da Silva-Rêgo, de Almeida, and Gasparotto, "Toxicological Effects of Mining Hazard Elements."
[87] Valenta, "Hattertown: Newtown's Bequest from the Hatting Trade."

where it borders Rocky Glen State Park.[88] Its pollution is from metal machining operations on cast iron and steel that a local business named R.S Watkins & Sons manufactured at this site from the early 1930s until 1974 then from the welding as well as brass wire drawing and annealing operations that the business added that year and continued to operate until 1990. To date the levels of groundwater contamination at this hazardous site have been lower than the limits that would otherwise require their remediation. However, the remediation process that the Town of Newtown has been leading at the property recommends post-remediation groundwater monitoring of potentially undetected impacts on a site assessed to drain toward the Pootatuck River and zoned within the Newtown APDs, albeit north of the two Pootatuck state APAs.[89]

Another possible line of further research into groundwater pollution could assess three Newtown locations where CT DEEP has listed "significant environmental hazards reported" to the agency between 1998 and 2023. These sites are within the Newtown APDs as well as the two Pootatuck APAs for the pair of public wellfields. The CT DEEP has listed these three sites as:

- a gas station placed on 151 South Main Street where "pollution was detected in a drinking water well above standards;"
- an office park located on 153 South Main Street where "pollution in the top two feet of soil may pose a risk to human health as a result of direct contact;"
- a former hospital situated on 20A Mile Hill Road where "pollution in the top two feet of soil may pose a risk to human health as a result of direct contact".[90]

The Pootatuck Watershed Association (PWA) created a documentary that promotes public awareness of two potential sources of groundwater contamination. These two features are the more recent heating oil spills into the Meeker Brook tributary of Deep Brook from the Fairfield Hills

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[88] Voket, "Glen Road Brownfield Cleanup Targeting Hazmat Materials"; Taylor, "Town Poised to Clean Up Two Sandy Hook Sites"; Ryser, "Newtown's $850K Plans to Clean up an Abandoned Toxic Eyesore to 'Benefit All of Sandy Hook.'"

[89] Down To Earth, LLC, "Analysis of Brownfield Cleanup Alternatives: 28 Glen Road; Newtown, CT (EPA File No. BF-97128501-0)"; Taylor, "Town Poised to Clean Up Two Sandy Hook Sites."

[90] CT DEEP, "List of Selected Significant Environmental Hazards Reported to DEEP: Period Covering 10/01/1998 through 2/28/2023."

area and, use of an organophosphate insecticide under the label “Dieldrin” at the site of the former Fairfield Hills Hospital prior to the U.S. EPA’s 1987 ban on its applications.[91]

[91] *Our Sole Source: Protecting Our Town’s Water*.

4. FLOOD DAMAGE PREVENTION/CLIMATE RESILIENCY

4.1 Flooding

According to the NOAA National Center for Environmental Information (NCEI), there have been 27 flooding and 128 flash flooding events from 1990 until 2023 in Fairfield County. Until early 2024, tropical storm Irene was one of the more well-known events that resulted in historic flooding in recent history, but throughout the years various severe thunderstorms and tropical storms have resulted in significant flooding throughout the PRW.

From August 18th to 19th of 2024, the Pootatuck River Watershed experienced a record-breaking flood that is beyond the temporal scope of this iteration of the PRWMP. Impacts and mitigation strategies will be incorporated into the next iteration of this PRWMP.[92]

4.1.1 Natural Hazard Mitigation Plans

The Towns of Easton, Monroe and Newtown have developed Natural Hazard Mitigation Plans, with the primary goals of protecting public safety and minimizing damage to property and infrastructure during natural disasters. Whereas the Newtown plan pays particular attention to flood risk reduction within the PRW, a shared draft update to both the Easton and Monroe plans recognizes all such concerns to be in watersheds beyond their headwaters of the Pootatuck River.[93] Past events like Hurricanes Irene and Sandy, which led to significant flooding, prompted the Town of Newtown to take proactive measures.

Despite significant flood-control projects, flood risk remains a concern within the watershed. FEMA-designated flood areas, including 100-year and 500-year flood zones, cover substantial portions of the PRW. Participation in the National Flood Insurance Program (NFIP), administered by FEMA, helps assess flood risk, establish development regulations in floodplains, and provide federally subsidized flood insurance to property owners.

The Town of Newtown has experienced flooding throughout every season in its recorded history. Spring rain, snowmelt, tropical storms, winter rain on frozen ground, and torrential rainstorms

[92] Taylor, "Torrential Rain, Flooding Rampages Across Newtown, Surrounding Area"; Gloninger and Douglas, "In a Summer of Severe Flooding in New England, a 1,000-Year Storm Hit Connecticut. Here's How."

[93] Town of Newtown, "Town of Newtown Hazard Mitigation Plan," 2015; Connecticut Metropolitan Council of Governments (METROCOG), "Draft 2024 Natural Hazard Mitigation Plan Update Prepared on Behalf of the Municipalities of Bridgeport, Easton, Fairfield, Monroe, Stratford, Trumbull."

have resulted in flooding events in Newtown. As noted by its hazard mitigation plan, flooding problems are most concentrated around the mainstem Pootatuck River. High risk areas include areas around Turkey Hill Road, Nearbrook Drive, and Meadow Brook Drive with minor flooding often occurring in the remainder of the watershed.

4.1.2 High- Hazard Dams

There are two dams in the PRW with High or Significant Potential to cause Harm or Damage. One of them is in the Curtis Pond Brook sub-watershed and another is in the Lower Pootatuck sub-watershed.

Curtis Pond Dam impounds Curtis Pond Brook. It is owned by the Town of Newtown, used to impound Curtis Pond for recreation, and assessed by the CT DEEP as a significant or Class B hazard from dam failure. The second most serious risk classification, "Class B dams are significant hazard potential dams that upon failure would result in possible loss of life; minor damage to habitable structures, residences, hospitals, convalescent homes, schools, and the like; damage or interruption of service of utilities; damage to primary roadways; and significant economic loss."[94] This dam has been maintained then replaced since its initial construction in 1856 and is located at the northern end of the Pond after which it is named. As hazards from Curtis Pond Dam, "[f]loodwaters from a dam failure have the potential to affect five houses and a large commercial building.[95]

Rocky Glen Dam impounds the lower Pootatuck River. It was initially built in 1870, and has been modified since then. It is owned by Sandy Hook Hydro LLC, and used to generate electricity using a "run-of-the river" flow management regime. It has been assessed by CT DEEP as a Class C hazard if it fails. The most serious risk designation, "Class C dams are high potential hazard dams that upon failure would result in loss of life and major damage to habitable structures, residences, hospitals, convalescent homes, schools, and main highways with great economic loss."[96] A failure

[94] CT DEEP designation referenced in Town of Newtown, "Town of Newtown Hazard Mitigation Plan," p. 8-1.

[95] Town of Newtown, "Town of Newtown Hazard Mitigation Plan," p. 8-6.

[96] CT DEEP classification referenced in Town of Newtown, "Town of Newtown Hazard Mitigation Plan," p. 8-1.

of Rocky Glen Dam, per the Newtown HMP would threaten six houses.[97] Actions related to Rocky Glen Dam are included in Section 10.

4.2 Drought and Wildfires

The PRW aquifer and its ability to supply water are threatened by more extreme and frequent droughts.

The Town of Newtown is "generally considered a high risk area for wildfires" and estimated to average an annual estimated loss of $1,685 due to wildfires.[98] In Newtown, "hazards associated with wildfires include property damage and loss of habitat."[99] In this largest municipal jurisdiction within the PRW, "Town officials indicated that out of approximately 1,500 calls in Newtown; about 80 are related to brush fires."[100] Temporally, at least until recent climate changes or "[t]raditionally, the highest forest fire danger in Connecticut occurs in the spring from mid-March to mid-May."[101] Spatially, "[w]ildfires are of particular concern in outlying areas without public water service and other areas with poor access for fire-fighting equipment."[102] Where it is unclear whether a more specific assessment includes the relatively newly designated Kazan Block of the Paugussett State Forest that is within the PRW along with two older State Forest Blocks which are outside of the watershed, "[t]he Paugussett State Forest may be considered a high risk area due to the amount of wooded areas."[103] To date, in Newtown "[w]ildfires are considered a likely event each year but, when one occurs, it is generally contained to a small range with limited damage to non-forested areas."[104]

The Town of Newtown HMP also states, "Nevertheless, wildfires are also a natural process, and their suppression is now recognized to have created a larger fire hazard as live and dead vegetation accumulates in areas where fire has been prevented. In addition, the absence of fire has altered or disrupted the cycle of natural plant succession and wildlife habitat in many areas. Consequently, federal, state, and local agencies are committed to finding ways such as prescribed burning to

[97] Town of Newtown, "Town of Newtown Hazard Mitigation Plan," p. 8-5.
[98] Town of Newtown, "Town of Newtown Hazard Mitigation Plan," p. 9-1, 9-6 (sic).
[99] Town of Newtown, "Town of Newtown Hazard Mitigation Plan," p. 9-1 (sic).
[100] Town of Newtown, "Town of Newtown Hazard Mitigation Plan," p. 9-3 (sic).
[101] Town of Newtown, "Town of Newtown Hazard Mitigation Plan," p. 9-3 (sic).
[102] Town of Newtown, "Town of Newtown Hazard Mitigation Plan," p. 9-1 (sic).
[103] Town of Newtown, "Town of Newtown Hazard Mitigation Plan," p. 9-6 (sic).
[104] Town of Newtown, "Town of Newtown Hazard Mitigation Plan," p. 9-1 (sic).

reintroduce fire into natural ecosystems while recognizing that firefighting and suppression are still important."[105]

4.3 Extreme Weather Change and Warming Average Temperature

Climate changes toward more extreme and frequent weather events such as heat waves raise vital resiliency concerns for the persistence of native species. They require waterway connectivity and riparian buffer shading to be protected and restored as infrastructural adaptations that minimize how much the changes degrade and reduce suitable habitat for cold-water obligate species such as native Eastern Brook Trout (*Salvelinus fontinalis*), which require colder-water thermal refuges to survive during the warm summer months. In addition to the resiliency reinforcement that riparian buffer shading that minimizes temperature increases can offer these aquatic species, connections between rivers and streams can make way for part of the adaptation of fish such as Brook Trout that under stress are forced to adapt by moving or migrating northward to colder water.

[105] Town of Newtown, "Town of Newtown Hazard Mitigation Plan," p. 9-2 (sic).

5. NATURAL HERITAGE

Despite the impacts of agriculture and urban development in the PRW, the watershed supports species and habitats of conservation concern. The CT DEEP's Natural Diversity Data Base (NDDB) identifies areas in the state that are home to ecologically important natural communities and species federally and/or State listed for protection from risks of extinction. As the map below shows, these areas of the PRW include:

- the Mainstem of the Pootatuck River from the confluence of the North Branch Pootatuck to Rocky Glen State Park.
- the Mainstem Pootatuck above Cogers Pond.
- the confluence of Morgan Brook and the Pootatuck River.
- the headwaters of Lewis Brook in Monroe.
- the headwaters of Lewis Brook in Newtown.
- the headwaters of Keating Pond Brook.[106]

5.1 Terrestrial Natural Heritage

The PRW is similar to other watersheds in Connecticut in the sense that it is highly influenced by glaciation events that occurred 10-15,000 years ago. These geological legacies shaped many unique habitats that in turn generated the evolution of substantial biodiversity within the watershed.

The State of Connecticut lists several notable species found in the watershed as rare, endangered, threatened, or a species of special concern. These species include the wood turtle (*Glyptemys insculpta*), Eastern ribbon snake (*Thamniphis sauritus*), little brown bat (*Myotis lucifugus*), Northern long-eared bat (*Myotis septentrionalis*) as well as numerous other avian, mammalian, reptilian, amphibian, and botanical species.[107] Many of these species are rare throughout the state and can only be found in a few places, meaning that their current habitat in the watershed is vital for their persistence.

[106] CT DEEP, "Natural Diversity Data Base Maps."
[107] CT DEEP, "A County Report of Connecticut's Endangered, Threatened and Special Concern Species."

During a 2019 fish community assessment of the Pootatuck River conducted by CT DEEP Fisheries and volunteers, a Wood Turtle (*Glyptemys insculpta*), a species of conservation concern, was discovered in the root wad habitat installed by the PWA in collaboration with HVA, CVTU, the Town of Newtown and Trout Scapes LLC. This is an important data point that supports the conservation value of this restoration practice, which is more commonly justified in terms of fisheries habitat and natural stream channel design.

A species of particular concern in the PRW is the Northern Long-Eared bat, which the state lists as endangered. Under the recent declines in bat populations attributed to a white-nose syndrome, this bat species is at a heightened risk of extinction. Only nine municipalities in Connecticut have known hibernacula for this state endangered species, including nearby Bridgewater. This limited distribution makes the protection and restoration of suitable habitat for northern long-eared bats even more important within the PRW.[108]

Invasive plants are a major threat to native species and habitats along stream corridors. Invasive plants tend to outcompete native plants in disturbed areas, as they can pioneer unshaded areas rapidly. Many woody invasive plants leaf out earlier in spring than native plants, and maintain

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[108] CT DEEP, "Northern Long-Eared Bat Areas of Concern in Connecticut to Assist with Federal Endangered Species Act Compliance."

their leaves later into the fall, giving them a competitive advantage. Floodplains and riparian areas are highly susceptible to invasive plant colonization, especially after large floods, which both cause disturbance and carry seeds and plant tissues that can start new colonies. The Town of Newtown compiled a list of the most common invasive plant species found within Newtown and the PRW. These species include but are not limited to Japanese Knotweed (*Fallopia japonica*), Mugwort (*Artemisia vulgaris),* Mile-a-Minute (*Persicaria perfoliata),* Asian Bittersweet (*Celastrus orbiculatus*), Norway Maple (*Acer platanoides*), Tree-of-Heaven (*Ailanthus altissima*), Japanese Barberry (*Berberis thunbergia*), Multiflora Rose (*Rosa multiflora*), Purple Loosestrife (*Lythrum salicaria*), and Water Chestnut (*Trapa natans*).[109]

While there is no comprehensive database detailing the extent of invasive species in the PRW, smaller-scale mapping and field assessments suggest that they constitute a significant portion of the local biomass. For example, Japanese Knotweed has continuously spread downstream along the banks of the Pootatuck River from Sandy Hook Center towards Glen Road and beyond. The warming climate and accelerated globalization are conducive to further establishment and spread of invasive species that were previously uncolonized.[110]

5.2 Aquatic Natural Heritage

The relatively high number of wetlands and forested areas within the PRW lends itself to generating a rich history with aquatic species. Newtown and the Pootatuck River Watershed as a whole have an extensive history with fishing and boast excellent sport fisheries for species such as trout and bass. Deep Brook and adjacent portions of the Pootatuck River are designated as a Class 1 Wild Trout Management Area, a distinction held by only ten areas in Connecticut.[111] Historically, it has supported populations of Eastern Brook Trout (*Salvelinus fontinalis*) and Brown Trout (*Salmo trutta*).

The watershed has faced significant challenges, including fish kills following 2003, 2004, and 2013 fuel oil spills into Meeker Brook, a tributary to Deep Brook that has since become known colloquially as 'Oil Creek.'[112] Fish community monitoring since these spills have not found Brook Trout in Meeker Brook, or in Deep Brook downstream of the Meeker Brook confluence- only

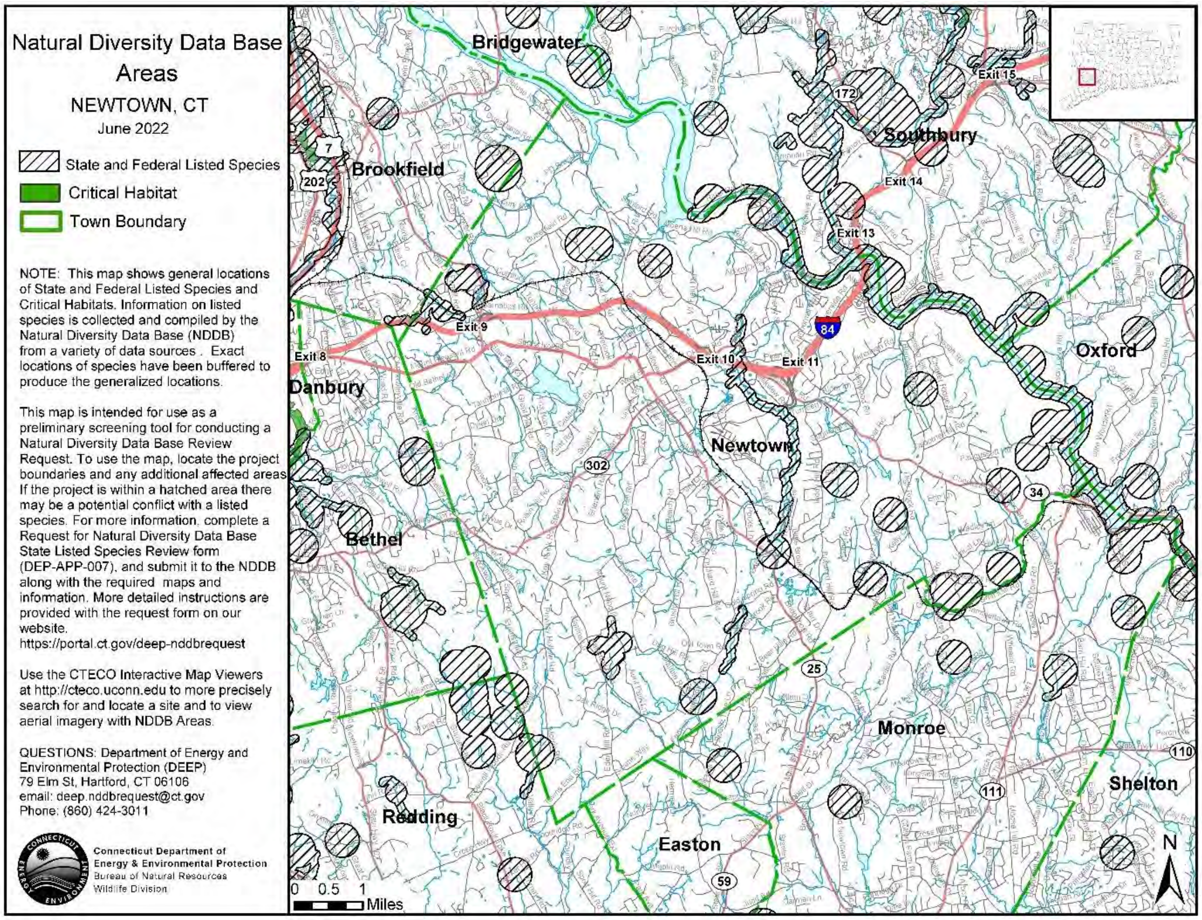
[109] Newtown Conservation Commission and Milone and MacBroom, Inc., "Town of Newtown Natural Resource Inventory."
[110] Hellmann et al., "Five Potential Consequences of Climate Change for Invasive Species."
[111] CT DEEP, "Wild Trout Management Areas (WTMAs)."
[112] *Our Sole Source: Protecting Our Town's Water*.

Brown Trout, which are stocked by CT-DEEP annually. The Pootatuck Watershed Association (PWA) conducted a geomorphic assessment of Deep Brook in 2016, rating sections of stream based on criteria such as anthropogenic impact. The assessment showed very little impact from the spills on Meeker Brook and an upstream portion of Deep Brook, highlighting potentially excellent habitat for target species even as past chemical spills resulted in large fish kills.

A 2016 collaboration between the Fisheries Division of the CT DEEP and the PWA introduced Eastern Brook Trout gathered from healthy streams in Litchfield County into Deep Brook, with the hope of restoring a breeding population. Fish community monitoring conducted in 2022 documented a small but reproducing population of Eastern Brook Trout in a small Deep Brook tributary located higher in the watershed. A project to address stormwater pollution flowing into this tributary to bolster this Eastern Brook Trout population- whose genetics are likely unique to the Pootatuck Basin- is identified as a priority Action in Section X.

As noted above, CT DEEP stocks non-native Brown Trout in Deep Brook and the Pootatuck River. In addition, the Potatuck Club stocks non-native Brown Trout in the ponds they maintain through low-head dams along the stream running through their property, which is confluent with the Pootatuck Mainstem. Brown Trout can outcompete native Eastern Brook Trout in some situations.

The health of aquatic species and habitats is heavily influenced by upstream land use/land use cover, especially by impervious surfaces and agriculture. Please see Section 3 for more information about the impacts of land use/land cover on aquatic species and habitats.



Natural Diversity Data Base for Newtown and Surrounding Area. Map depicts areas where State and Federally Listed Species are found, although does not list species specifically in order to prevent illicit harvesting. Development projects within an NDDB "bubble" must be reviewed by CT-DEEP to ensure potential natural heritage impacts are mitigated.

6. OUTDOOR RECREATION

Outdoor Recreation opportunities are abundant in the PRW, due to the efforts of the Town of Newtown, the Newtown Forest Association (NFA) and other local partners. CT-DEEP also supports Outdoor Recreation opportunities on the Pootatuck and its tributaries, most notably through fish stocking.

NFA is a member of the Pootatuck River Partners, and has been operating as a land trust in Newtown since 1924.[113] NFA provides public access at a number of their preserves.

Preserve Name	Newtown access address	Pootatuck waters	Recreational uses
Deep Brook Farm Preserve	32 Deep Brook Road	Deep Brook	Hiking, horseback riding, mountain biking
Cherry Grove Farm Preserve	15 Palestine Road	North Branch	Birding, dog walking, hiking, horseback riding, and mountain biking
Cullens Key Rock Preserve	9 Key Rock Road	Deep Brook	Birding and paddling
Fosdick Preserve	110 Boggs Hill Road	North Branch	Birding, dog walking, and hiking
Hattertown Pond Preserve	32 Castle Meadow Road	Upper Pootatuck	Fishing, hiking, and paddling
Jay Preserve	62 Glen Road	Lower Pootatuck	Birding, dog walking, and hiking
Nettleton Preserve	13 Castle Hill Road	Tom Brook and/or Deep Brook	Birding, dog walking, and hiking
The Glen	2 Washington Avenue	Lower Pootatuck	Natural socialization?
Wasserman Preserve	72 Walnut Tree Hill Rd.	Lower Pootatuck	Birding, hiking and paddling?

Table 11. Short List of Newtown Forest Association Preserves with Public Access [114]

NFA preserves, and their stewardship of those preserves, help conserve water quality and habitat in the PRW in addition to providing access for Outdoor Recreation.

6.1 Fishing

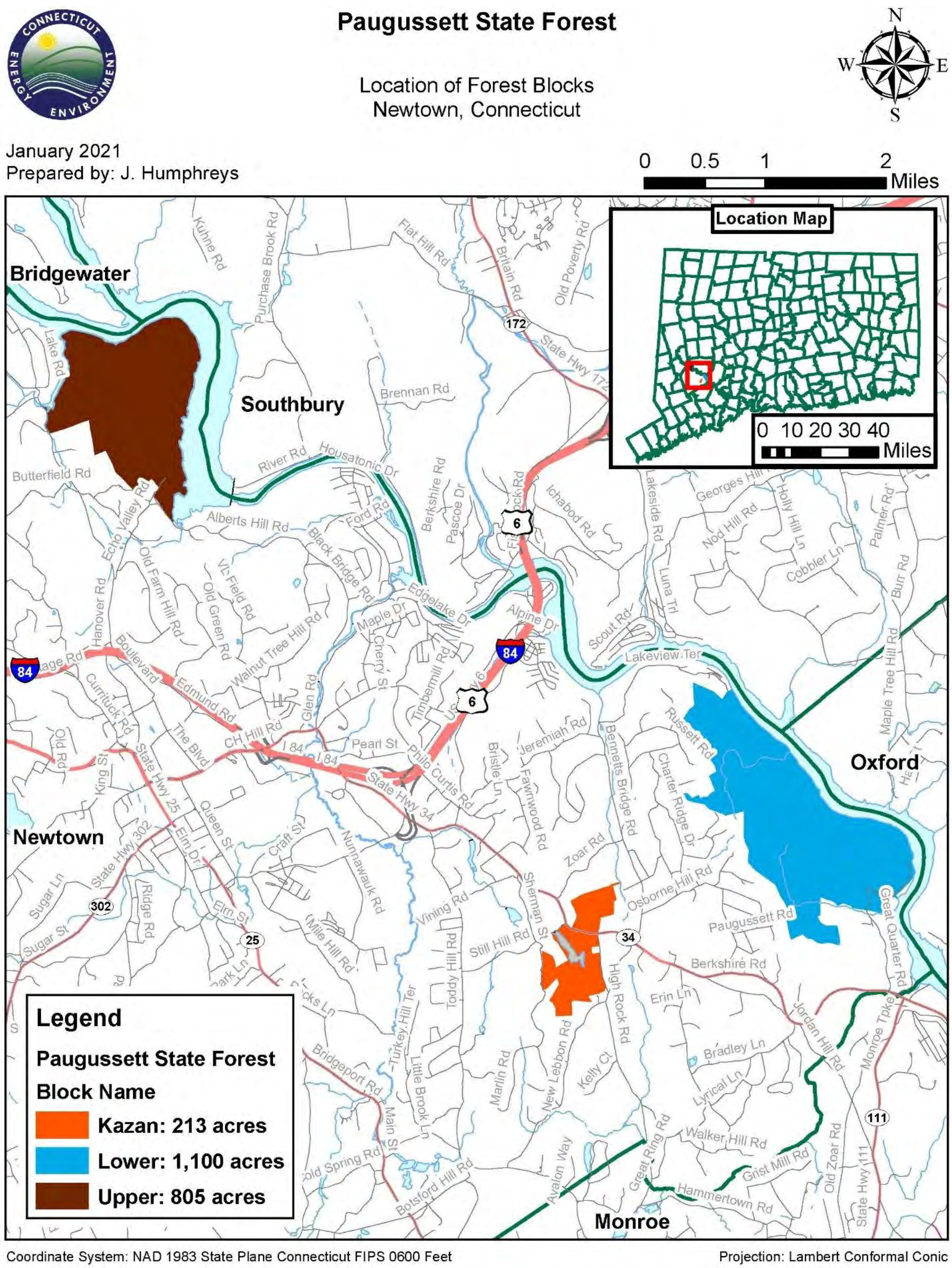
The PRW offers abundant and diverse fishing opportunities, including the Class 1 Wild Trout Management Areas (WTMA) along Deep Brook and the Mainstem Pootatuck. WTMA regulations restrict anglers to use of artificial lures with barbless hooks, and fish must be released without

[113] Hicks, “Newtown Forest Association Centennial Arrives with State Bonding Announcement.”
[114] Newtown Forest Association, “Explore Our Lands!”

intentional harm. CT-DEEP and the Town of Newtown maintain access points for the WTMA. NFA's Deep Brook Preserve also provides access to the WTMA for anglers.

The Fisheries Division of the CT DEEP stocks over 1,000 trout annually in the lower Pootatuck River to supplement wild trout populations. The Potatuck Club also stocks their 3-mile stretch of the Pootatuck River annually. Some of these fish end up downstream in reaches accessible to the public.

CT-DEEP manages the Paugussett State Forest, which includes the 213-acre Kazan Block within the PRW. The Kazan Block includes Kazan's Pond (a 13.8-acre impoundment on a tributary to Curtis Pond Brook), a heron rookery, vernal pools and other important resources of conservation significance. This area is open to the public, including fishing Kazan's Pond from the shore or from non-motorized boats.



Paugussett State Forest
Location of Forest Blocks
Newtown, Connecticut
January 2021
Prepared by: J. Humphreys
0 0.5 1 2 Miles
Location Map
0 10 20 30 40 Miles
Bridgewater
Southbury
Newtown
Oxford
Monroe
Legend
Paugussett State Forest
Block Name
Kazan: 213 acres
Lower: 1,100 acres
Upper: 805 acres
Coordinate System: NAD 1983 State Plane Connecticut FIPS 0600 Feet
Projection: Lambert Conformal Conic

6.2 Hiking, Cross Country Skiing, Biking and/or Horseback Riding

The PRW provides opportunities for hiking, cross country skiing, biking and horseback riding. The most prominent pathway is Al’s Trail, a Town of Newtown hiking route that spans 10.7 miles from the Pond Brook Boat Launch at the border with the Upper Block of the Paugussett State Forest to the Railroad Bridge on Deep Brook by the Reed Intermediate School in Fairfield Hills. Where its northwestern edge ends on a loop around the Boat Launch and into the Upper Paugussett State Forest, it even forays beyond the PRW and into the wider watershed of the Housatonic River that it scenically overlooks. Its official name has been the Newtown Trailway while its nickname memorializes how the late Al Goodrich inspired the trail blazing of many of its paths in town as a member with the Newtown Forest Association, an organization that is in turn part of the Pootatuck River Partners (PRP).[115] The trail winds through Rocky Glen State Park, town forest, Newtown Greenway, and several land easements providing a nice opportunity for residents to utilize green spaces through parts of the PRW. Al’s Trail does abut to the Pootatuck River and Deep Brook in places with several stream crossings, potentially creating drainage issues such as erosion along the trail. Maintenance is required regularly to upkeep riverside trails that limit sedimentation issues from dirt pathways and floodplain encroachment.

Rocky Glen State Park provides additional hiking opportunities that are of worldwide historic proportions while also rooted right at the watershed and the present-day such as through the potential of their recreation enhancement to be integrated into river restoration projects including but not limited to dam mitigations. Indeed, one of the two historic mill buildings located alongside two dams impounding the lower mainstem of the Pootatuck River at riverbanks bordering the Park is listed on the National Register of Historic Places[116].

[115] Marteka, “Crossing an Iron Bridge to the Gorgeous Wilds of Rocky Glen.”

[116] The Newtown Bee, “Get To Know: Historic 75 Glen Road.”

8.3.11 Rocky Glen Dam' and '8.3.10 'Lower' Rocky Glen Dam' below prioritize for mitigations and/or removals. These disconnected river habitats have the potential to be reconnected through mitigations and/or removals of the two historic dams that could preserve these histories of hydro-powered rubber industrialization. These prospects can be materialized through integration of the reconnecting river restoration with outdoor recreational conversations or interpretive signage, offsetting the restorative operational and/or physical alterations of the built structures—which themselves have also become worthy of preservation as material collections along the lines of an open-air museum.

An industrial history of not only rubber innovation, but also recycling innovation on the border of the forested Park site over nearly a century and a half through the decades from 1839 until 1977 offers immense public-programming and dam-mitigating potential to preserve and learn from environmental history, including past environmental injustice in a scientific sense of the term.[117]

Another major set of milestones over this industrial history occurred between 1859 and 1873 when this two-factory complex went on to also be used to recycle rubber, becoming what studies show to have been "one of the first commercial recycling endeavors in the U.S."[118]

As with the present-day Goodyear Road in Newtown within the Pootatuck watershed, the second largest annual event in Newtown, its largest river event, and its largest outdoor-recreation event all since 2000 serves as indicator of this untapped river programming potential. The event has been a fundraising Pootatuck Duck Race that nods to this Town history as the Newtown Lions Club floats a few thousand yellow rubber ducks down the lower mainstem of the Pootatuck River then responsibly removes them under the watch of several thousand event attendees.

The continued focus of the Newtown Greenway system on linking open and green spaces holds potential. While the Newtown Greenway currently provides access to green spaces in or around the center of Newtown and one of the programs that this Plan prioritizes for the short-term would extend it from Fairfield Hills to the Sandy Hook Center, it is feasible for it to pass through Rocky Glen State Park. Such longer extensions of the Newtown Greenway could be implemented through

[117] Explore Connecticut, "Rocky Glen State Park"; Howard, "A Sandy Hook Landmark Mill Was Once State of The Art"; "India-Rubber and Its Manufactures"; "India-Rubber Interests of the United States"; "Hard India-Rubber"; Marteka, "Take a Historic Hike through Rocky Glen State Park in Sandy Hook."
[118] Roth, p. 18; Marteka, "Take a Historic Hike through Rocky Glen State Park in Sandy Hook." See Ball, Reclaimed Rubber, p. 32, 46; Zimring, Cash for Your Trash: Scrap Recycling in America, p. 8, 20-27.

an integrated multi-modal scaling up that would also encompass paddling and/or eventually swimming along a Pootatuck River Green and Water way as described in section 10.

Indicative of how the 25-acre Orchard Hill Nature Center is a site of opportunities for outdoor recreation that are particularly accessible and suitable to be experienced on either horseback or over hikes, the Newtown Bridle Lands Association has joined the Newtown Lions Club and Scout Groups in collaborating with the Town of Newtown on the maintenance of trails that include benches as accommodations into this protected area along the North Branch of the Pootatuck River.

6.3 Paddling

Hattertown Pond as an impoundment of the Lewis Brook tributary to the upper Pootatuck River, Warner Pond or Kazan's Pond as an impoundment of the Curtis Pond Brook tributary to the lower Pootatuck River, the lower mainstem of the Pootatuck River itself, and the Pootatuck's confluence with the Housatonic River provide a few recreational opportunities for flatwater paddling. These paddles range across a spatial mix where public river access is currently formal in the two most upstream sites and informal in the two downstream spots. When river flows and levels are at their usual volumes, waterway users can enjoy such paddling opportunities along any of these four stream tributaries or river reaches along the Pootatuck River Watershed (PRW) on watercrafts such as canoes, kayaks or stand-up paddle boards.

In the most upstream of these four waterway reaches, recreational users can freely access and paddle at the Hattertown Pond Preserve on a namesake impoundment of a Lewis Brook tributary to the upper Pootatuck River thanks to the Newtown Forest Association (NFA) that privately protects and publicly opens this area. One of the NFA rules for the Preserve that is likely to be of particular interest to watercraft users is that no motorized vehicles such as power boats are permitted at the headwaters site.[119] Paddlers can put in for then take out from paddles that span up to a 5,195-feet or 1732-yard loop around the banks of the entire impounded stream, equally safely in either clockwise or counter-clockwise direction even when any minor pond overflows generate any pond currents from the two stream inflows that pace or even out any upstream and downstream parts of this experience.

119 Newtown Forest Association, "Explore Our Lands!"

More so than spots and/or activities anywhere else in the PRW, there is all-encompassing paddling potential to include more outdoor recreationists with all abilities at the impoundments at Hattertown Pond considered in the paragraph above and at the Warner or Kazan's Pond analyzed in the paragraphs below plus to a lesser extent at the similarly impounded site at Rocky Glen.

Winter view of parking area for Hattertown Pond Preserve that the Newtown Forest Association (NFA) protects and provides to the public for outdoor recreation.

Wintery car-top put-in for paddling Hattertown Pond impoundment of a Lewis Brook tributary to the upper Pootatuck River from the NFA's Hattertown Pond reserve.

6.4 Neighborhood Parks and Open Spaces

There are additional parks and open spaces that offer various recreational opportunities. Among these settings, Ram Pasture holds particular potential to mobilize river restoration for the foreseeable future even as it is considered by professional historians to be among the three town greens of the most historically notable human heritage across the state of Connecticut, a historical recognition that it shares with its counterparts in the City of New Haven and the Town of Lebanon.[120] The site holds both a special place in the heart of the Town of Newtown and a small tributary to Deep Brook that meanders along its green meadow, eventually flowing through a pond commonly used for winter ice-skating then ultimately joining Deep Brook. Colonially established in 1732, Ram Pasture in effect preserved the human heritage of much longer—multi-millennial—forms of Tribal land tenure that protected its natural heritage for several thousand years. Its colonial turn re-instituted management through a collective pasture or communal property that during colonial and post-colonial times was redirected toward flocks of sheep owned by individual settler

[120] On these historical considerations and recognition, please see Gagnon, "The Connecticut Town Green."

farmers and grazed under the common-pool tenure of another commons' provision of similarly decentralized natural protection such as from eventual overgrazing of its meadow and degradation of the central stream into which it drains.[121] Considering that revolutionary troops mobilized for U.S. Independence under French General Rochambeau camped on Connecticut town greens including Ram Pasture on their way to meet General Washington in Yorktown, the heritage of this site also shaped this very turn from colonial to post-colonial history. From the late 1700s until the 1920s, landowners then in effect privatized its property through more individually encroaching land grabs. The maternal family of a long-time Newtown resident named Mary Hawley—whose sources of inherited wealth included investments in water works and presidency over a major water business—purchased and reassembled its pieces during the 1920s.[122] Next, upon her passing her philanthropy returned the land back to civic forms of common-pool management that went through a brief ownership by Yale University and has survived since 1931 until today as a green meadow and open space under the soon-to-be centennial tenure of the non-profit Newtown Village Cemetery Association.[123] This past experience could be leveraged into interpretive recreational signage and volunteer events for hands-on river restoration that also facilitate learning how to manage environmental and/or resource commons from those of the sheep (over)grazing and their (detrimental) river uses in recent centuries to these of a renewed communal tenure for the local river under global commons such as the changing climate etc. in the present and the foreseeable future.

[121] On common-pool tenure of decentralized environmental and/or natural-resource protection, please see Committee on the Human Dimensions of Global Change (Ostrom, Elinor et al.), *The Drama of the Commons*.
[122] Hicks, "The ABCs Of Newtown: H Is For (Mary) Hawley, Part One."
[123] Please see Gagnon, "The Connecticut Town Green."

Adjacent to Ram Pasture, Dickinson Memorial Park is another excellent area for outdoor recreation. This Town of Newtown park provides recreationists an array of amenities such as sports courts/field, kids playground and creative-play areas, pavilion and picnic facilities with charcoal grills, and skate park.

S*ignage on a riverside trail along the upper Pootatuck River in the Moss Mountain Center for Connection with an unattributed quote that appears to be from* Zion Lee and is indicative of how the Center can make a unique contribution to the management of the watershed through the literal water-cycle and figurative mental-health senses of the quote: "Everyone wants happiness, [and] no one wants pain[,] but you can't make a rainbow without a little rain."

7. VISION AND GOALS

7.1 Pootatuck River Watershed Vision

Using the Existing Conditions Report as a guide, the Pootatuck River Partners worked together to craft this Vision for the future of the Pootatuck River:

"The Pootatuck River watershed is home to healthy lands and waters that support native species and their habitats, clean drinking water, and outdoor recreation opportunities for people of all backgrounds and abilities. The Pootatuck and its tributaries provide essential ecological services, including pollination, aesthetics, and nutrient cycling for watershed communities and ensuring functioning floodplains that reduce the risk of damage to property and infrastructure during floods and recharge aquifers. Community officials, government agencies, and other stakeholders work collaboratively to:

- *Ensure that surface waters are safe for swimming and fishing, and sub-surface waters are safe for drinking.*
- *Conserve healthy terrestrial and aquatic ecosystems that are resilient and adaptable to our changing climate.*
- *Create and maintain equitable access to open spaces and waterways that provide opportunities for active recreation (including swimming, fishing, hiking and wildlife watching), and for immersion in the natural world, reflection, and learning.*
- *Integrate current and predicted climate change impacts into watershed management decision-making, including local land use and development policies.*
- *Cultivate love and respect for the Pootatuck River and its watershed in residents and visitors through outreach, engagement, and education.*
- *Secure funding, technical support and other resources required to achieve and maintain our shared Vision for the Pootatuck River watershed."*

7.2 Pootatuck River Watershed Goals

The next step in the Watershed Planning process was to develop a set of Goals that must be achieved to realize the PRP's Vision for the future of Pootatuck River and its watershed. The PRP worked collaboratively to develop Goals in four focus areas:

Water Quality Restoration and Protection Goals:

1. All streams in the Pootatuck River watershed consistently meet Connecticut water quality standards (WQS) based on classification and use goals:
    a. Pollution loading to streams with existing impairments to recreational and aquatic life uses is reduced to remove those impairments.

b. A robust water quality monitoring program that characterizes trends in stream health and informs timely interventions to ensure WQS are met as land use and climate conditions change.

2. Drinking water supply continues to be safe and meets all drinking water quality standards.

3. Existing impervious cover connections to storm sewers are characterized to identify opportunities for installing Green Infrastructure/LID practices; retrofit projects that will result in significant pollution reduction are implemented.

4. Community decision-makers have the resources they need to effectively integrate Green Infrastructure/LID practices into new development and redevelopment.

5. Town staff have the resources they need to effectively implement the requirements of the MS4 General Permit, including detecting and eliminating illicit discharges to storm sewers and ensuring that construction projects have adequate erosion and sediment control measures.

6. Riparian buffers of at least 35' [(as in 35 feet in width)] along the Pootatuck River and its tributaries are protected and restored wherever possible.

7. Watershed landowners understand how their property management practices can impact water quality and have access to the resources they need to reduce their pollution contributions.

8. Functioning floodplains are protected and restored wherever possible to allow for sediment deposition and removal of pollutants.

9. Dams and barrier culverts are mitigated wherever possible to restore natural flows and reduce pollution arising from impoundments.

10. Wastewater is treated adequately throughout the watershed.

Natural Heritage Goals

1. Decision-makers, landowners, developers, and the public recognize that the unique natural heritage of the Pootatuck River watershed (geologic history, landscapes, biodiversity) is essential to the character of the community and should be conserved.

2. Assessments of species and habitats and their conservation needs are characterized to understand their distribution and habitats of conservation concern.

3. Potential impacts to species and habitats of conservation concern are carefully considered in watershed management and land-use decision making, using the best available information.

4. Landowners have access to resources for conserving habitat on their property, including managing invasive species, establishing native plants, and restoring natural hydrology.
5. Cold-water obligate species such as Eastern Brook Trout are present in the watershed.

6. Dams and barrier culverts are mitigated wherever possible to restore the ability of fish and wildlife to move along stream corridors.

Outdoor Recreation Goals

1. Existing and potential recreational opportunities/access sites are mapped to understand where access enhancements projects are most important; access enhancement projects are implemented.
2. Opportunities to recreate in the watershed are promoted and provided to all watershed residents and visitors, regardless of background or ability.
3. Visitors to recreation access sites become stewards of the Pootatuck River through passive engagement strategies (such as interpretive signage) and active engagement strategies (such as outreach events planned for busy days).
4. Recreation enhancement is integrated into watershed restoration projects wherever possible.

Floodplain Management and Climate Resiliency Goals

1. Monitoring of stream temperatures (and other parameters) to understand where areas that are vulnerable/resilient to climate change are located.
2. Green Infrastructure and Low Impact Development strategies are considered and implemented to reduce the impacts of climate change.
3. Local flood analysis is conducted to best identify the most effective flood infrastructure improvements, including reconnecting the Pootatuck and its tributaries to natural floodplains.
4. Watershed residents are educated about the importance of a resilient watershed in the face of climate change.
5. Watershed conservation measures are adaptable to changes in climate and climate related events (storms, drought, reduced snowpack).

8. IMPLEMENTATION STRATEGY/ACTION PLAN

8.1 General Management Recommendations

The Vision and Goals developed by the PRP provide the foundation for general management recommendations under the key focus areas below. Note that Collaboration and Capacity Building and Education/Community Engagement are cross-cutting focus areas that support the four core focus areas identified by the PRP:

- Water Quality Restoration and Protection
- Recreation Enhancement
- Floodplain Management and Climate Change Resiliency
- Species and Habitat Conservation

Recommended actions, a timeline, milestones and potential funding sources are included in each section.

8.1.1 Water Quality Restoration and Protection

Restoring and protecting water quality within the Pootatuck Watershed is a fundamental goal of this PRWMP. Effective water quality management requires a multifaceted approach, encompassing monitoring, mitigation, education, and community engagement. The following recommendations outline strategic actions and initiatives aimed at safeguarding and improving water quality:

Continue Water Quality Monitoring: Within the context of the PRWMP, continuing monitoring and assessment activities are crucial for successful implementation of watershed restoration efforts. While Harbor Watch and HVA have conducted monitoring during the watershed planning process, the PRWMP recommends additional efforts. These include continuation of Unified Stream Assessments (USA), Unified Site and Subwatershed Assessments (USSR), and Ambient Water Quality Monitoring, as well as the introduction of new programs like Pollution Trackdown Surveys. These future assessments will serve to inform development of new TMDLs (as necessary), help track the effectiveness of pollutant reduction Actions, make baseline water quality understanding more robust, and identify areas requiring restoration that are not identified in this iteration of the PRWMP.

Promote Best Management Practices (BMPs): Collaborate with municipal units, businesses, and residents to encourage the adoption of BMPs for stormwater management- including source reduction, restoration and land protection.

PRWMP updates: The PRP will regularly revisit the PRWMP. On an annual basis, they will assess progress towards the recommended actions and goals outlined in the Action Plan, and update the Action Plan based on new information- which may include the addition of new Construction Projects and non-Construction Programs. Every five years, a comprehensive update of the PRWMP will be conducted.

Pollution Trackdown Surveys: Pollution trackdown surveys identify the source and character of pollutants entering the storm sewer system. This method has been used very effectively by PRP member Harbor Watch to achieve rapid and cost-effective pollutant load reductions. Pollution Trackdown entails detailed testing of stormwater outfalls to determine if an illicit discharge is likely present. If yes, the next step is to test the storm sewer system (accessed through storm drains and manholes) at various junctures upstream of the outfall to bracket the origin of pollution on the landscape. That area is then investigated to understand the likely source of pollution and responsible parties. Once identified, municipalities can take regulatory measures to rectify pollution at its source.

USA streamwalks conducted as part of the Watershed Planning process included a rapid screen of each outfall encountered based on dry-weather flow, ammonia nitrogen concentration, surfactant concentration, and a visual assessment. This data formed the basis for compiling a list of suspicious outfalls that warrant further investigation using the pollution trackdown method.

HVA's approach involves integrating this USA outfall data with GIS-based analysis of remaining outfalls not flagged as flowing. The analysis takes into consideration the characteristics of each outfall's catchment area, utilizing available spatial data such as aerial photography, LIDAR, land use, hydrology, topography, parcels, and results from ambient monitoring. Collaborating with its partners, HVA prioritizes catchments that exhibit suspicious characteristics, including proximity to pollution hotspots like gas stations, poor condition, high outfall density, and more. Depending on the quality and type of data available in each site, HVA selects a set of key screening factors that indicate a heightened risk of polluted discharge and assigns scores to each factor. These scores are aggregated to generate a normalized cumulative score, which guides the prioritization of outfalls for further investigation.

High-priority outfalls, those scoring significantly on the cumulative scale, undergo screening for excessive levels of nutrients, bacteria, surfactants (detergents), and other relevant parameters. Outfalls demonstrating elevated pollutant levels prompt pollution trackdown investigations—a modified procedure involving tracing the stormwater flow within the pipe to isolate the source of contamination. Once the source is identified, HVA collaborates with municipalities and other stakeholders to address and ultimately mitigate pollutants.

While this passage used the examples of how Harbor Watch and HVA have carried out pollution trackdown surveys, the following recommendations extend well beyond them and are proposed for all current and prospective PRP stakeholders.

Recommended Actions:

- Update the PRWMP Action Plan annually to assess progress on prioritized Construction Projects and Non-Construction Programs, and incorporate additional Actions based on new information.
- Establish and execute a bacteria-monitoring program to conduct routine assessments for *E. coli*, nutrients, and other applicable pollutants at fixed locations throughout the Pootatuck River watershed. Sampling should occur during April to October and encompass both wet and dry weather conditions.
- Establish a baseline for water quality and subsequently measure water quality after project installation. These measurements should encompass locations both upstream and downstream of project sites.
- Conduct USA streamwalks to record impacts in areas presenting high potential for restoration that were not assessed during initial PRWMP development.
- Investigate suspicious outfalls flagged during USA and conduct Pollution Trackdown Assessments.
- Ongoing assessment of sites for stormwater retrofit potential using the Unified Stream and Subwatershed Assessments (USSR) protocol as areas of concern arise.

