NEW PALTZ CLIMATE SMART COMMUNITIES RIPARIAN BUFFER ASSESSMENT

"Stream in New Paltz, NY", Beth Roessler, NYS Department of Environmental Conservation, 2023

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This project was made possible by a program of Cornell Cooperative Extension Ulster County in partnership with the NYS DEC Hudson River Estuary Program, NY Water Resources Institute and Cornell University with support from the NYS Environmental Protection Fund.

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