Water Quality Recommendations

Recommended Actions & Milestones	Who	Timeframe	Deliverables & Evaluation Criteria	Estimated Costs	Potential Funding Sources
• Revisit Watershed Plan on a regular basis (minimum every year Action Plan; every 5 years full plan)	PRP	Annually (Action Plan) Every 5th year (Watershed Plan fully)	• Update appendix • Revisions to plan document as necessary	$	
• Establish and implement bacteria and nutrients monitoring program	PRP	Establish 0-1 year Seasonal sampling (Apr – Oct)	• Approved QAPP • Staff, interns & volunteers trained • Monitoring results/reports	$$	NFWF Long Island Sound Futures Fund
• Establish and conduct pollution trackdown surveys	Harbor Watch/ HVA/Town of Newtown	0-2 years)	• Approved QAPP • Track down survey results and recommendations	$$$	Funds NFWF Long Island Sound Futures Fund
$ = $0 to $5,000	s**$$** = $5,000 to $10,000		**$$$** = $10,000 to $50,000	**$$$$** = Greater than $50,000	

8.1.2 Collaboration and Capacity Building

One of the main objectives of the Pootatuck Watershed Plan is to bring together municipal staff and officials, agencies, environmental organizations, and engaged groups of residents to share information and resources and implement specific actions that accomplish shared goals for water quality and other watershed management considerations. While the interests of each of these entities may vary, the vision and set of goals is the same; to see a restored healthy watershed for all to enjoy. To make the vision a reality requires active participation and "buy-in" of the Pootatuck Watershed Plan and its recommendations as well as resources put toward implementation projects identified herein. This work has started through the formation of the Pootatuck River Partners (PRP), a core group of municipal staff, recreation enthusiasts, environmental groups, and engaged residents brought together to create the Pootatuck Watershed Plan. Already we have seen the effectiveness of this collaboration through the implementation of watershed projects. The next step to building capacity will come through greater engagement with watershed residents interested in volunteering, implementation of projects and programs identified during the watershed planning process, and the addition of project funding through grants and corporate sponsorship. Below are some recommendations aimed at accomplishing these goals:

Recommended Actions

- Continue the active engagement of PRP through quarterly meetings.
- Seek and secure funding as well as coordinate watershed implementation projects.
- Seek adoption of the watershed plan by watershed municipalities who will support the projects and recommendations of the watershed plan through funding, staff hours, and other resources.
- Seek and secure funding through a variety of sources including federal grants, state grants, private foundations, and corporate sponsorship.

Various potential funding sources can be explored to support the implementation of the Pootatuck Watershed Plan, including:

State and Federal Public Sources:

- CT DEEP Section 319 Nonpoint Source Grants
- Connecticut Clean Water Fund
- FEMA Grants for Flood Mitigation

Private/Civic Foundations:

- Fairfield County Community Foundation
- Northwest Hills Community Foundation
- Horizon Foundation
- Werth Foundation
- The Conservation Fund

Public-Private/Hybrid Sources:

- Long Island Sound Futures Fund

Corporate/Business Sponsorship:

- Lowe's
- Patagonia
- Union Savings Bank
- Locally-owned businesses

These funding avenues encompass a diverse range of public and/or private entities that have shown an interest in supporting environmental and watershed restoration initiatives. Exploring these sources and establishing strategic partnerships with them can significantly contribute to the successful implementation of the Pootatuck Watershed Plan.

Capacity Building Recommendations

Recommended Actions & Milestones	Who	Timeframe	Deliverables & Evaluation Criteria	Estimated Costs	Potential Funding Sources
• Continue coordination of the Pootatuck Watershed Plan • Continue to hold bi-annual PRP meetings • Hire a Pootatuck Watershed Coordinator	PRP	1 year Ongoing	• Published meeting minutes • Hired Coordinator	$$$	Various sources
• Municipal support of the Pootatuck Watershed Plan • Adoption of Pootatuck Watershed Plan during municipal meetings (Board of Selectman, Town Hall, and City Hall meetings)	PRP	2 years	• Municipal meeting minutes that indicate adoption • Integration of the Pootatuck Watershed Plan in municipal POCDs	$$$	Various sources
• Identify and secure funding • Review and prioritize funding sources • Prepare and submit grant applications • Secure grants	HVA	0-5 years Ongoing	• Funding sources secured for watershed based projects	$$	Various sources
$ = $0 to $5,000 **$$** = $5,000 to $10,000 **$$$** = $10,000 to $50,000 **$$$$** = Greater than $50,000					

8.1.3 Education and Community Engagement

As a suburbanized watershed, the public plays a crucial role in the restoration of the Pootatuck Watershed. Therefore, community engagement and education are necessary to accomplish watershed planning success as they empower people with the knowledge and skills to contribute to restoration actions and abate practices that deteriorate the watershed. Under the current MS4 stormwater management permit, municipalities are required to provide information to their residents on what they can do to minimize the impacts of stormwater pollution. Regional and statewide entities such as Western Connecticut Council of Governments and University of Connecticut's CLEAR NEMO program have published information on the impacts of stormwater pollution and best management practices for municipalities, residents, and businesses. Two particularly helpful resources are the 2023 Connecticut Stormwater Quality Manual and the CT CLEAR NEMO 2004 CT Stormwater Quality Manual, the latter of which includes an appendix with a number of different concepts for low-impact development (LID) and green infrastructure (GI). They can be found online at https://portal.ct.gov/deep/water-regulating-and-discharges/stormwater/stormwater-manual and https://ctstormwatermanual.nemo.uconn.edu/ each, respectively. In addition, public education is part of the mission of nonprofits such as HVA.

A number of programmatic efforts exist and are proposed in this PRWMP to educate the public on local environmental issues, including River Environmental Education Days, River Academies, River Watershed Connections programs, and CT River Smart. Programs and goals organized by their specific target audiences are outlined below. Each program is important to accomplish durable stewardship throughout the watershed.

In addition, upon the re-opening of this Pootatuck River Watershed Management Plan (PRWMP) for public comments in early 2024, the PRP received from a Newtown community member and are now incorporating here for their future consideration during updates to the PRWMP a proposal to possibly institute a program co-organized with town historians and public input to generate names for smaller unnamed streams in the basin. Indeed, such a program would act on the vision of the PRP to "cultivate love and respect for the Pootatuck River and its watershed" as well as to do so "for people of all backgrounds and abilities." It could also strike an engaging balance between these two purposes to create anew and a third purpose to simultaneously preserve or keep alive a long-lived choice that since at least 1859 has earned communities based in the basin nationwide praise such as one from the *Scientific American* for how these community members "have had the good taste to preserve the Indian name" of the present-day Pootatuck waterway.[124]

Youth Engagement

The Pootatuck River Watershed can serve as an outdoor lab for the three school districts of Easton, Monroe and Newtown. While sites for outdoor lessons or field trips are close to many young community members in their suburban center, relatively few of their opportunities for environmental education are being seized. This makes educational opportunities all the more important as organizations such as HVA, PWA, additional PRP members, municipal parks and recreation departments, and local school districts work together to facilitate watershed learning that addresses water quality and conservation, climate resiliency, natural heritage, and issues specific to the Pootatuck in a manner that provides first contact or continued experiences with outdoor recreation at the same time.

Education/Engagement Recommended Actions

- Pootatuck River Watershed Connections. A Pootatuck River Watershed Connections program has potential to connect high school students from the Pootatuck area with environmental restoration

[124] "India-Rubber and Its Manufactures." As a guide or resource for such future consideration on whether and how to institute such a stream naming program that balances all three purposes mentioned above, please see: Smith, "Monuments to the Unthinkable."

projects to provide hands-on environmental education, teach about environmental careers, provide job skills training, and raise awareness of the Pootatuck River in watershed communities. The program would also provide a reliable source of volunteer labor for restoration project installation and maintenance. Such a Connections program tends to be built on strong partnerships between area schools, non-profits offering social services to young community members, watershed municipalities, and conservation groups working to implement the Pootatuck River watershed plan.

- Implement Projects that include riparian buffer plantings, removing invasive plants, improving recreation access, mapping rare plant species, and much more.

Education and Community Engagement

Recommended Actions & Milestones	Who	Time-frame	Deliverables & Evaluation Criteria	Estimated Costs	Potential Funding Sources
• Expand Watershed Connections program to integrate suburban with urban participants and/or their home Housatonic tributaries—Pootatuck River with Still River	HVA and Site Partners such as the Town of Newtown and others also involved in the proposed new education center or program		• Number of students reached throughout the watershed • Number of BMP projects implemented and maintained • Project metrics tracked (ex. Square feet of invasives removed, length of riparian buffers established, lbs. of trash removed, etc.)	$$$	CT DEEP 319 NPS Grants, EPA EE Grants, Municipalities
• Provide homeowner outreach on LID, sustainable landscaping, pet waste disposal, and septic system maintenance • Develop outreach messages and materials • Distribute outreach materials • Facilitate public education programs	HVA and Municipalities	5-10 years On-going	• Education programming throughout the watershed • Number of people reached through social media, website traffic, email open rates, print media distribution) • Number of program participants	$$$	CT DEEP 319 NPS Grants, EPA EE Grants, Municipalities
• Provide education and training for municipal employees, planning and zoning boards, and other volunteer commissions dealing with land	HVA and Municipalities, UCONN, Western	2-5 years	• Municipal outreach and education program implemented	$$	Municipalities, additional grants as researched

use and development on LID retrofit, septic systems, sustainable landscaping, and stormwater management (MS4 permit) • Develop outreach messaging • Facilitate education and training programs on the above topics with appropriate experts • Provide ongoing support to municipalities to comply with the MS4 permit	CT Council of Govern-ments (WestCoG, including but not limited to that of Newtown where it is based in Sandy Hook)		• Number of municipal staff and volunteer commissioners that program reached • Accomplished goals of the MS4 permit		
• Participate in community events • Research list of relevant events in the watershed • Promote, publicize, support, and participate in existing events • Grow a list of local volunteers through event signups	HVA	On-going	• Created event list • Amount of event participation (tabling, presentation, etc.) • Number of volunteer signups garnered through event participation	$	HVA General Funds

$ = $0 to $5,000 **$$** = $5,000 to $10,000 **$$$** = $10,000 to $50,000 **$$$$** = Greater than $50,000

8.1.4 Outdoor Recreation Enhancement

Promoting outdoor recreation along the Pootatuck River is a central goal of this PRWMP. Various recreation groups are actively working to enhance river access and recreational opportunities within their respective municipalities. With additional funding and support from local communities and enthusiasts, the Pootatuck River can transform from an area of recent indifference into a sought-after destination. A growing interest among anglers, swimmers or waders, paddlers, hikers and hunters in exploring the Pootatuck River is a positive sign.

Newtown Preserve with Pootatuck River access site in background

Recommended Actions

- Establish a Pootatuck River Recreation Subcommittee of the PRP, comprising representatives from various groups dedicated to enhancing recreation and to collaborate across municipalities. This subcommittee's primary function will be to plan, design, and implement a Pootatuck River Greenway and Water Trail. To develop and maintain a network of outdoor recreational opportunities throughout the watershed, it will pool resources, seek funding, and coordinate efforts.
- Develop consistent messaging and branding for a Pootatuck River Green and Water Way to be used across all sections, access points, trailheads, and boat launches.
- Incorporate educational signage, workshops, activities, and materials into recreation projects to inform users about the Pootatuck River watershed, its history, and ongoing restoration efforts.
- Conduct a comprehensive assessment of existing and potential recreation opportunities throughout the watershed, creating linkages between open space, parks, trails, public transportation, sidewalks, pathways, river access points, and other transportation infrastructure where possible.
- Enhance accessibility to individuals of all ages, abilities, and backgrounds, promoting the accessibility of recreation activities such as hiking, boating, fishing, etc., to low-income individuals, people of color, persons with disabilities, children, and the elderly. Evaluate the impact of public transit and city/town infrastructure on recreation accessibility within the watershed. Develop engaging programming and messaging to attract and involve such diverse audiences in watershed recreation that fosters a sense of belonging.
- Implement river recreation programs and/or projects such as a program that this Plan prioritizes for the short-term to extend the Newtown Greenway from Fairfield Hills to the Sandy Hook Center and eventually onto a yet more extensive version of such a program that may become feasible by the time this PRWMP gets updated over the medium and long term. Over this longer run, the Plan may prioritize another lengthening of the Newtown Greenway as far south as the Newtown Public Works Department and as far north as the northernmost tip of Newtown and/or Southbury across the Housatonic River through an integrated multi-modal scaling up onto a Pootatuck River Green and Water Way that would also encompass paddling and/or eventually swimming along a fluvial waterway. Adaptive planning can become useful to maximize productivity over the long term in gradual or modular rounds of trail extension and to navigate the unpredictable turns involved in plan implementation and updates.

- As an example of this adaptive planning summarized in Figure 8 below, from the short-term to the long-term, this program can be operationalized through multiple alternative and/or modular contingency planning scenarios such as the eight (8) for a northern and more aquatically multi-modal end of the Green and Water Way. These scenarios would eventually recommend alternative and/or cumulative routes to lengthen the side of the Newtown Greenway that this iteration of the PRWMP prioritizes to be elongated onto Sandy Hook Center within the short term then even farther along from there through their alternate or cumulative directions by the time of future updates to the PRWMP. A northern end of the recreational pathway could eventually reach as far as locations such as a Newtown site and/or a Southbury spot both upstream on the Housatonic River as well as two different Southbury sites downstream along the Housatonic River. These northern trailheads would open multi-modal opportunities for bike rides, cross-country runs and/or hikes to be connected to a paddle or eventually a swim. As depicted in the two photos above and to the left, recreational users among the public could access a place of aquatic-terrestrial change in modes of active transportation into or out of calm waters through a cartop paddling launch site that is part of a Newtown Open Space Preserve located along the lower Pootatuck River as the waterway nears its confluence with the Housatonic River. Namely, this is the Preserve at the intersection of River Edge Drive and Walnut Tree Hill Road in Newtown. The Town of Newtown also owns and provides the public with ample parking spaces either at or alongside the curb of its Walnut Tree Baseball Field that is just around the corner from its Preserve property: on 5 Bridge End Farm Lane.

Access site at confluence of Housatonic and Pomperaug Rivers with pedestrian-linked I-84 bridge in background.

Fluvial distances in multi-modal scenarios to extend a Pootatuck River Green and Water Way

Pootatuck waterway scenarios	Fluvial length for aquatic part/s of Green and Water Way	
1. Pomperaug River: I-84 link	1.3 miles or 2,288 yards	*
2. Pomperaug River: Silver link		
3. Pomperaug River: rail link		
4. Wildlife watching: I-84 link	2.75 miles or 4,840 yards	***
5. Wildlife watching: Silver link		
6. Wildlife watching: rail link		
7. Millennial forest: dam portage	5.65 miles or 9,944 yards	******
8. Eagle watching: Silver link	2.1 miles or 3,696 yards	**

- In three scenarios oriented downstream on the Housatonic River and toward the Pomperaug River, such (a) northern end(s) of the Pootatuck River Green and Water Way could be placed at a river access site that the Newtown-based nonprofit Leaps of Faith (LOF) Adaptive Skiers manages at the confluence of these two rivers and where the organization now offers river access to the public at 351 River Road in Southbury. These versions of a future expansion would encompass approximately 1.3 miles or 2,288 yards along a waterway through the Pootatuck River, Housatonic River, and even any additional distance in and out of the Pomperaug River for extra active recreational users. As (a) terrestrial complement(s) to any aquatic modes of transportation through both river access sites reported above, such (a) route(s) could rely on any single or looped combination of three land-based options:
    - (1) a better connection between a wooded trail across another Newtown Open Space Preserve—as a publicly accessible property—along a high Housatonic riverbank that the upper two photos below depict and a newly constructed pedestrian link over the I-84 Rochambeau Bridge across the Housatonic River between Newtown and Southbury as shown on the lower four photos below and a photo above with the LOF Adaptive Skiers sign.
    - (2) any future construction of a different biker and/or pedestrian link along the Glen Road Silver Bridge across the Housatonic River that would create an additional multi-modal connection between Glen Road in Newtown and River Road in Southbury.
    - (3) any future throughfare property easements and construction of a biker and/or pedestrian bridge across the Housatonic River on the bridge pillar foundations that still stand in the river as remnants of a former railroad bridge from the current three-way intersection of Pootatuck Park Road, Edgelake Drive, and Fairview Drive in Newtown to 620 River Road in Southbury.
- (4, 5 and 6) In three scenarios oriented downstream on the Housatonic River and toward wildlife watching, a northern end of a Green and Water Way could be sited at a Lake Zoar Public Boat Launch that the State of Connecticut owns and operates at the southernmost tip of the Lake Zoar Wildlife Area in Southbury. These versions of a future expansion would encompass approximately 2.75 miles or 4,840 yards along a water way through the Pootatuck and Housatonic Rivers. As terrestrial complements to any aquatic mode of transportation through the

Newtown river access site reported above, such (a) route(s) could rely on any single or looped combination of the same three land-based itinerary options considered above for crossing and journeying parallel to the Housatonic River as well as on a combination of trails through the Lake Zoar Wildlife Area and residential roadways that surround this protected area.

- Last but certainly not least, there are two scenarios oriented upstream on the Housatonic River and toward a forested ecosystem and/or a Bald Eagle Observatory as another couple of northern ends of a Pootatuck River Green and Water Way. They could be placed in Newtown at the Upper Paugussett State Forest that the State of Connecticut owns and maintains across the Housatonic River from the confluence of this mainstem waterway with the Shepaug River at a Lake Lillinonah impoundment by the Shepaug Dam and/or in Southbury alongside an access site for portage around the dam as the location of a Shepaug Bald Eagle Observatory. Each of these two versions for a future expansion would encompass its own approximate length along a water way through the Pootatuck and Housatonic Rivers. Each would also be a terrestrial complement to any aquatic mode of transportation through the aforementioned Newtown river access site at the intersection of River Edge Drive with Walnut Tree Hill Road and either the State's Lake Lillinonah (Pond Brook) Boat Launch on 158 Hanover Road in Newtown at the edge of the State Forest or the lower Shepaug Dam portage access site. As such, these two routes could rely on a paddling or swimming portage through and/or to the Shepaug Dam and on any single or looped combination of two land-based itinerary options:
    - (7) any hiking or cross-country running that turns onto Al's Trail (Newtown Trailway) and continues journeying along it in a direction generally parallel to the Housatonic River that passes through the only non-coastal settlement or two—depending on whether one hypothesizes an unknown human boundary between their adjacency such as a reflection of their distinct if pan-Housatonic watersheds—where American Indians are documented to have been seasonally based in the inland and upland parts of what has since become western 'Connecticut' on Newtown swamps along Cavanaugh Brook and the Pootatuck River over the four centuries from 1350 radio carbon years (RCY) Before

Present (B.P.) to 950 RCY B.P.[125] This version of a future northern expansion of a Pootatuck River Green and Water Way ending at the Lake Lillinonah (Pond Brook) Boat Launch that borders the Upper Paugussett State Forest would encompass approximately 5.65 miles along a waterway through the Pootatuck and Housatonic Rivers.

- (8) any future construction of a biker and/or pedestrian link along the Glen Road Silver Bridge across the Housatonic River that would create an additional multi-modal connection between Glen Road in Newtown and River Road in Southbury as recommended above but with a northwestern direction on that road in this case. This version of a future northern expansion ending at the Bald Eagle Observatory by the lower Shepaug Dam portage access site would encompass approximately 2.1 miles or 3,696 yards along a water way through the Pootatuck and Housatonic Rivers.

Outdoor Recreation Enhancement

Recommended Actions & Milestones	**Who**	**Time-frame**	**Deliverables & Evaluation Criteria**	**Estimated Costs**	**Potential Funding Sources**
Establish a Pootatuck River Recreation Subcommittee: • Recruit PRP currently involved in recreation activities to the Recreation Subcommittee • Formulate vision, missions goals, and programs/projects that will enhance recreation in the watershed • Schedule regular meetings to update on the progress of those goals	HVA, Municipalities, Park and Rec. Departments, WestCoG		• Complete vision, mission, and goals statement • Meeting minutes • Number of engaged parties in the subcommittee • Number of completed projects/programs	$$	CT DEEP Rec Trails, National Recreation and Park Association
Integrate signage about watershed stewardship in recreation areas • Identify areas for signage • Develop outreach messages and appropriate signage specific to each area (kiosk, road sign, interpretative sign, nature trail, etc.)	HVA, CT DOT, CT DEEP, Municipal Commissions, Recreation Groups, Parks	0-2 years Ongoing as new recreation areas are	* Number of signage projects installed throughout the watershed	$$$	National Recreation and Park Association, Municipalities, CT DEEP Recreation Trails

[125] Lavin, *Connecticut's Indigenous Peoples*, p. 148, 167, 178.

• Work with appropriate parties to finalize signage and secure landowner permission	and Rec. Departments	develo ped			Grant
Create linkages between recreation opportunities throughout the watershed • Create an inventory of existing and potential recreation opportunities • Study linkages between recreation opportunities including trails, public transportation, sidewalks, pathways, river access points and other forms of transportation infrastructure. • Identify gaps in access and work with stakeholders to strengthen access	CT DOT, Municipaliti es, Land Trusts, H2H, WestCOG	2-5 years	• Completed inventory of recreation opportunities • Linkages/Access report including recommendations for improved access to open space and recreation • Improved access	$$	EPA Environmental Justice Grant, Meserve Foundation
Increase accessibility to people of all ages, abilities, and backgrounds. • Research accessibility gap in current recreation areas including but not limited to the connectivity of public transit and city/town infrastructure as well as handicap accessibility • Propose site specific solutions to improve access • Design and implement programming that cater to and excite these audiences in creative and engaging ways to encourage use of recreation infrastructure • Create messaging, branding and design of watershed recreation that pulls these audiences in, engages them in creative ways, and generates a sense of belonging. • Secure funding to implement accessibility projects	HVA, WestCOG, Municipal Parks and Recreation Depts., Pootatuck River Partners	2-5 years	Report on accessibility gap including recommended solutions • Programs and projects implemented that increase accessibility • Increased usership among targeted populations (low income communities, people of color, persons with disabilities, children, and the elderly	$$$$	EPA Environmental Justice Grant
$ = $0 to $5,000 **$$** = $5,000 to $10,000 **$$$** = $10,000 to $50,000 **$$$$** = Greater than $50,000					

8.1.5 Floodplain Management and Climate Change Resiliency

Flooding is a natural process inherent to the Pootatuck Watershed. Furthermore, the impacts of climate change, including increased precipitation in terms of both quantity and frequency, are expected to amplify the occurrence of flood events. According to the EPA (https://www.epa.gov/green-infrastructure/manage-flood-risk), the average 100-year floodplain is projected to expand by 45%. These factors underscore the critical importance of effective floodplain management within the Pootatuck Watershed.

The extent of current development and infrastructure within the floodplain varies significantly among different municipalities within the watershed. Consequently, floodplains in these areas function naturally, allowing the river's waters to overflow into undeveloped regions, naturally receding as water levels fluctuate. In such towns, the primary objectives of floodplain management are geared towards safeguarding these floodplains from future development and establishing guidelines for development setbacks in anticipation of the expanding floodplain areas caused by climate change. Achieving these goals necessitates the implementation of several solutions.

One approach involves the adoption of setback policies in alignment with updated FEMA floodplain maps, effectively prohibiting development within the 100-year floodplain zone. This can be supplemented by training inland wetlands agents and personnel from planning and zoning boards to gain a comprehensive understanding of flood dynamics, which will enable them to assess construction permits more effectively. Additionally, maintaining up-to-date floodplain maps and consistent flood regulations across towns and the State ensures that information remains uniform among all stakeholders.

Conversely, certain areas were historically constructed around waterways, leveraging the river for industrial and other purposes. In these instances, striking a balance between the existing built environment and flood realities poses a greater challenge. Encroachments such as fill, impervious cover, and development in floodplain areas exacerbate flood-related issues by intensifying the frequency and severity of floods, thereby threatening infrastructure located in close proximity to the river and its tributaries.

The key to effective floodplain restoration lies in the incorporation of green infrastructure practices. When integrated with existing grey infrastructure, green infrastructure can effectively reduce stormwater loads, thereby buffering the intensity of floods and mitigating their impact. This watershed-based plan advocates for a comprehensive assessment of impervious cover within the floodplain and the initiation of a prioritization process. This process would involve partnering with property owners to evaluate the feasibility of green infrastructure projects. To implement this, property owners are encouraged to collaborate with HVA and other conservation groups to secure funding for green infrastructure projects aimed at mitigating stormwater loading.

Recommended Actions

- Increase floodplain storage capacity in accordance with the latest FEMA floodplain mapping of the 100-year floodplain.

- Standardize floodplain regulations and floodplain management practices across all towns within the watershed.
- Implement climate-resilient strategies in watershed communities by prioritizing the development of green infrastructure, especially within floodplain areas, mapping rare plant species, and more.

Table 21. Floodplain Management and Climate Change Resiliency

Recommended Actions & Milestones	Who	Time-frame	Deliverables & Evaluation Criteria	Estimated Costs	Potential Funding Sources
• Increase floodplain storage to adjust to increased flood potential. Standardize floodplain regulation and floodplain management across the three Pootatuck watershed towns. • Review current zoning code/ ordinances in Newtown and potentially also Easton and Monroe • Propose changes to zoning to increase floodplain storage in new development	HVA	2-5 years	• Proposed changes to zoning code presented to municipal planning and zoning commissions and land use departments	$$	FEMA Hazard Mitigation Assistance
• Implement climate resilient strategies in watershed communities • Examine areas of high flood risk due to increase in precipitation • Design LID and GI solutions that can mitigate flooding in those areas • Install LID and GI solutions	HVA and Municipalities	2-5 years	* Number of LID/GI projects installed in flood risk areas * Decreased impact of flooding on infrastructure	$$$$	FEMA Hazard Mitigation Assistance
$ = $0 to $5,000 **$$** = $5,000 to $10,000 **$$$** = $10,000 to $50,000 **$$$$** = Greater than $50,000					

8.1.6 Natural Heritage

Land use within the Pootatuck Watershed can be broadly categorized into two primary categories. The first category can be characterized by higher levels of development, fragmented habitats, and open spaces primarily managed for human use. In contrast, areas situated outside this suburban center feature more open space, lower-density housing, and larger expanses of natural habitats. The approach to managing these diverse landscapes differs, broadly characterized as restoration versus protection.

It is essential to recognize that suburban areas can coexist harmoniously with native species and habitats when guided by intelligent urban planning. Cities can serve as havens for nature to flourish and wildlife to thrive by promoting the presence of native habitats wherever possible. This can be achieved through the establishment of native habitats in settings like parks, backyards, residential gardens, and business landscapes. Furthermore, creating wildlife corridors within urban areas, facilitating the movement of wildlife into less managed regions, is instrumental in preserving biodiversity. Concepts such as biophilic design, urban ecology, and sustainable development provide valuable tools for fostering habitat-friendly urban design. Rethinking fundamental city infrastructure to incorporate habitat-friendly design elements represents a promising starting point. For instance, replacing culverts with stream-simulated design bridges can eliminate barriers to fish and aquatic life while allowing terrestrial animals to move freely, reducing road crossings. A proactive approach involving the mapping of current infrastructure, identification of opportunities for habitat-friendly design, and the presentation of example redesigns sets the stage for the eventual replacement of failing infrastructure with more eco-friendly alternatives.

Invasive Species

Invasive species pose a pervasive and extensive challenge within the watershed. These invasive species exhibit aggressive growth patterns and often outcompete native flora, resulting in diminished biodiversity and the displacement of native habitats. Notable invasive species in the watershed include Japanese Knotweed, Barberry, Mugwort, Phragmites, and Japanese Hops. The management of these invasive species presents a considerable challenge due to the scale of the problem. However, invasive species removal coupled with habitat restoration using native plants can significantly increase the available habitat for native New England species.

Recommended Actions

- Continued Invasive Species Management: Continue to manage invasive species in previously identified areas while exploring new opportunities where invasive management is both cost-efficient and impactful.
- Stay Informed: Remain current with research on effective invasive management approaches and prevention strategies.
  Habitat Restoration: Restore areas previously cleared of invasive species with native plantings and habitat restoration to prevent further colonization by additional invasive species.

Table 22. Species and Habitat Conservation

Recommended Actions & Milestones	Who	Timeframe	Deliverables & Evaluation	Estimated	Potential Funding

			Criteria	Costs	Sources
Continue to manage invasive species and restore native habitat. • Identify areas where invasive management is both cost efficient and highly impactful • Research effective removal and management practices	HVA, Local Land Trusts, Parks and Rec. Departm ents	0-2 Years Ongoing	Volunteer program implemented	$$	FCCF, Horizon Foundation
Identify and protect areas of highest conservation value throughout the watershed through conservation easements, and other conservation mechanisms. • Develop criteria to define "conservation value" • Apply criteria to watershed and identify areas of high conservation value • Among those, identify parcels available for protection along with potential partners • Engage land owners in educational programming around land protection • Set in place easements where possible with willing landowners	HVA	0-2 Years Ongoing	Mapped areas of high conservation value • Number of acres of protected land throughout the watershed	$$$	Highland Act, Forest Legacy Fund
Increase open space, public access, and recreation opportunities throughout the watershed • Identify and evaluate areas of potential open space • Analyze feasibility of procurement • Secure funds for protection • Develop open space access and features (trails, recreation opportunities, signage, etc.)	H2H, Local Land Trusts	2-5 years Ongoing	Acres of open space Protected	$$$$	Highland Act, Forest Legacy Fund
$ = $0 to $5,000 **$$** = $5,000 to $10,000 **$$$** = $10,000 to $50,000 **$$$$** = Greater than $50,000					

8.2 Prioritization process for Construction Projects and non-Construction Programs

Field assessments were the first step in identifying and characterizing Construction Projects and non-Construction Programs that will help accomplish the goals of the PRP. The Construction Projects prioritized by the PRP (with stakeholder and public input) call for low-impact development, green infrastructure and habitat restoration. The non-construction programs prioritized by the PRP with stakeholder and public input include water quality monitoring, raising public awareness, capacity-building, habitat and species conservation and policy changes.

Once the PRP identified and developed a suite of construction projects and non-construction programs, their next task was to prioritize them for further action based on their potential to accomplish their shared Goals for the Pootatuck River under each Focus Area of the PRWMP (Focus Areas and Goals are described in more detail in Section 7 of the PRWMP). The highest-ranked Projects and Programs are those that accomplish Goals under multiple Focus Areas. All prioritized Actions are expected to lead to pollutant load reductions that address existing water quality Impairments.

Partners ranked each Construction Project and non-Construction Program on a 1-10 scale, with 1 being the highest priority and 10 being the lowest priority. Each Partner who operates solely within the Pootatuck watershed or Town of Newtown was eligible to submit up to two ranking forms:

- Newtown Forest Association
- Pootatuck Watershed Association
- Potatuck Club
- Town of Newtown

Each Partner whose service area extends beyond the Pootatuck watershed was eligible to submit one ranking form:

- Aquarion Water Company
- Candlewood Valley Trout Unlimited
- Connecticut Department of Energy and Environmental Protection
- Harbor Watch
- Housatonic Valley Association

- Northwest Conservation District
- Western Connecticut Council of Governments

Completed ranking forms were aggregated by HVA, and discussed during a prioritization workshop to finalize priorities.

This Plan features the suite of construction projects and non-construction programs that Pootatuck Partners identified in the order that the stakeholders prioritized them for further action based on their potential to accomplish their shared Goals for the Pootatuck River under each focus area of the Watershed Plan. Sections 8.3 and 8.4 below describe Actions in prioritized order, based on this exercise.

8.3 Priority Construction Project descriptions

8.3.1 Ram Pasture Riparian Buffer Enhancement and Goose Exclusion

Address: 4 S Main St, Newtown, CT 06470

Coordinates: 41.407636, -73.304638

Subwatershed: Deep Brook

Proposed Project: Natural Channel Restoration, Riparian Buffer Restoration, Canada Goose Management

Site Description: Ram Pasture is located in the heart of Newtown and is an important historical space to its residents. The large lawn creates a great space for picnics and other recreational activities during the summer and acts as an ice-skating pond in the winter, but it harbors issues with Canada Goose and nutrient runoff. Ram Pasture is currently mowed to the banks of the stream and pond that runs through the middle of it, but it provides an excellent opportunity to improve riparian habitat. Increasing the riparian buffer limiting the times it is mowed would help reduce the amount of excess nutrients running into the stream and ultimately Deep Brook. Additionally, there are erosion concerns throughout the stream corridor, resulting in sediment deposition in the pond. Riparian plantings would be targeted to address areas susceptible to erosion. There is also an opportunity to provide educational signage about riparian restoration in a popular public location.

Ram Pasture, view of Pond and stream corridor

Ram Pasture: Existing Conditions at Pond and along stream corridor.

Ram Pasture: Proposed Conditions

The proposed Best Management Practices for Rams Pasture targets riparian buffers along the stream corridor and pond edge. Broken into two phases (Pond and Stream), the plantings work to reduce nutrient loading, remove sight lines for Canada Goose, and stabilize streambanks.

Pond

1. Riparian plantings at waters edge.
    a. Planting beds will remove sight lines for geese.
    b. Will uptake nutrients before they enter the water.
2. Upland Planting beds set back from edge of pond with upland plant species.
    a. Beds will overlap with riparian plantings to block sight lines to and from the water for geese, but be set back so that there is 10' gap between staggered upland beds and riparian beds for recreational access to preserve stream access and views across the waterway for human site users.

Stream

1. Riparian plantings within the stream corridor. Will be targeted in areas that are currently lacking any buffer and mowed down to the banks, and expanding riparian areas that are susceptible to erosion (outside bend of stream).

Challenges:

- Historic space and pushback from altering amount of space available.
- Maintenance cost of riparian buffer.

Opportunities:

- Potential for interpretive signage and volunteer events to facilitate learning how to manage environmental and/or resource commons from the sheep (over)grazing and their (detrimental) river uses of recent centuries to a renewed communal tenure for the local river under global commons such as the changing climate etc. of the present.
- Potential for interpretive signage and volunteer events to mobilize younger interest in history through the historical preservation and restoration of buffering plants as living varieties of historical collections.
- Replant with Native species.
- Reduced streambank erosion and sediment loading.
- Remove sight lines from Canada Geese.
- Reduce nutrient loads into Deep Brook.
- Excellent location for Public Education/volunteer planting.
- Reduced mowing costs and opportunity for additional revenue to maintain the pasture through trees in honor or memory of individuals as the recent experience of Newtown's own Catherine Violet Hubbard Foundation shows with its restoration and fundraising through "legacy trees."

These plans are only recommendations that are meant to show a possible treatment for the property. More investigation, accurate surveys and detailed plans will be required prior to the installation of the BMPs.

Pollution Reduction Estimates:

Pollution reduction estimates were calculated with the EPA Pollution Load Estimation Tool (PLET). Parameters input into PLET were conservative with practice effectiveness set at 0.5 (0-1 scale with 1 being the most effective).

Pollution Reduction	Stream Channel	Pond
Nitrogen (lbs/year)	21.07	6.19
Phosphorus (lbs/year)	8.11	0.70
Biological Oxygen Demand (lbs/year)	42.14	21.05
Sediment (lbs/year)	15.49	0.26

Estimates for the reduction in *E. coli* were calculated by following the formula outlined in Meerburg et al. 2011, showing that population x average weight of fecal production per 24 hours x number of colony forming units per gram ($CFUg^{-1}$) of fecal bacteria equals the potential fecal contamination of bird species.

	Goose Population (Geese per day)			
% Reduction in Goose Population	0.10	0.5	1	2
0	140,800,000	704,000,000	1,408,000,000	2,816,000,000
25	105,600,000	528,000,000	1,056,000,000	2,112,000,000
50	70,400,000	352,000,000	704,000,000	1,408,000,000
75	35,200,000	176,000,000	352,000,000	704,000,000
100	0	0	0	0

Cost Estimate:

BMP	**Size**	**Plants ($8/plant)**	**Labor**	**Materials**	**Total**
Riparian Buffer (Pond)	8,850 ft^2	$7,800 (975 plants)	$5,520	$1,000	$14,320
Riparian Buffer (Stream)	7600 ft^2	$6,688 (836 plants)	$5,520	$0	$12,208

8.3.2 Connecticut Department of Transportation (CT DOT) Highway Garage

Address: 21 Old Farm Rd, Newtown, CT 06470

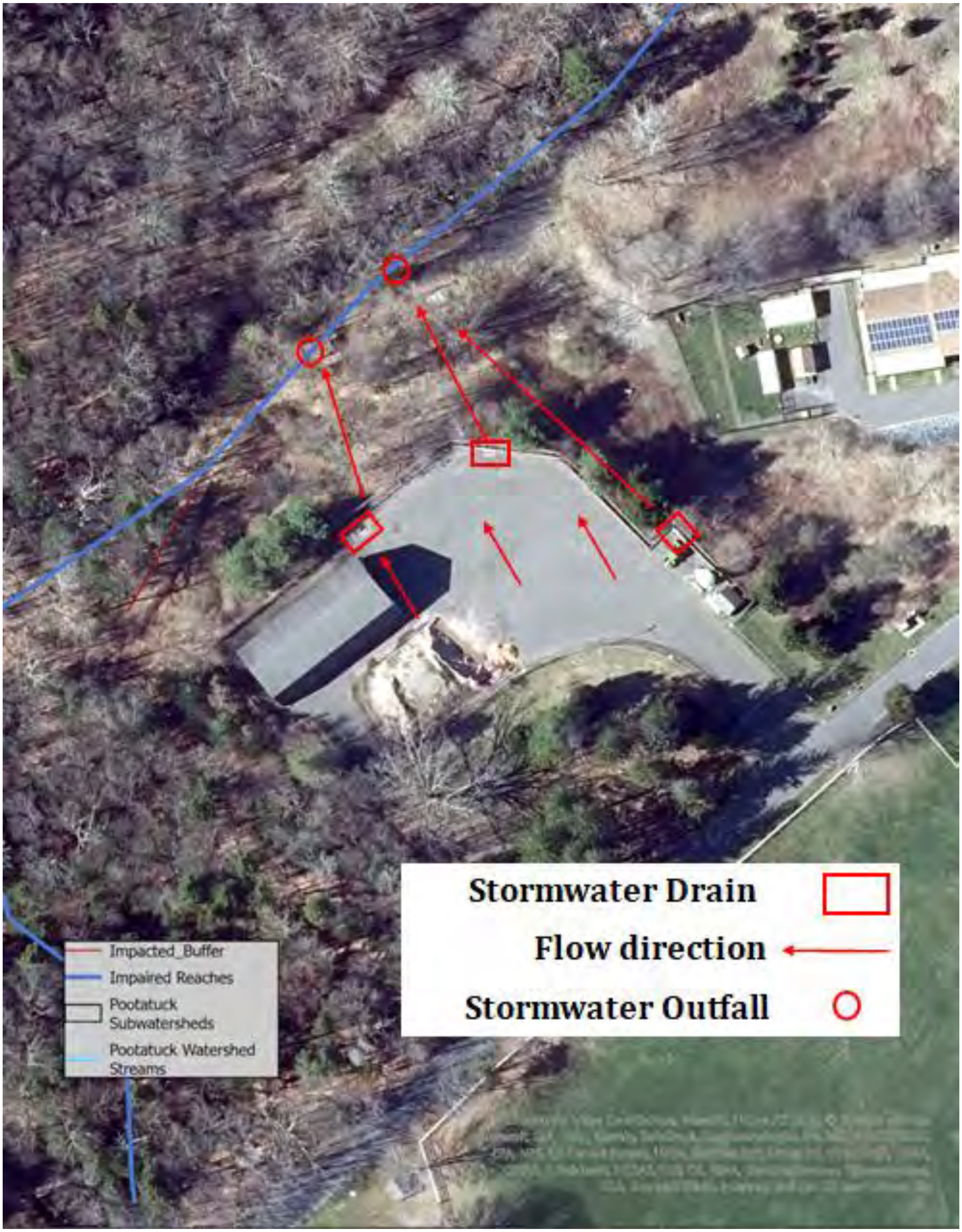
Coordinates: 41.407326, -73.286929

Subwatershed: Deep Brook

Proposed Project: Stormdrain disconnection/Bioretention System

Site Description: The salt and sand storage facility on Old Farm Road is adjacent to Deep Brook and the Wild Trout Management Area (WTMA) on Deep Brook. It is also next to the Dog Warden and Dog Park. Deep Brook is listed as impaired by CT DEEP and the salt and sand storage facility provides an opportunity to place a retrofit to improve water quality. The stormwater drains on the property appear to drain directly into Deep Brook, meaning all the stormwater runoff and the pollutants it picks up flow into the Brook. During Unified Stream Assessments two outfalls were recorded downslope of the facility, draining directly into Deep Brook. The total surface area of the facility drains about 39,000 square feet. The facility is also state owned which adds an additional challenge to implementing the project.

CT DOT Highway Garage Aerial Photo.

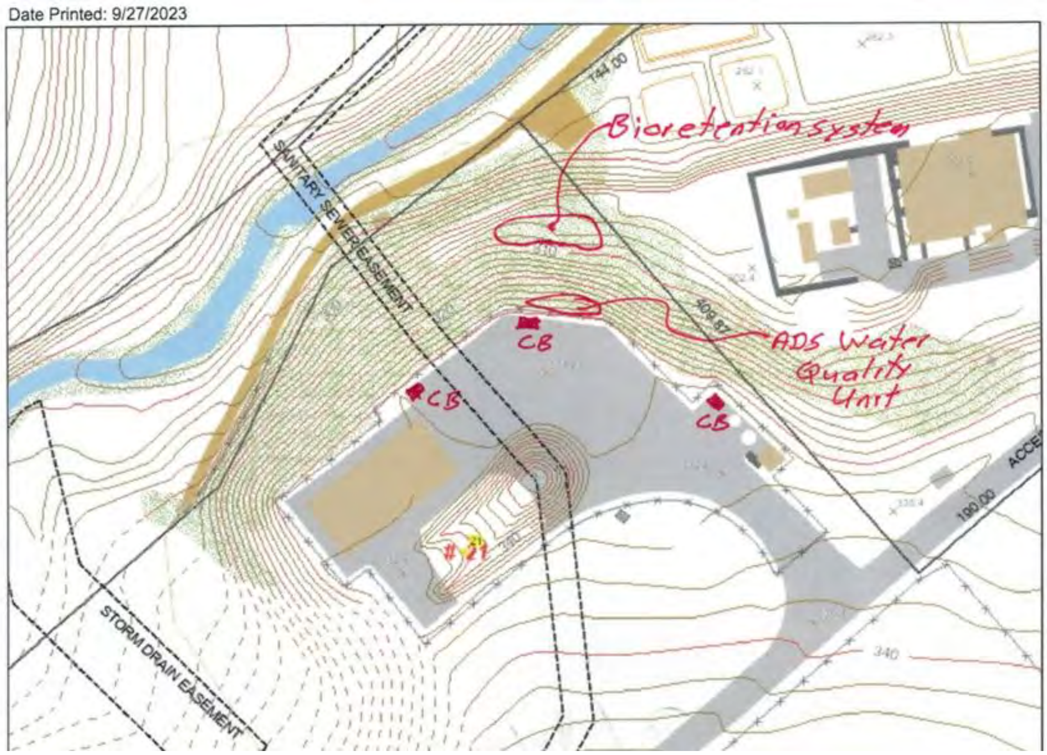


CT DOT Highway Garage Existing Conditions.

Stormwater outfalls into Deep Brook. Suspected connections to CT DOT Highway Garage.

This site is a CT DOT site with a salt storage shed. Based upon available Town of Newtown GIS mapping and Google Earth Pro, there are several catch basins in the parking lot which likely are directly discharged to Deep Brook which is located to the north and at the bottom of a large slope. Chlorides from deicing salts are impossible to remove from stormwater at this time as the chloride ions stay in solution in water. The ions will also bind to soil and remain there. The following are conceptual ideas to address runoff from the roof and paved areas of the site.

1. As this site is considered a high pollutant load site, infiltration cannot be done without a high degree of pre-treatment.
2. According to the NRCS Websoil Survey, the slope between the facility and Deep Brook consists of Hinckley soils which are well drained sands and gravels.
3. Installation of an offline ADS Water Quality Unit after the catch basins and before the existing discharge pipe sized for the required Water Quality Flow. This unit would remove large percentages of sediments, hydrocarbons and metals which are the dominant non-point source pollutants on this site. This unit would provide a high degree of pre-treatment of the runoff which would then allow infiltration to considered.
4. A long linear Bioretention system can be installed along the top of the slope above Deep Brook to handle any overland flow from the site which does not directly drain to one of the several catch basins on the site.
5. The discharge from the ADS Water Quality Unit can also be directed to the linear Bioretention system for infiltration.
6. A paved lip or other solid barrier should be installed at the opening of the salt shed to minimize any salt or runoff from leaving the inside of the building. The only thing which can be done to address chloride issues is to reduce the use of the product and also prevent its exposure to rainfall.
7. Possible locations of these systems are shown in the mapping sketch below.



21 Old Farm Rd, Newtown, CT 06470

Services	Estimated Costs
Land survey with topographic information:	$5,500
Civil Engineering (Design only):	$7,000
ADS Water Quality Unit/Piping	$30,000
Bioretention System	$6,500

Pollution Reduction Estimates:

Pollution reduction estimates were calculated with the EPA Pollution Load Estimation Tool (PLET). Parameters input into PLET were conservative with practice effectiveness set at 0.5 (0-1 scale with 1 being the most effective).

Pollutant		Reduction Estimates (lbs/year)
Nitrogen		6.26
Phosphorus		0.68
Biological Oxygen Demand (BOD)		0.00
Sediment		0.15

8.3.3 Head O'Meadow Elementary School

Address: 94 Boggs Hill Rd, Newtown, CT 06470

Coordinates: 41.382812, -73.314366

Subwatershed: Deep Brook

Proposed Project: Infiltration Basins/Stream Daylighting

Site Description: Head O'Meadow Elementary School is located in the headwaters of the Deep Brook Watershed. It is located on a tributary of Deep Brook that contains a wild population of Eastern Brook Trout. The school drains an area of approximately 175,000 square feet into the tributary. The school provides an excellent opportunity to install a retrofit to mitigate the amount of stormwater entering the stream. It also provides an excellent chance to engage the elementary students about water quality.

Head O'Meadow Elementary School.

Existing Conditions:

This site presents a challenge to treat runoff from the impervious areas. A perennial stream which enters the site from the southwest has been placed in some type of underground culvert system from the southwest corner of the parking lot through the parking lot and then exits off the northeast corner of the front parking lot. It appears that roof drains from the school may be connected to this underground culvert system, the dimensions of it are unknown at this time.

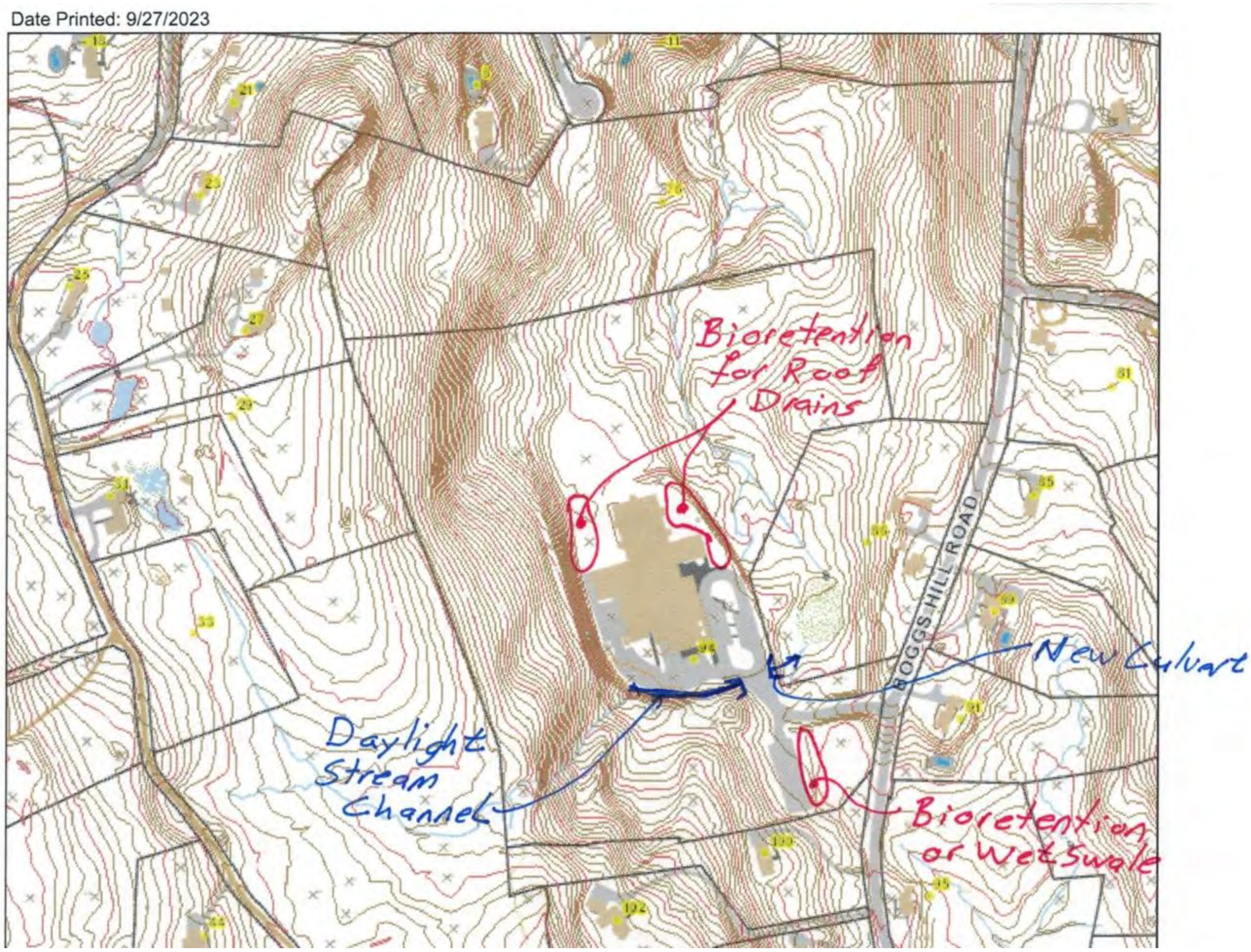
There is a surface parking area located to the south of the main school area and runoff appears to drain as overland flow into a wetland corridor which runs north and south through the site more of less parallel with Boggs Hill Road. There are several drainage structures within the driveway and parking areas of the school but it is not known at this time where the pipes discharge. It is possible that these catch basins may be connected to the underground culvert which the perennial stream is in.

Proposed BMPs 1:

According to the NRCS Websoil Survey, Hinckley and Canton Chatfield soils could be located on the site which would be suitable for infiltration. The following are conceptual ideas to address runoff from the roof and paved areas of the site.

1. If the soils are suitable for infiltration, a Bioretention system could be used to treat the runoff from the southernmost parking area prior to be directed to the wetland corridor.
2. If the soils are not suitable for infiltration, then a Wet Swale could be used to treat the same area.
3. If the roof drains could be disconnected from the existing underground culvert system, then these drains could be directed to one or more Bioretention systems around the school building to infiltrate the runoff if the soils are suitable for infiltration.
4. Divert the perennial stream which is currently in a culvert through the site along the southern perimeter of the parking area and then under the existing driveway in a much shorter culvert to the existing stream. DEEP encourages the removal of streams from culverts when possible. A restored stream channel would also provide a living habitat to be used for educational purposes.

5. ADS Water Quality Unit(s) could be used to treat the runoff currently directed to catch basins to reduce sediment, hydrocarbons, and metals loads. Unit location not shown as catch basins are not visible on any mapping.



6. Possible location of these systems are shown in the sketch above.

Estimated Costs:

Service	Cost
Land survey with topographic information:	$ 16,500.00
Civil Engineering (Design only):	$ 27,000.00
Stream Daylighting/New Culvert	$ 100,000.00
ADS Water Quality Unit/piping	$ 30,000.00
Bioretention Systems/Wet Swale	$ 11,500.00

Proposed BMPs 2:

A smaller BMP has also been conceptualized to address stormwater water coming from the parking lot near the entrance of the school where the turnaround is located. An infiltration basin will be used to capture and infiltrate stormwater before entering the stream, limiting the amount of pollutants that run off directly from the impervious surface into the stream. Preliminary estimates of stormwater water runoff using the National Stormwater Calculator show that runoff would be reduced from 33.51 inches/year to 13.73 inches/year using an infiltration basin that is 5% of the total area being treated (total average rainfall of 45.65 inches per year). An increase to 10% total area lowers total runoff to 7.18 inches/year, further reducing the amount of pollutants entering the Deep Brook Watershed.

Proposed infiltration basin to capture stormwater from parking lot.

Challenges:

- Working around School Schedule.
- Installation and maintenance of infiltration basin and their associated costs.
- Adequate area to install stormwater retrofits.
- Size of the area and subsequent size of retrofit projects.

Opportunities:

- Reduce a source or stormwater runoff from entering Tributary of Deep Brook with native Brook Trout.
- Infiltration basin doubles as pollinator/wildlife habitat.
- Involve School students with the project.
- Youth exposure to green infrastructure and low impact development.

Cost Estimate:

BMP	**Basin Size** (Basin size/total area)	**Cost**
Infiltration Basin	5%	$5,343 – $12,117
Infiltration Basin	10%	$6,145 – $14,295

Pollution Reduction Estimates:

Pollution reduction estimates were calculated with the EPA Pollution Load Estimation Tool (PLET). Parameters input into PLET were conservative with practice effectiveness set at 0.5 (0-1 scale with 1 being the most effective).

Pollutant	**Reduction Estimates (lbs/year)**
Nitrogen	8.53
Phosphorus	0.85
Biological Oxygen Demand (BOD)	0.00
Sediment	0.48

8.3.4 Country Club Riparian Buffer

Address: 2 S Main St, Newtown, CT 06470

Coordinates: 41.4001681, -73.2990147

Subwatershed: Deep Brook

Proposed Project: Natural Channel Design/Riparian Buffer Restoration

Site Description: The Newtown Country Club falls within the Deep Brook watershed. The same tributary to Deep Brook that runs through Ram Pasture also runs through the Country Club. There is currently very little riparian buffer along the stream and it is mowed down to the banks. Increasing the buffer to 30 feet on either side would reduce the amount of nutrients entering

Deep Brook and help reduce the temperature of the tributary. It would also increase the stability of the stream banks and reduce the amount erosion occurring along the stream channel. Being along the golf course there would be an excellent opportunity for educational signage about the importance of riparian buffers.

Challenges:

- Buy in from golf course management.
- Pushback from golfers.
- Maintenance cost of riparian buffer.
- Cost of planting large area.

Opportunities:

- Replant with Native species/pollinator resource.
- Reduce stream temperatures with increased buffer and shading.
- Increased bank stability/reduced streambank erosion.
- Reduce nutrient loads into Deep Brook.
- Excellent location for Public Education.
- Opportunity for volunteer planting event.

Pollution Reduction Estimates:

Pollution reduction estimates were calculated with the EPA Pollution Load Estimation Tool (PLET). Parameters input into PLET were conservative with practice effectiveness set at 0.5 (0-1 scale with 1 being the most effective).

Pollutant	Reduction Estimates (lbs/year)
Nitrogen	19.44
Phosphorus	7.48
Biological Oxygen Demand (BOD)	38.88
Sediment	14.29


Proposed Area
Impaired Reaches
Pootatuck Subwatersheds
Pootatuck Watershed Streams

8.3.5 Deep Brook Dam

Address: 63 S Main St, Newtown, CT 06470

Coordinates: 41.399412, -73.292911

Subwatershed: Deep Brook

Proposed Project: Dam Removal/Mitigation

Site Description: Deep Brook Dam is located behind the Taunton Press along Deep Brook. The dam acts as a barrier for fish passage and prevents any fish from moving upstream into Deep Brook from the Pootatuck River. There is also a record of another dam immediately downstream but was not found while conducting streamwalks. Upstream of the impoundment, there is a wetland that could be a cause for concern if the dam were to be removed. Removing Deep Brook dam would allow for a natural flow regime and fish passage up to the headwaters of the Deep Brook Watershed.

Challenges:

- Private ownership.
- Another dam immediately downstream (according to CT DEEP Files).
- Financial Cost to Remove.
- Environmental concerns: Sediment, Water Flow, Temperature.
- Wetlands immediately upstream.

Opportunities:

- Major barrier on Deep Brook.
- Fish passage from Pootatuck River to Deep Brook Headwaters possible.
- Restore natural flow and channel dynamics.

HVA Staff measuring Deep Brook Dam and facing the downstream wall of dam

Aerial photo of Deep Brook Dam.

8.3.6 Sand Hill Plaza

Address: 228 S Main St, Newtown, CT 06470

Coordinates: 41.3732238, -73.2725871

Subwatershed: Cold Spring Brook

Proposed Project: Stormwater Retrofits

Site Description: The Sand Hill Plaza is a large commercial shopping center that resides within the Cold Spring Brook subwatershed. It is unclear where each stormwater drain flows to but it is either into Cold Spring Brook or the Mainstem Pootatuck River. There are numerous drains throughout the parking lot offering many opportunities for retrofits to be installed. Conversely the volume of drains throughout the property will make installing retrofits more expensive. The most efficient solution would be to intercept the stormwater just before it enters Cold Spring Brook/Pootatuck River. Sand Hill plaza has an approximate area of 700,000 square feet, making it a substantial source of stormwater runoff.

Challenges:

- Commercial property.
- Installation and maintenance of retrofits and their associated costs.
- Adequate area to install stormwater retrofits.
- Size of the area and subsequent size of retrofit projects.

Opportunities:

- Reduce a significant source or stormwater runoff from entering waterways.
- Educational opportunities given the commercial use.

Sand Hill Plaza Location

Pollution Reduction Estimates:

Pollution reduction estimates were calculated with the EPA Pollution Load Estimation Tool (PLET). Parameters input into PLET were conservative with practice effectiveness set at 0.5 (0-1 scale with 1 being the most effective).

Pollutant	Reduction Estimates (lbs/year)
Nitrogen	8.53
Phosphorus	0.85
Biological Oxygen Demand (BOD)	0.00
Sediment	0.48

8.3.7 Newtown Transfer Station

Address: 4 Ethan Allen Rd, Newtown, CT 06470

Coordinates: 41.3793690, -73.2728139

Subwatershed: Lower Pootatuck

Proposed Project: Trash Cleanup and Prevention

Site Description: The Newtown Transfer Station is located along the Pootatuck River in the Lower Pootatuck subwatershed. Trash from the transfer station has migrated into the river corridor, resulting in a large amount of trash being in and around the river. There is an opportunity to create a river cleanup event to pick up trash from the transfer station, but also in other areas throughout the watershed. There is also a need to create a long-term solution for trash migrating into the river given its close proximity to the river corridor.

Challenges:

- Preventing future trash from falling into the river.
- Proximity to River creates a constant threat of trash in the river.

Opportunities:

- Remove large amounts of trash from the Pootatuck River.
- Chance to create a community cleanup event.
- Creation of a long-term solution to trash migration from transfer station.

Aerial of Newtown Transfer Station and cleanup area.

8.3.8 Aquarion Well Field

Address: 219 S Main St, Newtown, CT 06470
Coordinates: 41.3762335, -73.2727985
Subwatershed: Lower Pootatuck
Proposed Project: Riparian Corridor/ Instream Habitat Restoration

Site Description: The Pootatuck River runs through the Aquarion Water Company well field along Main Street in Newtown. The area has a large amount of invasive species such as Japanese Barberry, Mile-a-minute, and Japanese Knotweed. There is also a lack of trees and large cover that provides shade and habitat for wildlife. The well field creates an opportunity to remove a large number of invasive species and also augment instream habitat for fish, especially trout. This project would depend on how removing invasive plant species would impact the well field.

Challenges:

- Possible impacts to well field.
- Permission from Aquarion to work within well field.
- Initial cost to remove invasive species
- Maintenance cost and effort of invasive removal.

Opportunities:

- Replant with Native species.
- Aquarion has recently planted 53 trees and shrubs to mitigate some of these riparian buffer and cover issues.
- Improved in-stream habitat for fish and wildlife.
- Prevent warming of Pootatuck River through trees and shrubs.

Aerial image of Aquarion Well Field and Proposed area of restoration.

8.3.9 Potatuck Club Dams

Address: 100 Mile Hill Rd, Sandy Hook, CT 06482
Coordinates: 41.4059324, -73.2714611
Subwatershed: Lower Pootatuck
Proposed Project: Dam Removal/Mitigation

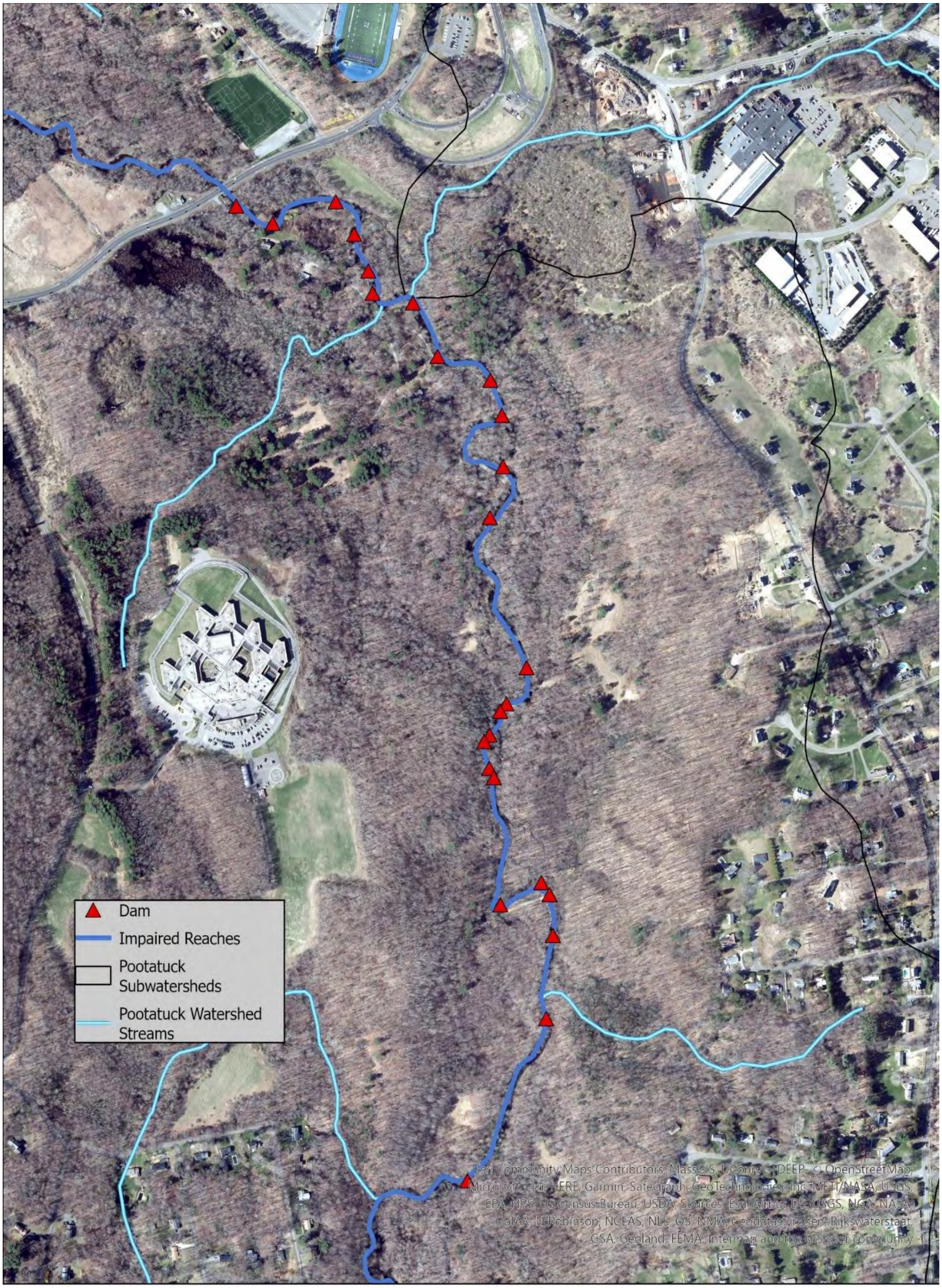
Site Description: The Potatuck Club owns a large section of property on the mainstem Pootatuck River with a series of over 20 rock dams over the course of about one and a half stream miles. The dams create pools that provide angling opportunities to members of the club. The series of dams that occur of the course of the property limit fish passage through the rest of the Pootatuck River and the tributaries upstream of the properties. There is the possibility of mitigating the dams by partially removing them rather than completely removing each dam. This project would be dependent on if the Club would be open to any remediation of the dams.

Challenges:

- Private ownership.
- Series of dams (>20).
- Time, effort, and cost to remove all dams.
- Environmental concerns: Sediment, Water Flow, Temperature.

Opportunities:

- Would allow for fish passage to the upper Pootatuck and its tributaries.
- Restore natural flow and channel dynamics.



Aerial image of Mainstem Pootatuck River along Potatuck Club Property. Dams are marked with red triangles.

One rock dam in the series of many dams.

8.3.10 ‘Lower’ Rocky Glen Dam

Address: 27 Glen Rd, Sandy Hook, CT 06482
Coordinates: 41.425888, -73.281598
Subwatershed: Lower Pootatuck
Proposed Project: Dam Removal/Mitigation

Site Description: The ‘Lower’ Rocky Glen Dam is located just upstream of the Rocky Glen Dam, counterintuitively or unconventionally named as their locations make this use of a ‘Lower’ qualifier. The Steering Committee identified this site as a possible candidate for removal or mitigation. This dam is the second major barrier in the Pootatuck River Watershed and acts as a barrier for fish passage for anything trying to move upstream from the Housatonic River. Removing the Lower Rocky Glen Dam would open up fish passage for a significant portion of the Lower Pootatuck Subwatershed and Tom Brook Watershed but would still be limited by the Rocky Glen Dam downstream.

Challenges:

- Hydroelectric power generation.
- Another dam immediately downstream.
- Expensive to remove dams.
- Environmental concerns: Sediment, Water Flow, Temperature.
- Historic space.

Opportunities:

- As a removal opportunity for this second major barrier on the Pootatuck River, bundle it with downstream dam removal to open up Mainstem Pootatuck and tributaries such as Tom Brook for fish passage.
- In a mitigation opportunity, the Lower Rocky Glen dam has operation issues that could cause problems for the watershed such as on occasions during the year when the facility shuts off the river flow in order to do maintenance. Low-cost or no-cost changes to its operating procedures could result in significant improvements for the lower Pootatuck.

Aerial image of Lower Rocky Glen Dam.

8.3.11 Rocky Glen Dam

Address: 75 Glen Rd, Sandy Hook, CT 06482

Coordinates: 41.432919, -73.276274

Subwatershed: Lower Pootatuck

Proposed Project: Dam Removal/Mitigation

Site Description: The Rocky Glen Dam is located just upstream of the confluence of the Pootatuck River and Housatonic River. The Steering Committee identified this site as a possible candidate for removal or mitigation. This dam is the first major barrier in the Pootatuck River Watershed and acts as a barrier for fish passage for anything trying to move upstream from the Housatonic River. The dam also acts as a hydroelectric power station, presenting an additional challenge for removal. There is also another dam upstream, meaning any removal would only open a very short segment of the Pootatuck River.

Challenges:

- Hydroelectric power generation.
- Another dam immediately upstream.
- Expensive to remove dams.
- Environmental concerns: Sediment, Water Flow, Temperature.
- Historic space.

Opportunities:

- First major barrier on the Pootatuck River.
- Bundle with upstream dam to open up Mainstem Pootatuck and its tributaries for fish passage.

Aerial image of Rocky Glen Dam.

8.4 Priority Non-Construction Program Descriptions

8.4.1 Engaging streamside landowners with impacted buffers and supporting riparian restorations (River Smart)

Streamside landowners often maintain turf lawns that are mowed down to the banks of the waterway, leaving very little vegetation to act as a buffer for pollution resultant from fertilizers, pesticides, pet waste and other sources. Turf lawns also have shallow roots, leading to increased erosion along the impacted buffer. Hence, there is a need to engage such streamside owners to encourage "River Smart" practices but also support the implementation of restoration projects with technical and financial assistance.

On the one hand, these practices may confront challenges such as:

- Large number of streamside landowners
- Previous lack of technical and financial support for interested landowners.
- Facilitating relationships with landowners with whom Partners do not have a current relationship or contact.
- Funding for implementation of buffers and other RiverSmart practices.

On the other hand, these same practices may seize opportunities such as:

- Mobilization of existing resources from the RiverSmart program.[126]
- Utilizing connections from other programs such as those of the CT DEEP unit for the stream-side Rocky Glen State Park or the CT Department of Corrections (DOC) staff and collaborators for the stream-side Garner Correctional Institution.
- Current expertise to support homeowners with technical assistance.
- Reduced impacts from residential sources.

8.4.2 Pollution track down

A program could be instituted to track down pollution within the Pootatuck Watershed. Track down programs have been successful in other watersheds (Still River) where they have not only made a productive contribution to locate, but also freed up resources to address pollution concerns. Track downs involve systematically working up from an outfall to identify the exact source of pollution within the system. Once identified, action can be taken to remediate the source of pollution.

[126] Housatonic Valley Association et al., "Be River Smart: Clean Water Starts with You."

On the one hand, these practices may confront challenges such as:

- Requirement of initial sampling to find outfalls that are high in pollutants.
- Funding can be difficult to obtain.
- Working with landowners to find and/or fix existing pollution sources can be challenging.

On the other hand, these same practices may seize opportunities such as:

- Identification of "low-hanging fruit" that can quickly improve stream health in some situations.
- Identification of specific pollutant sources and informative input into intervention.
- Optimization or moderation of sufficient assessment efforts to maximize remediation of pollution sources.

If warranted, PRP stakeholders such as Harbor Watch or the Town of Newtown could conduct additional monitoring to track pollution sources using repetitive sampling for indicator bacteria, ammonia, chlorine, and/or surfactants instream as well as outfall screening and sampling within stormwater structures to identify sewage sources such as illicit connections or broken sewer pipes. Pricing for track-down is variable depending on the project and parameters tested and would need to be evaluated at the time of the project.

8.4.3 Water quality monitoring

A program could be established to monitor water quality across the entire watershed. Parameters monitored could include but not necessarily be limited to pH, temperature, conductivity, dissolved oxygen, indicator bacteria, and nutrients. Water quality monitoring would be designed to support performance tracking of watershed management activities and track trends in water quality over time to inform management.

On the one hand, these practices may confront challenges such as:

- Comprehensive monitoring is time intensive and requires some level of training before taking samples and measurements.
- Funding for water quality monitoring not tied to a specific project can be difficult to obtain.
- Agencies like the CT DEEP do not actively encourage monitoring programs.

On the other hand, these same practices may seize opportunities such as:

- Understanding the water quality of the Pootatuck River watershed in its entirety.
- Being able to identify areas of concern and pollution sources.
- Robust data set for future comparison as the climate changes.

- Identification of habitat for species of concern (cold water refugia).
- Installation of gauges and sondes in areas of interest could lower the time intensiveness of these practices.

The Pootatuck River mainstem and 5 of its subwatersheds (Cold Spring Brook, Curtis Pond Brook, Deep Brook, North Branch Pootatuck River, and Tom Brook) have 17 years of water quality data (physical, chemical, and biological) collected by various organizations, namely the Pootatuck Watershed Association, USGS, and Harbor Watch at Earthplace. Continual and frequent monitoring within the watershed is important to understand current water quality conditions of the watershed in its entirety, identify hot spots to prioritize for pollution source identification and remediation, determine if water quality standards are being met, maintain a robust dataset to track trends over time to inform management solutions, and support performance tracking of implemented watershed management activities.

Plan recommendations:

- Seek funding to conduct water quality monitoring throughout the watershed to establish an annual monitoring program, support data collection on a wide variety of parameters, and encourage track-down projects to identify pollution sources and determine steps remove them from the watershed.
- Establish an annual pathogen monitoring program at a set list of stations with a goal of 10 sampling events (twice per month) from May through September (minimum of 8 sampling events conducted to collect enough data for potential use by CT DEEP in their assessments).
    - Monitoring should be conducted on a randomized schedule every two weeks (in order to not bias sampling on a particular day of the week).
    - Monitoring should be conducted regardless of weather conditions so as to not bias wet vs. dry weather sampling.
- Conduct pollution track-down when elevated bacteria concentrations are observed to identify sources and prioritize remediation. This monitoring should include a combination of repetitive indicator bacteria samples over short period of time, field kits for ammonia, chlorine, and surfactants, and any other methods available to isolate pollution sources.
- Evaluate watershed concerns annually to determine if additional parameters should be monitored; either added to the annual program or on a modified schedule determined by

funding and need. Potential parameters include nutrients, pH, PFAS, and other emerging contaminants of concern.

- Install data loggers to monitor physical and chemical parameters that are important for assessing habit including but not limited to dissolved oxygen, water temperature, conductivity, and water level.

Proposed monitoring locations selected based on past sites of sample collection by Harbor Watch and Pootatuck Watershed Association as well as new sites that appear to have easy access at public road crossings.

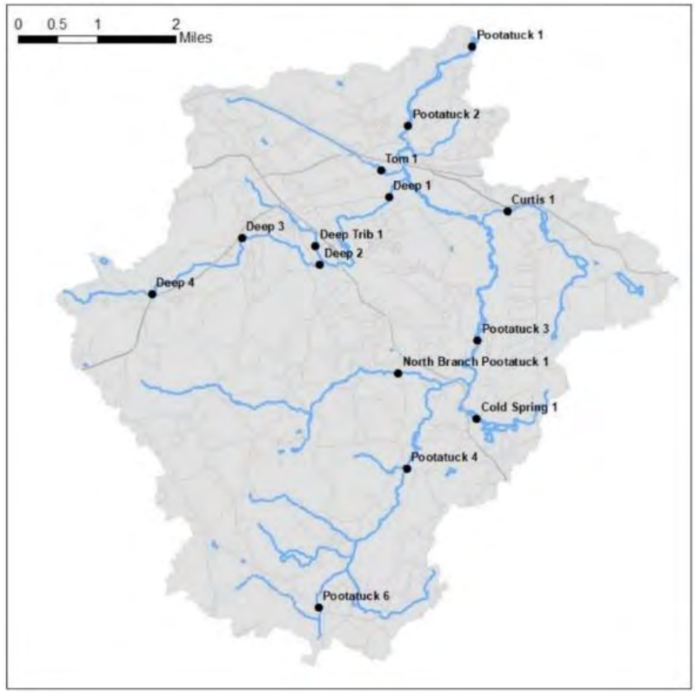


Table 23. Budget for Proposed Monitoring

Proposed budget:

Item	Cost
Personnel (field and laboratory)	$4,450
Supplies (sample bottles, reagents, standards, etc)	$2,985
Travel	$500
TOTAL	$7,935

A program could monitor the Pootatuck River watershed from May to September for indicator bacteria (*E. coli*), dissolved oxygen, water temperature, and conductivity. Sampling would be conducted throughout the watershed, with priority given to the main stem of the Pootatuck River and Deep Brook, both which are currently assessed waterways by CT DEEP and have segments that are listed as impaired. Additional sites would be located on the tributaries to assist in determining if the sub-watersheds are contributing to poor water quality (Figure 9). Data would be collected approximately twice per month (about every two weeks on randomized schedule) during the May through September monitoring season.

For an added monitoring effort, Harbor Watch has the ability to collect samples for nutrient analysis

as well, should the stakeholders be interested in that data. There are two contract laboratories that could

process the samples. Harbor Watch could collect the samples during the regular monitoring at no

additional personnel cost. Funding would be required to pay for the sample analysis by the contract laboratory at approximately $57 per sample for TN, TP, Ammonia, Nitrate, Nitrite, and TKN (price varies

by lab, as does minimum detection limits).

8.4.4 Education on proper septic maintenance and practices

A program could be generated to educate individuals about septic systems in a manner that facilitates their understanding of how these systems work, what an important difference regular septic maintenance makes, and how to properly dispose of wastewater. Properly functioning septic systems are essential for preventing contamination of groundwater, surface water, and nearby ecosystems. This knowledge empowers homeowners to take responsible actions that safeguard the environment and protect water quality.

On the one hand, these practices may confront challenges such as:

- Difficulty in identifying exactly where septic tanks are in use versus where sewer lines are in use across the watershed.
- Approaching septic owners without implication of fault or presumption of knowledge gap.

On the other hand, these same practices may seize opportunities such as:

- Some resources are already on the RiverSmart website.
- Possibility to work with septic companies to spread proper maintenance practices.
- Assurance of public and environmental health through accessible education materials.

8.4.5 Wetlands education center and/or program

A wetlands education center and/or program at a Newtown public outdoor site such as Dickinson Park or behind a ball field on the confluence of the Pootatuck River with the Housatonic River at Lake Zoar off of Walnut Tree Road would provide an easily accessible space for community members to learn and engage in wetland conservation and restoration. A center and/or program would also be an opportunity for local schools to take advantage of a place to conduct wetland research and give students a hands-on experience in conservation. Development of a program and staffing an environmental educator would be the biggest strains to such a program and/or center.

On the one hand, these practices may confront challenges such as:

- Funding an education center and/or program including staffing and resources will be difficult.

- Infrastructure would also be needed to facilitate a weather-proof education center.

On the other hand, these same practices may seize opportunities such as:

- Generating a sense of stewardship for the environment among the community.
- A place to provide resources and support for those interested in improving their environment.
- Possible community-based science location.
- Promotion of wetland conservation and restoration.
- A broader watershed training program could be included either in the education center itself or in the like-minded while nearby Catherine Violet Hubbard Animal Sanctuary and/or the temporary riverside sites of Newtown's 23-year-old annual Rubber Duck Race.

8.4.6 Land protection program

Land protection refers to the conservation and preservation of land and natural resources to safeguard their ecological, cultural, recreational, and economic values for present and future generations. It involves various strategies and mechanisms aimed at preventing the degradation, fragmentation, or loss of important land areas. Land protection also protects water quality, valuable habitat for fish and wildlife, and provides recreational opportunities. Areas that contain important habitat, water resources, and species of concern should be considered for land protection.

On the one hand, these practices may confront challenges such as:

- Funding requirements to purchase parcels of land.
- Approaching landowners about possible easements.

On the other hand, these same practices may seize opportunities such as:

- Protection of natural areas.
- Water quality benefits of protecting forested areas.
- Fish and wildlife habitat protection.
- Recreational opportunities.

8.4.7 Invasive species management program

An invasive species management program is a comprehensive strategy designed to address the threats and impacts of invasive species within the Pootatuck River Watershed. It outlines a systematic approach to identify, prevent, control, and manage invasive species populations, aiming to minimize their negative effects on native biodiversity, ecosystems, economies, and human well-being. Prevalent invasive species in the watershed include Japanese Barberry, Japanese Knotweed, Mile-a-minute, Asian Bittersweet, and many more.

On the one hand, these practices may confront challenges such as:

- Invasives are persistent through the entire watershed and a major effort would be needed to make any meaningful impact.
- Proper disposal of plants is needed to prevent spreading.
- Significant investment of finance and time.

On the other hand, these same practices may seize opportunities such as:

- Replacement of invasive species with native species.
- Maximize effectiveness through integration with soil erosion plans and efforts.
- Prevention of invasive species from spreading further.

8.4.8 Education on waste management and best practices for backyard farming

Backyard farming, also known as urban or suburban farming, refers to the practice of growing food and raising animals in residential areas, typically in small-scale settings such as home gardens, balconies, rooftops, or community plots. It involves utilizing available space to cultivate a variety of crops, raise livestock or poultry, and engage in sustainable agricultural practices. By providing backyard farmers with educational resources about best management practices for backyard farming, the possible negative impacts can be minimized while any positive impacts can be maximized.

On the one hand, these practices may confront challenges such as:

- Identifying backyard farmers tends to be more time-consuming than finding conventional farmers such as those on the Pootatuck River Watershed itself.
- Approaching backyard farmers with educational resources.

On the other hand, these same practices may seize opportunities such as:

- Raising awareness of sustainable practices such as composting, rain barrels, and reduced pesticide use.
- Nurturing relationships with more community members.
- Fostering a sense of environmental stewardship among the backyard farming community.

8.4.9 Work with Town Officials to place greater emphasis on protection of watercourses

A program could institute work with Town of Newtown, Town of Easton and/or Town of Monroe officials to include language and policy that places greater emphasis on protecting watercourses. This would include advocacy and lobbying for town officials to incorporate low-impact development (LID) and green infrastructure (GI) into town policies and plans (erosion management plan, hazard mitigation plan, etc.).

On the one hand, these practices may confront challenges such as:

- Compromise between development and protection/restoration.
- Implementation and enforcement of environmental plans.

On the other hand, these same practices may seize opportunities such as:

- Updates to erosion management plan.
- Inclusion of LID/GI practices for new developments.
- Best management practices for Town-managed turf.

8.4.10 Conifer revetment

A conifer revetment program is a proactive approach to stabilize riverbanks, shorelines or slopes repurposing Holiday conifer trees as a natural erosion control measure. The post-Holidays program involves securing conifer species such as spruce or pine to the streambank along vulnerable areas to prevent soil erosion and provide long-term stability. Conifer revetment programs provide opportunities for community engagement and education while also enhancing habitat and reducing erosion.

On the one hand, these practices may confront challenges such as:

- Ongoing maintenance requirements.
- Site preparation and installation.
- Landowner cooperation and buy-in.

On the other hand, these same practices may seize opportunities such as:

- Community engagement and education.
- Cost-minimization through volunteer labor and Holiday-tree donations.
- Erosion control and habitat enhancement along stream and river banks.

8.4.11 Homegrown National Park program

The concept of Homegrown National Parks recognizes that urban and suburban areas can play a crucial role in supporting biodiversity and ecological health. Such a program promotes reduction of lawn desert areas and elimination of synthetic lawn chemicals and pesticides. As an alternative, it encourages individual homeowners, businesses, schools, and other organizations to create and maintain native plant habitats in their yards, gardens, parks, and other available spaces. By doing so, these individual habitats collectively form a network of "mini-parks" or "micro-reserves" that provide food, shelter, and breeding sites for a variety of native species.[127]

On the one hand, these practices may confront challenges such as:

- Community engagement and buy-in.
- Lack of incentive outside of environmental benefits.
- Numerous conflicting resources that may lead to exotic, non-native plants being planted.

On the other hand, these same practices may seize opportunities such as:

- Encouragement for homeowners to plant native and embrace wildlife.
- Landowners can be involved in multiple ways.
- Encouragement for property owners to get on the map and make the watershed a hotspot that serves native animals and plants as a welcoming habitat.

8.4.12 Municipal ban on neonicotinoid pesticides for non-agricultural use

Neonicotinoids have been the subject of considerable concern due to their potential adverse effects on pollinators, particularly bees and other beneficial insects. These effects are attributed to the toxicity of neonicotinoids and their ability to persist in nectar and pollen, which are essential food sources for bees and other pollinators. A municipal ban on these pesticides would benefit pollinators throughout the watershed and limit the amount that enter watercourses from runoff.

On the one hand, these practices may confront challenges such as:

- Uncertainty as to how pervasive neonicotinoid use in the watershed is outside of agriculture.
- A municipal ban would be difficult to enforce at the local level and might make more sense as a State-level policy initiative.

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[127] Homegrown National Park (HNP), "Homegrown National Park."

- Public concern about the risks from insect vectors of emerging mosquito-borne diseases such as eastern equine encephalitis or west Nile virus.

On the other hand, these same practices may seize opportunities such as:

- Ban on neonicotinoid use would be a win for pollinators and environment.
- Impose restrictions on neonicotinoids similar to those in New Jersey, New York and Vermont.
- Serve as an example for other municipalities and advocate at the State level for non-agricultural restrictions that could become policy consistently enforced across Connecticut.
- Advocate for alternative methods of pest control that are more environmentally friendly.

8.4.13 Winter water quality monitoring

Winter water quality monitoring entails the same sampling as normal summertime monitoring, but during the winter months instead. Sampling during the winter would provide a complete picture of water quality throughout the year. Winter sampling is not typically done because most parameters of interest (bacteria, DO, etc.) are not a concern during the winter months like they are during the summer.

On the one hand, these practices may confront challenges such as:

- Some parameters (indicator bacteria) are better measured during the warm season to understand stream health; winter data can dilute year-round results.
- Winter monitoring is not supported by the state.
- Safety is a concern while working in and around water with ice or snow under freezing temperatures.

On the other hand, these same practices may seize opportunities such as:

- Full year worth of data.
- Alternative option could be a more targeted form of monitoring only for tracking road salts during the winter (in-situ conductivity loggers, chloride etc.).

8.4.14 Enhancement of buffer and native plants in utility right-of-ways, particularly those next to streams

Planting native vegetation in utility right-of-ways (ROWs) involves establishing and maintaining native plant species within the areas where utility infrastructure such as power lines, pipelines, or transportation corridors are located. Depending on where the right-of-ways are located, there can be restrictions on the mature size of plants that can be planted, often limiting them to less than 15' tall.

On the one hand, these practices may confront challenges such as:

- Continuous maintenance needed to remove invasive plant species and trees from right-of-ways.
- Approaching utilities about working in right-of-ways.

On the other hand, these same practices may seize opportunities such as:

- Connecting areas of land that could act as pollinator habitat.
- Chance to remove invasives in and around watercourses.
- Support food chains for native animal species.

8.4.15 Develop master inventory and plan for trails and stream habitat improvements along the Pootatuck River from Lower Agricultural Field of Fairfield Hills to Sandy Hook Center

A program could be designed to take inventory and develop a trail system from Fairfield Hills down to Sandy Hook. Such an inventory of trails could then be used to develop new trails in areas that do not have adequate access while also making these trails accessible to everyone. There is also a need to ensure that trail development does not negatively impact habitats or put species of concern at risk.

On the one hand, these practices may confront challenges such as:

- Working with landowners to allow trails to go through their property.
- Making sure trails and access do not negatively impact the environment.

On the other hand, these same practices may seize opportunities such as:

- Connecting a trail system through the Pootatuck River Watershed.
- Greater access to open and green spaces throughout the watershed.
- Viability of including more accessible trails within plan.

8.4.16 Advocacy for municipal and State tax credits or rebates for those reducing lawn and increasing native plants

Municipal tax credits or rebates for reducing lawn and planting native vegetation would incentivize homeowners and property owners to adopt more sustainable landscaping practices. The tax incentives would aim to promote environmental conservation, improve biodiversity, conserve water resources, reduce chemical use, and create habitat for native species. Advocacy for such tax credits would have to be done at the local level with Newtown policy makers.

On the one hand, these practices may confront challenges such as:

- Convincing municipality to adopt such credits.
- Buy-in from Newtown homeowners or property owners to reduce lawn and increase native plants.

On the other hand, these same practices may seize opportunities such as:

- Precedents and lessons can be learned from similar incentives instituted elsewhere in jurisdictions including but not limited to the City of Aurora, sixty-one (61) communities in the State of Utah, Los Angeles County (Waterworks Districts), (Municipal Water District of) Orange County, San Diego County, Metropolitan Water District of Southern California, Southern Nevada Water Authority in and around Las Vegas, the State of Colorado, and the State of California.
- Incentivizing homeowners to increase buffers and plant natives will help pollinators and other wildlife.
- There are plenty of resources about native planting (Homegrown National Park, Million Pollinator Garden Challenge etc.).

9. PARTNER REVIEW AND PUBLIC COMMENT ON DRAFTS

9.1 Partner Reviews Received on an 11/28/2023 Draft of this Plan

9.1.1 Review Received on 12/4/2023

"There are several sections which contain redundant material that make the report longer and somewhat repetitive. If we had the time to do some tightening, I think it would be more valuable to the general public.

The link to the stream walks information on page 19 (all my page references are to the pages that appears in the PDF, not the number at the bottom of the page) is useful. However, it is a bit challenging for the Citizen to use. Including a table and drawing which highlights some of the more challenged stream sections would be a helpful addition.

The town of Newtown, PWA, and CVTU have collected E. coli, temperature, macroinvertebrate, and nutrient data in the watersheds since 2006. While, I understand that the data were not necessarily collected using an approved QUAP, a qualified laboratory performed all analyses while the temperature and macroinvertebrate data were collected under the DEEP RBV or VSTM programs. It's disappointing that these efforts were not recognized and incorporated more fully into the report. For example, while the state RBV and VSTM programs are mentioned, the information collected is not acknowledged, or incorporated into the report. Please see Neil Baldino's PowerPoint of November 2023 for a summary of the Newtown/PWA 2006-2023 data.

Some of the sections of the report are clearly work that is "reused" from other reports. While some of these sections are certainly appropriate, it would make the report more specific to the Pootatuck/Deep Brook watersheds with more editing on these sections. Some examples, references to kayaking and water skiing on Deep Brook make the report less credible. I also see some references to the "Still River Alliance Commission" (page 83) and Danbury and Bethel (page 85) that should be cleaned up.

If you have a Word version of the document, I'd be willing to provide some more specifics.

Some comments Section 10:

10.3.2 The DOT salt storage facility has a history of washing materials over the side of the hill from the pad which resulted in significant vegetation kill in the past. Perhaps there are operating procedures that could be modified resulting in improvements with no capital cost. I believe the design details of the Salt Shed drainage system are available that would be helpful as well.

10.3.3 The detailed estimated cost is very different than many of the other sections. An explanation of why this section received the detailed estimates could improve the credibility of the report.

10.3.10 the lower Rocky Glen damn has significant operation issues which could cause some of the Pootatuck river problems. On occasions during the year, the facility shuts off the river flow in order to do maintenance. Revised operating procedures at that location could result in significant improvements at the lower end of the Pootatuck with essentially no capital cost.

10.4.1 mentions the Garner facility as being "streamside". I think there is a significant parcel of Potatuck Club property between Garner and Pootatuck.

10.4.2. The town of Newtown could also be involved in pollution "track down", particularly after samples indicate high results. The challenge in all E. coli "track down" efforts is the time interval between taking a sample which has the high E. coli concentration and getting the actual laboratory results.

10.4.3. The proposed water quality monitoring program can also incorporate water flow from the USGS gages, the DEEP/CVTU temperature and conductivity logger programs, and local rainfall.

10.4.8 there are a significant number of real farms, in addition to the “citizens farms“ in the watersheds

10.4.10 “planting“ is not done in a conifer Revetments, the conifers are actually secured to the stream bank.

The second document which has the calculations on waste and E. coli from geese was eye-opening and very worthwhile. Is there something similar on other agricultural operations such as stables?

Thanks so much for all the work that HVA and they PRPs have invested in this effort. Looking forward to our meeting tomorrow.”

9.1.2 Review Received on 12/5/2023

“Page No.	Comment / Issue
Cover	Like inclusion of all the partner logos but not clear how all those have or are currently engaged.
1	Mike Humphreys - DEEP (Retired)
11	3rd Paragraph - LISFF funding work done/recievied by Town or HVA?
Thoughts	Where do we capture total load of water usage versus aquifer capacity for potable water needs and irrigation? Supply is tied to rainfall which is not controllable but the efficiency and capture of water run-off can be improved to offset impervious surface impacts.
14-15	Identify PWA, CVTU, Town data efforts but no reference to data or illustrations of where "pollution" hotspots are or give summary what that data points to as priorities for further study, E-Coli, Conductivity, nutrient load, etc.
22	3rd Paragraph - rain, snow, hail, fog and dew.
29	1st Full paragraph - are there different EPA salt level standards for drinking water supplies, surface & aquifer? Like to have stated if they exist so reader can reference on-line water quality data for compliance.
30	What are the benthic macroinvertebrate goals for the state and how do the findings for the Pootatuck Watershed compare?
32	TMDL for nutrients, what is the relative load for the Pootatuck as compared to Housatonic Stem and Long Island Sound ?
40	Bullet one add to read "and residential areas, such as lawns (for emphasis)
40	Bullet four : Salt from road, parking lot, and sidewalk de-icing agents;
41	Where does one find the 3 Towns Stormwater Management Plans?
42	What program was used to create the cover maps, CLEAR I think produces maps that are less grainy and better to read.
45	This would be a good place to show or summarize what the "PWA/Town" non-Quap data shows
Question	When linking out to the reference material on Tom Brook there is a disclaimer statement, what is its purpose? Just curious as to the concern.
51	Species of concern, add Wood Turtle to Brook Trout
52	Put upper and Lower Pootatuck Maps on separate pages to make them more readable.
53	Appreciate stating that the Town not State or Federal government is responsible to protect the watershed.
54	Do we have the Town's MS4 response that shows BMPs? If so include in reference materails.
54	Also note stream habitat work done by PWA and managed by HVA.
57	Wells on club property are owned by Town?

58	Appears to be silent on PFAs chemical levels, Aquarion I know has identified its levels, do we have that or should we have that for the Fairfiled Hills wells?
59	Do we have any knowledge of what the sources are for the high levels or chemicals of concern at Fairfield Hills wells?
64	1st bullet, last sentence need some editing, not clear.
65	What is the purpose of the commentary on history, solely to provide examples of historical facts that fit "untapped river programming potential"
67	The wetlands education center was first proposed for Dickinson Park but might also fit in another open space area adjacent to the Pootatuck, such as along the confluence of the Pootatuck and Lake Zoar
75	The PRP, including HVA and other stakeholders, have committed to regularly revisiting this Watershed Plan. On an annual basis, they will assess progress towards the recommended actions and goals outlined in the Action Plan.
75	Every five years, a comprehensive update of the plan will take place based on achievements, outcomes, and newly identified priorities
75-76	This section seems to mandate HVA solely doing assessments and not PRP partners or the Town which earlier it is stated has almost sole jurisdiction for the watershed.
76	Spelling, second recommended bullet "smonitoring" spellcheck document
78	Table 6.1.2 - Who manages, calls bi-annual meetings, leads the PRP? Town/PWA, others? All all partners committed to do that?
	Who hires/pays for Pootatuck Watershed Coordinator
79	Do we have a current status of Newtown MS4 communications? Under the current MS4 stormwater management permit, municipalities are required to provide information to their residents on what they can do to minimize the impacts of stormwater pollution.
Thought	Develop a synopsis of Vision and Recommended Actions for general public to be used in presentations.
80	Who is WestCoG? Relative to Newtown.
81	Establish a Pootatuck River Recreation Subcommittee, (Subcommitte of what, who establishes, potential partners) comprising representatives from various groups dedicated to enhancing recreation, to collaborate across municipalities.
82	Municipal Parks and Recreation - Should this be more specific - Newtown Parks & Recreations
83	Should we be talking about the Plan of Conservationa and Development here??? The extent of current development and infrastructure within the floodplain varies significantly among different municipalities within the watershed.
84	Whole section and Tabel 6.1.5 needs to be made singular for Newtown vs. Towns, Danbury, Bethel, etc. Conversely, certain areas, such as Danbury and portions of Bethel, were historically constructed around waterways, leveraging the river for industrial and other purposes. I
86	Isn't the Pootatuck Watershed a re gional watershed - singular or does this refer to Deep Brook, Tom's Brook, etc. Apply criteria to regional watershed areas and identify areas of high conservation value"

9.2 Partner Reviews Received on a 1/17/2024 Draft of this Plan

9.2.1 Review Received on 2/24/2024

"I have reviewed the Draft Pootatuck River Watershed Management Plan (January 2024) and offer the following comments:

General

1. To make sure that the above referenced document includes all of the information necessary to be considered an EPA 9 Element Watershed Based Plan, HVA should review and complete the "CT DEEP CWA Section Grant Program Watershed Based Plan Checklist" which can be found on the following CT DEEP webpage: Watershed Based Plans (ct.gov) (See link to document in first paragraph). When the draft plan is revised and officially submitted to CT DEEP and EPA for review, a copy of the completed checklist should also be included.
2. Recommend reorganizing and streamling document. (I believe there was a comment made at the 1-24-24 public meeting in which someone suggested that perhaps the main part of the document should "cut to the chase" re: water quality, etc. in the Pootatuck watershed and proposed actions.) Much of the information in the document is helpful and supportive. However, some of it is redundant and could perhaps be "boiled down" and summarized more succinctly. Some of the information could serve as a background "reference" for readers who are less familiar with certain topics. Perhaps certain info should go into Appendices? As an alternative, perhaps consider creating separate but distinct subsections - such as sidebars, etc. - that provide informative background that readers can choose to read or skip, depending on their level of knowledge of subject matter? (May also want to consider looking at the formats of some of the other Watershed Based Plans on CT DEEP's website at: Watershed Management Plans and Documents (ct.gov) . Some plans are better than others but you may find a few that are particularly helpful.)
3. Consider having someone with strong editorial abilities and an eye for detail review the document for content and consistency. (For example, formatting of some terminology or information is inconsistent; etc.)
4. In the revised, final version of document, will the lists of Tables (p 7), Figures (p 8) and Maps (p 9) include page numbers and/or live links?
   [*]
5. Consider creating an Executive Summary section at beginning of Plan. (I believe I heard HVA staff mention at the 1-24-24 public meeting that HVA was already planning to do this?)
6. Because of the way that information in the document is presented, it is unclear if: Monitoring and Assessment and, Plan Implementation Effectiveness where adequately addressed, as defined by EPA's 9 Elements.
7. Document ends without any sort of conclusion to wrap-up the plan.

Specific

8. Cover page – Should acknowledgement also be provided for NFWF LISFF project funding? Should a NFWF logo also be added?
9. p 10 – Map 1 – Map does not have much contrast. Can watershed boundaries be made a little darker? Also, place names and sub-basin names appear to be the same size/type face with makes it a little difficult to distinguish between the two. Perhaps make sub-basin names more prominent?
10. p 10 – First Paragraph – Re: "leaner parts of the PRW" … Would suggest changing "leaner" language which sounds a little odd in this context.
11. p 10 – Second Paragraph – Nonpoint source *water* pollution … Current language assumes that reader already knows that "nonpoint source pollution" is a form of water pollution. Need to consider that some readers may not be familiar with this terminology. Also, it might be helpful to generally mention "point sources" of water pollution to add context. (Is regulation or disappearance of certain point sources the reason why water quality in the Pootatuck has improved, as compared to the past?)
12. p 10 - Second Paragraph re: "All non-point sources of pollution are caused by runoff of precipitation … " Would suggest modifying language to something such "Non-point sources of pollution are generally caused by …" EPA's definition of NPS also includes other things such as malfunctioning septic systems, hydromodification, etc. (See EPA website at: Basic Information about Nonpoint Source (NPS) Pollution | US EPA)

13. p 10 – Second Paragraph – This paragraph confuses non-regulated, nonpoint sources with regulated stormwater (considered point sources by EPA), especially with regard to communities regulated under the MS4 General Permit, such as Newtown. (Helpful info describing difference can be found in the recently revised CT Stormwater Quality Manual (Sept. 2023): [Stormwater Manual (ct.gov)] (See Chapter 2 – paragraph starting at bottom of first page)
14. p 11 – Please also mention the aquatic life use impairment (due to unknown causes) impacting and unnamed trib of Deep Brook, especially since it is identified later in the Plan on pp 36-37.
15. p 11 – In this section, after discussing impairments, consider adding language about how one of the goals of the Plan is also to identify sources of nutrients (P & N) impacting downstream waterbodies such as Housatonic River/Lake Zoar and LIS – especially since LISFF has been identified in one of the preceding paragraphs as a source of funding.
16. p 12 – EPA Nine Elements of Watershed-Based Plan Development Process – In this section or elsewhere, it would be good to include information that this is a non-regulatory, voluntary approach to addressing nonpoint source pollution water quality issues. (This discussion came up during the public information meeting on 1-24-24 in Newtown.)
17. p 12 – EPA Nine Elements of Watershed-Based Plan Development Process – In this section or elsewhere (such as Introduction), it would be good to make a distinction between this Nine Element Watershed Based Plan to address nonpoint sources of water pollution (non-regulatory) … and the Town of Newtown – Stormwater Plan required under the CT DEEP MS4 General Permit to address point sources of stormwater pollution (regulatory). (Rob Sibley raised this concern in a recent e-mail exchange between HVA, CT DEEP and others because he feels that the public may not understand the distinction between these two planning documents.) (See also Comment #26)
18. p 12 – Step 6 – Consider rewording this phrase slightly, such as: "measure the progress of those actions on reducing pollutant loading and improving water quality and make any necessary adjustments …"
19. p 12 – Nine Elements Watershed-Based Plan list – Impairment – Suggest changing "watershed goals" to "water quality goals".
20. pp 12-13 – Nine Elements Watershed-Based Plan list – Load Reduction - Some readers may not be familiar with "load reduction" terminology and not understand that it applies specifically to reducing pollutants. Consider modifying references to "load reductions" (here and elsewhere) to "pollutant load reductions".
21. p 13 - Table 9 – The more specific, the better with regard to identifying where to find 9 Element components within the body of the plan. For example, for Element 1 – Impairments, you have to do a lot of scrolling to find references in Section II and Section III.
22. p 15 – Under 1.4 Field Assessments – First sentence – Do you mean "To assess the negative impacts and potential restoration opportunities within the Pootatuck River *watershed* … "? As currently written, it sounds as though "restoration" is to be conducted within the river and tribs. While this may be partially true, I assume that the primary goal would be to address problematic riparian and upland sites that are nonpoint sources of bacteria, nutrients and other pollutants causing the impairments and other downstream water quality issues.
23. p 15 – 18 – Did HVA also conduct USSR surveys to identify potential upland sources of impairment, as discussed in the 319/LISFF project QAPP? If not, why not. (Consider including the QAPP as an appendix to the Plan.)
24. p 16 – Second Paragraph – Suggest adding info on how many miles of stream were walked and perhaps naming the tributaries that were covered.
    - [* Link to mapping tool here and in Executive summary while updating actual streamwalk data and adding new data onto the tool]
25. p 18 – First Paragraph – Suggest modifying language: "The Pootatuck River watershed has been thoughtfully divided into seven sub-watersheds … " I realize that this language is trying to say that watershed was broken into smaller chunks, so that it could be covered more easily for planning and management purposes. However, language sounds a little odd as currently written since sub-watersheds are based on natural drainage divides.

26. p 18 - Third/Last Paragraph – Second and third sentences – Why do these sentences use "future" verbs? Specifically: " These identified sites *will* be subjected to further reconnaissance efforts … " and " This detailed evaluation *will* contribute to the prioritization of restoration projects … " Weren't these sites identified and evaluated as part of this watershed based planning process? If not, why not?
27. p 19 – Sec. II. Watershed Characteristics – As I read through this section, I find it a bit confusing as it seems to go back and forth between general, background topics (such as water cycle) and specific information about the Pootatuck watershed. Some related topics are separated spatially by several pages. Also, the subsection on the Housatonic watershed and LIS is important information but seems a bit out of place, as it is inserted into a section that is mostly focused on the Pootatuck watershed which is at a smaller scale.
28. p 22 – Suggest that for first reference to IWQR (only) that text be revised to say: Integrated Water Quality Report *to Congress* since this indicates that CT has to report to federal government (in this case, EPA) on the status of water quality within the state.
29. p 23 – First and Second Paragraphs – Duplicative info about water quality impairments in these two paragraphs. (First paragraph mentions impairments in general terms; Second paragraph is more specific.)
30. p 23 – First Paragraph – At the end of the first paragraph, the term NPS is introduced again. Suggest adding some language that defines NPS and perhaps reference CWA Sec. 303(d) since other CWA sections are mentioned in sections above. (Although NPS is discussed in Introduction, it would be helpful to have some info reiterated here.)
31. p. 23 – Following-up on above comment, this might also be a good spot to briefly discuss differences between regulated stormwater (and the fact that Newtown is subject to MS4 General Permit) and non-regulated stormwater run-off (nonpoint source)?
32. pp 22-23 – 2.4 Water Quality Regulations – Consider inserting CT Water Quality Classifications map for Pootatuck watershed.
    [*]
33. pp 22-23 – 2.4 Water Quality Regulations – Consider inserting graphic here or elsewhere that illustrates types of NPS pollution.
34. p 24 – Map 2 – It would be helpful to identify the names of the impaired waterbodies on the map. Someone unfamiliar with the watershed would not necessarily know which segments are Deep Brook vs. Pootatuck River. It would also be helpful to identify the types of impairments. (Map should identify not only recreation impairments but also aquatic life use impairment.) May want to consider moving this map so that it with discussion of impairments and Table 6 assessment results on pp 36 – 37 (or visa-versa).
    [Jillian]
35. p 26 – pH – Consider also mentioning that pH of water is also influenced by underlying geology.
36. p 29 – Indicator Bacteria – Text mentions that approx. 20% of watershed was covered by ag land at time of TMDL assessment. Did HVA investigate potential impacts of ag land and bacteria contributions as part of watershed assessment under ECR? (Not necessarily suggesting that be discussed here but seems that it might be important info to discuss elsewhere?)
37. p 31 – The Housatonic River Watershed and Long Island Sound – It is difficult to read the map figure, even when blown up to larger scale.
    [Jillian?]
38. p 31 – The Housatonic River Watershed and Long Island Sound – Second Paragraph – I don't know if HVA is referring to drainage basins by national HUC system or by CT DEEP basin system? While Pootatuck drains to Housatonic Main Stem, I have never heard it referred to as Housatonic Mainstem *Lakes* sub-watershed. (Note – CT DEEP classifications system: Housatonic Major Basin > Housatonic Mainstem Regional Basin > Pootatuck Subregional Basin.)
39. p 31 – As follow-up to above comment – and before discussion of LIS – consider adding brief text about potential nutrient impacts (primarily from phosphorus) from Pootatuck basin on downstream Lake Zoar.

40. pp 32 – Discussion of LIS TMDL does not mention that it covers both point and nonpoint sources of nutrients. Section also does not specifically discuss relevance to Pootatuck watershed to LIS, as a potential contributing source (among many) of NPS-derived nutrients.
41. p 32 – Pootatuck Basin WQ Monitoring – First Paragraph – IWQR is biennial (every two years), not biannual (twice a year)
42. p 34 – Table 3 – HW WQ sampling locations – Consider including a map of sampling locations which would help with visualizing locations
    [Jillian?]
43. p 34 – Second Paragraph – This paragraph re: HW data discusses septic systems and small farms as being potential contributors of bacteria
44. p 35 – Table 4 – Consider using different colors to highlight exceedances.
45. p 36 – Table 5 – Ditto above comment.
46. pp 36-37 – Recommend presenting info from 2022 IWQR in its own separate subsection. As currently presented as a follow-on to HW data discussion seems a little odd, although the topics are obviously related.
    [Whether or not this comment is worth a response appears to depend on how the next comment gets addressed.]
47. p 37-38 – Discussion of water temperature out of context. What report?
    [* Looked at the 2022 Report to Congress online to confirm, but did not find temperature data there nor in Matt's shared 365 folder or the P-drive, so unless (you) Mike knows we need to ask Matt this question.]
48. P 39 – 53 Land Use in Drainage Basin – As I read through this section, it seemed to me that there is a bit of confusion between land use and land cover. It wasn't until I started looking at the maps more closely that I realized they were labelled "Land Use Cover" maps (eg - Map 4, Map 6, etc). I have heard of Land Cover maps and Land Use maps but my understanding is that the information on these maps is slightly different.
49. p 40 – The Pootatuck River Watershed – First Paragraph – Map 12 is not on p. 50. Is this the correct map to reference which only shows a portion of the watershed? Do you mean Map 4?
50. p 40 – First Paragraph - Discussion of % land cover, as presented, is a bit confusing …
51. p 40 – Suggest making a distinction between land use and land cover. For example, Fig. 2 shows Land Cover with Ag at 5%. However, text states: "Agriculture still ranks as the second-highest land use category, underscoring its continued significance to the town." This may be confusing to reader who looks at Fig. 2 and sees that Forest and Grass/Open Space have much higher % than Ag. Suggest also have diagram that shows Land Use.
52. p 41 – First Paragraph – While it is true that DCIA terminology is often used in the context of municipalities subject to the MS4 General Permit, DCIA can also exist in municipalities that are not subject to the MS4 General Permit. (For example, an impervious area can be directly connected to a storm sewer system in a small town that is not considered a MS4.) So, need to be careful as to how define terminology.
53. p 41 – Third paragraph – Be careful when discussing MS4 permit and NPS. MS4 General Permit has expanded a lot over the years and many things that were once considered NPS (nonregulatory and allowable under 319 NPS grant) are now required as part of MS4. However, if a particular action goes above and beyond what is required in the MS4 General Permit, then it may be considered okay to pursue under (nonregulated) NPS scenario. (This primarily applies to funding. For example, 319 NPS is not supposed to fund anything that is *required* under the MS4 General Permit.)
54. p 41 – Paragraph 5 – Mentions "all three towns in the watershed" … but does not refer to towns by name or percentage of the watershed that they occupy. May also want to refer readers to Map 5. May also want to emphasize that activities in Newtown have the strongest influence since most of the watershed is located in this community.
55. P 43 – 46 – Deep Brook – This section needs to be reviewed and reworked. There is redundant language and information throughout. Consider discussing impairment info separately in other,

appropriate sections and not combining with land use/ land cover. In other words, make this section more consistent with discussions of land use/land cover in other Pootatuck sub-watersheds.

56. p 43 - Deep Brook – Re: language: " considered *unfit* for recreational use"; Would suggest that use term "impaired" rather than "unfit".
57. p 44 – Deep Brook – Third Paragraph – Second sentence seems to confuse TMDL created by CT DEEP and 319 NPS funding awarded to HVA to develop watershed based plan. Do not understand what "The reduction plan has been in effect through the HVA since 2019 … "means. Language in last sentence also needs work.
58. pp 54 – 55 – Watershed Management – As mentioned in other sections, this section seems to confuse stormwater that is regulated under the CT MS4 General Permit versus nonpoint which is handled, in part, through nonregulatory programs such as the 319 NPS grant program. Some info in this section is helpful but seems repetitive on info in other sections.
59. p 57 – Water Quality – Suggest revising the title of this section which is a bit confusing, as almost all of the preceding information in this document is about water quality within a broader, watershed context. It appears to me that this section focuses on drinking water and more specifically on groundwater that is used for drinking water.
60. p 57 – Drinking water and Groundwater – Second Paragraph – The term "aquifer" is used without defining it. (For more info, see: Connecticuts Aquifers)
61. p 57 – Drinking Water Sources – Language in this section is a bit awkward and could use some reworking.
62. p 57 – Drinking Water Sources - APAs are a State of CT - not a federal, EPA - designation. More info on CT's APA program can be found at: Aquifer Protection Program , including in "Connecticut's Aquifer Protection Area Program Municipal Manual" which can be found at: Municipal Manual (ct.gov) (Perhaps CT's APAs are being confused with Sole Source Aquifers which is an EPA designation? There may be an overlap but these are two different programs. If more info is needed, suggest consulting with CT DEEP Water Quantity program.)
63. p 78 – Water Quality Goals – Re: "6. Riparian buffers of at least 35' along the Pootatuck River and its tributaries … " Should this perhaps indicate that the buffers should be at least 35' in *width*?
64. p 81 - Implementation Strategy – This section is rather confusing and needs to be reworked. As currently presented it seems to be a blend of information about work that was accomplished as part of the field assessment (which belongs elsewhere in plan) and recommendations for future actions. It would also be helpful to explain why certain actions are recommended as on-going and why these actions were not fully accomplished as part of this current watershed planning process (eg - lack of resources, time, more work than anticipated, etc.) (Reviewers such as EPA will be asking this question.)
65. p 81 – Pollution Source Identification and Mitigation – While identifying "hotspots" is an important goal, it is unclear why "gas stations" are mentioned specifically. Also, there seems to be a disconnect between the EPA 9 Elements approach of developing a watershed based plan which includes identifying causes and sources of water quality impairments.
66. p 81 – Pollution Source Identification and Mitigation … and … Promote BMPs – Similar to above comment, there seems to be a bit of a disconnect … As presented, neither of these two topics seems to specifically address EPA 9 Elements re: recommendation of specific management measures to address sources of impairment.
67. p 81 - Bottom of page – What is meant by "While the CT DEEP and HVA have conducted monitoring during the watershed planning process … "? As written, it sounds as though CT DEEP was involved in water monitoring as part of the development of this plan which was not the case.
68. p 81 – 83 – Last paragraph on p 81 and first two paragraphs on p 82 seem like a rehash of information discussed previously and belong in fieldwork assessment sections of plan, not in recommendations for future work. If recommendation is to continue some of this work then it should be future-oriented and not repetitive of work already accomplished as part of planning process.

69. P 84 – Water Quality - Recommended Actions – Information in this section seems to be a bit redundant of information presented later in document under prioritized non-construction programs under Sect. 10.4
70. p 85 – Table – Potential Funding Sources – CT DEEP 319 is no longer able to provide funding to for general monitoring programs or for conducting pollution trackdown surveys
71. P 87 - E&O - The CT Stormwater Quality Manual was revised in 2023. For more info, see: [Stormwater Manual (ct.gov)]
72. p 98 – 115 – Construction Projects (Deep Brook) – While it appears that five important construction projects have been identified within the Deep Brook portion of the watershed, it has been noted by both EPA and CT DEEP that only one of these projects – Rams Pasture – has been connected to potential bacteria reductions, despite the fact that the 319 funded portion of the project was supposed to focus on Deep Brook water quality impairments – especially recreation impairments associated with bacteria. As a preamble to this section, it would be helpful to explain why this is the case. Is this location considered the primary source of bacteria impairments and is it anticipated that implementing recommended measures here will address all or most of the impairment? If not, did HVA and PRP look for other potential bacteria source within the Deep Brook watershed but fail to find any other obvious hotspots? Were agricultural lands (mentioned elsewhere in this document) investigated as potential sources? Does HVA and PRP feel that other, less obvious sources – failing septics, illicit connections, etc. – may be the primary culprits which can only be identified through trackdown surveys, etc.?
73. p 98 – 115 – Construction Projects (Deep Brook) – Does HVA and PRP feel that any of the identified constructions sites are connected to the aquatic life use impairment impacting Meeker Brook?
74. pp 130 - Priority Non-Construction Program Descriptions – Some of the information in this section is redundant of information presented early in the document under Management Recommendations – Water Quality (starting on p 81).
75. pp 96 - 139 - Priority Construction and Non-Construction Projects - Tables with Recommended Actions, Interim Milestones, Responsible Party, Timeframes, Potential Funding Sources, etc. have not been provided for these projects, as was done for items in preceding section."

11.2.2 Review Received on 5/7/2024

"Would be OK to insert the Homegrown National Park website in the section about that education initiative?"

11.2.3 Review Received on 5/10/2024 - 6/4/2024

"…[H]e asked if all the EPA 9 element watershed based plan (WBPs) projects currently underway will include sections on environmental justice (EJ) and climate change. (…)

I just did a quick 'search' and confirmed that HVA does discuss climate change in different sections of the document. I realize that EJ considerations may/may not apply to the Pootatuck/Deep watershed. However, to the extent that HVA can do so, it would be good to address this topic in some way, shape or form within the document, even if it is just to recognize that this topic does not really apply to this particular watershed.

Apologies for this belated request.

(…)

I should mention that it is also okay to describe potential "downstream" benefits to EJ communities, if applicable. (For example, we have another project underway – an implementation project – in an area that is not an EJ community. However, there in an EJ community "downstream" of this project that will benefit from improved water quality.)

Thank you."

11.3 Public Comments Received on a 1/17/2024 Draft of this Plan

11.3.1 Comment Received on 1/19/2024

"WOW!!!"

11.3.2 Comment Received on 1/23/2024

"Great recommendations in the report. I especially love:

1. Increased water testing – add neonicotinoids if not too expensive. A good history of data points makes it so much easier to ID a problem and/or a trend. With increased rain events and increasing temps one would expect to see more changes and problems.

2. Increase in riparian buffers will help to mediate run-off effects and distribute pollution before it reaches the watercourse. I'm not familiar with "River Smart" but it sounds good.

3. Invasive species – big problem with NO support from the State. I think the town could have a special Invasive Species Committee (could be part of the Conservation Comm or not) with funding from the town and also the state. We can't keep ignoring this – it is getting worse all the time.

4. Homegrown National Park – let's keep it going in some form or another. Tremendous potential in all those back yards.

5. Ban on neonicotinoids – Unfortunately the town can implement such a ban on town property only. Not sure but I think Carl is not using neonics on much of the lawn areas. I know he has reduced some. Anyhow, town usage would be small compared to homeowners who use lawn care professionals and many of whom use neonics for grub control, even though effective and safer alternatives do exist. Problem is best addressed at the state level. Working on it as you know.

6. Tax credits for reducing lawns and planting invasives – YES. It has been done in other states.

I am not sure if I can get to the meeting tomorrow[...] Anyhow, the Plan is such a great resource and glad to see concrete recommendations. Hope that many of them will be implemented. Lots of opportunities for members of the public to get involved either personally or to be in support of town/state programs. Feel free to share any of the above with your group."

11.3.3 Comment Received on 1/24/2024

"I had a question about water temperature. Just briefly, I know nothing about it. So, it's just a question. I've heard different things about water temperature over the years, so I got a little confused. One of the ideas in this proposal was to take a ground culvert at the Head O'Meadow School and convert it into an open-air stream. And that would tend to especially with climate change to warm it up. But I've also heard that there are certain places such as where the culvert water that goes into Meeker Brook for example and flows almost under a building comes out pretty cold. And one of the reasons is that because I presume when Fairfield Hills was built it was buried underneath the campus, somehow that led it to stay cool. So, my question is just a general question of engineering and water temperature and how much we might be able to do to improve things and whether it's generally better to go in one direction or another. Just a general comment."

11.3.4 Comment Received on 1/24/2024

"I'm just wondering if you can tell me what you think are the causes of the bacteria in the Pootatuck and Deep Brook. Have they been identified?"

11.3.5 Comment Received on 1/24/2024

"You feel that is the extent of it [bacterial pollution above], geese?"

11.3.6 Comment Received on 1/24/2024

"One recommendation would be to do DNA testing, you could do it by location and it would lead you to what it [the source of the bacterial pollution above] is."

11.3.7 Comment Received on 1/24/2024

"About the e. coli, I guess the term is impairment on the waterway: I am not familiar with that term, but it doesn't seem that this issue is publicly discussed. I see people recreating, I fish. I didn't know until about a week ago that it was impaired with e. coli. I don't know if that is the kind of thing that we should be proud of. But to me, that is something that the public should be more aware of. And that is a comment.

I get notices after it rains that a beach is closed because of e. coli. I have never heard that to stay out of a river or for my children to stay out of a river. I hope that that would change.

If you will indulge me, the plan mentions equipping decision-makers with resources to facilitate low-impact development. A group of conservation-minded folks, organizations here in Newtown are actively planning in parallel to this plan on how to get our decision-makers and regulations updated. We feel that they are significantly outdated. And as a result, we are constantly fighting really egregious development proposals like one to build on 6 Commerce Road and [that] is also on Deep Brook. We would much rather approach where our decision-makers aren't actively marketing to the highest bidder for those types of proposals that keep coming in. I am just wondering if, how detailed the plan is going to go, if are any or will be any guidance or help to provide us with funds and going beyond resources to bring about changes to regulations and processes. I've recently learned that our Inland Wetlands Commission does not require [its commissioners] to take the UConn basic course, I forget what it's called, aquatics whatever. A little change like that would really probably go a long way just in heading back things off from the path. You are from the [CT] DEEP and we are interested in possible, certain types of proposals being automatically triggering of a DEEP review if they are near an area with a DEEP list—I forget what it's called—of native species in these types of places? So, I'll stop talking, but I just wanna know how detailed when you say resources are included in there, how detailed, what kind of help we can tap into now that might help with our fight in the Inland [and Wetlands Commission].

Thank you."

11.3.8 Comment Received on 1/24/2024

"I have a question. When you talked about invasive species, you talked a lot about or mentioned about the landowner, educating people. But how about the Town? I mean, what is the town; I mean the Pootatuck is bloated right now with a lot of Japanese knotweed, a lot of other bad guys. What is the Town, you know is there going to be money in your budget, is the Town going to be educated on the removal of these species?"

11.3.9 Comment Received on 1/24/2024

"Education is huge because most homeowners can't identify an invasive and a native. So, education is going to be huge. It needs to be increased.

The other thing I was going to ask is: Has the group thought about maybe incentives for homeowners to not use pesticides and chemical fertilizers on the lawn, which I am sure are contributing to pollution on the rivers?

Yes, to that end, I’ve always, not always but for the last ten years I’ve been […inaudible…] concerned with the risks from vectors of diseases but it turns out there are all kinds of species but more particularly insects that are the basis of the food web. […inaudible…] So, we need to be [living] with them. One of those things that the homeowner can do especially is to have a discussion on lawn care [empathy]. That is, to ask them what they’re putting on their lawn because they’re probably putting in [any insect-harmful substance] that is better [in terms of what is in it] for them. So, please ask them what they’re putting down. And there are alternatives that work. This would be a big help for people with […inaudible…] if you have a lawn in this Town. They are everywhere really, it’s huge. [So, our outreach at each of our personal levels would help.] I do have a handout if anybody is interested [with a range of neonicotinoids] and the alternatives.”

11.3.10 Comment Received on 1/24/2024

“Education is critical. We all know that. I think that’s great. But really to truly educate the masses, the average homeowner is not gonna pick up and read this report. I had a hard time getting through all its pages, but I thought it was great. It’s gonna take a budget. I think it’s great that we have a Commissioner here from the most obvious Commission at this point. At least they are represented here. But they don’t have a budget. They don’t have power. I’m really disappointed that there’s no other Commissioners or I don’t see any other Commissioners that I recognize or elected officials here. How do we compel more people who hold the purse strings and the authority to engage in this whole process? It’s a plan that sounds fantastic. But unless those people step up and commit, we are all wasting our time to a certain extent. Thank you.

Have other communities gone through this process? Are there […] notes that we could borrow [from them]?”

11.3.11 Comment Received on 1/24/2024

“You know, one of the things that I think this has to consider is elevating the so-called…inaudible… [management of invasive species]. …inaudible… For so long, the wonderful volunteers in town, it’s like, I don’t know [a drop of water in the ocean] yes… And the problem gets worse all the time, no matter how many volunteers go out there. …inaudible… One thing that has got to be done is that the state [has to provide some money for this.] They do for aquatic species, but not for terrestrial species. I think, I mean [… inaudible.]

11.3.12 Comment Received on 1/24/2024

“What’s the timeline to get the Town to commit to this? Is it legislative for it to get adopted?”

11.3.13 Comment Received on 1/24/2024

“Thank you for your time Randy because we know how badly it is that you want this to work and thank you to the rest of you also. We just have a bunch of people here who are super concerned. Yes, this is education. Yes, there is a plan for going forward. It’s the implementation and how to make this work that I think most of us are concerned about.”

11.3.14 Comment Received on 1/24/2024

“I have no idea what goes into planning watershed management but it sounds critical to the health of the area in which we live.

I do know that the banks and biota of the Pootatuck River are increasingly under threat as Japanese knotweed continues to spread and travel down stream from Sandy Hook Center towards Glen Rd and beyond. I will reference the damaging capabilities of this plant from http://www.newtownknotweed.org/environmental-damage.html

‘Knotweed thrives in disturbed areas, such as roadsides and construction sites as well as streams, riverbanks and railways. Once established, it can spread alarmingly fast, dominating the landscape and creating monoculture stands that threaten native plant communities and destabilize riverbanks.’

I ask that you add, ‘Hire a professional such as All Habitat or Christian Allyn of Invasive Plant Solutions LLC to restore the native flora’ to the plan.

These folks actually know the phenology of this noxious weed and can successfully combat the occupation of this destructive plant.

Thanks for your consideration and concern for the health and heritage of the Pootatuck.”

11.3.15 Comment Received on 1/25/2024

“I am a Newtown resident, but am sorry to have missed the hearing last night on the Pootatuck River Watershed Management Plan. I thought I might make one constructive observation.

By virtue of good intentions and generosity with their time, many people contribute to car-washing fundraisers across from the Newtown High School, at Berkshire Motors. This is a wonderful idea, except that the area is within the Pootatuck River watershed, and the wastewater is not recaptured (as is legally required at car washes). Unfortunately, the waste, with its detergents and contaminants, eventually makes its way into the river. The right thing would be to discontinue the car washes, leaving that to professionals with suitable non-polluting facilities, and find another fundraising vehicle.”

11.3.16 Comment Received on 1/25/2024

“Thanks for presenting the Draft Pootatuck Watershed Management Plan yesterday (1/24/24). I think it looks great. I had one more question and two more comments but since we ran out of time at the public hearing, I am including them in this email instead.

Question: On p.81 something called the "Pootatuck River Greenway and Water Trail" is mentioned a couple times. I was hoping to clarify as much as possible what this project might include, given that the Bike & Trail Committee I am a member of has been interested in projects that might overlap with this. Does this refer to the proposed Greenway linking Fairfield Hills to Sandy Hook Center? Or does it refer to something more extensive, such as a connection all the way from Rocky Glen State Park to the Newtown Highway Dept.?

Comment 1: I might have missed it, but I don't think the lists of parks and recreation opportunities in the watershed included the Orchard Hill Nature Center. This great town property is full of history and trails centered around a stretch of the North Branch of the Pootatuck River, so I think it is very relevant. In fact, it might be appropriate to add signs there with educational material about the entire watershed, and how the north branch contributes.

Comment 2: I have long felt that we could use a project in Newtown to generate names for more of the smaller streams in town, presumably guided by the town historian and neighborhood input. I was struck by how well this draft watershed plan illustrates the potential benefits of such a project. First, there are numerous times in the document where streams need to be referred to as unnamed tributaries, illustrating how many important streams do not have names yet. Second, on p. 70 it mentions the goal to "Cultivate love and respect for the Pootatuck River and its watershed . . ", which does a great job of summarizing what more names could help accomplish. In an earlier life I was on a Conservation Board in a town in NY, and when we created an open space map and added new names to small streams, my impression was that this had a significant impact on the value residents placed on protecting them. If a town proposes names and starts to use them locally they may not be "official" in the sense that they have been adopted by the USGS, but they can still be useful, and their widespread local use could lead to them being officially recognized eventually. Maybe we could start with the Pootatuck Watershed?"

11.3.17 Comment Received on 1/27/2024

"Good morning,

A big thanks to everyone who worked on this comprehensive report. It will provide guidance in efforts to maintain and improve the watershed. I have serval comments:

1) Continued and perhaps increased water quality monitoring should be done. Those data points are so important in identifying trends and problem areas. I would suggest adding a test for imidacloprid, one of the neonicotinoids, if possible. The USGS has released testing results for pesticides in two testing sites in CT. One of those at the mouth of the Norwalk River found imidacloprid levels between 0.01 and 0.1 ug/l, which "exceeds aquatic life benchmarks". The source of the imidacloprid is not cited but that area of the state is not unlike Newtown's. Thus I think it would be worthwhile to determine if Newtown might have a similar problem. I can provide the USGS testing data if you would like. I also have a hand out for homeowners who use lawn care professionals – giving names of neonicotinoids and appropriate alternatives.

2) Support efforts for state reform of pesticide regulations, especially for neonicotinoids. They are now being called the new DDT, affecting so many species that whole ecosystems are at risk.

3) Support efforts for invasive removal in Newtown. Currently the town has no real program – just leaves it up to the Conservation Commission. I suggest a new committee or commission be established to develop a plan and to have budgetary resources to implement the plan. This problem is reducing value of open spaces, diminishing their function of providing healthy habitat for many species. And this problem is getting worse and is generally unrecognized by the general public. The State needs to step up also to provide support and financial assistance for terrestrial invasives.

4) Tax credits for reducing lawns and removing invasives. YES. Great idea and it has been done in other states. A little financial incentive to change homeowners landscapes should be effective and could make a big difference overall.

Thanks again for the work that went into this valuable document."

11.3.18 Comment Received on 1/27/2024

"I would like to draw attention to the inordinate amount of Japanese Knotweed chocking out the banks of the Pootatuck as it meanders through Sandy Hook center. This is a highly invasive plant that needs to be managed with a comprehensive and cohesive plan. Thank you"

11.3.19 Comment Received on 2/5/2024

"I've spent some time "studying" the Plan. It is very comprehensive and informative.

Proposed Projects. I imagine one would start with the project that will have the most benefit for the cost involved. Of course, they are all important. My guess is that grants will be needed for funding. Wondering if this Committee would be required to obtain these grants.

I'm curious if the Newtown Village Cemetary and/or Newtown Country Club (NCC) are the least bit interested in changes to these sites. After all, this was a recommendation made to them many years ago. Maureen Crick, Pres. of the Village Cemetary Association, attended the Meeting and is also listed as a contributor in the Management Plan. Kevin Cragin was also in attendance, representing NCC. Also wondering if the town could **require them to create buffers**. Seems to me if their improper management is impacting water quality, the town would have the right.

Development. There must be acceptance and willingness on the part of town officials, Land Use, IW and P&Z to adopt higher standards for development regulations. As you say, our town should be using the latest technology and low impact development techniques, especially facing the impacts of a changing climate.

Education and Community Engagement. This too is a challenge. People need to understand the impacts of spreading chemical fertilizers and pesticides. As with Ram's Pasture and NCC, landowners should be **required to buffer streams and ponds** and also be **restricted from using these chemicals** BECAUSE they are impacting water quality for everyone. I also want to see the town initiate and support education of town residents for all the issues outlined in the Manag[e]ment Plan. So far, it's been left to conservation groups with limited funds. I'll do all [I] can as […].

That's my two cents."

11.3.20 Comment Received on 2/15/2024

"I would like to offer up a concern that I have regarding the [Pootatuck River Watershed Management Plan or] PRWMP.

The so-called Meeker Brook is little more than a few hundred feet long and conveys the entirety of a 140+ acre campus stormwater system. This would more aptly be named a conveyance drainage area but the PRWMP has equated this area to a possible fishery area.

I believe stormwater improvements, as labeled stormwater conveyance, would be more apt to fit the 319 programs and possible funding sources. These would include sediment capture areas, treatment trains and LID modifications.

These are of course my personal opinions and I did want them lifted up as a public comment.

Thanks"

11.3.21 Comment Received on 2/23/2024

"My notes on the WMP (pdf pages listed):

Page 2: Sarah Crosby of Harbor Watch is Dr. Sarah Crosby of Maritime Aquarium,

Page 85, second bullet point of Recommended Actions: "Establish and execute a bacteria-monitoring program..." should be a "Establish and execute an integrated water quality monitoring program..."

Page 86, in Recommended Actions, add a bullet point for "Engage with existing collaborations and efforts, such as the River Restoration Network, to develop and fund combined efforts at barrier removal.

Page 87,:

Private/Civic Foundations: add the Jeniam Foundation

Public-Private/Hybrid Sources: add the Long Island Sound Stewardship Fund”

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APPENDIX A: Deep Brook TMDL

A Total Maximum Daily Load Analysis for Recreational Uses of the Deep Brook Sub-Regional Basin

FINAL

This document has been established pursuant to the requirements of Section 303(d)of the Federal Clean Water Act

_/s/ Betsey Wingfield____________ _9/19/11____
Betsey Wingfield Date
Bureau Chief
Bureau of Water Protection and Land Reuse

/s/ Macky McCleary
_Deputy C ommissioner___________ _9/22/11___
Daniel Esty Date
Commissioner

Connecticut Department of
ENERGY &
ENVIRONMENTAL
PROTECTION

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INTRODUCTION

The Total Maximum Daily Load (TMDL) analysis is a management tool used to restore impaired waters by establishing the maximum amount of a pollutant that a waterbody can receive without adverse impacts to fish, wildlife, recreation, or other public uses. A TMDL takes into account pollutant loadings from point sources, nonpoint sources, background levels and incorporates a margin of safety. The completed analysis provides guidance for responsible parties to use as a framework for developing an implementation plan to reduce pollutants in impaired waters.

A Total Maximum Daily Load (TMDL) analysis was completed for indicator bacteria in the Deep Brook Sub-Regional Basin (Figure 1 of Appendix A). This waterbody is included on the most recent *List of Connecticut Waterbodies Not Meeting Water Quality Standards* (Chapter 3 of the *2010 State of Connecticut Integrated Water Quality Report*[1]) due to exceedences of the indicator bacteria criteria contained within the State *Water Quality Standards*[2] (WQS). Under section 303(d) of the Federal Clean Water Act (CWA), States are required to develop TMDLs for waters impacted by pollutants that are included on their Impaired Waters Lists, and for which technology-based controls are insufficient to achieve water quality standards.

In general, the TMDL represents the maximum loading that a waterbody can receive without exceeding the water quality criteria, which have been adopted into the WQS for that parameter. Federal regulations specify that TMDL loadings may be expressed as a mass per time, toxicity, or other appropriate measure[3]. In this TMDL, loadings are expressed as the average percent reduction from current loadings that must be achieved to meet water quality standards. The U.S. Environmental Protection Agency‟s (EPA) most recent guidance recommends that all TMDLs and associated load allocations and wasteload allocations be expressed in terms of daily time increments[4]. The percent reduction TMDL for the Deep Brook Regional Basin is applicable each and every day until recreational use goals are attained. Federal regulations require that the TMDL analysis identify the portion of the total loading which is allocated to point source discharges (termed the Wasteload Allocation or WLA) and the portion attributed to nonpoint sources (termed the Load Allocation or LA), which contribute that pollutant to the waterbody. In addition, TMDLs must include a Margin of Safety (MOS) to account for uncertainty in establishing the relationship between pollutant loadings and water quality. Seasonal variability in the relationship between pollutant loadings and WQS attainment is also considered in TMDL analysis.

The Deep Brook Sub-Regional Basin is located within the Town of Newtown. Newtown has designated urban areas, as defined by the U.S. Census Bureau[5] and is required to comply with the General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems (MS4 permit) (see Appendix E) issued by the Connecticut Department of Energy and Environmental Protection (DEEP). This general permit is applicable to municipalities that are identified in Appendix A of the MS4 permit, that contain designated urban areas and discharge stormwater via a separate storm sewer system to surface waters of the State. The permit requires municipalities to develop a Stormwater Management Plan (SMP) to reduce the discharge of pollutants, as well as to protect water quality. The MS4 permit is discussed further in the "TMDL Implementation Guidance" section of this document. Additional information regarding stormwater management and the MS4 permit can be obtained on DEEP"s website (see Appendix E).

TMDLs that have been established by states are submitted to the EPA Regional Office for review. The EPA can either approve the TMDL or disapprove the TMDL and act in lieu of the State. TMDL analyses for indicator bacteria in the Deep Brook Sub-Regional Basin are provided herein. As required in a TMDL analysis, load allocations are determined, a margin of safety is included, and seasonal variation is considered. This document also includes recommendations for TMDL implementation as well as a water quality monitoring plan.

PRIORITY RANKING

Within the Integrated Water Quality Report (Table 3-8)[1], DEEP indentifies water body segments for which TMDLs are expected to be prepared in the near term. Waters are prioritized for TMDL development based on a variety of reasons such as threats to human health, the potential for a TMDL analysis to result in improved water quality, coordinating with or providing support to regulatory programs designed to improve water quality and comments received during the public review of the proposed 303(d) list. Changes may be made from this list based on data availability, the need to revise priorities to address additional water quality concerns or staff and other resource constraints.

Table 1. The impairment status and TMDL development priority for the Deep Brook Sub-Regional Basin based on the *State of Connecticut Integrated Water Quality Report*[1]**.**

Waterbody Name	Waterbody Segment	Waterbody Segment Description	303(d) Listed	Impairment Use / Cause	Priority
Deep Brook Sub-Regional Basin (Newtown)	CT6019-00_01	From mouth at confluence with Pootatuck River (south side of I84, near exit 10), US to headwaters at Deep Brook Pond outlet dam, parallel to Head of Meadow Road), Newtown.	Yes	Recreation / *Escherichia coli*	2011

DESCRIPTION OF THE WATERBODY

See "Site Specific Information" in Appendix B.

POLLUTANT OF CONCERN AND POLLUTANT SOURCES

Potential sources of indicator bacteria include point and nonpoint sources, such as stormwater runoff, agriculture, sanitary sewer overflows (collection system failures), illicit discharges and inappropriate discharges to the waterbody. Potential sources that have been tentatively identified based on land-use (Figure 3 of Appendix A) and site survey work for each of the waterbodies are presented in Table 2 below. However, the list of potential sources is general in nature and is not comprehensive. There may be other sources not listed here which contribute to the observed water quality impairment. More detailed evaluation of sources is expected to become available as activities are conducted to implement this TMDL.

Table 2. Potential sources of bacteria for the Deep Brook Sub-Regional Watershed.

Waterbody Name	Nonpoint Sources	Point Sources
Deep Brook Sub-Regional Basin	Failed Septic Systems, Unspecified Urban stormwater, Source unknown	Regulated stormwater runoff, illicit connections to storm sewers, Animal waste, other unknown sources

There are no municipal wastewater treatment plants that discharge to the Deep Brook Sub-Regional Basin. There is the town wide MS4 permit (Figure 2 of Appendix A) listed below in Table 3. Two samples of stormwater were collected by the Town of Newtown under the MS4 permit in this watershed. The samples were collected in 2004 and 2005 with values ranging from 350 - 2,500 col/100ml *E. coli*.

Table 3. Permits issued by DEEP in the Deep Brook Sub-Regional Basin.

Registrant	NPDES ID	Discharges to	Type of Permit
Town of Newtown	GSM000048	Watersheds within the Town of Newtown	Municipal Stormwater General Permit

APPLICABLE SURFACE WATER QUALITY STANDARDS

Connecticut's WQS establish criteria for bacterial indicators of sanitary water quality that are based on protecting recreational uses such as swimming (both designated and non-designated swimming areas), kayaking, wading, water skiing, fishing, boating, aesthetic enjoyment and others. Indicator bacteria criteria are used as general indicators of sanitary quality based on the results of EPA research conducted in areas with known human fecal material contamination[6]. The EPA established a statistical correlation between levels of indicator bacteria and human illness rates, and set forth guidance for States to establish numerical criteria for indicator bacteria organisms so that recreational use of the water can occur with minimal health risks. However, it should be noted that the correlation between indicator bacteria densities and human illness rates varies greatly between sites and the presence of indicator bacteria does not necessarily indicate that human fecal material is present since indicator bacteria occur in all warm-blooded animals.

The applicable water quality criteria for indicator bacteria to the Deep Brook Sub-Regional Regional Basin are presented in Table 4. These criteria are applicable to all recreational uses established for these waters. However, it should be noted that the water quality classification and criteria should not be considered as a certification of quality by the State or an approval to engage in certain activities such as swimming. Full body contact should be avoided immediately downstream of wastewater treatment plants, in areas known to have high levels *E. coli*, and during times when *E. coli* levels are expected to be particularly high, such as during and following storm events. The general recreational criteria listed in the WQS for "all other recreational uses" are applicable throughout the watershed since there are no designated or non-designated swimming areas located in segments covered by the TMDL.

Table 4. Applicable indicator bacteria criteria for the subject waterbodies.

Waterbody Name	Waterbody Segment ID	Class	Bacterial Indicator	Criteria
Deep Brook Sub-Regional Basin (Newtown)	CT6019-00_01	A	*Escherichia coli* (*E. Coli*)	Geometric mean less than 126 col/100ml Single sample maximum 576 col/100ml

NUMERIC WATER QUALITY TARGET

TMDL calculations were performed consistent with the analytical procedures presented in the guidelines for *Development of TMDLs for Indicator Bacteria in Contact Recreation Areas Using the Cumulative Frequency Distribution Function Method*[7] included in Appendix D. All data used in the analysis and the results of all calculations are presented in Appendix B. In addition, Appendix B contains a summary of the TMDL analyses for the waterbody. The results are summarized in Table 5.

Table 5. Summary of TMDL analysis.

Waterbody Name	Waterbody Segment Description	Waterbody Segment	Monitoring Site	Average Percent Reduction to Meet Water Quality Standards			
				TMDL	WLA	LA	MOS
Deep Brook (Newtown)	From mouth at confluence with Pootatuck River (south side of I84, near exit 10), US to headwaters at Deep Brook Pond outlet dam, parallel to Head of Meadow Road), Newtown.	CT6019-00_01	43	34	43	28	Implicit

MARGIN OF SAFETY

TMDL analyses are required to include a margin of safety (MOS) to account for uncertainties regarding the relationship between load and waste load allocations, and water quality. The MOS may be either explicit or implicit in the analysis.

The analytical approach used to calculate the TMDLs incorporates an implicit MOS. Sampling results that indicate quality better than necessary to achieve consistency with the criteria are assigned a percent reduction of “zero” instead of a negative percent reduction. This creates an excess capacity that is averaged as a zero value thereby contributing to the implicit MOS. The indicator bacteria criteria used in this TMDL analysis were developed exclusively from data derived from studies conducted by EPA at high use designated public bathing areas with known human fecal contamination[6]. Therefore, the criteria provide an additional level of protection when applied to waters not used as designated swimming areas or contaminated by human fecal material. As a result, achieving the criteria results in an "implicit MOS". Additional explanation concerning the implicit MOS incorporated into the analysis is provided in Appendix D.

SEASONAL ANALYSIS

Previous investigations by DEEP into seasonal trends of indicator bacteria densities in surface waters indicate that the summer months typically exhibit the highest densities of any season[8]. This phenomenon is likely due to the enhanced ability of indicator bacteria to survive in surface waters and sediment when ambient temperatures more closely approximate those of warm-blooded animals, from which the bacteria originate. In addition, resident wildlife populations are likely to be more active during the warmer months and more migratory species are present during the summer. These factors combine to make the summer, recreational period representative of "worst-case" conditions. Achieving consistency with the TMDLs through the summer months will result in achieving full support of recreational uses throughout the remainder of the year.

TMDL IMPLEMENTATION GUIDANCE

There are two major approaches to identifying and implementing changes within a watershed to address water quality impairments and incorporate the recommendations of the TMDL: management of stormwater under the stormwater permitting program and development of watershed based plans. The percent reductions established in this TMDL can be achieved by implementing control actions where technically and economically feasible that are designed to reduce *E. coli* loading from nonpoint sources (Load Allocation) and point sources (Waste Load Allocation).

DEEP advocates that a watershed based plan for the Deep Brook Basin be developed to implement the TMDL. The following guidance offers suggestions regarding BMP implementation, however the goal is to allow responsible parties flexibility in developing a TMDL implementation plan. DEEP supports an adaptive and iterative management approach where reasonable controls are implemented and water quality is monitored in order to evaluate for achievement of the TMDL goals and modification of controls as necessary.

The TMDLs establish a benchmark to measure the effectiveness of BMP implementation. Achievement of the TMDL is directly linked to incorporation of the provisions of the MS4 permit by municipalities, as well as the implementation of other BMPs to address nonpoint sources. Improper disposal of pet waste and waste from wildlife are potential nonpoint sources of bacteria in the Basin. Information on nuisance wildlife control and pet waste disposal can be found on DEEP‟s website (see Appendix E). It is expected that as progress is made implementing BMPs, bacteria levels will decrease and the water quality criteria for recreational use will be achieved and maintained. For additional information on Source Control and Pollution Prevention please refer to Chapter 5 of DEEP‟s Stormwater Manual (see Appendix E). Some point source discharges may be easier to control through identification and regulation, however some sources such as wildlife living in stormdrains or birds nesting under bridges could prove more difficult to control.

DEEP encourages the use of Low Impact Development (LID) techniques as a management measure that may address a variety of nonpoint source issues. LID is a site design strategy intended to maintain or replicate predevelopment hydrology through the use of small-scale controls integrated throughout the site to manage stormwater runoff as close to its source as possible. Infiltration of stormwater through LID helps to remove sediments, nutrients, heavy metals, and other types of pollutants from runoff. Examples of these recommendations can be found in Connecticut‟s approved watershed based plans (see Appendix E).

It is important to note that the TMDLs are applicable to the entire watershed because they are a measurement of compounded impacts at a single point. As such, corrective actions must be undertaken at the source(s) throughout the watershed whether it is a tributary or illicit discharge pipe, in order to achieve the required percent reductions. Also, the approach to TMDL implementation is anticipated to be on a watershed wide scale, which will require that all sources within the regional basin that are contributing to the in-stream impairment be addressed. Action may be taken by State and Local government, business, academia, volunteer citizens groups, and individuals to promote effective watershed management.

Stormwater Permits

Potential point sources to Deep Brook and its tributaries include regulated and unregulated stormwater. Control actions for regulated stormwater include those specified in the General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems (MS4 Permit). Under this permit, municipalities are required to implement minimum control measures in their Stormwater Management Plan (SMP) to reduce the discharge of pollutants, protect water quality, and satisfy the appropriate water quality requirements of the Clean Water Act. The six minimum control measures are:

- Public Education and Outreach
- Public Participation/Involvement
- Illicit Discharge Detection and Elimination
- Construction Site Runoff Control (>1 acre)
- Post-construction Runoff Control
- Pollution Prevention/Good Housekeeping

The minimum control measures include a number of Best Management Practices (BMP) for which an implementation schedule must be developed and submitted to DEEP as Part B

Registration. Under the MS4 permit, all minimum control measures must be implemented by January 8, 2009. Each regulated municipality must identify, implement, and assess the effectiveness of measures utilized to comply with SMP requirements. Information regarding Connecticut's MS4 permit can be found on DEEP's website (see Appendix E). In addition, the EPA has developed fact sheets, which provide an overview of the Phase II final rule and MS4 permit, and provide detail regarding the minimum control measures, as well as optional BMPs not required in Connecticut's MS4 permit. The fact sheets can be found on the EPA's website (see Appendix E). Some of the information includes guidance for the development and implementation of Stormwater Management Plans, as well as guidance for establishing measurable goals for BMP implementation.

Upon approval of a TMDL by EPA, Section 6(k) of the MS4 Permit requires the municipality to review its SMP to determine if its stormwater discharges contribute the pollutant(s) for which the TMDL had been designated. If the municipality contributes a pollutant(s) in excess of the designated TMDL allocation, the municipality must modify its SMP to implement the TMDL within four months of TMDL approval by EPA. For the discharges to the TMDL waterbody(ies), the municipality must assess the six minimum measures of its SMP and modify the plan to implement additional necessary controls for each appropriate measure. Particular focus should be placed on the following plan components: public education program, illicit discharge detection and elimination, stormwater structures cleaning, priority for the repair, upgrade, or retrofit of storm sewer structures.

Watershed Based Plans

One approach to TMDL implementation would be to develop a watershed based plan for the Deep Brook Sub-Regional Basin. A watershed based plan formulated at the local level will most efficiently make use of local resources by assigning tasks to responsible parties and serving as an agreed roadmap to reducing bacteria levels in the Basin. DEEP encourages all local stakeholders to continue their efforts by working together to formulate a watershed based plan to implement the TMDL.

Watershed Based Plans funded under the Clean Water Act Section 319 grant program require incorporation of EPA"s 9 Planning Elements (see Appendix E). Identification of impairments, load reduction, management measures, technical and financial assistance, public information and education, schedule, milestones, performance and monitoring. The Watershed Based Plan should include a flexible schedule and future implementation of management measures recommended to reduce nonpoint source pollution within the watershed. In some cases, implementation efforts included in the Section 319 funded Watershed Based Plan and the TMDL may be scheduled and coordinated together.

Members of DEEP's Watershed Management Program will continue to provide technical and educational assistance to the local municipalities and other stakeholders, as well as identify potential funding sources, when available, for implementation of the TMDL and monitoring plan. Please see Appendix E for a link to contact information for involved DEEP staff .

WATER QUALITY MONITORING PLAN

A comprehensive water quality monitoring program is necessary to guide TMDL implementation efforts and should be designed, at a minimum, to accomplish two major objectives; source detection and tracking water quality improvements. Monitoring is needed to identify specific sources of bacterial loading which will, in turn, direct BMP implementation efforts. As changes are made within the watershed and BMPs applied, additional monitoring is needed to quantify progress in achieving TMDL established goals.

Water quality monitoring can be incorporated into any implementation activity, however, it is explicitly required under the MS4 permit. Stormwater monitoring is required under Section 6(h)(1)(A) of the MS4 Permit which specifies the following monitoring requirement:

> *"Stormwater monitoring shall be conducted by the Regulated Small MS4 annually starting in 2004. At least two outfalls apiece shall be monitored from areas of primarily industrial development, commercial development and residential development, respectively, for a total of six (6) outfalls monitored. Each monitored outfall shall be selected based on an evaluation by the MS4 that the drainage area of such outfall is representative of the overall nature of its respective land use type."*

This type of monitoring may be referred to as event monitoring because it is scheduled to coincide with a stormwater runoff event. Event monitoring can present numerous logistical difficulties for municipalities and may not be the most efficient way to measure progress in achieving water quality standards. This is particularly true for streams draining urbanized watersheds where many sources contribute to excursions above water quality criteria.

However, a comprehensive water quality monitoring program is necessary to guide TMDL implementation efforts. Therefore, the monitoring program should be designed to accomplish two objectives; source detection to identify specific sources of bacterial loading and direct BMP implementation efforts with fixed station monitoring to quantify progress in achieving TMDL established goals. In order to customize their monitoring plan to better identify TMDL pollutant sources and track the effectiveness of TMDL pollutant reduction measures, the municipality may request written approval from DEEP for an alternative monitoring program as allowed by Section 6(h)(1)(B) of the permit:

> *"The municipality may submit a request to the Commissioner in writing for implementation of an alternate sampling plan of equivalent or greater scope. The Commissioner will approve or deny such a request in writing."*

DEEP advises municipalities with discharges that contribute pollutant(s) for which a TMDL(s) has been designated to request approval for an alternative monitoring program to address both source detection and track the effectiveness of TMDL pollutant reduction measures. Source detection monitoring may include visual inspection of storm sewer outfalls under dry weather conditions, event sampling of individual storm sewer outfalls, and monitoring of ambient in-stream conditions at closely spaced intervals to identify "hot spots" for more detailed investigations leading to specific sources of high bacteria loads. Such monitoring may be performed by municipal staff, citizen volunteers, or contracted to an environmental consulting firm. Further guidance for an alternative municipal monitoring is attached as Appendix C.

Progress in achieving TMDL established goals through BMP implementation may be most effectively gauged through implementing a fixed station ambient monitoring program. DEEP strongly recommends that routine monitoring be performed at the same sites used to generate the data to perform the TMDL calculations. Sampling should be scheduled at regularly spaced intervals during the recreational season (May 1- Sept 30). In this way the data set at the end of each season will include ambient values for both "wet" and "dry" conditions in relative proportion to the number of "wet" and "dry" days that occurred during that period. As additional data is generated over time it will be possible to repeat the TMDL calculations and compare the percent reductions needed under "dry" and "wet" conditions to the percent reductions needed at the time of TMDL adoption.

All pollutant parameters must be analyzed using methods prescribed in the Code of Federal Regulations[9]. Electronic submission of data to DEEP is highly encouraged. Results of monitoring that indicate unusually high levels of contamination or potentially illegal activities should be forwarded to the appropriate municipal or State agency for follow-up investigation and enforcement. Consistent with the requirements of the MS4 permit, the following parameters should be included in any monitoring program:

pH (SU)
Hardness (mg/l)
Conductivity (umos)
Oil and grease (mg/l)
Chemical Oxygen Demand (mg/l)
Turbidity (NTU)
Total Suspended Solids (mg/l)
Total Phosphorous (mg/l)
Ammonia (mg/l)
Total Kjeldahl Nitrogen (mg/l)
Nitrate plus Nitrite Nitrogen (mg/l)
E. coli (col/100ml)
Precipitation (in)

DEEP is committed to providing technical assistance in monitoring program design and establishing procedures for electronic data submission.

REASONABLE ASSURANCE

The MS4 Permit is a legally enforceable document that provides reasonable assurance that the municipalities will take steps towards achieving the target TMDL and reducing point sources of stormwater containing bacteria. If portions of a watershed are not subject to the Connecticut's

MS4 Permit Program, DEEP has the authority to include those additional municipally-owned or municipally-operated Small MS4s located outside an Urbanized Area as may be designated by the Commissioner.

In addition, DEEP continues to work with watershed stakeholders to draft Watershed Based Management Plans (WBMPs) under the CWA 319 program (see Appendix E). As part of these WBMPs, watershed stakeholders are required to investigate impairments and promote the implementation of nonpoint source pollution best management practices and stormwater management practices in the watershed. DEEP approves CWA 319 Watershed Based Plans, including those that address management measures to reduce bacteria and source mitigation in order to support the TMDLs. WBMPs include watershed-wide and place-based recommendations aimed at reducing nonpoint sources of pollution, including bacteria. These recommended WBMP projects may be eligible for CWA 319 funding, as long as such projects are not used for permit compliance.

PROVISIONS FOR REVISING THE TMDL

DEEP reserves the authority to modify the TMDL as needed to account for new information made available during the implementation of the TMDL. Modification of the TMDL will only be made following an opportunity for public participation and will be subject to the review and approval of the EPA. New information, which will be generated during TMDL implementation, includes monitoring data, new or revised State or Federal regulations adopted pursuant to Section 303(d) of the Clean Water Act, and the publication by EPA of national or regional guidance relevant to the implementation of the TMDL program. DEEP will propose modifications to the TMDL analyses only in the event that a review of the new information indicates that such a modification is warranted and is consistent with the anti-degradation provisions in Connecticut Water Quality Standards. The subject waterbodies of this TMDL analysis will continue to be included on the *List of Connecticut Waterbodies Not Meeting Water Quality Standards* until monitoring data confirms that recreation use is fully supported.

PUBLIC PARTICIPATION

This TMDL document will be public noticed for review and comment by the general public. It is expected that open forums will continue as implementation of the TMDL occurs.

Connecticut Department of Energy and Environmental Protection
Bureau of Water Protection and Land Reuse
Planning and Standards Division
79 Elm St
Hartford, CT 06106

REFERENCES

1 – Connecticut Department of Environmental Protection, 2010. Table 3-2: List of Connecticut Water bodies Not Meeting Water Quality Standards. In: *Integrated Water Quality Report to Congress. Bureau of Water Protection and Land Reuse*, 79 Elm Street, Hartford, CT 06106-5127.

2 - Connecticut Department of Environmental Protection, 2011 *Connecticut Water Quality Standards*. Bureau of Water Management, 79 Elm Street, Hartford, CT.

3 - Code of Federal Regulations, Title 40, CFR, section 130.2(i).

4 – United States Environmental Protection Agency. November 15, 2006 memorandum. *Establishing TMDL "Daily" Loads in Light of the Decision by the U.S. Court of Appeals for the D.C. Circuit in Friends of the Earth, Inc. v. EPA, et al., No.05-5015, (April 25, 2006) and Implications for NPDES Permits*.

5 - U.S. Census Bureau, March 2002. www.census.gov/geo/www/ua/ua_2k.html.

6 - United States Environmental Protection Agency, 1986. *Ambient Water Quality Criteria for Bacteria -1986.* EPA 440/5-84-002.

7 - Connecticut Department of Environmental Protection, 2005. *Development of Total Maximum Daily Loads (TMDLs) for Indicator Bacteria in Contact Recreation Areas Using the Cumulative Distribution Function Method*. Bureau of Water Management, 79 Elm Street, Hartford, CT.

8 - Connecticut Department of Environmental Protection, 2002. *Water Quality Summary Report for Sasco Brook, Mill River, Rooster River, Fairfield County Connecticut*. November 2002. Bureau of Water Management, 79 Elm Street, Hartford, CT.

9 - Code of Federal Regulations, Title 40, CFR, Part 136.

Appendix A. Regional Basin Maps

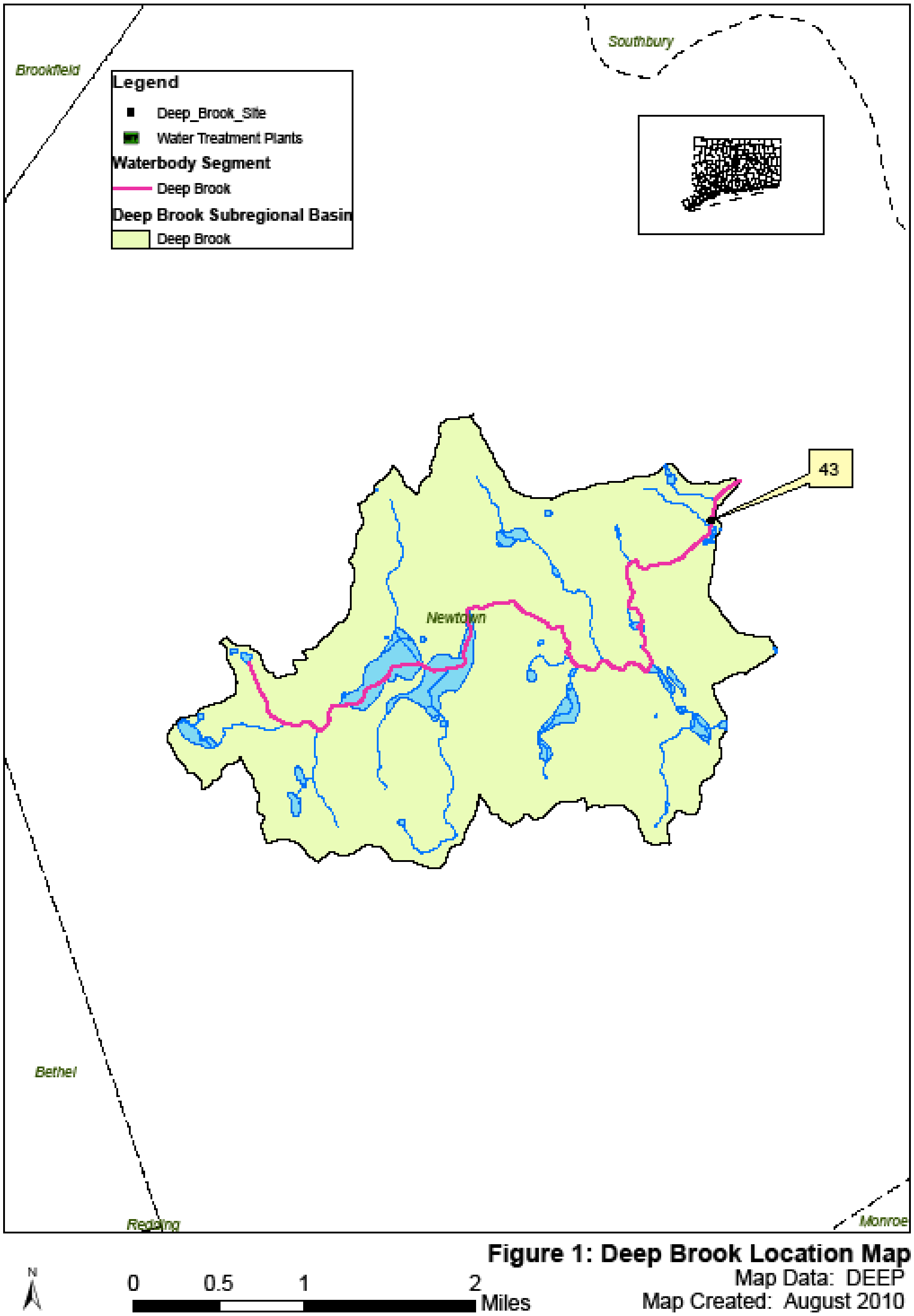


Figure 1: Deep Brook Location Map
Map Data: DEEP
Map Created: August 2010

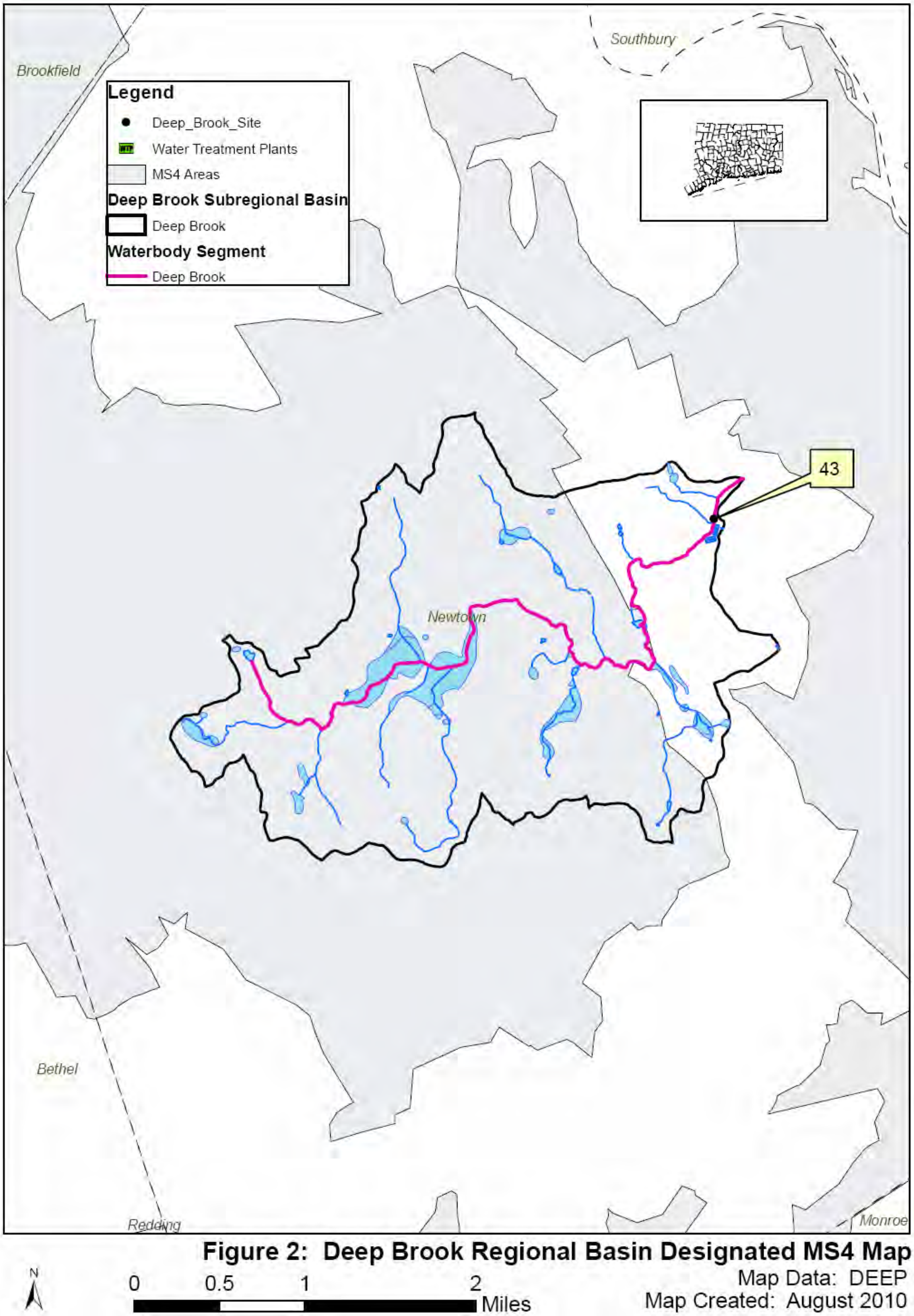


Figure 2: Deep Brook Regional Basin Designated MS4 Map

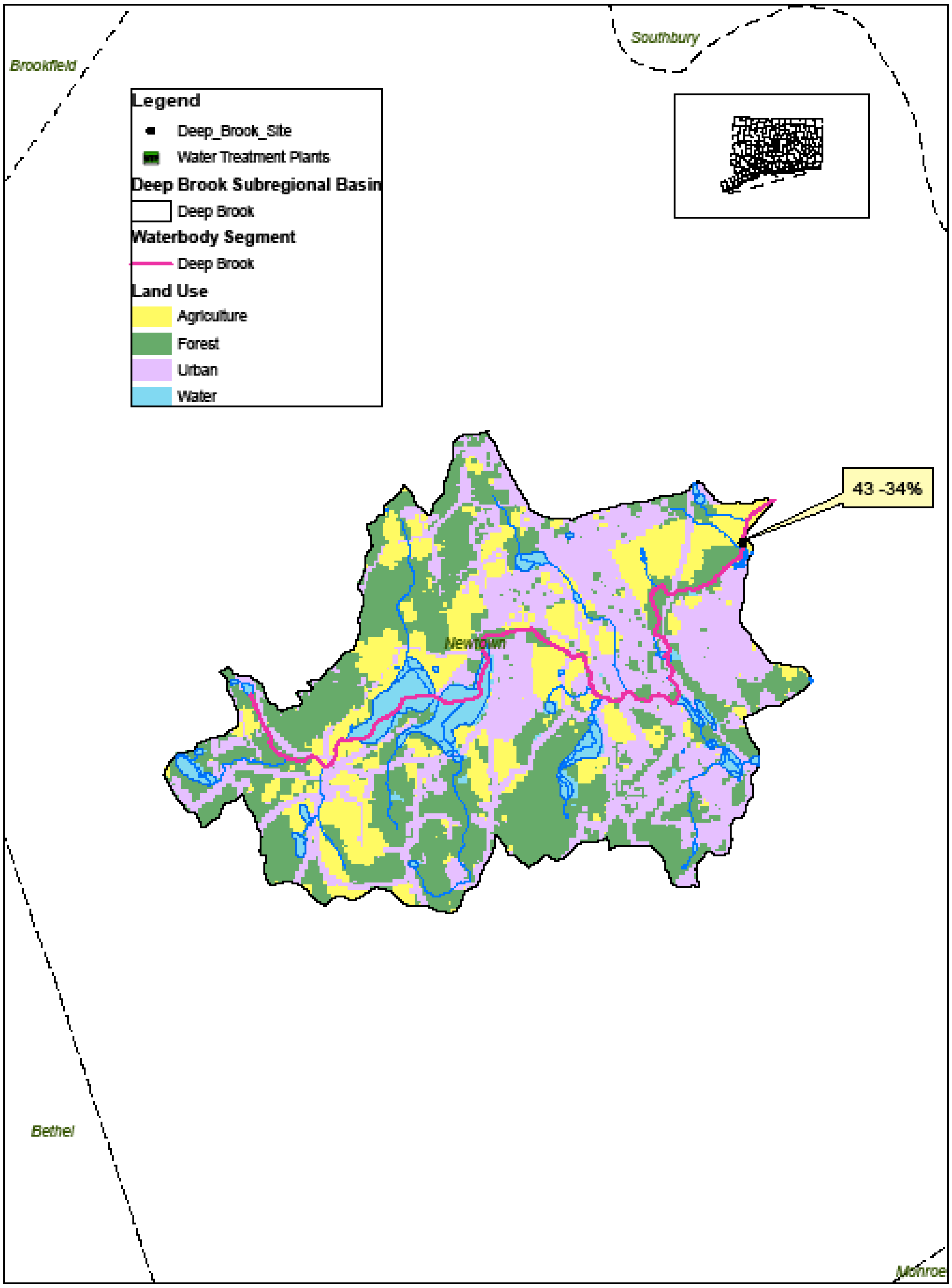


Figure 3: Deep Brook Regional Basin Land Use and TMDL % Reduction Map

Map Data: DEEP
Map Created: August 2010

Appendix B. Site Specific Information and TMDL Calculations

Appendix B
Deep Brook Sub-Regional Basin
Waterbody Specific Information

<u>Impaired Waterbody</u>
Waterbody Name: Deep Brook Sub-Regional Basin
Waterbody Segment IDs: CT6019-00_01
Waterbody Description: From mouth at confluence with Pootatuck River (south side of I84, near exit 10), US to headwaters at Deep Brook Pond outlet dam, parallel to Head of Meadow Road), Newtown
Waterbody Segment Size: 5.25 miles

<u>Impairment Description:</u>
Designated Use Impairment: Recreation
Surface Water Classification: Class A

<u>Watershed Description:</u>
Total Drainage Basin Area: 3422.181 acres
Sub-regional Basin Name & Code: Deep Brook Sub-Regional Basin, 6019
Regional Basin: Housatonic Main Stem Regional Basin
Major Basin: Housatonic River Basin
Watershed Towns: Newtown
MS4 applicable? Yes
Applicable Season: Recreation Season (May 1 to September 30)
Sub-Regional Basin Land Use*:

Land Cover Category	Percent Composition
Agriculture	21% (732 acres)
Forest	41% (1391 acres)
Urban	33% (1139 acres)
Water	5% (160 acres)

*Data Source2002 Land Cover, CLEAR - Center for Land Use Education and Research.

Deep Brook

CT6019-00_01

Data Used in the Analysis

Monitoring Site: 43, Newtown, Downstream Bridge Crossing @ former STP Outfall

Date	Precip.(in)[1] 24h	48h	96h	Condition[2] (WET/DRY)	E. coli (col./100 ml)	Rank	Proportion	Criteria Value	% Reduction
6/6/2007	0.00	0.00	0.71	DRY	710	30.0	0.8333	307	57
6/12/2007	0.04	0.20	0.25	DRY	300	24.0	0.6667	187	38
6/12/2007	0.04	0.20	0.25	DRY	310	25.0	0.6944	201	35
6/27/2007	0.09	0.09	0.09	DRY	86	8.0	0.2222	62	28
7/5/2007	0.14	1.00	1.00	**WET**	3100	35.0	0.9722	576	81
7/10/2007	0.00	0.00	0.01	DRY	63	7.0	0.1944	57	10
7/17/2007	0.00	0.00	0.11	DRY	20	4.5	0.1250	44	0
7/25/2007	0.00	0.00	1.20	DRY	240	22.0	0.6111	163	32
8/2/2007	0.00	0.00	0.00	DRY	10	3.0	0.0833	35	0
8/9/2007	0.01	0.74	0.74	**WET**	390	27.0	0.7500	235	40
8/30/2007	0.00	0.00	0.00	DRY	110	11.0	0.3056	79	28
9/6/2007	0.00	0.00	0.00	DRY	360	26.0	0.7222	217	40
9/13/2007	0.00	0.00	0.06	DRY	150	15.5	0.4306	107	29
5/22/2008	0.12	0.24	0.50	**WET**	580	29.0	0.8056	279	52
6/5/2008	0.00	0.32	0.32	**WET**	5	1.5	0.0417	26	0
6/5/2008	0.00	0.32	0.32	**WET**	5	1.5	0.0417	26	0
6/9/2008	0.00	0.05	0.42	DRY	120	13.0	0.3611	91	24
6/19/2008	0.00	0.11	1.62	DRY	230	20.5	0.5694	148	36
6/26/2008	0.00	0.00	0.45	DRY	120	13.0	0.3611	91	24
7/8/2008	0.00	0.00	1.35	DRY	97	9.5	0.2639	70	27
7/23/2008	0.86	0.86	1.18	**WET**	840	31.5	0.8750	363	57
7/31/2008	0.12	0.45	0.45	**WET**	1600	33.0	0.9167	450	72
8/4/2008	0.00	0.00	0.39	DRY	840	31.5	0.8750	363	57
8/14/2008	0.46	0.46	1.09	**WET**	170	17.0	0.4722	118	30
9/9/2008	0.97	0.97	6.19	**WET**	4200	36.0	1.0000	576	86
6/11/2009	0.34	0.35	1.09	**WET**	260	23.0	0.6389	175	33
6/17/2009	0.01	0.01	0.99	DRY	120	13.0	0.3611	91	24
7/2/2009	0.13	0.27	0.41	**WET**	150	15.5	0.4306	107	29
7/9/2009	0.00	0.01	0.38	DRY	2500	34.0	0.9444	547	78
7/16/2009	0.32	0.32	0.32	**WET**	500	28.0	0.7778	255	49
7/23/2009	0.23	0.24	1.09	**WET**	230	19.0	0.5278	134	42
7/23/2009	0.23	0.24	1.09	**WET**	210	20.5	0.5694	148	30
8/6/2009	0.00	0.07	0.09	DRY	41	6.0	0.1667	52	0
8/6/2009	0.00	0.07	0.09	DRY	97	9.5	0.2639	70	27
8/12/2009	0.02	0.02	0.23	DRY	20	4.5	0.1250	44	0
8/19/2009	0.00	0.00	0.03	DRY	180	18.0	0.5000	126	30

Statistics

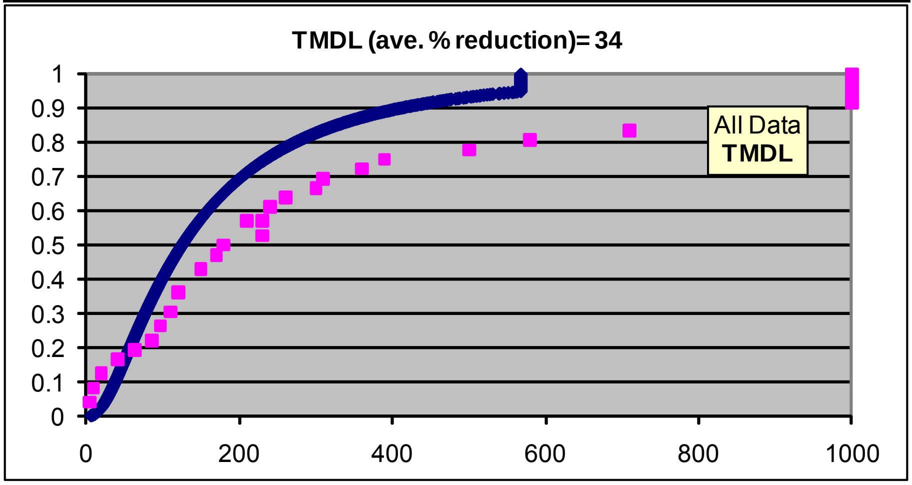
# Samples DRY	**22**
# Samples WET	**14**
# Samples Total	**36**
Geomean	**181**
Log std deviation	**0.6959**

Avg % Reduction

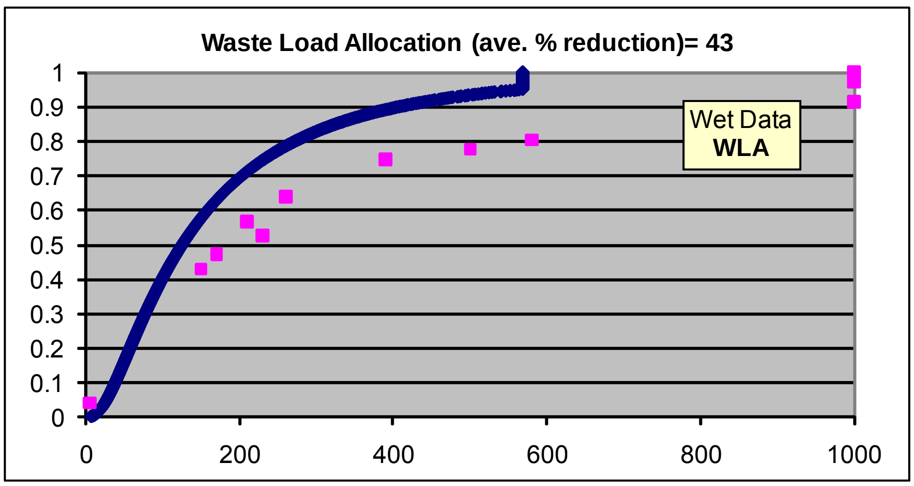
Wet (WLA)	**43**
Dry (LA)	**28**
Total (TMDL)	**34**

Precipitation data provided by NOAA and Weather Underground. E. coli data provided by DEEP. **WET** Condition defined as greater than 0.1" precipitation in 24 hours or 0.25" precipitation in 48 hours, or 2.0" precipitation in 96 hours.

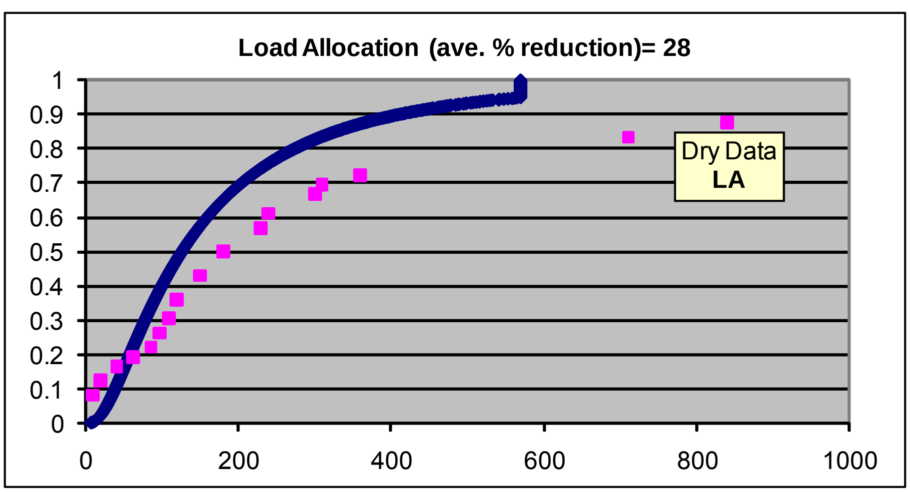
Criteria Curve for Monitoring Site 43
y axis = cumulative frequency; x axis = *E.coli* (col/100mL)



TMDL needed from current condition (magenta squares) to meet criteria (blue line). Current condition based on dry and wet weather data.



Waste Load Allocation (WLA) needed from current condition (magenta squares) to meet criteria (blue line). Current condition based on wet weather data.



Load Allocation (LA) needed from current condition (magenta squares) to meet criteria (blue line). Current condition based on dry weather data.

Deep Brook Sub-Regional Basin
TMDL Summary

The TMDL analysis for the Deep Brook Sub-Regional Basin was conducted at one site, station 43, which is representative for this segment. The analysis indicates that the site is influenced by sources of bacteria active under both wet weather and dry weather conditions. Station 43 indicated a 43% wet weather reduction of indicator bacteria and a 28% reduction for dry weather. Generally, percent reductions for wet weather conditions were found to be slightly higher than dry weather conditions. Reductions in the Waste Load Allocation (WLA) can be achieved through the detection and elimination of illicit discharges to the storm sewers and the upgrade of failed sanitary infrastructure. The WLA also includes regulated stormwater and can be further reduced by the installation of engineered controls to minimize the surge of stormwater to the river, promote groundwater recharge, and improve water quality will also reduce inputs of bacteria to the river. Since illicit discharges and failed sanitary collection systems may also be active at some sites during dry conditions, it is likely that corrective actions aimed at eliminating these sources will also reduce the Load Allocation (LA). Other contributors to the LA include domestic animal waste, wildlife, and stormwater input as sheet flow.

Station 43 in the Deep Brook Sub-Regional Basin, Newtown Connecticut.
Map available at www.Bing.com .

Appendix C. Municipal Stormwater alternative monitoring guidance

Guidance for Implementing Bacteria-based TMDLs within DEEP Stormwater Permitting Program

DEEP investigates impaired waterbodies to determine the major causes of impairment. This information is expressed as Total Maximum Daily Load (TMDL). TMDLs provide the framework for restoring impaired waters by establishing the maximum amount of a pollutant that a waterbody can take in without adverse impact to fish, wildlife, recreation, or other public uses. If a TMDL includes requirements for control of stormwater discharges it is the responsibility of the municipalities within the watershed to implement the recommendations of the TMDL (typically bacteria reduction). Management of stormwater quality within the municipality is governed by the General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems (MS4 General Permit).

The MS4 General Permit is required for any municipality with urbanized areas that initiates, creates, originates or maintains any discharge of stormwater from a storm sewer system to waters of the state. The MS4 permit requires towns to design a Stormwater Management Plan (SMP) to reduce the discharge of pollutants in stormwater to improve water quality. The plan must address the following 6 minimum measures.

1. Public Education and Outreach.
2. Public Involvement/Participation.
3. Illicit discharge detection and elimination.
4. Construction site stormwater runoff control.
5. Post-construction stormwater management in the new development and redevelopment.
6. Pollution prevention/good housekeeping for municipal operations.

Section 6(k) of the MS4 General Permit requires a municipality to modify their Stormwater Management Plan to implement the TMDL within 4 months of TMDL approval by EPA if stormwater within the municipality contributes pollutant(s) in excess of the allocation established within the TMDL. For the discharges to the TMDL waterbody(ies), the municipality must assess the six minimum measures of its plan and modify the plan to implement additional, necessary controls for each appropriate measure. Particular focus should be placed on the following plan components: public education program, illicit discharge detection and elimination, stormwater structures cleaning, priority for the repair, upgrade, or retrofit of storm sewer structures. The goal of the modifications is to establish a program to improve water quality consistent with the requirements of the TMDL. Modifications to the Stormwater Management Plan in response to TMDL development should be submitted to the Stormwater Program of DEEP for review and approval.

Also required under the MS4 General Permit is annual stormwater monitoring. The permit provides a general framework for monitoring stormwater quality within a municipality. At minimum, stormwater from six sample locations are to be collected annually: two outfalls from commercial areas, two from industrial areas, and two from residential areas. These six sample locations are point source discharges that drain areas with distinct characteristics. Each stormwater sample is tested for 12 parameters using methods prescribed in Title 40, CFR, Part 136.

pH (SU)	Total Suspended Solids (mg/l)
Hardness (mg/l)	Total Phosphorous (mg/l)
Conductivity (umos)	Ammonia (mg/l)
Oil and grease (mg/l)	Total Kjeldahl Nitrogen (mg/l)
Chemical Oxygen Demand (mg/l)	Nitrate plus Nitrite Nitrogen (mg/l)
Turbidity (NTU)	E. coli (col/100ml)

However, DEEP encourages municipalities affected by the establishment of a TMDL to develop an alternative stormwater monitoring plan to assess progress in meeting the goals of the TMDL. Alternate monitoring programs are established in accordance with Section 6(h)(1)(B) of the MS4 permit which allows towns to submit written requests to the Commissioner for the review and approval of alternate stormwater monitoring plans of equivalent or greater scope. This gives towns freedom to develop a plan that better assesses the stormwater quality in their watershed. The monitoring program should be designed to accomplish two objectives; source detection to identify specific sources of bacterial loading and direct BMP implementation efforts with fixed station monitoring to quantify progress in achieving TMDL established goals. Monitoring may be performed by municipal staff, citizen volunteers, or contracted to an environmental consulting firm. In order to secure DEEP approval, the program must include sampling to address both objectives (source detection and progress quantification). Source detection monitoring may include such activities as visual inspection of storm sewer outfalls under dry weather conditions, event sampling of individual storm sewer outfalls, and monitoring of ambient (in-stream) conditions at closely spaced intervals to identify "hot spots" for more detailed investigations leading to specific sources of high bacteria loads.

DEEP strongly recommends that stream monitoring be performed at the same locations DEEP sampled during TMDL development. Samples should also be collected at other key locations within the watershed, such as above and below potential contributing sources or areas slated for BMP implementation. Since watershed borders and TMDLs do not follow town borders there is a possibility DEEP did not sample locations in your town. If this is the case collecting a sample where the waterbody enters your town and another where the waterbody leaves your town maybe helpful to determine how stormwater from your town influences water quality. In all cases, sampling should be scheduled at regularly spaced intervals during the recreational season. In this way, the data set at the end of each season will include ambient values for both "wet" and "dry" conditions.

Appendix D. Cumulative Frequency Distribution Function Method

DEVELOPMENT OF TOTAL MAXIMUM DAILY LOADS (TMDLs) FOR INDICATOR BACTERIA IN CONTACT RECREATION AREAS USING THE CUMULATIVE FREQUENCY DISTRIBUTION FUNCTION METHOD

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Mary E. Becker, Environmental Analyst
CT Department of Environmental Protection
Total Maximum Daily Load Program

Last revised: November 8, 2005

OVERVIEW OF APPROACH

The analytical methodology presented in this document provides a defensible scientific and technical basis for establishing TMDLs to address recreational use impairments in surface waters. Representative ambient water quality monitoring data for a minimum of 21 sampling dates during the recreational season (May 1 – September 30) is required for the analysis. The reduction in bacteria density from current levels needed to achieve consistency with the criteria is quantified by calculating the difference between the cumulative relative frequency of the sample data set and the criteria adopted by Connecticut to support recreational use. Connecticut"s adopted water quality criteria for indicator bacteria (*Escherichia coli*) are represented by a statistical distribution of the geometric mean 126 and log standard deviation 0.4 for purposes of the TMDL calculations.

TMDLs developed using this approach are expressed as the average percentage reduction from current conditions required to achieve consistency with criteria. The procedure partitions the TMDL into wet weather allocation and dry weather allocation components by quantifying the contribution of ambient monitoring data collected during periods of high stormwater influence and minimal stormwater influence to the current condition. The partition is used to determine the effect of high stormwater influence on the contribution of sources to the waterbody. TMDLs developed using this analytical approach provide an ambient monitoring benchmark ideally suited for quantifying progress in achieving water quality goals as a result of TMDL implementation.

APPLICABILITY

The methodology is intended solely for use in developing TMDLs for waters that are identified as impaired on the *List of Connecticut Water Bodies Not Meeting Water Quality Standards* [1]. It is expected that implementation of these TMDLs will be accomplished through implementing the provisions of the Small Municipal Separate Storm Sewer System general permit (MS4 permit) [2] in designated urban areas, as well as through measures that address non-point sources. The method as described here is not intended for use as an assessment tool for purposes of identifying use attainment status relative to listing or delisting of waterbody segments pursuant to Section 303(d) of the federal Clean Water Act. Assessment of use support is performed in accordance with the Department"s guidance document, *Connecticut Consolidated Assessment and Listing Methodology (CT-CALM)* [3].

BACKGROUND

TMDLs are established by the State in accordance with the requirements established in the federal Clean Water Act. Section 303(d) of the Act requires the State to perform an assessment of waters within the State relative to their ability to support designated uses including recreational use. The procedure used by the Department to assess use attainment is described in the guidance document, *CT-CALM* [3]. The list of waterbody segments in Connecticut that do not currently support recreational use is updated to incorporate the most recent monitoring information by the Department every two years. As a result of this process, waterbodies may be added to or deleted from the list of impaired waters in accordance with the *CT-CALM* guidance. Once complete, the list is submitted to the Regional office of the federal EPA for approval. Section 303(d) of the Act requires the State to establish TMDLs for each pollutant contributing to the impairment of each waterbody segment identified on the list.

WATER QUALITY CRITERIA FOR INDICATOR BACTERIA

Connecticut‟s adopted water quality criteria for the indicator bacteria *Escherichia coli (E.coli)* in the CT Water Quality Standards [4] include a geometric mean and upper confidence limit (i.e. single sample maximum), which are based on three recreational use categories. The categories include designated swimming, non-designated swimming, and all other recreational uses. „Designated swimming‟ includes areas that have been designated by State or Local authorities. „Non-designated swimming‟ includes waters suitable for swimming but have not been designated by State or Local authorities, as well as water that support recreational activities where full body contact is likely, such as tubing or water skiing. „All other recreational uses‟ include waters that support recreational activities where full body contact is infrequent, such as fishing, boating, kayaking, and wading. The recreational uses and applicable criteria are provided in the following table.

Recreational Use Category	Indicator Bacteria	Geometric Mean	Single Sample Maximum Upper Confidence Limit
Designated Swimming			235col/100mls 75th Percentile
Non-designated Swimming	*E.coli*	126col/100mls	410col/100mls 90th Percentile
All Other Recreational Uses			576col/100mls 95th Percentile

Table 1. Applicable indicator bacteria (*E.coli*) water quality criteria for recreational uses

The indicator bacteria, *E. coli*, is not pathogenic, rather its presence in water is an indicator of contamination with fecal material that may also contribute pathogenic organisms. Connecticut‟s criteria are based on federal guidance [5]. In this guidance, the basis for the criteria and the relationship between the geometric mean criterion and the single sample maximum criterion is explained in detail.

The geometric mean criterion was derived by EPA scientists from epidemiological studies at beaches where the incidence of swimming related health effects (gastrointestinal illness rate) could be correlated with indicator bacteria densities. EPA‟s recommended criteria reflect an average illness rate of 8 illnesses per 1000 swimmers exposed. This condition was predicted to exist based on studies cited in the federal guidance when the steady-state geometric mean density of *E. coli* was 126 col/100ml. The distribution of individual sample results around the geometric mean is such that approximately half of all individual samples are expected to exceed the geometric mean and half will be below the geometric mean.

EPA also derived a single sample maximum criterion from this same database to support decisions by public health officials regarding the closure of beaches when an elevated risk of illness exists. Because approximately half of all individual sample results for a beach where the risk of illness is considered "acceptable" are expected to exceed the geometric mean criteria of 126 col/100ml, an upper boundary to the range of individual sample results was statistically derived that will be exceeded at frequencies less than 50% based on the variability of sample data. The mean log standard deviation for *E. coli* densities at the freshwater beach sites studied by EPA was 0.4. The single sample maximum criterion of 235 col/100mls, 410 col/100mls, and 576 col/100mls adopted by Connecticut represents the 75^{th}, 90^{th}, and 95^{th} percentile upper confidence limit, respectively, for a statistical distribution of data with a geometric mean of 126 and a log standard deviation of 0.4 as recommended by EPA [5].

Consistent with the State‟s disinfection policy (Water Quality Standard #23), the critical period for application of the indicator bacteria criteria is the recreational season, defined as May 1 through September 30. For waters that do not receive point discharges of treated sewage subject to the disinfection policy, a review of ambient monitoring data contained in the State‟s Ambient Monitoring Database [6] confirms that bacteria densities are typically highest during the summer months. Consistency with criteria during the summer is indicative of consistency at all times of the year. Lower densities reported during other portions of the year are most likely a result of several environmental factors including more rapid die-off of enteric bacteria in colder temperatures and reduced loadings from wildlife and domestic animal populations. Further, human exposure to potentially contaminated water is greatly reduced during the colder months, particularly exposure that results from immersion in the water since cold temperatures discourage participation in recreational activities that typically involve immersion.

Connecticut‟s adopted criteria are based on federal guidance and reflect an idealized distribution of bacteria monitoring data for sites studied by EPA that can be represented by statistical distribution with a geometric mean of 126 col/100ml and a log standard deviation of 0.4. The criteria can therefore be expressed as a cumulative frequency distribution or "criteria curve" as shown in figures 1a through1c for each of the specified recreational uses in Connecticut‟s bacteria criteria.

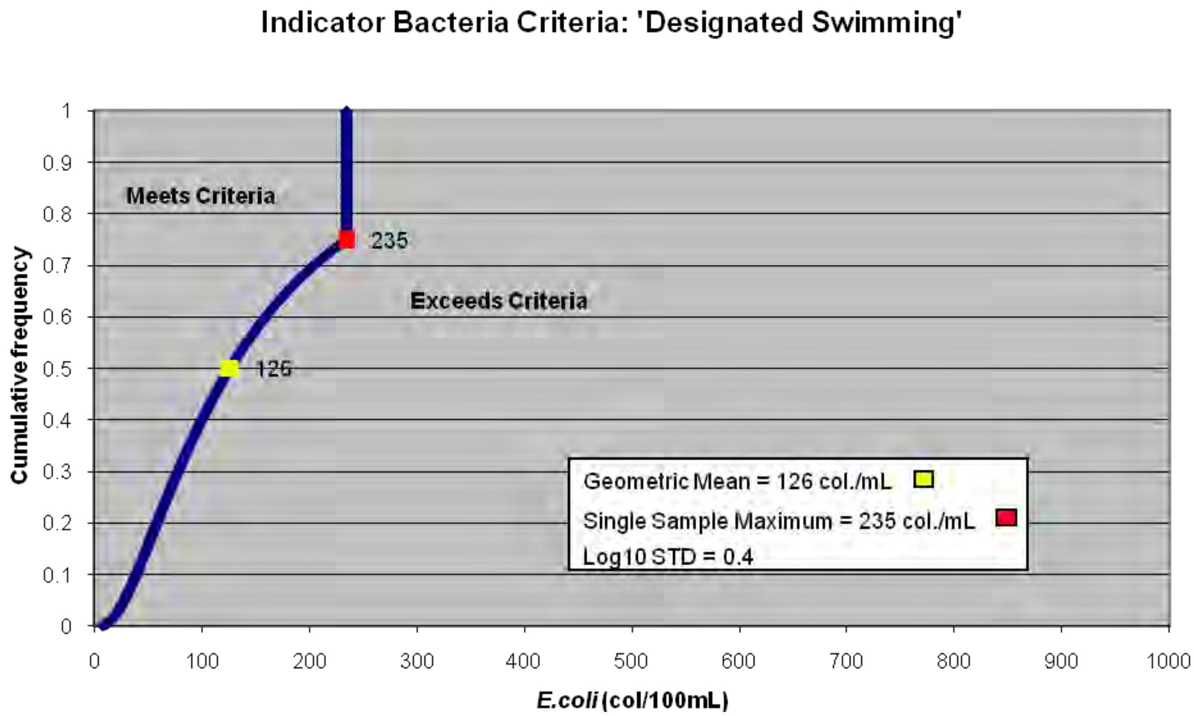


Figure 1a. Cumulative Relative Frequency Distribution representing water quality to support designated swimming use.

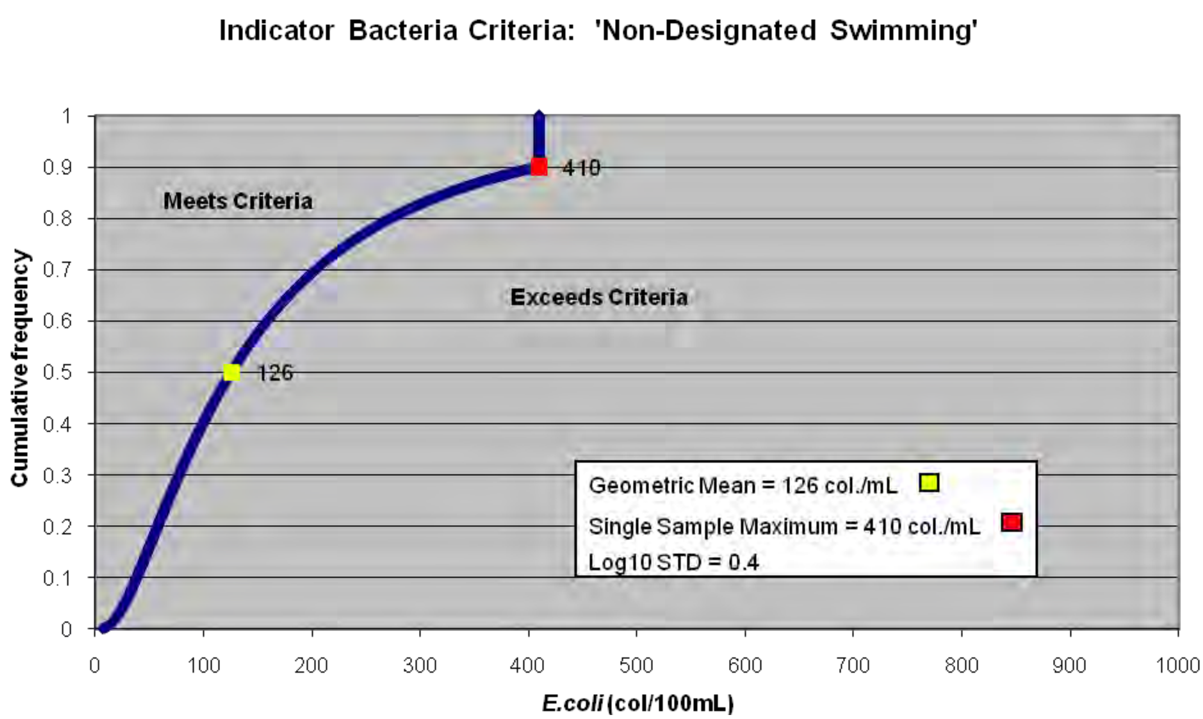


Figure 1b. Cumulative Relative Frequency Distribution representing water quality to support non-designated swimming use.

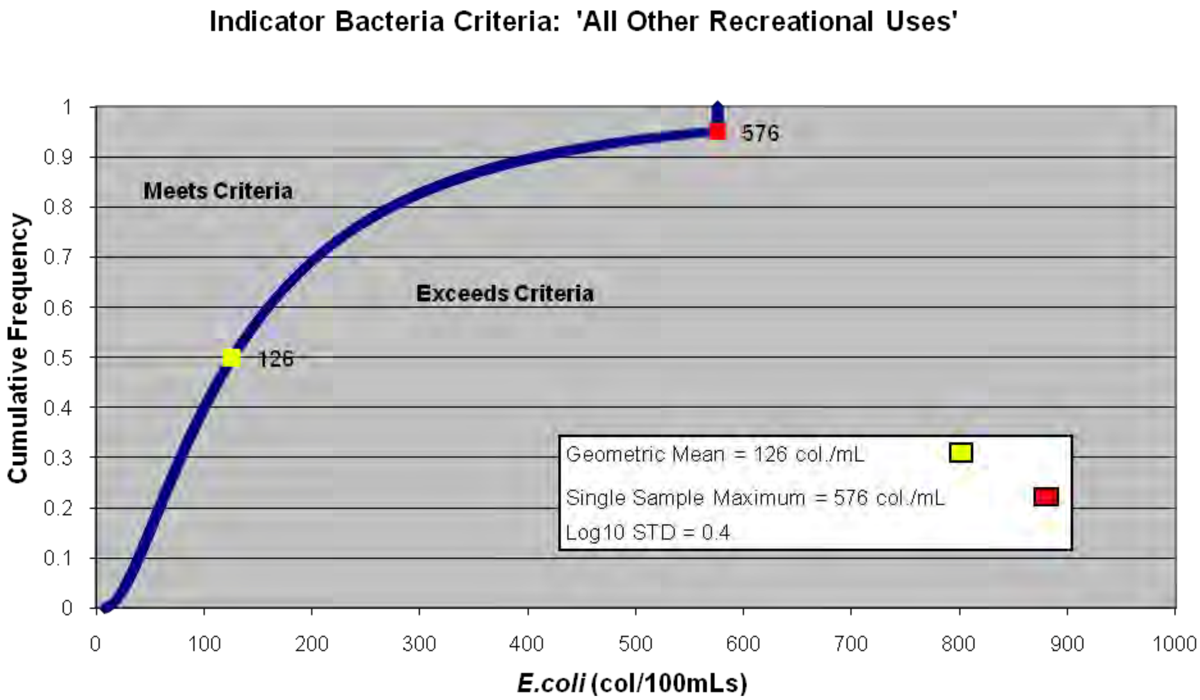


Figure 1c. Cumulative Relative Frequency Distribution representing water quality criteria to support all other recreational uses.

TMDL

As with the cumulative relative frequency curves representing the criteria shown in Figure 1a through 1c, a cumulative relative frequency curve can be prepared using site-specific sample data to represent current conditions at the TMDL monitoring site. The TMDL for the monitored segment is derived by quantifying the difference between these two distributions as shown conceptually in Figures 2a through 2c. This is accomplished by calculating the reduction required at representative points on the sample data cumulative frequency distribution curve and then averaging the reduction needed across the entire range of sampling data. This procedure allows the contribution of each individual sampling result to be considered when estimating the percent reduction needed to meet a criterion that is expressed as a geometric mean.

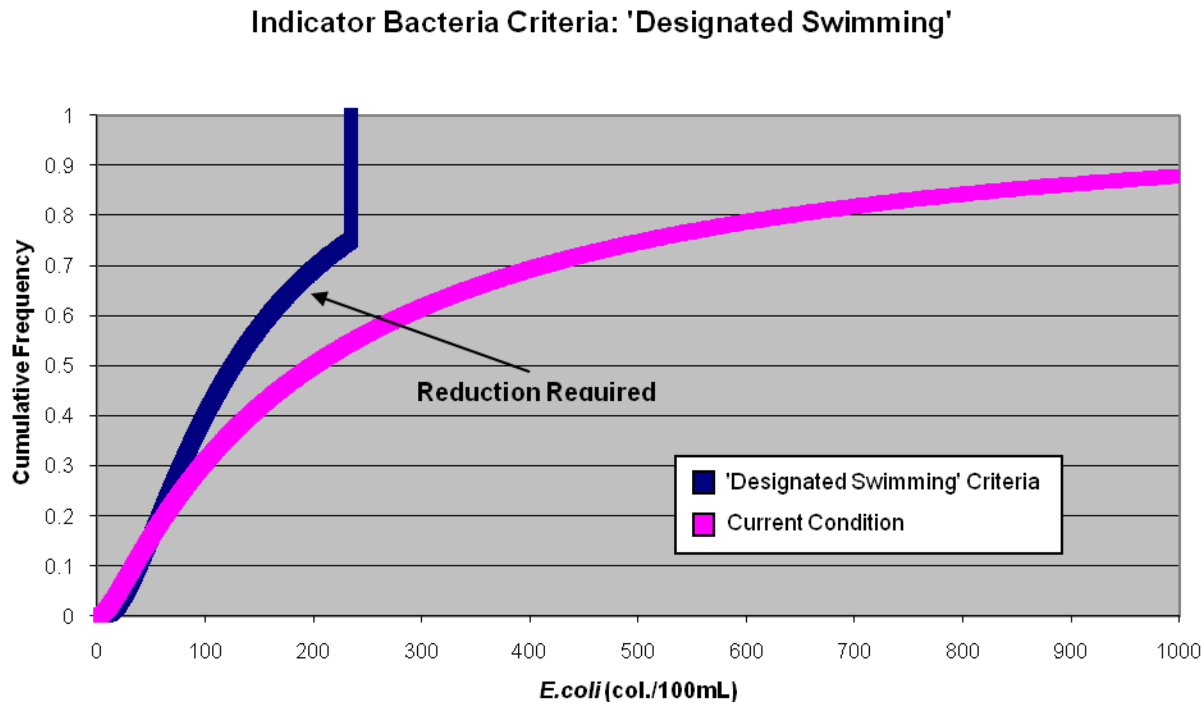


Figure 2a. Reduction indicator bacteria density needed from current condition to meet 'designated swimming' criteria based on cumulative relative frequency distribution.

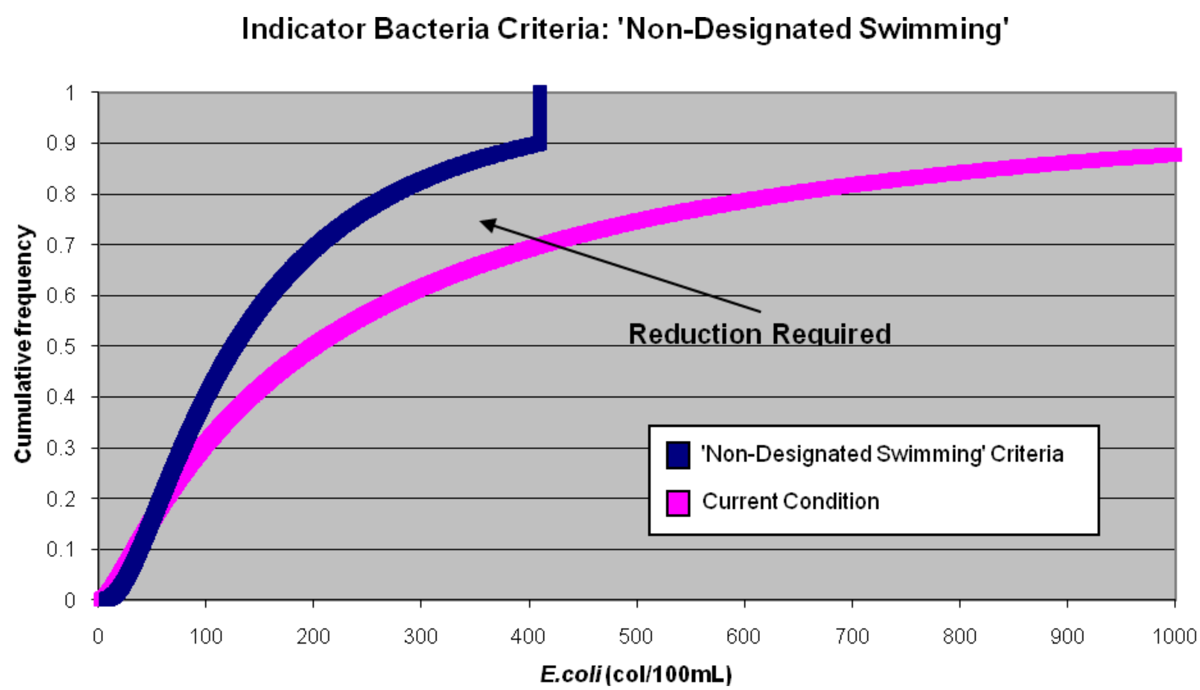


Figure 2b. Reduction indicator bacteria density needed from current condition to meet 'non-designated swimming' criteria based on cumulative relative frequency distribution.

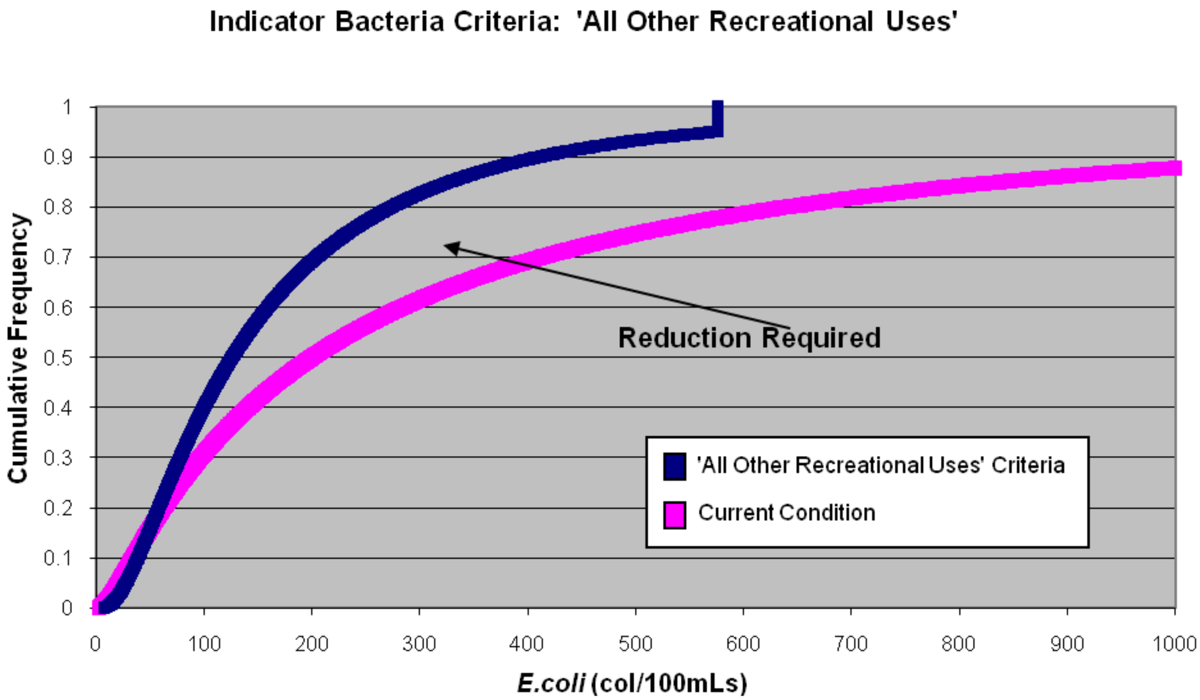


Figure 2c. Reduction indicator bacteria density needed from current condition to meet 'all other recreational uses' criteria based on cumulative relative frequency distribution.

TMDL ALLOCATIONS

Federal regulations require that the TMDL analysis identify the portion of the total loading which is allocated to point source discharges and the portion attributed to non-point sources, which contribute that pollutant to the waterbody. Stormwater runoff is considered a point source subject to regulation under the NPDES permitting program in designated urbanized areas. Designated urban areas, as defined by the US Census Bureau [7], are required to comply with the General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems (MS4 permit). The general permit is applicable to municipalities that contain designated urban areas (or MS4 communities) and discharge stormwater via a separate storm sewer system to surface waters of the State. TMDLs for indicator bacteria in waters draining urbanized areas must therefore be partitioned into a WLA to accommodate point source stormwater loadings of indicator bacteria and a LA to accommodate non-point loadings from unregulated sources. One common characteristic of urbanized areas is the high percentage of impervious surface. Much of the impervious surface is directly connected to nearby surface waters through stormwater drainage systems. As a result, runoff is rapid following rain events and flow in urban streams is typically dominated by stormwater runoff during these periods. Monitoring results for samples collected under these conditions are strongly influenced by stormwater quality. During dry conditions, urban streams contain little stormwater since urban watersheds drain quickly and baseflows are reduced due to lower infiltration rates and reduced recharge of groundwater. At baseflow, urban stream water quality is dominated by non-point sources of indicator bacteria since stormwater outfalls are inactive.

A WLA for stormwater discharges is not warranted in non-designated urbanized areas and in waterbody segments where there are no stormwater outfalls. As such, sources of bacteria in these waterbodies segments are attributed solely to nonpoint sources. However, wet weather and dry weather percent reductions are partitioned in the LA analysis to demonstrate the effect of stormwater events on the contribution of nonpoint sources of bacteria to the waterbody.

The relative contribution of indicator bacteria loadings occurring during periods of high or low stormwater influence to the geometric mean indicator density is estimated by calculating separate averages of the reduction needed to achieve consistency with criteria under "wet" and "dry" conditions. In urbanized areas, the reduction needed under "wet" conditions is assigned to the WLA and the reduction needed under "dry" conditions is assigned to the LA. In non-designated urbanized areas, the LA is comprised of "wet" and "dry" conditions, which are partitioned into separate reduction goals. Separate reduction goals are established for baseflow and stormwater dominated periods that can assist local communities in selection of best management practices to improve water quality. The technique also facilitates the use of ambient stream monitoring data to track future progress in meeting water quality goals.

The sources contributing to the WLA and LA can be further subdivided depending on knowledge of sources present in the watershed (Table 2). Some existing sources such as dry weather flows from stormwater collections systems, illicit discharges to stormwater systems, and combined sewer overflows are allocated "100 percent reduction" since the management goal for these sources is elimination. Permitted discharges of treated and disinfected domestic wastewater (sewage treatment plants) are allocated "zero percent reduction" since disinfection required by the NPDES permit is sufficient to reduce indicator bacteria levels to below levels of concern. Natural sources such as wildlife are also allocated a "zero percent reduction" since the management goal is to foster a sustainable natural habitat and stream corridor to the extent practicable. Management measures to control nuisance populations of some wildlife species that can result in elevated indicator bacteria densities such as Canadian geese however should be considered in developing an overall watershed management plan. The management goal for point sources in designated swimming areas is elimination when the source is determined to be the main contributor of bacteria to the swimming area. This is consistent with the United States Environmental Protection Agency"s (EPA) advisory for swimmers to avoid areas with discharge pipes [8] and a recent study indicating an increased potential for health risk to people swimming in areas near storm drains [9].

Source	Critical Conditions	Assigned To
On-Site Septic	Baseflow (DRY)	LA
Domestic Animal	Baseflow (DRY)	LA
Natural (Wildlife)	Baseflow (DRY)	LA
Wastewater Treatment Plants	Baseflow (DRY)	WLA
Regulated Urban Runoff/Storm Sewers	Wet Weather Flow (WET)	WLA
Dry Weather Overflow	Baseflow (DRY)	None
Illicit Discharges	Baseflow (DRY)	None
Combined Sewer Overflow	Wet Weather Flow (WET)	None

Table 2: Establishing WLA and LA Pollutant Sources

MARGIN OF SAFETY

Federal regulations require that all TMDL analyses include either an implicit or explicit margin of safety (MOS). The analytical approach described here incorporates an implicit MOS. Factors contributing to the MOS include assigning a percent reduction of "zero" to sampling results that indicate quality better than necessary to achieve consistency with the criteria. The increase in loadings on those dates that could be assimilated by the stream without exceeding criteria is not quantified (as a negative percent reduction) and averaged with the load reductions needed on other sampling dates. Rather, this excess capacity is averaged as a zero value thereby contributing to the implicit MOS.

The means of implementing the TMDL also contributes to the MOS. The loading reductions specified in the TMDL for regulated stormwater discharges and nonpoint sources must be sufficient to achieve water quality standards since confirmation that these reductions have been achieved will be based on ambient monitoring data documenting that water quality standards are met. Further, achieving compliance with the requirements of the MS4 permit includes elimination of high loading sources such as illicit discharges and dry weather overflows from storm sewer systems. Eliminating loads from these sources, as opposed to allocating a percent reduction equal to that given other sources, contributes to the implicit MOS. Further assurance that implementing the TMDL will meet water quality standards is provided by the iterative implementation required for compliance with the MS4 permit. This approach mandates that additional management efforts must be implemented until ambient monitoring data confirms that standards are met.

Many of the best management practices that are implemented to address either wet or dry weather sources will have some degree of effectiveness in reducing loads under all conditions. For example, the TMDL allocates all the percent reduction needed to meet standards under wet weather conditions to the WLA. However, reductions resulting from best management practices implemented to reduce dry weather loads (LA) will provide some benefit during wet weather conditions as well. These reductions also contribute to the implicit MOS.

DATA REQUIREMENTS

Ambient monitoring data for a minimum of 21 sampling dates during the recreational season (May 1 – September 30) is required. Data collected at other times during the year are excluded from the analysis. In addition to data on indicator bacteria density, precipitation data for each sampling date and the week prior to the sampling is necessary. Sampling dates should be selected to insure that representative data is available for both wet and dry conditions. This may be accomplished most easily by selecting sampling dates without prior knowledge of the meteorological conditions likely to be encountered on that date.

Data must reflect current conditions in the TMDL segment. The monitoring location where data is collected must therefore be sited in an area that can be considered representative of water quality throughout the TMDL segment. Data obtained under unusual circumstances may be excluded from the analysis provided the reason for excluding that data is provided in the TMDL. Potential reasons for excluding data may include such things as evidence that a spill, upset in wastewater treatment, or sewer line breakage occurred that resulted in a short-term excursion from normal conditions. Data that represent conditions during an extreme storm event that resulted in widespread failure of wastewater treatment or stormwater best management practices may also be excluded. However, data for periods following typical rainfall events must be retained. Reasons for excluding any data must be provided in the TMDL Analysis.

All data must be less than five years old. If circumstances in any watershed suggest that conditions have changed during the most recent five-year period, the analysis may be restricted to more recent data in order to be representative of the current status provided the minimum data requirements are met.

Assurance of acceptable data quality must be provided. Typically, all data should be collected and results analyzed and reported pursuant to an EPA approved Quality Assurance Project Plan (QAPP). Data collected in the absence of a QAPP may be acceptable provided there is evidence that confirms acceptable data quality.

ANALYTICAL PROCEDURE – TMDL

1.

The *E. coli* monitoring data is ranked from lowest to highest. In the event of ties, monitoring results are assigned consecutive ranks in chronological order of sampling date. The sample proportion (p) is calculated for each monitoring result by dividing the assigned rank (r) for each sample by the total number of sample results (n):

$$p = r / n$$

2.

Next, a single sample criteria reference value is calculated for each monitoring result according to the specified recreational use (designated swimming, non-designated swimming, or all other) in a waterbody segment from the statistical distribution used to represent the criteria following the procedure described in steps **3 - 6** below:

3.

Designated Swimming	Non-Designated Swimming	All Other Recreational Uses
If the sample proportion is ≥ 0.75, the single sample criteria reference value is equivalent to the single sample criterion adopted into the Water Quality Standards (235 col/100ml)	If the sample proportion is ≥ 0.90, the single sample criteria reference value is equivalent to the single sample criterion adopted into the Water Quality Standards (410 col/100ml)	If the sample proportion is ≥ 0.95, the single sample criteria reference value is equivalent to the single sample criterion adopted into the Water Quality Standards (576 col/100ml)

4.

Designated Swimming	Non-Designated Swimming	All Other Recreational Uses
If the sample proportion is less than 0.75, and greater than 0.50, the single sample criteria reference value is calculated as:	If the sample proportion is less than 0.90, and greater than 0.50, the single sample criteria reference value is calculated as:	If the sample proportion is less than 0.95, and greater than 0.50, the single sample criteria reference value is calculated as:

$$\textit{criteria reference value} = \text{antilog}_{10}\,[\log_{10} 126\ \text{col/100ml} + (F * 0.4)]$$

N.B. 126 col/100ml is the geometric mean indicator bacteria criterion adopted into Connecticut"s Water Quality Standards, *F* is a factor determined from areas under the normal probability curve for a probability level equivalent to the sample proportion, 0.4 is the $\log_{10}$ standard deviation used by EPA in deriving the national guidance criteria recommendations (Table 4).

5.

Designated Swimming	Non-Designated Swimming	All Other Recreational Uses
If the sample proportion is equal to 0.50, the single sample reference criteria value is equal to the geometric mean criterion adopted into the Water Quality Standards (126 col/100 ml)		

6.

Designated Swimming	Non-Designated Swimming	All Other Recreational Uses
If the sample proportion is less than 0.50, the single sample reference criteria value is calculated as:		

$$\textit{criteria reference value} = \text{antilog}_{10}\,[\log_{10} 126\ \text{col/100ml} - (F * 0.4)]$$

7. The percent reduction necessary to achieve consistency with the criteria is then calculated following the procedure described in steps **8 - 9** below:

8. If the monitoring result is less than the single sample reference criteria value, the percent reduction is zero.

9. If the monitoring result exceeds the single sample criteria reference value, the percent reduction necessary to meet criteria on that sampling date is calculated as:

$$\textit{percent reduction} = [(\textit{monitoring result} - \textit{criteria reference value})/\textit{monitoring result}]*100$$

10. The TMDL, expressed as the average percent reduction to meet criteria, is then calculated as the arithmetic average of the percent reduction calculated for each sampling date.

ANALYTICAL PROCEDURE – WET AND DRY WEATHER EVENTS

Precipitation data is reviewed and each sampling date is designated as a "dry" or "wet" sampling event. Although a site-specific protocol may be specified in an individual TMDL analysis, "wet" conditions are typically defined as greater than 0.1 inches precipitation in 24 hours or 0.25 inches precipitation in 48 hours, or 2.0 inches precipitation in 96 hours.

In designated urbanized areas the average percent reduction for all sampling events used to derive the TMDL that are designated as "wet" is computed and established as the WLA. The average percent reduction for all sampling events used to derive the TMDL that are designated as "dry" is computed and established as the LA.

In areas that do not have point sources, the average percent reduction for all sampling events used to derive the TMDL that are designated "wet" is computed as the wet weather LA, and the average percent reduction for all sampling events used to derive the TMDL that are designated as "dry" is computed as the dry weather LA.

ANALYTICAL PROCEDURE – SPREADSHEET MODEL

An Excel$^{(tm)}$ spreadsheet has been developed that performs all calculations necessary to derive a TMDL using this procedure. Copies of the spreadsheet in electronic form may be obtained from DEEP by contacting Mary Becker at (860) 424-3262 or by email at mary.becker@ct.gov .

REFERENCES

1. 2004 List of Connecticut Water Bodies Not Meeting Water Quality Standards, Connecticut Department of Environmental Protection, Adopted April 28, 2004, approved June 24, 2004.

2. General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems. Connecticut Department of Environmental Protection. Issued January 9, 2004.

3. Connecticut Consolidated Assessment and Listing Methodology for 305(b) and 303(d) Reporting. Connecticut Department of Environmental Protection, April 2004.

4. Water Quality Standards. Connecticut Department of Environmental Protection. Effective December 17, 2002.

5. Ambient Water Quality Criteria for Bacteria – 1986. U.S. Environmental Protection Agency, Office of Water, January 1986. (EPA440/5-84-002).

6. Water Quality Database. Connecticut Department of Environmental Protection, Monitoring and Assessment Program.

7. U.S. Census Bureau, March 2002. www.census.gov/geo/www/ua/ua_2k.html

8. Environmental Protection Agency, 2004. http://www.epa.gov/beaches/.

9. Haile, RW et al, 1999. *The Health Effects of Swimming in Ocean Water Contaminated by Storm Drain Runoff***.** Epidemiology. 10 (4) 355-363.

Appendix E. Links to web sites mentioned in this document

Stormwater Program information -MS4, Industrial, Construction and Commercial general permits: www.ct.gov/dep/stormwater

EPA's Stormwater website: http://cfpub.epa.gov/npdes/stormwater/swphases.cfm

Nuisance wildlife www.ct.gov/dep/enconpolice listed under featured links

Pet waste disposal:
http://www.ct.gov/Dep/cwp/view.asp?a=2708&q=457360&depNav_GID=1763

DEEP Water Quality Manual-Source Control & Pollution Prevention including Nuisance Wildlife & Pet waste:
http://www.ct.gov/dep/lib/dep/water_regulating_and_discharges/stormwater/manual/Chapter_5.pdf .

Staff list: Watershed Management Program:
http://www.ct.gov/dep/cwp/view.asp?a=2719&q=325624&depNav_GID=1654

List of approved stormwater management plans:
http://www.ct.gov/dep/cwp/view.asp?a=2719&q=379296&depNav_GID=1654

The nine planning elements in an EPA approved Watershed Based Plan:
http://www.ct.gov/dep/cwp/view.asp?a=2719&q=335504&depNav_GID=1654

CWA 319 program:
http://www.ct.gov/dep/cwp/view.asp?a=2719&q=325588&depNav_GID=1654

APPENDIX B: Quality Assurance Project Plan

EPA RFA No. 21121

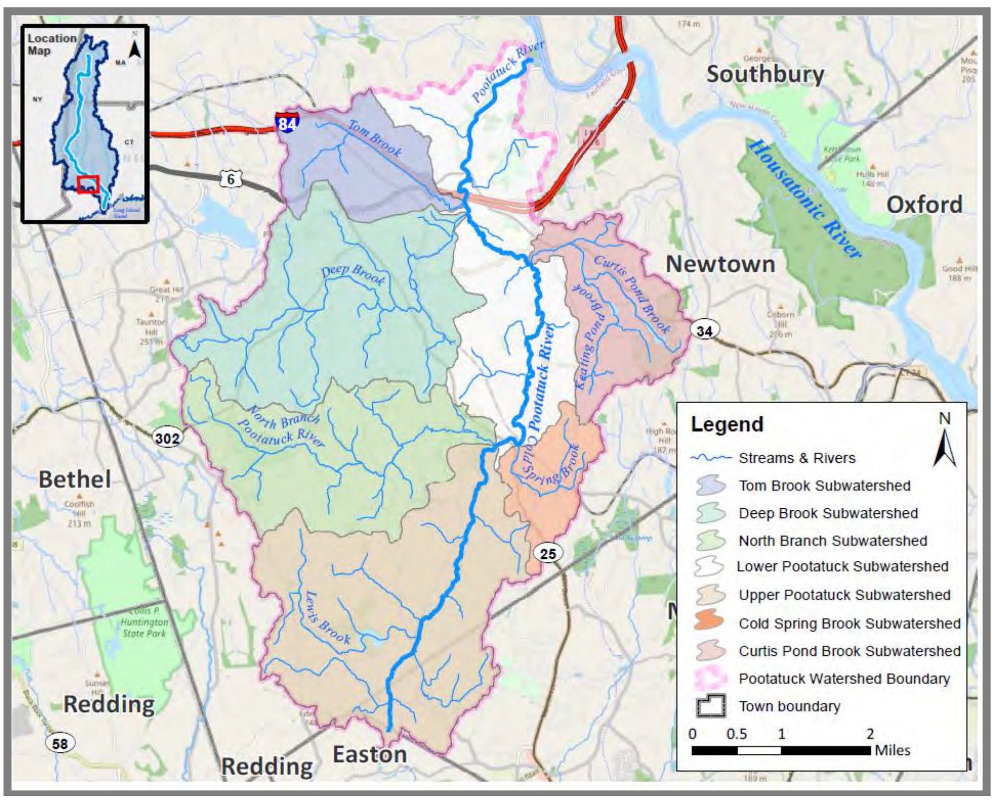
Watershed Planning to Reduce Nonpoint Source Pollution in the Pootatuck River Basin

Quality Assurance Project Plan

September 9, 2021

In support of:

1. CT DEEP CWA Section 319 NPS Grant #18-06, "*Action Plan for Nonpoint Source Pollution Reduction in the Pootatuck River Watershed*", Recipient: Housatonic Valley Association, Inc., Funding provided by the U.S. EPA.
2. National Fish and Wildlife Foundation (NFWF) Long Island Sound Futures Fund Program "*Watershed Planning to Reduce Water Pollution in the Pootatuck River Basin of Long Island Sound (CT) (70280)*", Recipient: Town of Newtown, U.S. EPA funding: Cooperative Agreement LI-00A00694 (NFWF FC.R456), Subrecipient: Housatonic Valley Association.



PREPARED BY:
Housatonic Valley Association
150 Kent Road South
Cornwall Bridge, CT 06754
On behalf of the Town of Newtown, CT

A1- TITLE AND APPROVAL SHEET

Date: 9/8/2021

Michael Jastremski
Project/QA Manager, Housatonic Valley Association
Watershed Conservation Director

Date: 9/9/2021

Rob Sibley
Project Manager, Town of Newtown
Deputy Director of Planning, Land Use and Emergency Management, Town Of Newtown
Zoning Enforcement Officer and Conservation Director, Borough of Newtown

Date: 9/8/2021

Lindsay Larson
Field Operations Manager, Housatonic Valley Association
Connecticut Watershed Manager

Date: 9/8/2021

Erik Hazelton
Field Operations Manager, Housatonic Valley Association
Southern Valley Conservation Projects Manager

Lynn Dwyer Digitally signed by Lynn Dwyer DN: cn=Lynn Dwyer, o=NFWF, ou=NERO, email=lynn.dwyer@nfwf.org, c=US Date: 2021.09.09 12:06:32 -04'00'

Date:

Lynn Dwyer
Program Director
National Fish and Wildlife Foundation
Program Director, Northeast - Coastal

Date: 9-13-2021

Christopher Bellucci
QA Manager, CT DEEP
Assistant Director

Susan C. Peterson Date: 9-13-21

Susan Peterson
Project Manager, CT DEEP
Environmental Analyst 3

STEVEN WINNETT Digitally signed by STEVEN WINNETT Date: 2021.09.14 09:23:03 -04'00' Date:

Steve Winnett
Project Manager, U.S. EPA Region 1
Environmental Scientist

ELIZABETH WRIGHT Digitally signed by ELIZABETH WRIGHT Date: 2021.09.15 07:35:38 -04'00' Date:

Bessie Wright
Project Officer, U.S. EPA Region 1

NORA CONLON Digitally signed by NORA CONLON Date: 2021.09.14 08:41:07 -04'00' Date:

Nora Conlon
QA Reviewer/Chemist, U.S. EPA Region 1

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A PROJECT MANAGEMENT

A3 DISTRIBUTION LIST

All personnel listed below will receive copies of this Quality Assurance Project Plan (QAPP), and any approved revisions of this plan. Once approved, this QAPP will be available to any interested party by requesting a copy from the project management.

Title	Name (Affiliation)	Phone Number/E-mail
Project/QA Manager	Mike Jastremski, Housatonic Valley Association	mj.hva@outlook.com (860) 672-6678
Project Manager	Rob Sibley, Town of Newtown	rob.sibley@newtown-ct.gov (203) 270-4351
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Field Operations Manager	Erik Hazelton, Housatonic Valley Association	ehazelton.hva@gmail.com (860) 942-0189
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QA Reviewer/Chemist	Nora Conlon, US EPA	conlon.nora@epa.gov (617) 918-8335

A4 PROJECT/TASK ORGANIZATION

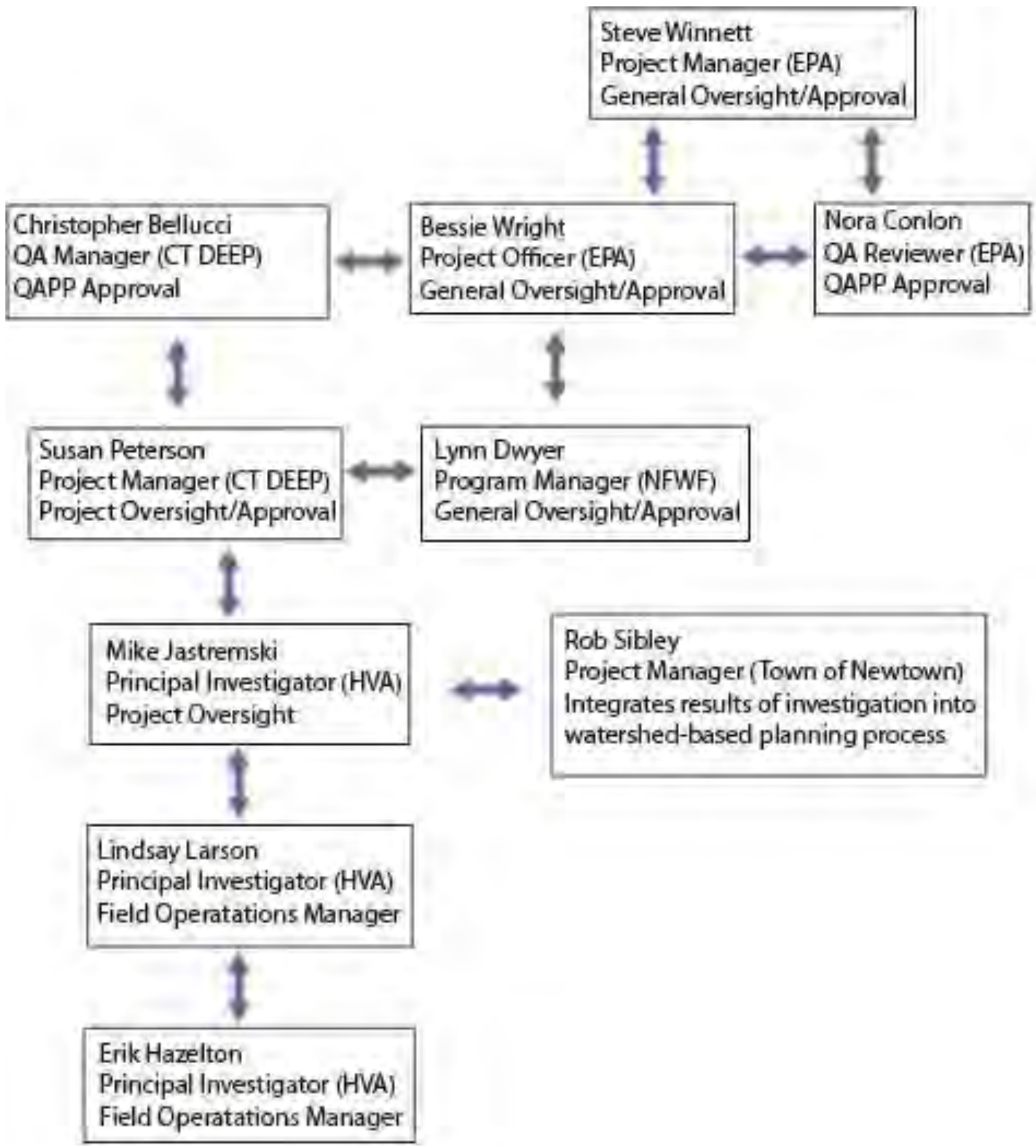

Figure 1. Project Task/Organization

Key personnel associated with the project are identified in Figure 1. Michael Jastremski will provide direct oversight of the project, including liaising with CT DEEP, management of field staff, dissemination of results to Pootatuck River Watershed Plan partners and integration of results with planning process.

A5 Problem Definition/Background

Deep Brook, a major tributary of the Pootatuck River, has been listed as impaired for recreation due to excess bacteria since 2008[1]. A Total Maximum Daily Load (TMDL) was assigned to the Deep Brook watershed due to this impairment in 2012.The TMDL document lists failed septic systems and unspecified urban stormwater as likely contributors to the impairment, but it goes on to say that the list of potential sources is general, and there may be other sources not listed in the TMDL that contribute to the water quality impairment. The TMDL document recommends watershed-based planning as strategy for implementing the pollutant load reductions called for by the TMDL. Since then, the Pootatuck has also been identified as impaired for recreation (bacteria), as per the State of Connecticut's 2020 Integrated Water Quality Report (IWQR) to Congress[2].

The Pootatuck River Watershed is also a significant source of nutrient loading to the Housatonic River and Lake Zoar as well as Long Island Sound. Nutrient loading is identified as a significant threat to the health of Long Island Sound in the Long Island Sound Comprehensive Conservation Management Plan (LIS CCMP)[3]. The Pootatuck River is also listed as a priority waterbody for action plan development in the 2020 CT IWQR because of its total phosphorus concentrations. In 2016 the United States Geological Survey (USGS) began the Northeast Stream Quality Assessment (NESQA). According to the 2016 NESQA scorecard, the Pootatuck River scored "high" for total nitrogen and phosphorus (1.14 mg/L and 0.06 mg/L respectively)[4].

The Town of Newtown, the Housatonic Valley Association (HVA), the Pootatuck Watershed Association (PWA), Candlewood Valley Trout Unlimited (CVTU), and Newtown Forest Association (NFA) are partnering to complete a Watershed-Based Plan[5] for the entire Pootatuck Watershed. The goal of the plan is to identify and develop nonpoint source (NPS) pollution reduction projects and eliminate sources of NPS pollution.

This project is being funded by both the CT DEEP Clean Water Act (CWA) Section 319 NPS Grant and National Fish and Wildlife Foundation (NFWF) Long Island Sound Futures Fund (LISFF) Programs. The 319 grant is focused on recreation impairments due to elevated levels of bacteria in the Deep Brook tributary. The LISFF grant is focused on nutrient issues in the greater Pootatuck Watershed that are contributing to downstream water quality issues in the Housatonic River and Long Island Sound. Both recreation impairments and nutrient loading are interrelated and work to address one of these issues likely will help the other issue. The development of a watershed plan with the assistance of these two grants will improve water quality within the Pootatuck River, its tributaries, and all water bodies downstream.

Center for Watershed Protection (CWP) Universal Streamwalk Assessment protocols will be used to survey stream reaches in the Pootatuck watershed to characterize NPS pollution in the watershed with a focus on Deep Brook water quality impairments. Funding from CT DEEP will go towards 5.32 miles of stream walks in the Deep Brook subwatershed while funding from NFWF LISFF will cover 10 miles of stream walks along the mainstem Pootatuck River as well as key tributaries (Tom Brook, Curtis Pond Brook, Cold Spring Brook, Keating Pond Brook and Lewis Brook). A total of 16 miles of streams will be assessed to meet project quality objectives (15.32 miles will need to be surveyed to yield a successful project).

A6 Project/Task Description

Field assessments using the Center for Watershed Protection (CWP) protocols will be used to identify and develop NPS pollution reduction projects and eliminate sources of NPS pollution. A total of 16-miles of field assessments will occur along the Pootatuck main stem and key tributaries such as Deep Brook in order to characterize NPS pollution in the watershed. Priority reaches will be chosen based on previous Town planning, GIS impervious cover data, known impairments, and water quality data.

The objective of this document is to identify the quality assurance components that are necessary to implement the project activities under the Watershed-Wide Action Plan for Non-Point Source Pollution Reduction in the Deep Brook Basin (CT DEEP project) and Watershed Planning to

Reduce Water Pollution in the Pootatuck River Basin (LISFF project). This objective will be achieved by using two methods from the CWP Unified Stream Assessment (USA) and Unified Subwatershed and Source Reconnaissance (USSR). Combined these methods will identify impacts in the stream corridor, locate upland stormwater Best Management Practice (BMP) projects, and inform source controls.

The USA is a continuous stream walk that systematically evaluates conditions and identifies restoration opportunities within the urban stream corridor. The USA offers a means of assessing, documenting, and organizing stream corridor data to identify sources of impairment and potential pollution reduction projects[6]. Field assessment forms are used to document conditions, problems, and possible restoration/improvement actions. Potential stream impacts are noted on one of eight Impact Assessment Forms (Stormwater Outfalls, Severe Erosion, Impacted Buffers, Utility Impacts, Trash and Debris, Stream Crossings, Channel Modification, and Miscellaneous Agricultural Impacts); and overall conditions of the reach are summarized on a Reach Assessment Form (found in Appendix A). In order to maximize efficiency and facilitate data management in HVA's Geographic Information System (GIS), field assessment forms will be digitized into electronic forms to be used on a tablet computer. These digital forms will be used in conjunction with a GPS unit capable of collecting highly accurate spatial data about each feature. The information collected on the tablet and GPS for each feature will be combined into a single record using GIS mapping software and incorporated into a project database. This database will be used to facilitate further planning and analysis, including prioritization and development of pollution reduction projects within the Pootatuck River watershed and focusing on the Deep Brook water quality impairments

If a stormwater outfall discharge showing signs of fecal contamination is encountered during the USA, a grab sample of the effluent will be collected and tested for ammonia nitrogen concentration. This test will serve as confirmation of a potential source of excess nutrients or pathogens, and will be added to the standard USA protocol for the purposes of this field investigation. To incorporate this additional data, the Stormwater Outfall (OT) data form will be modified to include a field for ammonia nitrogen parts per million. If stream corridor surveys indicate the need for further investigations, possible upland sources will be assessed using CWP's USSR method[7].

If deemed significant, the USSR will be used to track impacts identified in the stream corridor back to their source. We will use the four components of the USSR - Neighborhood Source Assessment (NSA), Hotspot Site Investigation (HSI), Pervious Area Assessment (PAA) and the analysis of Streets and Storm Drains (SSD) - to examine pollution sources and potential NPS reduction projects within upland areas draining to problem areas identified by the USA. These rapid USSR surveys will help to identify potential upland stormwater BMP projects and source controls.

Taken together, these assessments will help to identify, categorize and rank possible pollution reduction projects in the watershed. Standardized field forms promote consistency and help establish quality control for data collection. Prior to conducting surveys, aerial photos, topographic maps, and existing data about known problem areas will be reviewed, and survey reaches will be delineated. If it is determined that conducting a USSR is necessary; subwatersheds, neighborhoods, and hotspots will be identified and delineated.

A7 QUALITY OBJECTIVES AND CRITERIA

The track down survey effort consists of collecting observational data. Quality objectives require that observational survey data be collected in a manner that is consistent or comparable from one stream segment to the next and between field crew members, and complete or thorough in that all applicable field forms are filled out. There are no quantitative quality objectives for track down survey data collection.

Secondary data (existing data/previous studies or non-direct measurements) is needed to prepare an Existing Conditions Report (ECR) component of this project. The ECR is intended to address data gaps that will be identified in the development of the Pootatuck Watershed Based Plan. Existing data and previous studies (i.e., secondary data) that may be used in support of this project, include but are not be limited to, the following resources:

- Baseline water quality data from the (2016, 2018, and 2020) CT IWQR, the Fairfield County River Report (2017 and 2019) from Harbor Watch, and from the Town of Newtown
- CT DEEP TMDL Analysis for Recreational Uses of the Deep Brook Sub-Regional Basin (2011)
- CT Phosphorus Reduction Strategy for Inland Non-Tidal Waters
- Maps of Connecticut Aquifer Protection Areas from CT DEEP
- Maps of Stormwater and Water Quality from CT DEEP
- General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems
- Fisheries data from CVTU and CT DEEP
- The Town of Newtown will provide information on stormwater monitoring, flood zone maps
- Geomorphic Assessments (2016) and Habitat Restoration Plans (2017) from the PWA
- Instream Flow Studies from the Pootatuck Land Company (2004)
- USGS hydrogeology study (2010)
- Natural Resource Inventory Maps published to create Town Plans of Conservation and Development
- USGS Topographical Maps
- GIS and related information available through the University of Connecticut - Center for Land Use Education and Research (UCONN CLEAR) such as high resolution aerial photography of the area found on Connecticut Environmental Conditions Online (CT ECOS).

Areas to be investigated during the USA reach assessments will be selected by the project team based upon review of existing data and previous studies on watershed land use, water quality impairments, and pollutant sources, including identified data gaps.

The extent of impacted buffers along stream segments in the watershed will be examined using existing GIS data from CT ECOS (UCONN & CT DEEP), and land owner information available from the Town of Newtown.

All data sources will be identified and fully referenced and all metadata, if applicable, will be included in the final report for the project.

Proposed Plan of Work

Item	**Task**	**Anticipated Schedule**
1	QAPP approved for project	Month 1
2	Training – HVA will receive technical training from the Center for Watershed Protection in the USA and USSR procedures.	Complete
3	Plan USA surveys, including delineation of segments, and review of aerial photos and topo maps and gather information relevant to the survey area, including existing field/water quality data	Months 1-2
4	Conduct USA surveys	Months 2-12
5	Compile/evaluate USA data	Months 2-12
6	Plan USSR surveys, including delineation of subwatersheds, and review of aerial photos and topo maps and gather information relevant to the survey area, including existing field/water quality data	Months 9-14
7	Conduct USSR surveys	Months 9-16
8	Compile/evaluate USA and USSR data	Months 9-16

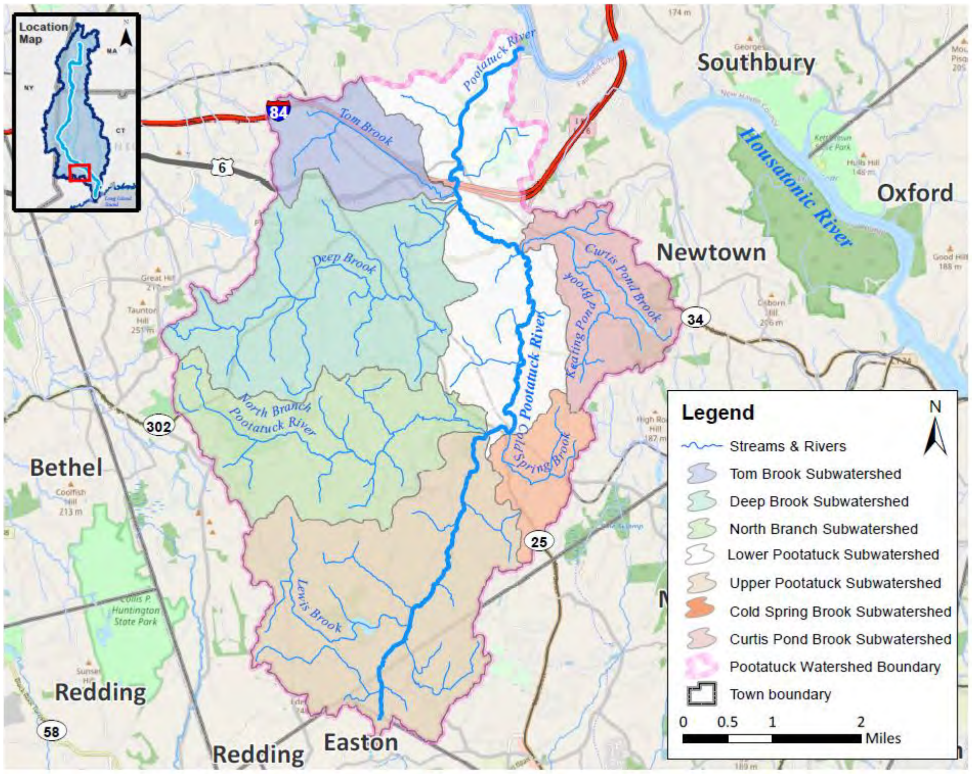

Figure 2. Pootatuck Watershed Project Area

A8 SPECIAL TRAINING/CERTIFICATION

Key HVA staff (Project/QA and Field Operations Managers) have been trained by Center for Watershed Protection staff in the Unified Stream Assessment and Unified Subwatershed and Site Reconnaissance methods. Field training for HVA staff was conducted in Bethel, CT on October 6th and 7th, 2015.This training was a part of a different but similar watershed planning project for the Still River watershed.

Assessments will be conducted by one field crew that will generally be made up of two trained HVA staff members. However, HVA may decide to combine trained staff with volunteers if there are suitable volunteers available. Volunteers as well as new HVA staff will receive comprehensive training in the USA and USSR before being allowed to join the field crew. There will be one trained HVA staff member for each volunteer on the field crew at all times. The HVA Field Operations Manager will be responsible for maintaining a list of all trained individuals including date and location of training.

All field crew members will be required to review Manuals 10 and 11 of the Center for Watershed Protection's Subwatershed Restoration Manual Series: *Unified Stream Assessment: A User's Manual and Unified Subwatershed* and *Site Reconnaissance: A User's Manual*. These manuals provide detailed information about the methods and use of each field assessment form, as well as background information about the stream features and why they are included in the assessments.

HVA staff conducting field assessments will also be trained in the use of HVA's GPS unit (Trimble GeoXT, see attached specifications in Appendix B), which will be used to take photos using the onboard camera, in addition to recording the location of features important to the assessments.

A9 DOCUMENTATION AND RECORDS

The HVA Project/QA Manager will be responsible for distributing the most current approved QAPP to project staff. If any changes are made to the current QAPP they will be communicated by the HVA Project/QA Manager to project staff. Likewise, if these changes merit a revision that must be resubmitted and reapproved, this latest approved QAPP will be distributed to the project staff by the HVA Project/QA Manager.

Field crew will be equipped with a tablet computer (see Attachment B for specifications) loaded with fillable PDF field forms for each impact assessment, reach level assessment forms, and photo inventory forms. The tablet will also be loaded with topographic maps and aerial photos of each survey area. Once a survey is completed, information from the field forms will be reviewed and forms will be filled out by the field team at the time of their field walk. Survey participants will record their names, the watershed/subwatershed name, the survey reach identification number, photo id number, site id number, the lat/long, and GPS unit id, and the time and date of the survey on each impact assessment form. The Reach Level Assessment Form will also include the beginning and ending lat/long, as well as a description of the location of entry and exit points. Survey reaches or segments will be delineated in advance by HVA. Completed field forms will be uploaded to the HVA server at the end of each field day by the HVA Project/QA Manager. These digital copies will be organized by town, subwatershed, and stream reach.

If it is determined that a USSR must be conducted (i.e. suspicious discharges from an outfall) after the USA has been completed, the team will return to the field with fillable PDF field forms for each USSR field survey sheet. These forms are to be filled out by the field team at the time of the USSR assessment and then reviewed. Subwatersheds, neighborhoods, and potential hotspots will be identified and delineated in advance by HVA. Completed field forms will be uploaded to the HVA server at the end of each field day by the HVA Project/QA Manager. These digital copies will be organized by town and subwatershed.

Once a survey is completed, GPS data will be downloaded and post-processed to improve accuracy, and information from the field forms will be reviewed. All records generated by this project will be stored at HVA's main office. The records of all project information and data used to complete the activities of the project will be retained for at least seven years from the date of data collection, report, or application.

B DATA GENERATION AND ACQUISITION

B1 SAMPLING PROCESS DESIGN

<u>Unified Stream Assessment</u>

Stream corridor assessments will be completed along reaches of the Pootatuck River and its tributaries as part of an effort to locate sources of impairments and identify potential pollution (i.e. pathogens and nutrients) reduction projects. The following tributaries will be included in the assessments:

- Deep Brook (CT DEEP award to focus on addressing water quality impairments here)
- Tom Brook
- Curtis Pond Brook
- North Branch Pootatuck River
- Lewis Brook

- Cold Spring Brook
- Keating Pond Brook

These surveys will be conducted according to the Unified Stream Assessment (USA) method developed for small urban watersheds by the Center for Watershed Protection. The USA is a continuous stream walk that systematically evaluates conditions of the stream channel needed to identify restoration opportunities, including storm water retrofits, stream restoration, riparian management, and discharge prevention. Field assessment forms are used to document conditions, problems, and possible restoration/improvement actions. Eight Impact Assessment Forms collect specific information about the condition and restorability of individual problem sites identified along the stream corridor. They include Stormwater Outfalls, Severe Erosion, Impacted Buffers, Utility Impacts, Trash and Debris, Stream Crossings, Channel Modification, and Miscellaneous Issues. A Reach Assessment Form is used to summarize overall physical conditions of the entire survey reach.

If a stormwater outfall discharge showing signs of fecal contamination is encountered during the USA, a grab sample of the effluent will be collected and tested for ammonia nitrogen concentration using a LaMotte 1200 Colorimeter Ammonia Nitrogen test kit (See Appendix B). This information is not a required element of the USA but can serve as a confirmation of a potential source of excess nutrients and/or pathogens. To incorporate this additional data, the Stormwater Outfall (OT) data form will be modified to include a field for ammonia nitrogen parts per million. Two 150-ml samples will be collected from every suspicious outfall and labelled with the appropriate site ID number. Samples will be filtered using a 0.45 μ syringe filter, stabilized with the addition of 2 mL of concentrated $H2SO4$ and taken back to the office for testing and proper disposal. If ammonia nitrogen is identified at a specific outfall, concentration in parts per million will be documented in the corresponding Stormwater Outfall data form.

Finally, each assessed site will be photographed and all photographs are documented on a Photo Inventory form. Forms are included in Appendix A. Standardized collection forms will promote consistency and help establish quality control for data collection.

The USA method was chosen due to its direct applicability to the goals of the track down survey effort. It thoroughly covers potential stream impacts and concerns that we expect to encounter. The USA is a proven method that has been used successfully by HVA for the Still River Watershed-Based Plan; and its focus on identifying not only impacts but also restoration opportunities makes it ideal for the end goal of developing pollution reduction projects.

Why Use the USA?

- Cheap, fast
- Applies to all kinds of streams—rural and highly urban
- One of two basic tools used to initially assess restoration potential in the field
- Can and should be adapted to local needs
- Identifies problems in the stream corridor
- Collects basic feasibility factors on "restorability"
- Helps assemble initial inventory of stream corridor restoration sites, such as:

Discharge investigations
Stream daylighting projects
Storm water retrofits
Local stream repair/outfall stabilization
Bank stabilization or grade control
Buffer reforestation
Structural repairs to sewer lines

Stream cleanup sites
Fish barrier removal projects
Culvert repair/replacement sites
Natural channel design
De-channelization
Riparian wetland restoration
Enforcement actions

Source: *Unified Stream Assessment: A User's Manual*, February 2005, Center for Watershed

Protection.

The USA consists of four steps: Pre-field Preparation; Stream Corridor Assessment; Quality Control; and Data Interpretation.

1. Pre-field Preparation

Prior to conducting the surveys, field crew will be established and trained (see Training Requirements/Certification, Element A8), supplies gathered and organized, survey reaches defined, field maps generated, assessment routes and schedules planned, and the public/ streamside landowners notified about the surveys. Aerial photos, topographic maps, and existing data about known problem areas will be reviewed to assist in defining survey reaches of uniform character and to familiarize field staff with the area to be surveyed. Each reach will be assigned an identification number. Reaches will be about 1 linear mile of stream, depending on access points.

2. Stream Corridor Assessment

Field surveys will be conducted by trained staff and interns. Surveys will be conducted on foot or by boat, as necessary. Field crew of two to four will conduct the surveys during July, August and September when water flows are lower, making it both possible and safe to walk in the stream along most reaches. At this time, potential concerns (e.g. excessive algal growth, increased deposition, bank scouring, open canopy) are also more visible. Initial surveys will be conducted during dry weather conditions to eliminate the possible effects that a rain event may have on normal conditions, such as washing away algae, or obscuring the presence of aquatic vegetation, or making it difficult to determine normal turbidity, water levels or water color. However, if further investigation is required to determine possible nonpoint sources, these may be conducted during or following rainstorms.

Field Crew responsibilities are divided as follows: one team member will focus on the reach assessment and impact assessments, and the other will focus on taking photos and recording GPS locations. Field crew will walk up the stream corridor, but face downstream when determining right/left bank problems. Individual impact sites are mapped and photographed as they are encountered, and impact assessment forms completed and ID numbers assigned. The location and ID are drawn on the reach diagram located on the reach assessment form.

Reach Assessment Forms are completed after walking the entire survey reach. If conditions vary too much to assign an average, the survey reach will be divided into more uniform segments for the purposes of completing the Reach Assessment Form.

3. Quality Control

Survey data will be compiled in a GIS database and mapped with input from DEEP staff. Data will be entered immediately after fieldwork is completed, and spot checked by the HVA QA manager. Field Crew members will review draft stream corridor maps with site impact assessment locations and survey reach scores to identify inaccuracies in data entry and any gaps in stream corridor coverage.

4. Data Evaluation

USA data will be used to create detailed maps of the stream corridor showing degraded and nonimpacted reaches, and location of problem areas and restoration candidates.

HVA staff will work with the Pootatuck Watershed Association, Candlewood Valley Trout Unlimited, Newtown Forest Association, Aquarion, and the Town of Newtown in planning and conducting the surveys; their local knowledge and experience will greatly benefit efforts to identify sources of impairments. In addition, HVA staff will ask the municipality to publicize the survey project in advance through some form of public notice to be determined by municipal officials (e.g. letters to streamside landowners), and notify the local police department. Field crew will carry several copies of an official municipal notice/authorization letter explaining the survey project and field activities, and providing a contact number for more information while conducting their field work. Copies of the letter can be provided to any private landowners. Should a private landowner request that field team leave and not survey their property, the field team will comply with the request and leave the private landowner's property.

Unified Subwatershed and Site Reconnaissance:

If stream corridor surveys indicate the need for further investigations, possible upland sources will be assessed using CWP's Unified Subwatershed and Site Reconnaissance (USSR) method. The USSR is a rapid field survey to evaluate potential pollution sources and restoration opportunities within urban subwatersheds. As with the USA, the USSR method was chosen due to its direct applicability to the goals of the track down survey effort. The USA and USSR are complimentary survey systems that address both stream corridors and their associated uplands.

The USSR is comprised of four major assessment components which are represented by four field forms. The Neighborhood Source Assessment (NSA) looks within individual neighborhoods for pollution source areas, stewardship behaviors, and residential restoration opportunities. The Hotspot Site Investigation (HSI) ranks the potential severity of hotspots within a subwatershed. Pervious Area Assessments (PAA) evaluate the potential to reforest turf areas or restore remnants of natural areas at all open parcels within the subwatershed. The Streets and Storm Drains (SSD) assessment measures the average pollutant accumulation in the streets, curbs, and catch basins of a subwatershed, and looks at potential for on-site retrofits for parking lots.

The USSR consists of three phases: Desktop Analysis; Field Survey; and Post-field Analysis. These three phases are broken into seven steps as detailed in Table 1.

Table 1.Seven Steps of the USSR

Seven Steps of the USSR		
Pre-Field	Step 1: Gather required information	NPDES permittees Existing neighborhood maps Municipal maintenance schedule for roads Census data List of HOA and contact information Current development projects Mapping data and aerial photographs
Pre-Field	Step 2: Generate field maps	Delineate subwatersheds Delineate residential neighborhoods Review environmental databases for regulated hotspots Perform business permit review for additional hotspots Put together emergency contact list
Field	Step 3: Conduct the USSR	Drive all roads Evaluate residential neighborhoods (NSA form) Survey all hotspot locations (HSI form) Complete PAA form for all pervious area sites Complete SSD form at select storm drains Take photos and GPS readings
Post-Field	Step 4: Verify data/maps	Rectify differences between pre-fieldwork maps and field notes Identify additional data to be collected
Post-Field	Step 5: Data entry	Enter data from field forms into a spreadsheet or GIS. This involves downloading GPS unit and digital cameras (or getting film developed), and recording details on field maps
Post-Field	Step 6: Produce list and map of candidate sites for each subwatershed	Screen retrofit, restoration, and pollution prevention projects to identify sites where further investigation is needed
Post-Field	Step 7: Compile data for all subwatersheds into a single table	Develop subwatershed metrics to develop initial restoration strategy

NPDES – National Pollutant Discharge Elimination System
HOA – Homeowner Association
Source: Unified Subwatershed and Site Reconnaissance: A User's Manual, February 2005, Center for Watershed Protection.

B2 Sampling Methods

Unified Stream Assessment

The USA method consists of nine stream corridor assessments: eight impact assessments and an overall reach assessment. They are summarized in Table 2, below. One impact assessment form is completed for each impacted site, and a reach assessment form is completed for each reach. Photographs are documented on a photo inventory form as they are taken in the field and cross referenced to impact assessment or reach assessment forms using the date, stream/reach, a location ID and photo number.

Table 2. Components of the USA

Components of the USA
Impact assessments are site-specific and record data on condition and "restorability" at each problem site. Impact forms comprise an initial inventory of restoration opportunities. The eight impact assessment forms are as follows: • **Outfalls** (OT)—*all storm water and other discharge pipes* • **Severe erosion** (ER)—*bank sloughing, active widening or incision* • **Impacted buffer** (IB)—*lack of natural vegetation, width* • **Utilities in the Stream Corridor** (UT)—*leaking sewer, exposed pipes susceptible to damage* • **Trash and Debris in the Stream Corridor** (TR)—*trash and illegal dumping* • **Stream Crossing** (SC)—*culverts, dams, natural features, etc.* • **Channel Modification** (CM)—*straightening, channelization, dredging, etc.* • **Miscellaneous** (MI)—*unusual features or conditions* The reach level assessment (RCH) form characterizes the average physical conditions over the entire survey reach. The RCH tracks individual problem sites and provides information used to compare reach quality throughout the entire stream corridor. • **Reach Level Assessment** (RCH)—*average bank stability, in-stream habitat, riparian vegetation, flood plain connectivity, access, flow, and substrate over the entire reach.*

The information collected for each of the nine impact assessments and the reach assessment, as well as associated restoration practices, is summarized in Table 3 below.

Table 3. USA Impact and Reach Assessment Forms and Restoration Practices

USA Impact and Reach Assessment Forms and Restoration Practices		
Assessment Form	**What It Assesses**	**Information Collected** *(In addition to photo & GPS)*
Outfalls **(OT)**	All discharge pipes or channels that discharge storm water or wastewater.	Basic type, source, and condition. If flowing, then flow conditions should be recorded and potentially reported to authorities.
Severe Bank Erosion **(ER)**	Slope failures, bank sloughing, head cuts, and incision or widening in areas noticeably worse than the average erosive condition of the survey reach. Also infrastructure or property threatened by erosion.	Location (meander or straight section), threat to property or infrastructure, accessibility; and basic bank measurements (height, angle, and bottom and top widths).
Impacted Buffer **(IB)**	Corridor lengths >100 feet long that lack at least a 25 feet wide, naturally-vegetated riparian buffer on one or both sides of stream.	Diversity and density of vegetation, flood plain conditions, adjacent land use, available area for reforestation
Utilities in Stream Corridor **(UT)**	Leaking or exposed sewer, water, or other utility lines causing water quality, habitat, or channel stability problems. Includes manhole stacks, pipes along bottom, in the bank, or above the stream susceptible to damage due to lack of maintenance or exposure.	Type, condition, and discharge characteristics associated with leaks (odors, color, etc). If leaking, report immediately to authorities. Record relevant information if potential fish barrier (see SC)
Stream Crossing **(SC)**	All man-made or natural structures that cross the stream, such as roadways, bridges, railroad crossings, or dams. Pipe crossings and other overhead utilities are assessed under UT.	Type of crossing, culvert dimensions, relative information if suspected fish barrier (6" water drop, or less than ½" water depth during normal flow conditions)
Channel Modification **(CM)**	Channelized, concrete-lined, or reinforced sections of stream >50 feet in length, regardless of construction material used. Locations of existing stream restoration or bank stabilization projects included. Enclosed sections are assessed under SC or OT.	Type of modification, length of stream impacted
Trash and Debris **(TR)**	Areas of significant trash and debris accumulation greater than average levels observed across the survey reach. Any areas where potentially hazardous or unknown chemicals have been dumped.	Mobility, dispersal, amount and type of trash; level of effort and type of equipment required for removal; location on public or private property
Misc. Impacts **(MI)**	High quality areas or unusual feature or activity impacting the stream corridor that doesn't fit into other seven impact assessments. This may include fish kills, cattle access, near stream construction, flood plain excavation, adjacent wetlands, grade controls, or other notable features.	
Reach Level **(RCH)**	Average characteristics for each survey reach. Tracks locations of impact assessments; used for screening restoration opportunities and for comparing reaches across the subwatershed.	

Unified Subwatershed and Site Reconnaissance:

The USSR method consists of four major assessments: Neighborhood Source Assessment, Hotspot Site Investigation, Pervious Area Assessment, and Streets and Storm Drains assessment. One field form is completed for each impacted site. Sites for USSR surveys will be identified based on a number of criteria as seen in Table 4.

Table 4. Selection Criteria for USSR Site Assessment

Selection Criteria for USSR Site Assessment		
USSR Field Form	**Land Use**	**Selection Criteria**
NSA	Residential	Visit all neighborhoods and sample a subset of individual homes
HSI	Commercial Industrial Institutional Municipal Transport - Related	Visit all regulated hotspots and priority non-regulated hotspots
PAA	Pervious Areas	Visit all publicly-owned pervious areas > 2 acres and all privately-owned pervious areas > 5 acres
SSD	Streets and Storm Water Conveyance	Evaluate road and storm drain conditions at random, pre-selected points Evaluate all parking lots > 2 acres

Source: *Unified Subwatershed and Site Reconnaissance: A User's Manual*, February 2005, Center for Watershed Protection.

A summary of how information from the four USSR assessments is applied to subwatershed restoration is detailed in Table 5.

Table 5. How the USSR Helps in Subwatershed Restoration

How the USSR Helps in Subwatershed Restoration
<u>Neighborhoods</u> • Evaluates pollutant-producing behaviors in individual neighborhoods and assigns a pollution severity index for screening purposes • Rates each neighborhood for overall restoration potential and identifies specific restoration projects • Examines the feasibility of on-site storm water retrofits • Indicates restoration projects that may require more direct municipal assistance for implementation (tree planting, storm drain stenciling, etc.) <u>Hotspots</u> • Creates an inventory of storm water hotspots, including regulated and non-regulated sites • Rates the severity of each hotspot with regard to its potential to generate storm water runoff or illicit discharges • Suggests appropriate follow-up actions for each hotspot, including referral for immediate enforcement • Examines the feasibility of on-site storm water retrofits <u>Pervious Areas</u> • Evaluates the current condition of natural area remnants and their potential management needs • Determines the reforestation potential of large pervious areas <u>Streets and Storm Drains</u> • Estimates the severity of pollutant accumulation on roads and within storm drain systems • Assesses large parking areas for storm water retrofit potential • Rates the feasibility of four municipal maintenance strategies

B3 SAMPLE HANDLING AND CUSTODY

Upon completion of field surveys, Field crew will bring their tablet computer and GPS/digital camera to the HVA office. If suspect stormwater outfalls are encountered during field surveys, stabilized, labeled grab samples of discharge will be brought back to the office. Samples will be filtered using a 0.45 µ syringe filter, stabilized with the addition of 2 mL of concentrated H2SO4 and taken back to the office for testing and proper disposal. GPS data will be post-processed to improve location accuracy. All electronic field forms will be uploaded and included with other digital data in a database on the HVA server. All data will be available upon request to CT DEEP and U.S. EPA, as well as Pootatuck River Watershed partners.

B4 ANALYTICAL METHODS

The equipment associated with the track down survey project are:

- iPad Mini 2 tablet computer to fill out electronic field forms
- Trimble GeoXT Geoexplorer 6000 series GPS unit with onboard camera to record spatial data and take photographs of identified impacts
- LaMotte Ammonia Nitrogen Test Kit (Code 3304-01) or stormwater outfall testing
- 100’ measuring tape
- Stadia rod

Instrumentation specifications are included in Attachment B.

USA and USSR observational data gathering methods do not have quantitative performance standards associated with them. We will ensure consistency in making observations, evaluating impacts and recording information through thorough training of field staff.

B5 QUALITY CONTROL REQUIRMENTS

Quantitative measurement is not within the scope of the USA and USSR data collection processes. For observational data collection, "standardizing" evaluation and reporting techniques through field staff training, and overlap of field team staff will help establish consistency and objectivity and thus serve as a method of quality control.

In addition, to enhance the effectiveness and efficiency of field data collection, field assessment forms will be digitized and organized into folders kept on a tablet computer and backed up at the HVA office.

When a survey is completed, survey forms will be checked by the HVA Project/QA Manager for completeness, and to ensure that reach assessment sketches include all site impacts, and reach ID numbers and photo numbers are properly cross-referenced.

The track down survey data does not require lab checks.

B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

The iPad Mini 2 tablet and Trimble GeoXT GPS unit will be charged at night before every field workday. Upon arrival at the office and before departure to a field site the iPad and GPS unit will be checked for a full battery. The iPad Mini 2 tablet can also be charged via a car adapter in the case of a drained battery in the field. There will be no spare battery as the power source for the GPS unit is internal.

The LaMotte 1200 Colorimeter is inspected one month prior to first field work day and the day before each field day. Inspection checks the battery life and that the unit functioning properly. Spare batteries and reagents are purchased before the field sampling. Sampling bottles and kit vials are cleaned and sterilized between each sample and at the end of the day by rinsing each bottle/vial three times with distilled/deionized water.

There is no other equipment used that requires testing, inspection or maintenance records.

B7 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

The LaMotte 1200 Colorimeter is calibrated one month prior to the field season using distilled/deionized water and 0.25 ppm standard ammonia solution. According to the manufacturer's instruction, a difference of 5% of the calibration standard value falls within the calibration acceptance criteria. If the instrument does not calibrate properly, HVA will contact the manufacturer.

B8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

This element is not applicable to the track down survey project.

B9 NON-DIRECT MEASUREMENTS (SECONDARY DATA)

A few data sources will be used in planning for the track down surveys. These will include but not be limited to:

1. High resolution aerial photography of the area obtained from CT Environmental Conditions Online (CT ECOS).
2. Natural Resource Inventory Maps published to create Town Plans of Conservation and Development.
3. USGS Topographical Maps
4. Baseline water quality data from the (2016, 2018, and 2020) CT IWQR, the Fairfield County River Report (2017 and 2019) from Harbor Watch, and from the Town of Newtown.
5. Fisheries data from CVTU and CT DEEP
6. The Town of Newtown will provide information on stormwater monitoring and flood zone maps
7. Geomorphic Assessments (2016) and Habitat Restoration Plans (2017) from the PWA
8. Instream Flow Studies from the Pootatuck Land Company (2004)
9. USGS hydrogeology study (2010)

CT ECOS and other data will be used to create maps for reference in the field. The track down survey database will also be linked to a GIS to display results graphically.

B10 DATA MANAGEMENT

Data sheets are checked and signed by the HVA Project/QA manager. Data checks identify any results where information is incorrect, missing, or inadequate. Such data will be marked as unacceptable and will not be entered into the electronic data base and/or otherwise used for project analysis, reporting or other purpose.

Copies of data collection sheets and electronic media reports will be kept for review by the Housatonic Valley Association. When a survey is completed, field data forms will be uploaded to the HVA server at the office and checked by the HVA Project/QA Manager. When field forms are determined to be complete, data will be entered into the watershed map. The survey data and photos will be compiled into a document, and will be easily referenced to their corresponding points on the map. This document will also display photos of typical conditions in many of the watersheds reaches for comparison with impacted reaches.

As suggested in the USA and USSR manuals, there are multiple ways to analyze the data, all of which are all useful in planning restoration strategies. Stream Corridor Project Counts will be done as an initial screening tool. This screening tool identifies the number of impacts per stream reach. Counts will focus on impact sites that have the greatest potential for stream corridor restoration. They can be expressed as simple numbers, e.g. the number of severe bank erosion sites or potential outfall retrofit sites, or as a fraction of stream or survey reach length, e.g. the length of inadequate buffers relative to total stream length. A GIS base map of the watershed will be used to gain a better understanding of the spatial distribution of stream impacts, potential restoration projects and overall reach quality; the types of information chosen to display graphically will depend on initial findings and restoration goals. Stream Corridor Metrics are a way to summarize relative conditions of survey reaches and stream corridors to prioritize and target further investigation or restoration activities. For example, stream corridors with a relatively high density of outfalls that have signs of polluted stormwater contamination would be a high priority for the installation of a stormwater quality retrofit measure. An example of upland data analysis is identifying the portion of the subwatershed with upland reforestation potential. These metrics can also be used to compare subwatersheds as part of larger watershed-based restoration strategies.

The data generated will be converted to a standard database format maintained by HVA and available for CT DEEP and NFWF staff review when requested. This review is for Quality Assurance(QA)/Quality Control (QC) purposes only and will not be used for any other purpose. All project information will remain confidential. See Section 4.2 for additional information on this data reporting requirement.

After data entry or data transfer procedures are completed for each data collection event, data will be inspected for data transcription errors, and corrected as appropriate. After the final QA checks for errors are completed, the data will be added to the final database.

C ASSESSMENT AND OVERSIGHT

C1 ASSESSMENTS AND RESPONSE ACTIONS

Data must be consistently assessed and documented to determine whether project Quality Assurance Objectives have been met, quantitatively assess data quality and identify potential limitations on data use. Assessment and compliance with quality control procedures will be undertaken during the data collection phase of the project.

After an initial track down survey is completed in a sub-watershed, the results and method will be evaluated for effectiveness by the HVA Project/QA Manager and field staff. If the surveys are not effectively and efficiently meeting the goals of the track down survey project, components of the method will be revised as necessary, including field data forms, training requirements, field assessment methods, quality control, data management and analysis. Any significant revisions to HVA's approach will trigger a modification of this document and will require subsequent approval by signatories listed on Title and Approval Sheet. As future surveys are completed, methods will continue to be evaluated and changed if needed.

C2 REPORTS TO MANAGEMENT

During the project, NFWF may require periodic reporting, as noted below. There is no similar reporting requirement for CT DEEP.

The following table summarizes the types of data to be reported:

Data	Data Description	Reporting Method	Frequency
Best Management Practice (BMP) Data	Raw data from project reports in units of miles, linear feet, acres, individuals, etc.	Spreadsheet, electronically via e-mail.	Annually
Monitoring Data	Raw data on project effectiveness, ambient water quality in priority watershed, stormwater flow, project conclusion data, etc.	Raw data, reports, and/or spreadsheets, electronically on CD or via e-mail.	At NFWF Request during the closeout procedure
Geospatial Data	Google polygon maps, latitude/longitude info, watershed segment	Spreadsheet	Annually

At project completion, the data collection team will provide copies of the data collection data sheets as a representative sample subset submittal of analysis. At a minimum, information must be provided to NFWF staff according to the QA Summary Report template, included as Appendix C.

All results meeting data quality objectives and results having satisfactory explanations for deviations from objectives will be reported in the QA Summary Report. Results will be reported to NFWF at project completion as noted in Section 4.2 above. Reports may be submitted electronically along with the final programmatic report.

As track down surveys are completed, information will be integrated into the development of an EPA 9-Element Watershed-based Plan for the Pootatuck River. Reports for this element of the planning process will be delivered to CTDEEP as a field assessment summary in an Existing Conditions Report.

D DATA VALIDATION AND USABILITY

D1 Data Review, Verification and Validation

All completed survey forms will be reviewed by the HVA Project/QA Manager to ensure that quality objectives are being met (forms are thoroughly completed, observations are being made and recorded in a consistent manner, impacts are being measured and evaluated in the same way).

D2 Verification and Validation Methods

If inconsistencies are found in survey data collection, surveys will be re-done to ensure that data are comparable and of use. Once the data has been entered in the database, any problems associated with transcribing data will be corrected as they are found while spot-checking the forms against data entry forms and printed maps.

All data will be stored at the HVA office. Copies of the electronic database will be provided to the DEEP. Results will also be summarized and graphically displayed for distribution to other users.

Reconciliation with User Requirements

Track down survey results are expected to be used in locating sources of impairments and planning for restoration projects. If after completion of the pilot track down survey projects, including field data collection and analysis, the data cannot be used as required, the survey methods will be re-evaluated and changes will be made where needed. Project and Field Operations Managers at HVA will work with DEEP staff and other data users to gather input and plan for and address needed changes.

E REFERENCES

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[4] USGS. (2016). Site Scorecard for Pootatuck River at Sandy Hook, CT. NESQA Program.

[5] U.S. EPA 2008. Handbook for Developing Watershed Plans to Restore and Protect Our Waters. Office of Water, Washington, D.C. EPA 841-B-08-002.

[6] Center for Watershed Protection. 2005. Unified Stream Assessment: A User's Manual.

[7] Center for Watershed Protection. 2005. Unified Subwatershed and Source Reconnaissance: A User's Manual.

Appendix A – CWP USA & USSR Field Forms

Track Down Survey (USA and USSR) Field Forms

Storm Water Outfalls **OT**

WATERSHED/SUBSHED:		**DATE:** ___/___/___	**ASSESSED BY:**
SURVEY REACH ID:	**TIME:** ___:___ AM/PM	**PHOTO ID:** (*Camera-Pic #*)	/#
SITE ID (*Condition #*): **OT-**_____	**LAT** ___° ___' ___" **LONG** ___° ___' ___"	**LMK** _____	**GPS:** (*Unit ID*)

BANK: ☐ LT ☐ RT ☐ Head **FLOW:** ☐ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:	**TYPE:** ☐ Closed pipe	**MATERIAL:** ☐ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:	**SHAPE:** ☐ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:	**DIMENSIONS:** Diameter: _____ (in)	**SUBMERGED:** ☐ No ☐ Partially ☐ Fully
	☐ Open channel	☐ Concrete ☐ Earthen ☐ Other:	☐ Trapezoid ☐ Parabolic ☐ Other:	Depth: _____ (in) Width (Top): _____ (in) " (Bottom): _____ (in)	*NOT APPLICABLE*

CONDITION: ☐ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:	**ODOR:** ☐ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:	**DEPOSITS/STAINS:** ☐ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:	**VEGGIE DENSITY:** ☐ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:	**PIPE BENTHIC GROWTH:** ☐ None ☐ Brown ☐ Orange ☐ Green ☐ Other: **POOL QUALITY:** ☐ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY	**COLOR:**	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:
OTHER CONCERNS:	☐ Excess Trash (paper/plastic bags) ☐ Needs Regular Maintenance	☐ Dumping (bulk) ☐ Bank Erosion ☐ Excessive Sedimentation ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization
☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:
Length of vegetative cover from outfall: _________ ft Type of existing vegetation: _______________ Slope: _______ °

If yes for stormwater:
Is stormwater currently controlled? Land Use description: _______________
☐ Yes ☐ No ☐ Not investigated Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.		Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.		Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5	4	3	2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Severe Bank Erosion **ER**

WATERSHED/SUBSHED: | **DATE:** ___/___/___ | **ASSESSED BY:**

SURVEY REACH: | **TIME:** ___:___ AM/PM | **PHOTO ID (CAMERA-PIC #):** /#

SITE ID: *(Condition-#)* ER-_____ | *START* **LAT** ___° ___' ___" **LONG** ___° ___' ___" **LMK** ____ | **GPS:** *(Unit ID)*
END **LAT** ___° ___' ___" **LONG** ___° ___' ___" **LMK** ____

PROCESS: ☐ Currently unknown
☐ Downcutting ☐ Bed scour
☐ Widening ☐ Bank failure
☐ Headcutting ☐ Bank scour
☐ Aggrading ☐ Slope failure
☐ Sed. deposition ☐ Channelized

BANK OF CONCERN: ☐ LT ☐ RT ☐ Both *(looking downstream)*
LOCATION: ☐ Meander bend ☐ Straight section ☐ Steep slope/valley wall ☐ Other:
DIMENSIONS:
Length *(if no GPS)* LT_____ft and/or RT_______ft | Bottom width ______ft
Bank Ht LT_____ft and/or RT_______ft | Top width ________ft
Bank Angle LT______° and/or RT______° | Wetted Width ______ft

LAND OWNERSHIP: ☐ Private ☐ Public ☐ Unknown | **LAND COVER:** ☐ Forest ☐ Field/Ag ☐ Developed:

POTENTIAL RESTORATION CANDIDATE: ☐ Grade control ☐ Bank stabilization
☐ No ☐ Other:

THREAT TO PROPERTY/INFRASTRUCTURE: ☐ No ☐ Yes (Describe):

EXISTING RIPARIAN WIDTH: ☐ ≤25 ft ☐ 25 - 50 ft ☐ 50-75ft ☐ 75-100ft ☐ >100ft

EROSION SEVERITY *(circle#)* Channelized= ☐ 1	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.
	5 4	3 2	1
ACCESS:	Good access: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	Fair access: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	Difficult access. Must cross wetland, steep slope or other sensitive areas to access stream. Minimal stockpile areas available and/or located a great distance from stream section. Specialized heavy equipment required.
	5 4	3 2	1

NOTES/CROSS SECTION SKETCH:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Impacted Buffer **IB**

WATERSHED/SUBSHED:		**DATE:** / /	**ASSESSED BY:**
SURVEY REACH:	**TIME:** __:__ AM/PM	**PHOTO ID:** (*Camera-Pic #*)	#
SITE ID: (*Condition-#*) IB-____	*START* **LAT** ___° ___' ___" **LONG** ___° ___' ___" **LMK** ____ *END* **LAT** ___° ___' ___" **LONG** ___° ___' ___" **LMK** ____		**GPS:** (*Unit ID*)

IMPACTED BANK: ☐ LT ☐ RT ☐ Both

REASON INADEQUATE: ☐ Lack of vegetation ☐ Too narrow ☐ Widespread invasive plants ☐ Recently planted ☐ Other:

LAND USE: (*Facing downstream*)

	Private	Institutional	Golf Course	Park	Other Public
LT Bank	☐	☐	☐	☐	☐:
RT Bank	☐	☐	☐	☐	☐:

DOMINANT LAND COVER:

	Paved	Bare ground	Turf/lawn	Tall grass	Shrub/scrub	Trees	Other
LT Bank	☐	☐	☐	☐	☐	☐	☐:
RT Bank	☐	☐	☐	☐	☐	☐	☐:

INVASIVE PLANTS: ☐ None ☐ Rare ☐ Partial coverage ☐ Extensive coverage ☐ unknown

STREAM SHADE PROVIDED? ☐ None ☐ Partial ☐ Full **WETLANDS PRESENT?** ☐ No ☐ Yes ☐ Unknown

POTENTIAL RESTORATION CANDIDATE ☐ Active reforestation ☐ Greenway design ☐ Natural regeneration ☐ Invasives removal
☐ no ☐ Other:

RESTORABLE AREA

	LT	RT
Length (ft):	______	______
Width (ft):	______	______

REFORESTATION POTENTIAL: (*Circle #*)

Impacted area on public land where the riparian area does not appear to be used for any specific purpose; plenty of area available for planting	Impacted area on either public or private land that is presently used for a specific purpose; available area for planting adequate	Impacted area on private land where road; building encroachment or other feature significantly limits available area for planting
5 4	3	2 1

POTENTIAL CONFLICTS WITH REFORESTATION ☐ Widespread invasive plants ☐ Potential contamination ☐ Lack of sun ☐ Poor/unsafe access to site ☐ Existing impervious cover ☐ Severe animal impacts (deer, beaver) ☐ Other:

NOTES:

Stream Crossing **SC**

WATERSHED/SUBSHED: **DATE:** __/__/__ **ASSESSED BY:**

SURVEY REACH ID: **TIME:** __:__ AM/PM **PHOTO ID:** (*Camera-Pic #*) /#

SITE ID: (*Condition-#*) SC-____ **LAT** __°__'__" **LONG** __°__'__" **LMK**____ **GPS** (*Unit ID*)

TYPE: ☐ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☐ Circular ☐ Other:

 # BARRELS: ☐ Single ☐ Double ☐ Triple ☐ Other:

MATERIAL: ☐ Concrete ☐ Metal ☐ Other:

ALIGNMENT: ☐ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*) Barrel diameter: _____(ft) Height: _____(ft) Culvert length: _____(ft) Width: _____(ft) Roadway elevation:_____(ft)

CONDITION: (*Evidence of…*) ☐ Cracking/chipping/corrosion ☐ Downstream scour hole ☐ Sediment deposition ☐ Failing embankment ☐ Other (*describe*):

CULVERT SLOPE: ☐ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit ☐ no ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☐ No ☐ Yes ☐ Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE: ☐ Total ☐ Partial ☐ Temporary ☐ Unknown

CAUSE: ☐ Drop too high Water Drop: ____ (in) ☐ Flow too shallow Water Depth:____ (in) ☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.

5 4 3 2 1

NOTES/SKETCH:

REPORTED TO AUTHORITIES ☐ Yes ☐ No

Channel Modification **CM**

WATERSHED/SUBSHED:		**DATE:** ___/___/___	**ASSESSED BY:**
SURVEY REACH ID:	**TIME:** ___:___ AM/PM	**PHOTO ID:** (*Camera-Pic #*) ___ #	
SITE ID: (*Condition-#*) CM-____	*START* **LAT** ___° ___' ___" **LONG** ___° ___' ___" **LMK** ____ *END* **LAT** ___° ___' ___" **LONG** ___° ___' ___" **LMK** ____		**GPS:** (*Unit ID*)

TYPE: ☐ Channelization ☐ Bank armoring ☐ concrete channel ☐ Floodplain encroachment ☐ Other:

MATERIAL:	Does channel have perennial flow?	☐ Yes ☐ No	**DIMENSIONS:**
☐ Concrete ☐ Gabion	Is there evidence of sediment deposition?	☐ Yes ☐ No	Height ____________(ft) Bottom Width ____________(ft)
☐ Rip Rap ☐ Earthen ☐ Metal	Is vegetation growing in channel?	☐ Yes ☐ No	Top Width: ____________(ft)
☐ Other:	Is channel connected to floodplain?	☐ Yes ☐ No	Length: ____________(ft)

BASE FLOW CHANNEL Depth of flow ____________(in) Defined low flow channel? ☐ Yes ☐ No % of channel bottom ________%	**ADJACENT STREAM CORRIDOR** Available width LT________(ft) RT________(ft) Utilities Present? ☐ Yes ☐ No Fill in floodplain? ☐ Yes ☐ No

POTENTIAL RESTORATION CANDIDATE ☐ Structural repair ☐ Base flow channel creation ☐ Natural channel design ☐ Can't tell
☐ no ☐ De-channelization ☐ Fish barrier removal ☐ Bioengineering

CHANNELIZATION SEVERITY: (*Circle #*)	A long section of concrete stream (>500') channel where water is very shallow (<1" deep) with no natural sediments present in the channel.	A moderate length (> 200') ,but channel stabilized and beginning to function as a natural stream channel. Vegetated bars may have formed in channel.	An earthen channel less than 100 ft with good water depth, a natural sediment bottom, and size and shape similar to the unchannelized stream reaches above and below impacted area.
	5 4	3	2 1

NOTES:

Trash and Debris **TR**

WATERSHED/SUBSHED:		**DATE:** ___/___/___	**ASSESSED BY:**
SURVEY REACH ID:	**TIME:** ___:___AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#	
SITE ID: (*Condition-#*) TR-_____	**LAT** ___°____'____" **LONG** ___°____'____" **LMK** _____		**GPS:** (*Unit ID*)

TYPE: ☐ Industrial ☐ Commercial ☐ Residential	**MATERIAL:** ☐ Plastic ☐ Paper ☐ Metal ☐ Tires ☐ Construction ☐ Medical ☐ Appliances ☐ Yard Waste ☐ Automotive ☐ Other:	**SOURCE:** ☐ Unknown ☐ Flooding ☐ Illegal dump ☐ Local outfall	**LOCATION:** ☐ Stream ☐ Riparian Area ☐ Lt bank ☐ Rt bank	**LAND OWNERSHIP:** ☐ Public ☐ Unknown ☐ Private **AMOUNT** (*# Pickup truck loads*):

POTENTIAL RESTORATION CANDIDATE ☐ Stream cleanup ☐ Stream adoption segment ☐ Removal/prevention of dumping
☐ no ☐ Other:

If yes for trash or debris removal	**EQUIPMENT NEEDED :** ☐ Heavy equipment ☐ Trash bags ☐ Unknown **WHO CAN DO IT:** ☐ Volunteers ☐ Local Gov ☐ Hazmat Team ☐ Other	**DUMPSTER WITHIN 100 FT:** ☐ Yes ☐ No ☐ Unknown

CLEAN-UP POTENTIAL: (*Circle #*)	A small amount of trash (i.e., less than two pickup truck loads) located inside a park with easy access	A large amount of trash, or bulk items, in a small area with easy access. Trash may have been dumped over a long period of time but it could be cleaned up in a few days, possibly with a small backhoe.	A large amount of trash or debris scattered over a large area, where access is very difficult. Or presence of drums or indications of hazardous materials
	5	4 3	2 1

NOTES:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Utility Impacts **UT**

WATERSHED/SUBSHED:	**DATE:** ___/___/___	**ASSESSED BY:**	
SURVEY REACH ID:	**TIME:** ___:___AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#	
SITE ID: (*Condition-#*) UT-____	**LAT** ___° ___' ___" **LONG** ___° ___' ___"	**LMK:** ____	**GPS:** (*Unit ID*)

TYPE:	**MATERIAL:**	**LOCATION:**	**POTENTIAL FISH BARRIER:**	**PIPE DIMENSIONS:**
☐ Leaking sewer ☐ Exposed pipe ☐ Exposed manhole ☐ Other:	☐ Concrete ☐ Corrugated metal ☐ Smooth metal ☐ PVC ☐ Other:	☐ Floodplain ☐ Stream bank ☐ Above stream ☐ Stream bottom ☐ Other:	☐ Yes ☐ No	Diameter: ____ in Length exposed: ____ ft
			CONDITION: ☐ Joint failure ☐ Protective covering broken ☐ Other:	☐ Pipe corrosion/cracking ☐ Manhole cover absent

EVIDENCE OF DISCHARGE:		
	COLOR	☐ None ☐ Clear ☐ Dark Brown ☐ Lt Brown ☐ Yellowish ☐ Greenish ☐ Other:
	ODOR	☐ None ☐ Sewage ☐ Oily ☐ Sulfide ☐ Chlorine ☐ Other:
	DEPOSITS	☐ None ☐ Tampons/Toilet Paper ☐ Lime ☐ Surface oils ☐ Stains ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Structural repairs ☐ Pipe testing ☐ Citizen hotlines ☐ Dry weather sampling
☐ no ☐ Fish barrier removal ☐ Other:

If yes to fish barrier, Water Drop: _______ (in)

UTILITY IMPACT SEVERITY: (*Circle #*)			
Leaking= ☐ 5	Section of pipe undermined by erosion and could collapse in the near future; a pipe running across the bed or suspended above the stream; a long section along the edge of the stream where nearly the entire side of the pipe is exposed; or a manhole stack that is located in the center of the stream channel and there is evidence of stack failure.	A moderately long section of pipe is partially exposed but there is no immediate threat that the pipe will be undermined and break in the immediate future. The primary concern is that the pipe may be punctured by large debris during a large storm event.	Small section of exposed pipe, stream bank near the pipe is stable; the pipe is across the bottom of the stream but only a small portion of the top of the pipe exposed; the pipe is exposed but is reinforced with concrete and it is not causing a blockage to upstream fish movement; a manhole stack that is at the edge of the stream and does not extend very far out into the active stream channel.
	5	4 3	2 1

NOTES:

REPORTED TO LOCAL AUTHORITIES ☐ Yes ☐ No

Miscellaneous **MI**

WATERSHED/SUBSHED:	**DATE:** ___/___/___	**ASSESSED BY:**
SURVEY REACH ID:	**TIME:** ___:___ AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#
SITE ID: (*Condition-#*) **MI-**____	**LAT** ___° ___' ___" **LONG** ___° ___' ___" **LMK:** ____	**GPS:** (*Unit ID*)

POTENTIAL RESTORATION CANDIDATE ☐ Storm water retrofit ☐ Stream restoration ☐ Riparian Management
☐ no ☐ Discharge Prevention ☐ Other:

DESCRIBE:

REPORTED TO LOCAL AUTHORITIES ☐ Yes ☐ No

WATERSHED/SUBSHED:	**DATE:** ___/___/___	**ASSESSED BY:**
SURVEY REACH ID:	**TIME:** ___:___ AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#
SITE ID: (*Condition-#*) **MI-**____	**LAT** ___° ___' ___" **LONG** ___° ___' ___" **LMK:** ____	**GPS:** (*Unit ID*)

POTENTIAL RESTORATION CANDIDATE ☐ Storm water retrofit ☐ Stream restoration ☐ Riparian Management
☐ no ☐ Discharge Prevention ☐ Other:

DESCRIBE:

REPORTED TO LOCAL AUTHORITIES ☐ Yes ☐ No

WATERSHED/SUBSHED:	**DATE:** ___/___/___	**ASSESSED BY:**
SURVEY REACH ID:	**TIME:** ___:___ AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#
SITE ID: (*Condition-#*) **MI-**____	**LAT** ___° ___' ___" **LONG** ___° ___' ___" **LMK:** ____	**GPS:** (*Unit ID*)

POTENTIAL RESTORATION CANDIDATE ☐ Storm water retrofit ☐ Stream restoration ☐ Riparian Management
☐ no ☐ Discharge Prevention ☐ Other:

DESCRIBE:

REPORTED TO LOCAL AUTHORITIES ☐ Yes ☐ No

Reach Level Assessment **RCH**

Survey Reach ID: ____	**Wtrshd/Subshd:**	**Date:** __/__/__	**Assessed by:**
Start **Time:** __:__ AM/PM **LMK:** ____ **Lat** __° ____' ____" **Long** __° ____' ____" **Description:**	*End* **Time:** __:__ AM/PM **LMK:** ____ **Lat** __° ____' ____" **Long** __° ____' ____" **Description:**		**GPS ID:**

Rain in last 24 hours ☐ Heavy rain ☐ Steady rain ☐ None ☐ Intermittent ☐ Trace

Present conditions ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☐ Overcast ☐ Partly cloudy

Surrounding land use: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☐ Suburban/Res ☐ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

Average Conditions *(check applicable)*

Base Flow as % Channel Width ☐ 0-25% ☐ 50%-75% ☐ 25-50 % ☐ 75-100%

Dominant Substrate
☐ Silt/clay (fine or slick) ☐ Cobble (2.5 –10")
☐ Sand (gritty) ☐ Boulder (>10")
☐ Gravel (0.1-2.5") ☐ Bed rock

Water Clarity ☐ Clear ☐ Turbid *(suspended matter)* ☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)* ☐ Other *(chemicals, dyes)*

Aquatic Plants in Stream Attached: ☐ none ☐ some ☐ lots Floating: ☐ none ☐ some ☐ lots

Wildlife in or Around Stream (Evidence of) ☐ Fish ☐ Beaver ☐ Deer ☐ Snails ☐ Other:

Stream Shading (water surface)
☐ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

Channel Dynamics
☐ Downcutting ☐ Bed scour
☐ Widening ☐ Bank failure
☐ Headcutting ☐ Bank scour
☐ Aggrading ☐ Slope failure
☐ Sed. deposition ☐ Channelized
☐ Unknown

Channel Dimensions *(Facing downstream)*
Height: LT bank ________(ft)
RT bank ________(ft)
Width: Bottom ________(ft)
Top ________(ft)

Reach Accessibility

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	Fair: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	Difficult. Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3 2	1

Reach Sketch and Site Impact Tracking

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB, SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow

Notes: *(biggest problem you see in survey reach)*

Reported to authorities ☐ Yes ☐ No

OVERALL STREAM CONDITION				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
IN-STREAM HABITAT *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
VEGETATIVE PROTECTION *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
BANK EROSION (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN CONNECTION	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
OVERALL BUFFER AND FLOODPLAIN CONDITION				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
VEGETATED BUFFER WIDTH	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN VEGETATION	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN HABITAT	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN ENCROACH-MENT	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: _____ /80 + Buffer/Floodplain: _____ /80 = **Total Survey Reach** _____ /160

Photo Inventory
(By Camera)

Project: ____________
Group: ____________
Camera: ____________

This field sheet is to be completed AS photos are taken in the field. The intent is to force us to organize pictures taken on a camera basis. Fill out one sheet per camera (add sheets as needed). Only fill in Date/Reach/Location ID when you start in a new spatial or temporal location.

Date	Stream/ Reach	Location ID	Photo #	Description

Neighborhood Source Assessment **NSA**

WATERSHED:	**SUBWATERSHED:**	**UNIQUE SITE ID:**	
DATE: ___/___/_____	**ASSESSED BY:**	**CAMERA ID:**	**PIC#:**

A. NEIGHBORHOOD CHARACTERIZATION

Neighborhood/Subdivision Name: ______________________ Neighborhood Area (acres) _______

If unknown, address (or streets) surveyed: ______________________

Homeowners Association? ☐ Y ☐ N ☐ Unknown If yes, name and contact information: ______________________

Residential *(circle average single family lot size):*

☐ Single Family Attached (Duplexes, Row Homes) <1/8 1/8 1/4 1/3 1/2 acre ☐ Multifamily (Apts, Townhomes, Condos)

☐ Single Family Detached <¼ ¼ ½ 1 >1 acre ☐ Mobile Home Park

Item			INDEX*
Estimated Age of Neighborhood: _____ years	Percent of Homes with Garages: _____% With Basements ____%		
Sewer Service? ☐ Y ☐ N			○
Index of Infill, Redevelopment, and Remodeling ☐ No Evidence ☐ <5% of units ☐ 5-10% ☐ >10%			○
Record percent observed for each of the following indicators, depending on applicability and/or site complexity	**Percentage**	**Comments/Notes**	
B. YARD AND LAWN CONDITIONS			
B1. % of lot with impervious cover			
B2. % of lot with grass cover			○
B3. % of lot with landscaping (e.g., mulched bed areas)			◇
B4. % of lot with bare soil			○
**Note: B1 through B4 must total 100%*			
B5. % of lot with forest canopy			◇
B6. Evidence of permanent irrigation or "non-target" irrigation			○
B7. Proportion of *total neighborhood* turf lawns with following management status:	High: ____		○
	Med: ____		
	Low: ____		
B8. Outdoor swimming pools? ☐ Y ☐ N ☐ Can't Tell Estimated # ____			○
B9. Junk or trash in yards? ☐ Y ☐ N ☐ Can't Tell			○
C. DRIVEWAYS, SIDEWALKS, AND CURBS			
C1. % of driveways that are impervious ☐ N/A			
C2. Driveway Condition ☐ Clean ☐ Stained ☐ Dirty ☐ Breaking up			○
C3. Are sidewalks present? ☐ Y ☐ N If yes, are they on one side of street ☐ or along both sides ☐			
☐ Spotless ☐ Covered with lawn clippings/leaves ☐ Receiving 'non-target' irrigation			○
What is the distance between the sidewalk and street? _____ ft.			◇
Is pet waste present in this area? ☐ Y ☐ N ☐ N/A			○
C4. Is curb and gutter present? ☐ Y ☐ N If yes, check all that apply:			
☐ Clean and Dry ☐ Flowing or standing water ☐ Long-term car parking ☐ Sediment			○
☐ Organic matter, leaves, lawn clippings ☐ Trash, litter, or debris ☐ Overhead tree canopy			◇

* INDEX: ○ denotes potential pollution source; ◇ denotes a neighborhood restoration opportunity

Neighborhood Source Assessment **NSA**

D. ROOFTOPS			
D1. Downspouts are directly connected to storm drains or sanitary sewer			◇ ○
D2. Downspouts are directed to impervious surface			
D3. Downspouts discharge to pervious area			
D4. Downspouts discharge to a cistern, rain barrel, etc.			
**Note: C1 through C4 should total 100%*			
D5. Lawn area present downgradient of leader for rain garden? ☐ Y ☐ N			◇
E. COMMON AREAS			
E1. Storm drain inlets? ☐ Y ☐ N If yes, are they stenciled? ☐ Y ☐ N Condition: ☐ Clean ☐ Dirty			◇
Catch basins inspected? ☐ Y ☐ N If yes, include Unique Site ID from SSD sheet: ______			○
E2. Storm water pond? ☐ Y ☐ N Is it a ☐ wet pond or ☐ dry pond? Is it overgrown? ☐ Y ☐ N What is the estimated pond area? ☐ <1 acre ☐ about 1 acre ☐ > 1 acre			◇
E3. Open Space? ☐ Y ☐ N If yes, is pet waste present? ☐ Y ☐ N dumping? ☐ Y ☐ N			○
Buffers/floodplain present: ☐ Y ☐ N If yes, is encroachment evident? ☐ Y ☐ N			
F. INITIAL NEIGHBORHOOD ASSESSMENT AND RECOMMENDATIONS			
Based on field observations, this neighborhood has significant indicators for the following: *(check all that apply)* ☐ Nutrients ☐ Oil and Grease ☐ Trash/Litter ☐ Bacteria ☐ Sediment ☐ Other ______			○

Recommended Actions

Specific Action

- ☐ Onsite retrofit potential?
- ☐ Better lawn/landscaping practice?
- ☐ Better management of common space?
- ☐ Pond retrofit?
- ☐ Multi-family Parking Lot Retrofit?
- ☐ Other action(s) ______

Describe Recommended Actions:

Initial Assessment

NSA Pollution Severity Index

- ☐ Severe (More than 10 circles checked)
- ☐ High (5 to 10 circles checked)
- ☐ Moderate (Fewer than 5 circles checked)
- ☐ None (No circles checked)

Neighborhood Restoration Opportunity Index

- ☐ High (More than 5 diamonds checked)
- ☐ Moderate (3-5 diamonds checked)
- ☐ Low (Fewer than 3 diamonds checked)

NOTES:

Hotspot Site Investigation **HSI**

WATERSHED:	**SUBWATERSHED:**		**UNIQUE SITE ID:**
DATE: __/__/____	**ASSESSED BY:**	**CAMERA ID:**	**PIC#:**
MAP GRID:	**LAT** __° __' __" **LONG** __° __' __"		**LMK #**

A. SITE DATA AND BASIC CLASSIFICATION

Name and Address: ________________

Category: ☐ Commercial ☐ Industrial Miscellaneous ☐ Institutional ☐ Municipal ☐ Golf Course ☐ Transport-Related ☐ Marina ☐ Animal Facility

SIC code (if available): __________

Basic Description of Operation: ________________

NPDES Status: ☐ Regulated ☐ Unregulated ☐ Unknown

	INDEX*
B. VEHICLE OPERATIONS ☐ **N/A** *(Skip to part C)* — **Observed Pollution Source?**	☐
B1. Types of vehicles: ☐ Fleet vehicles ☐ School buses ☐ Other: ________	
B2. Approximate number of vehicles: ______	
B3. Vehicle activities *(circle all that apply)*: Maintained Repaired Recycled Fueled Washed Stored	O
B4. Are vehicles stored and/or repaired outside? ☐ Y ☐ N ☐ Can't Tell Are these vehicles lacking runoff diversion methods? ☐ Y ☐ N ☐ Can't Tell	O
B5. Is there evidence of spills/leakage from vehicles? ☐ Y ☐ N ☐ Can't Tell	O
B6. Are uncovered outdoor fueling areas present? ☐ Y ☐ N ☐ Can't Tell	O
B7. Are fueling areas directly connected to storm drains? ☐ Y ☐ N ☐ Can't Tell	O
B8. Are vehicles washed outdoors? ☐ Y ☐ N ☐ Can't Tell Does the area where vehicles are washed discharge to the storm drain? ☐ Y ☐ N ☐ Can't Tell	O
C. OUTDOOR MATERIALS ☐ **N/A** *(Skip to part D)* — **Observed Pollution Source?**	☐
C1. Are loading/unloading operations present? ☐ Y ☐ N ☐ Can't Tell If yes, are they uncovered *and* draining towards a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell	O
C2. Are materials stored outside? ☐ Y ☐ N ☐ Can't Tell If yes, are they ☐ Liquid ☐ Solid Description: ______ Where are they stored? ☐ grass/dirt area ☐ concrete/asphalt ☐ bermed area	O
C3. Is the storage area directly or indirectly connected to storm drain (circle one)? ☐ Y ☐ N ☐ Can't Tell	O
C4. Is staining or discoloration around the area visible? ☐ Y ☐ N ☐ Can't Tell	O
C5. Does outdoor storage area lack a cover? ☐ Y ☐ N ☐ Can't Tell	O
C6. Are liquid materials stored *without* secondary containment? ☐ Y ☐ N ☐ Can't Tell	O
C7. Are storage containers missing labels or in poor condition (rusting)? ☐ Y ☐ N ☐ Can't Tell	O
D. WASTE MANAGEMENT ☐ **N/A** *(Skip to part E)* — **Observed Pollution Source?**	☐
D1. Type of waste *(check all that apply)*: ☐ Garbage ☐ Construction materials ☐ Hazardous materials	O
D2. Dumpster condition *(check all that apply)*: ☐ No cover/Lid is open ☐ Damaged/poor condition ☐ Leaking or evidence of leakage (stains on ground) ☐ Overflowing	O
D3. Is the dumpster located near a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell If yes, are runoff diversion methods (berms, curbs) lacking? ☐ Y ☐ N ☐ Can't Tell	O
E. PHYSICAL PLANT ☐ **N/A** *(Skip to part F)* — **Observed Pollution Source?**	☐
E1. Building: Approximate age: ______ yrs. Condition of surfaces: ☐ Clean ☐ Stained ☐ Dirty ☐ Damaged Evidence that maintenance results in discharge to storm drains (staining/discoloration)? ☐ Y ☐ N ☐ Don't know	O O

*Index: O denotes potential pollution source; ☐ denotes confirmed polluter (evidence was seen)

A-5 *Urban Subwatershed Restoration Manual*

Hotspot Site Investigation **HSI**

E2. Parking Lot: Approximate age _____ yrs. Condition: ☐ Clean ☐ Stained ☐ Dirty ☐ Breaking up Surface material ☐ Paved/Concrete ☐ Gravel ☐ Permeable ☐ Don't know	O
E3. Do downspouts discharge to impervious surface? ☐ Y ☐ N ☐ Don't know ☐ None visible Are downspouts directly connected to storm drains? ☐ Y ☐ N ☐ Don't know	O
E4. Evidence of poor cleaning practices for construction activities (stains leading to storm drain)? ☐ Y ☐ N ☐ Can't Tell	O
F. TURF/LANDSCAPING AREAS ☐ N/A *(skip to part G)*	**Observed Pollution Source?**
F1. % of site with: Forest canopy ___% Turf grass _____% Landscaping ____% Bare Soil ___%	O
F2. Rate the turf management status: ☐ High ☐ Medium ☐ Low	O
F3. Evidence of permanent irrigation or "non-target" irrigation ☐ Y ☐ N ☐ Can't Tell	O
F4. Do landscaped areas drain to the storm drain system? ☐ Y ☐ N ☐ Can't Tell	O
F5. Do landscape plants accumulate organic matter (leaves, grass clippings) on adjacent impervious surface? ☐ Y ☐ N ☐ Can't Tell	O
G. STORM WATER INFRASTRUCTURE ☐ N/A *(skip to part H)*	**Observed Pollution Source?**
G1. Are storm water treatment practices present? ☐ Y ☐ N ☐ Unknown If yes, please describe: ________	O
G2. Are private storm drains located at the facility? ☐ Y ☐ N ☐ Unknown Is trash present in gutters leading to storm drains? If so, complete the index below.	O

Index Rating for Accumulation in Gutters

	Clean				Filthy
Sediment	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Organic material	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Litter	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

G3. Catch basin inspection – Record SSD Unique Site ID here: ________ Condition: ☐ Dirty ☐ Clean

H. INITIAL HOTSPOT STATUS - INDEX RESULTS

☐ Not a hotspot (fewer than 5 circles and no boxes checked) ☐ Potential hotspot (5 to 10 circles but no boxes checked)
☐ Confirmed hotspot (10 to 15 circles and/or 1 box checked) ☐ Severe hotspot (>15 circles and/or 2 or more boxes checked)

Follow-up Action:
- ☐ Refer for immediate enforcement
- ☐ Suggest follow-up on-site inspection
- ☐ Test for illicit discharge
- ☐ Include in future education effort
- ☐ Check to see if hotspot is an NPDES non-filer
- ☐ Onsite non-residential retrofit
- ☐ Pervious area restoration; complete PAA sheet and record Unique Site ID here: ______________
- ☐ Schedule a review of storm water pollution prevention plan

Notes:

Pervious Area Assessment **PAA**

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID:	
DATE: __/__/____	ASSESSED BY:	CAMERA ID:	PIC #:
MAP GRID:	LAT __° __' __" LONG __° __' __"		LMK #

A. PARCEL DESCRIPTION

Size: ___acre(s) Access to site (*check all that apply*): ☐ Foot access ☐ Vehicle access ☐ Heavy equipment access
Ownership: ☐ Private ☐ Public Current Management: ☐ School ☐ Park ☐ Right-of-way ☐ Vacant land
☐ Other (please describe) ____________________
Contact Information: ____________________
Connected to other pervious area? ☐ Y ☐ N If yes, what type? ☐ Forest ☐ Wetland ☐ Other ________
Estimated size of connected pervious area: ____ acre(s) Record Unique Site ID of connected fragment: ________

PART I. NATURAL AREA REMNANT

FOREST	WETLAND
B. CURRENT VEGETATIVE COVER	**B. CURRENT VEGETATIVE COVER**
B1. Percent of forest with the following canopy coverage: Open ____% Partly shaded ____% Shaded ____% **Note – these should total 100%* **B2.** Dominant tree species: ________ **B3.** Understory species: ________ **B4.** Are invasive species present? ☐ Y ☐ N ☐ Unknown If yes, % of forest with invasives: ______ Species: ________	**B1.** % of wetland with following vegetative zones: Aquatic: ______ Emergent: ______ Forested: ______ **Note – these should total 100%* **B2.** Dominant species: ________ **B3.** Are invasive species present? ☐ Y ☐ N ☐ Unknown If yes, % of wetland with invasives: ______ Species: ________
C. FOREST IMPACTS	**C. WETLAND IMPACTS**
C1. Observed Impacts (*check all that apply*): ☐ Animals ☐ Clearing/encroachment ☐ Trash and dumping ☐ Storm water runoff ☐ Other	**C1.** Observed Impacts (*check all that apply*): ☐ Animals ☐ Clearing/encroachment ☐ Trash and dumping ☐ Storm water runoff ☐ Hydrologic impacts ☐ Other
D. NOTES	**D. NOTES**

E. INITIAL RECOMMENDATION

☐ Good candidate for conservation/protection
☐ Potential restoration candidate
☐ Poor restoration or conservation candidate

Pervious Area Assessment **PAA**

PART II. OPEN PERVIOUS AREAS

A. CURRENT VEGETATIVE COVER

A1. Percent of assessed surface with:
Turf ____% Other Herbaceous ____% None (bare soil) ____% Trees ____% Shrubs ____% Other ____%
(please describe): ______________________ **Note – these should total 100%*

A2. Turf: Height: ____ inches Apparent Mowing Frequency: ☐ Frequent ☐ Infrequent ☐ No-Mow ☐ Unknown
Condition (*check all that apply*): ☐ Thick/Dense ☐ Thin/Sparse ☐ Clumpy/Bunchy ☐ Continuous Cover

A3. Thickness of organic matter at surface: ______ inches

A4. Are invasive species present? ☐ Y ☐ N ☐ Unknown If yes, % of site with invasives: ____
Species: ______________________

B. IMPACTS

B1. Observed Impacts (*check all that apply*): ☐ Soil Compaction ☐ Erosion ☐ Trash and Dumping
☐ Poor Vegetative Health ☐ Other (describe): ______________________

C. REFORESTATION CONSTRAINTS

C1. Sun exposure: ☐ Full sun ☐ Partial sun ☐ Shade ☐ Unknown

C2. Nearby water source? ☐ Y ☐ N ☐ Unknown

C3. Other constraints: ☐ Overhead wires ☐ Underground Utilities ☐ Pavement ☐ Buildings
☐ Other (please describe): ______________

D. NOTES

E. INITIAL RECOMMENDATION

☐ Good candidate for natural regeneration
☐ May be reforested with minimal site preparation
☐ May be reforested with extensive site preparation
☐ Poor reforestation or regeneration site

PART III. SKETCH

Streets and Storm Drains **SSD**

WATERSHED:	**SUBWATERSHED:**	**UNIQUE SITE ID:**
DATE: ___/___/_____	**ASSESSED BY:**	**CAMERA ID:**
MAP GRID	**RAIN IN LAST 24 HOURS** ☐ Y ☐ N	**PIC #**

A. LOCATION

A1. Street names or neighborhood surveyed:
____

A2. Adjacent land use: ☐ Residential ☐ Commercial ☐ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related

A3. Corresponding HSI or NSA field sheet? If so, circle HSI or NSA and record its Unique Site ID here ____________

B. STREET CONDITIONS

B1. Road Type: ☐ Arterial ☐ Collector ☐ Local ☐ Alley ☐ Other: ________

B2. Condition of Pavement: ☐ New ☐ Good ☐ Cracked ☐ Broken

B3. Is on-street parking permitted ☐ Y ☐ N If yes, approximate number of cars per block: _______

B4. Are large cul-de-sacs present? ☐ Y ☐ N

B5. Is trash present in curb and gutter? If so, use the index to the right to record amount.

	Index Rating for Accumulation in Gutters				
	Clean				Filthy
Sediment	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Organic Material	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Litter	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

C. STORM DRAIN INLETS AND CATCH BASINS

C1. Type of storm drain conveyance: ☐ open ☐ enclosed ☐ mixed

C2. Percentage of inlets with catch basin storage: ☐ N/A

Sample 1-2 catch basins per NSA/HSI	**C3**. Catch basin #1	**C4**. Catch basin #2
Latitude	___° ___' ___"	___° ___' ___"
Longitude	___° ___' ___"	___° ___' ___"
LMK #		
Picture #		
Current Condition	☐ Wet ☐ Dry	☐ Wet ☐ Dry
Condition of Inlet	☐ Clear ☐ Obstructed	☐ Clear ☐ Obstructed
Litter Accumulation	☐ Y ☐ N	☐ Y ☐ N
Organics Accumulation	☐ Y ☐ N	☐ Y ☐ N
Sediment Accumulation	☐ Y ☐ N	☐ Y ☐ N
Sediment Depth (in feet)	______ ft.	______ ft.
Water Depth	______ ft.	______ ft.
Evidence of oil and grease	☐ Y ☐ N	☐ Y ☐ N
Sulfur smell	☐ Y ☐ N	☐ Y ☐ N
Accessible to vacuum truck	☐ Y ☐ N	☐ Y ☐ N

D. NON-RESIDENTIAL PARKING LOT (>2 acres)

D1. Approximate size: ________ acres

D2. Lot Utilization: ☐ Full ☐ About half full ☐ Empty

D3. Overall condition of Pavement: ☐ Smooth (no cracks) ☐ Medium (few cracks) ☐ Rough (many cracks) ☐ Very Rough (numerous cracks and depressions)

D4. Is lot served by a storm water treatment practice? ☐ Y ☐ N If yes, describe: ____________________

D5. On-site retrofit potential: ☐ Excellent ☐ Good ☐ Poor

Appendix B – Equipment Specifications

Apple iPad mini with Retina Display MF575LL/A (64GB, Wi-Fi + T-Mobile, Black with Space Gray) OLD VERSION
Available from these sellers.

Product Description

Size:**64 GB** | Item Shape:**Wi-Fi + T-Mobile** | Color:**Space Gray**

iPad mini with Retina display is amazing to hold. And behold. Every photo is incredibly detailed and vibrant, and every line of text is remarkably crisp and clear. With higher resolution than an HDTV, it's stunning. iPad mini is powered by the new A7 chip with 64-bit architecture. A7 delivers killer performance. It is up to four times faster CPU and up to eight times faster graphics performance than the previous generation.

Product Information

Size: **64 GB** | Shape: **Wi-Fi + T-Mobile** | Color: **Space Gray**

Technical Details   Collapse all

Summary

Screen Size	7.9 inches
Screen Resolution	2048 x 1536
Max Screen Resolution	1536 pixels
Processor	1.3 GHz Cortex A7
RAM	1 GB DDR2
Hard Drive	64 GB
Wireless Type	802.11abg
Number of USB 2.0 Ports	1
Number of USB 3.0 Ports	1
Average Battery Life (in hours)	10 hours

Other Technical Details

Brand Name	Apple
Series	Apple iPad mini with Retina Display
Item model number	MF575LL/A
Hardware Platform	PC
Operating System	Apple IOS 7
Item Weight	12 ounces
Item Dimensions L x W x H	7.87 x 5.30 x 0.29 inches
Color	Space Gray
Rear Webcam Resolution	5 MP
Processor Brand	Apple
Processor Count	2
Computer Memory Type	SIMM
Flash Memory Size	64
Hard Drive Interface	Serial ATA
Battery Type	Lithium Polymer (LiPo)
Batteries:	1 Lithium ion batteries required. (included)

DATASHEET

GEOEXPLORER 6000 SERIES GEOXT HANDHELD

KEY FEATURES

220 channel GNSS receiver
Submeter real-time and 50 cm postprocessed accuracy

Floodlight satellite shadow reduction technology option
More positions and increased accuracy in tough environments

Sunlight readable display
4.2" polarized screen for unmatched clarity in bright sunlight

3.5G modem option
Integrated cellular for Internet connectivity in the field

5 megapixel autofocus camera
Capture high quality photographs and link directly to features

Field swappable battery
More than 8 hours operation on a single charge and swap-and-go battery replacement in the field

A NEW STANDARD FOR PRODUCTIVE GNSS DATA COLLECTION

The Trimble® GeoExplorer® 6000 series takes GNSS productivity to a whole new level. Combining submeter accuracy GNSS, high quality photo capture, wireless Internet, and connectivity options in a single product, the GeoXT™ handheld is the ideal field device for organizations mapping critical assets and infrastructure, or for anyone needing dependable submeter accuracy GNSS data, simple operation, and repeatable results.

Together with the latest field software enhancements and GNSS innovations—including Trimble Floodlight™ satellite shadow reduction technology—the GeoXT handheld is the ideal submeter field solution for any industry, including utility companies, local government organizations, and federal agencies.

Reliable submeter performance

Integrating the latest in Trimble GNSS receiver technology, with the optional ability to track both GPS and GLONASS satellites, the GeoXT handheld delivers consistent submeter accuracy in real time and 50 cm accuracy after postprocessing.

For submeter accuracy, the GeoXT handheld's integrated SBAS receiver can be used to obtain real time corrections such as WAAS, EGNOS, or MSAS, or the GeoXT handheld's built-in Bluetooth® wireless technology can be used to seamlessly connect to a Trimble GeoBeacon™ receiver.

For 50 cm accuracy, data collected with Trimble field software can be postprocessed using the Trimble GPS Pathfinder® Office software or GPS Analyst™ extension for Esri ArcGIS Desktop software. These office processing suites use Trimble DeltaPhase™ technology to achieve 50 cm accuracy for GNSS code measurements after postprocessing, and even higher levels of postprocessed accuracy are possible if GNSS carrier data is logged for extended periods.

Floodlight satellite shadow reduction

Trees and buildings create shadows, limiting the environments where reliable high-accuracy GNSS data collection can be performed. Using the innovative Trimble Floodlight satellite shadow reduction technology, the GeoXT handheld continues to deliver prodeuctive, usable positioning data in areas where legacy GNSS receiver systems cannot.

With the optional Floodlight technology option installed, the GeoXT receiver can compute positions even with very weak satellite signals. Floodlight technology increases the number of positions that are gathered in difficult locations, and boosts accuracy in those places where normally only low accuracy data is available. With the GeoXT handheld, field crew can now work with fewer disruptions, meaning better data, faster, at less cost.

Never-seen-before display performance

The GeoXT handheld includes a sunlight-optimized, display designed specifically for outdoor operation. It maintains exceptional clarity in all outdoor conditions, including direct sunlight. Text is crisp and easy to read. Background maps and photos are rich and vibrant. At 4.2" (10.7 cm), the display is also big, so the touch panel is spacious and easy to control.

Work online, anywhere

Internet access in the field gives workers live access to the information they need to make better decisions, faster. Once connected, field workers can collaborate with their office and with each other, even from remote locations.

The GeoXT handheld offers a choice of wireless technology to enable Internet connections directly on the device—including an optional 3.5G cellular modem built into the handheld itself, integrated Wi-Fi, or Bluetooth wireless technology.

Whether connecting to corporate networks, or accessing web-based services such as real-time map data or VRS™ corrections, accessing and updating live information in the field is simple and fast.

Bluetooth technology also enables wireless connection to other external devices such as Bluetooth-enabled laser range finders, barcode scanners or RFID readers.

High quality photo capture

A photograph is often the best way to capture information about an asset, event, or site. The GeoXT handheld includes a 5 megapixel autofocus camera with geo-tagging capability. The camera can be controlled by the TerraSync™ software and other third party applications, so photo capture and linking of images to GIS features is seamless and simple to integrate with existing data capture workflows.

Designed for work

The GeoExplorer 6000 series was designed with a single goal in mind—delivering a high-accuracy handheld GNSS system that works faster, longer, and in more places than any other.

The Lithium-Ion battery provides up to 8 hours of GNSS operation on a single charge, and can be swapped on-the-go without shutting down the device—enabling near-continuous operation and minimizing field worker downtime.

The GeoXT handheld is powered by a super-fast OMAP 3503 series processor and 256 MB RAM. With 2 GB of internal storage and the capacity to add an additional 32 GB via SDHC card, the GeoXT handheld has the capacity and power you need to work with high resolution maps and complex datasets.

The fully ruggedized IP65 construction is designed to withstand the harshest environments. Wherever field workers go, they can take the GeoXT handheld with the confidence that the equipment can handle the toughest conditions.

These smart design features combine with unprecedented accuracy and productivity to deliver the ultimate high performance handheld field solution.

The GeoXT handheld. Designed for work.

GEOEXPLORER 6000 SERIES GEOXT HANDHELD

SYSTEM SUMMARY

- Single-frequency GNSS receiver and antenna with Everest™ multipath rejection technology and optional Trimble Floodlight satellite shadow reduction technology
- Sunlight readable 4.2" polarized screen
- Optional integrated 3.5G cellular modem
- Integrated Wi-Fi and Bluetooth wireless technology
- 5 megapixel autofocus camera
- Windows Mobile® 6.5 (Professional edition)
- Rugged and water-resistant design

SIZE AND WEIGHT

Height	234 mm (9.2 in)
Width	99 mm (3.9 in)
Depth	56 mm (2.2 in)
Weight (inc. battery)	925 g (2.0 lb)

GNSS

Receiver	Trimble Maxwell™ 6 GNSS chipset
Channels	220 channels
Systems	GPS, GLONASS[1], SBAS
GPS	L1C/A
GLONASS[1]	L1C/A, L1P
SBAS[2]	WAAS/EGNOS/MSAS
Update rate	1 Hz
Time to first fix	45 s (typical)
NMEA-0183 support	Optional
RTCM support	RTCM2.x/RTCM3.x
CMR support	CMR/CMR+/CMRx

GNSS ACCURACY (HRMS) AFTER CORRECTION[3]

Real-time code corrected	
VRS or local base	75 cm + 1 ppm
SBAS (WAAS/MSAS/EGNOS)	< 1 m
Code postprocessed	50 cm + 1 ppm
Carrier postprocessed[3]	
After 10 minutes	20 cm + 2 ppm
After 20 minutes	10 cm + 2 ppm
After 45 minutes	1 cm + 2 ppm

TEMPERATURE

Operation	–20 °C to +50 °C (–4 °F to 122 °F)
Storage	–30 °C to +70 °C (–22 °F to 158 °F)
Charging	0 °C to +45 °C (32 °F to 113 °F)

MECHANICAL SHOCK

Drop	1.2 m (4 ft) concrete under plywood
Vibration	Method 514.5

ALTITUDE & HUMIDITY RATINGS

Relative humidity	95% non-condensing
Maximum operating altitude	3,658 m (12,000 ft)
Maximum storage altitude	5,000 m (16,400 ft)

INGRESS PROTECTION

Water/Dust	IP65

BATTERY

Type	Rechargeable, removable Li-Ion
Capacity	11.1V 2.5 AH
Charge time	4 hours (typical)

BATTERY RUN TIME[4]

GNSS only	11.5 hours
GNSS & VRS over BT	11 hours
GNSS & VRS over Wi-Fi	10 hours
GNSS & VRS over Cellular modem	8.5 hours
Standby time	50 days

BUTTONS & CONTROLS

- Power key
- Left & right application keys
- Camera key

CONNECTORS & INPUTS

- Internal microphone and speaker
- Mini USB connector
- DE-9 serial via optional USB to serial converter
- External power connector
- SIM socket
- SDHC socket

CAMERA

Still mode	Autofocus 5 MP
Still image format	JPG
Video mode	Up to VGA resolution
Video file format	WMV with audio

CELLULAR[5] & WIRELESS[6]

UMTS/HSDPA	850/900/2100 MHz
GPRS/EDGE	850/900/1800/1900 MHz
Wi-Fi	802.11 b/g
Bluetooth	Version 2.1 + EDR

DISPLAY

Type	Transflective LED-backlit LCD
Size	4.2" (diagonal)
Resolution	480x640
Luminance	280 cd/m²

HARDWARE

Processor	TI OMAP 3503
RAM	256 MB
Flash	2 GB
External storage	SD/SDHC up to 32 GB

LANGUAGES

- English (US), Spanish, French, German, Italian, Portuguese (Brazilian), Chinese (Simplified), Korean, Japanese, Russian

IN THE BOX

- GeoExplorer 6000 series handheld
- Pouch
- Hand strap
- USB data cable
- Rechargeable battery pack
- AC Power adaptor
- Screen protector kit
- Spare stylus & tether
- Documentation

OPTIONAL ACCESSORIES

- Tempest™ external GNSS antenna
- 1.5 m & 5 m external antenna cable
- Range pole kit for external antenna
- Backpack kit for external antenna
- Vehicle mount
- Hard carry case
- TDL 3G cellular modem
- GeoBeacon receiver
- Null modem cable
- USB to serial converter cable

SOFTWARE COMPATIBILITY

- TerraSync™ software
- Trimble GPScorrect™ extension for Esri ArcPad software
- Trimble GPS Controller software
- GNSS Connector software
- GPS Pathfinder® Office software
- Trimble GPS Analyst™ extension for Esri ArcGIS Desktop software
- Third party NMEA-based applications[7]

1 GLONASS tracking is available only if the Trimble Floodlight satellite shadow reduction option is activated.
2 SBAS (Satellite Based Augmentation System). Includes WAAS available in North America only, EGNOS available in Europe only, and MSAS available in Japan only.
3 HRMS refers to Horizontal Root Mean Squared accuracy, 1-sigma (68%). Except in conditions where most GNSS signals are affected by trees, or buildings, or other objects. 45 minute carrier postprocessed accuracy is limited to data collected within 10 km of the base station. Except when using VRS corrections, accuracy varies with proximity to base station by +1 ppm for code postprocessing and real-time. Carrier postprocessed accuracy varies with proximity to base station by +2 ppm.
4 Tested by Trimble with default system settings at 21°C ambient. Actual run time will vary with conditions of use.
5 3.5G edition handhelds only. The GeoXT 3.5G edition handheld is PTCRB certified and can operate on supported networks that do not require carrier certification. Consult with your local reseller for more information.
6 Bluetooth and Wi-Fi type approvals are country specific. GeoExplorer 6000 series handhelds have Bluetooth and Wi-Fi approval in the U.S. and in most European countries. For further information please consult your local reseller.
7 NMEA output is an optional upgrade.

Specifications subject to change without notice.

Wi-Fi CERTIFIED
Bluetooth

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LaMotte

1200 COLORIMETER
AMMONIA-NITROGEN
CODE 3680-01

QUANTITY	CONTENTS	CODE
30 mL	Ammonia Nitrogen Reagent #1	V-4797-G
3 x 30 mL	*Ammonia Nitrogen Reagent #2	*V-4798-G
1	Pipet, 1 mL, plastic	0354
1	Colorimeter Tubes, with caps	0290-6
1	Water Sample Collecting Bottle	0688
1	1200 Colorimeter for Ammonia Nitrogen	26737

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

To order individual reagents or test kit components, use the specified code number.

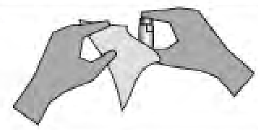
INTRODUCTION

Ammonia nitrogen is present in various concentrations in many surface and ground water supplies. Any sudden change in the concentration of ammonia nitrogen in a water supply is cause for suspicion. A product of microbiological activity, ammonia nitrogen is sometimes accepted as chemical evidence of pollution when encountered in natural waters.

Ammonia is rapidly oxidized in natural water systems by special bacterial groups that produce nitrite and nitrate. This oxidation requires that dissolved oxygen be available in the water. Ammonia is an additional source of nitrogen as a nutrient which may contribute to the expanded growth of undesirable algae and other forms of plant growth that overload the natural system and cause pollution.

AMMONIA NITROGEN TEST PROCEDURE: NESSLER METHOD

Read the 1200 Colorimeter Manual before proceeding. Carefully wipe tubes dry before inserting into the colorimeter chamber.

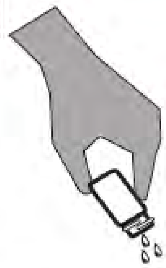


AMMONIA NITROGEN

1.

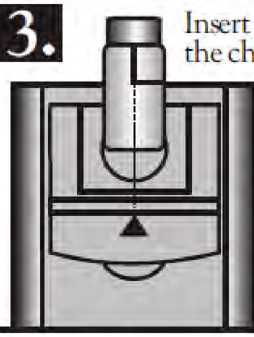
Fill the Water Sample Collecting Bottle (0688) with sample water. This will be used to dispense sample water for the tests.

2.



Rinse and fill a colorimeter tube (0290) to the 10 mL line with sample water. Cap and wipe dry.

3.



Insert the tube into the chamber, being sure to align the index line with the arrow on the meter. Close the lid. This tube is the blank or zero.

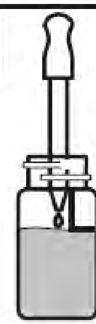
4.

Push the **READ** button to turn the meter on. Press the **ZERO** button and hold it for 2 seconds until BLA is displayed. Release the button to take a blank reading (0.0 ppm).

5.

Remove tube from colorimeter.
Add 8 drops of Ammonia Nitrogen Reagent #1 (V-4797).
Cap and mix.

6.



Use 1.0 mL pipet (0354) to add 1.0 mL of *Ammonia Nitrogen Reagent #2 (V-4798).

7.

Cap and invert to mix. Wait 5 minutes for full color development. Wipe tube dry.

8.

Align the index line with the arrow on the meter, insert tube into chamber. Close the lid. Push the **READ** button. Record results as ppm Ammonia Nitrogen (NH_3-N).

2

NOTE: For the best possible results, carry a reagent blank through the procedure. After scanning the blank in Step 4, perform the test procedure on clear, colorless, distilled or deioized water. Subtract results of regent blank from all subsequent test results.

NOTE: If the reading displays *ER2*, repeat procedure on diluted sample, and multiply the result by the appropriate dilution factor. See 1200 Colorimeter Instruction Manual for procedure.

CALCULATIONS

To express results as Unionized Ammonia (NH_3):

Unionized Ammonia (NH_3) = ppm Ammonia Nitrogen (NH_3-N) x 1.2

To express results as Ionized Ammonia (NH_4^+):

Ionized Ammonia (NH_4^+) = ppm Ammonia Nitrogen (NH_3-N) x 1.3

Ammonia in water occurs in two forms: toxic unionized ammonia (NH_3) and the relatively non-toxic ionized form, ammonium ion (NH_4^+). This test method measures both forms as ammonia-nitrogen (NH_4-N) to give the total ammonia-nitrogen concentration in water. The actual proportion of each compound depends on temperature, salinity, and pH. A greater concentration of unionized ammonia is present when the pH value and salinity increase.

1. Consult the table below to find the percentage that corresponds to the temperature, pH and salinity of the sample.
2. To express the test result as ppm Unionized Ammonia Nitrogen (NH_3-N), multiply the total ammonia-nitrogen test result by the percentage from the table.
3. To express the test result as ppm Ionized Ammonia Nitrogen (NH_4^+-N), subtract the unionized ammonia-nitrogen determined in Step 2 from the total ammonia nitrogen.

	10°C		15°C		20°C		25°C	
pH	**FW[1]**	**SW[2]**	**FW**	**SW**	**FW**	**SW**	**FW**	**SW**
7.0	0.19		0.27		0.40		0.55	
7.1	0.23		0.34		0.50		0.70	
7.2	0.29		0.43		0.63		0.88	
7.3	0.37		0.54		0.79		1.10	
7.4	0.47		0.68		0.99		1.38	
7.5	0.59	0.459	0.85	0.665	1.24	0.963	1.73	1.39
7.6	0.74	0.577	1.07	0.836	1.56	1.21	2.17	1.75
7.7	0.92	0.726	1.35	1.05	1.96	1.52	2.72	2.19
7.8	1.16	0.912	1.69	1.32	2.45	1.90	3.39	2.74
7.9	1.46	1.15	2.12	1.66	3.06	2.39	4.24	3.43
8.0	1.83	1.44	2.65	2.07	3.83	2.98	5.28	4.28
8.1	2.29	1.80	3.32	2.60	4.77	3.73	6.55	5.32
8.2	2.86	2.26	4.14	3.25	5.94	4.65	8.11	6.61
8.3	3.58	2.83	5.16	4.06	7.36	5.78	10.00	8.18
8.4	4.46	3.54	6.41	5.05	9.09	7.17	12.27	10.10
8.5	5.55	4.41	7.98	6.28	11.18	8.87	14.97	12.40

[1] Freshwater data from Trussel (1972).

[2] Seawater values from Bower and Bidwell (1978). Salinity for the Seawater values = 34% at an ionic strength of 0.701 m.

FOR EXAMPLE:

A fresh water sample at 20°C has a pH of 8.5 and the test result is 1.0 ppm as total Ammonia-Nitrogen.

1. The percentage from the table is 11.18% (or 0.1118).
2. 1 ppm total Ammonia-Nitrogen x 0.1118 = 0.1118 ppm Unionized Ammonia-Nitrogen
3. Total Ammonia-Nitrogen 1.0000 ppm

Total Ammonia-Nitrogen		1.0000 ppm
Unionized Ammonia-Nitrogen	–	0.1118 ppm
Ionized Ammonia-Nitrogen	=	0.8882 ppm

AMMONIA NITROGEN TEST METHOD SPECIFICATIONS

APPLICATION

Drinking , surface, and saline waters; domestic and industrial wastes.

RANGE

0 to 5.0 ppm Ammonia Nitrogen

METHOD

Ammonia forms a colored complex with Nessler's Reagent in proportion to the amount of ammonia present in the sample. Rochelle salt is added to prevent precipitation of calcium or magnesium in undistilled samples.

HANDLING & PRESERVATION

Preservation is accomplished by the addition of 2 mL of concentrated H_2SO_4 at 4°C.

INTERFERENCES

Sample turbidity and color may interfere. Turbidity may be removed by a filtration procedure. Color interference may be eliminated by adjusting the instrument to 100%T with a sample blank.

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3680-01 • 10/11

Appendix C –Project Close out

[Insert Project Name]

QA Summary Report - Components

This project resulted in **[Insert deliverable description]**. This work product received the required nature and scope of QAPP oversight appropriate for the intended use of the data.

The data sets, data products and other supporting QA documentation is/are maintained on file with the assigned research staff as noted in the QAPP until **[Insert date].**

All QAPP elements were met and completed according to the procedures and methods outlined therein.

NFWF QA Summary Reports will be submitted to NFWF annually and at project completion as requested. The QA Summary reports will include the following information, as appropriate –

1. QA Summary Closeout reports include the extent to which projects are implemented according to the stated scope of work and the methodologies specified in this QAPP in their final programmatic reports.
2. Significant changes to the objective, scope, or methodology of environmental data collection or use of environmental technology require the review and approval of the NFWF Program Manager and the NFWF QA reviewer. Therefore, if needed, appropriate revisions to this QAPP will be completed and submitted to the NFWF Program Manager for review and approval prior to implementation of changes.
3. Additionally, periodic QA Summary Reports will be submitted to NFWF annually (to be provided in annual NFWF interim reports), if requested, according to the table, below.

The following table summarizes the types of data to be reported and the method in which that information will be delivered to NFWF staff.

Data	Data Description	Reporting Method	Frequency
BMP Data	Raw data from project reports in units of miles, linear feet, acres, individuals, etc.	Spreadsheet, electronically via e-mail.	Annually
Monitoring Data	Raw data on project effectiveness, ambient water quality in priority watershed, stormwater flow, project conclusion data, etc.	Raw data, reports, and/or spreadsheets, electronically on CD or via e-mail.	At NFWF Request during the closeout procedure
Geospatial Data	Google polygon maps, latitude/longitude info, watershed segment	Spreadsheet	Annually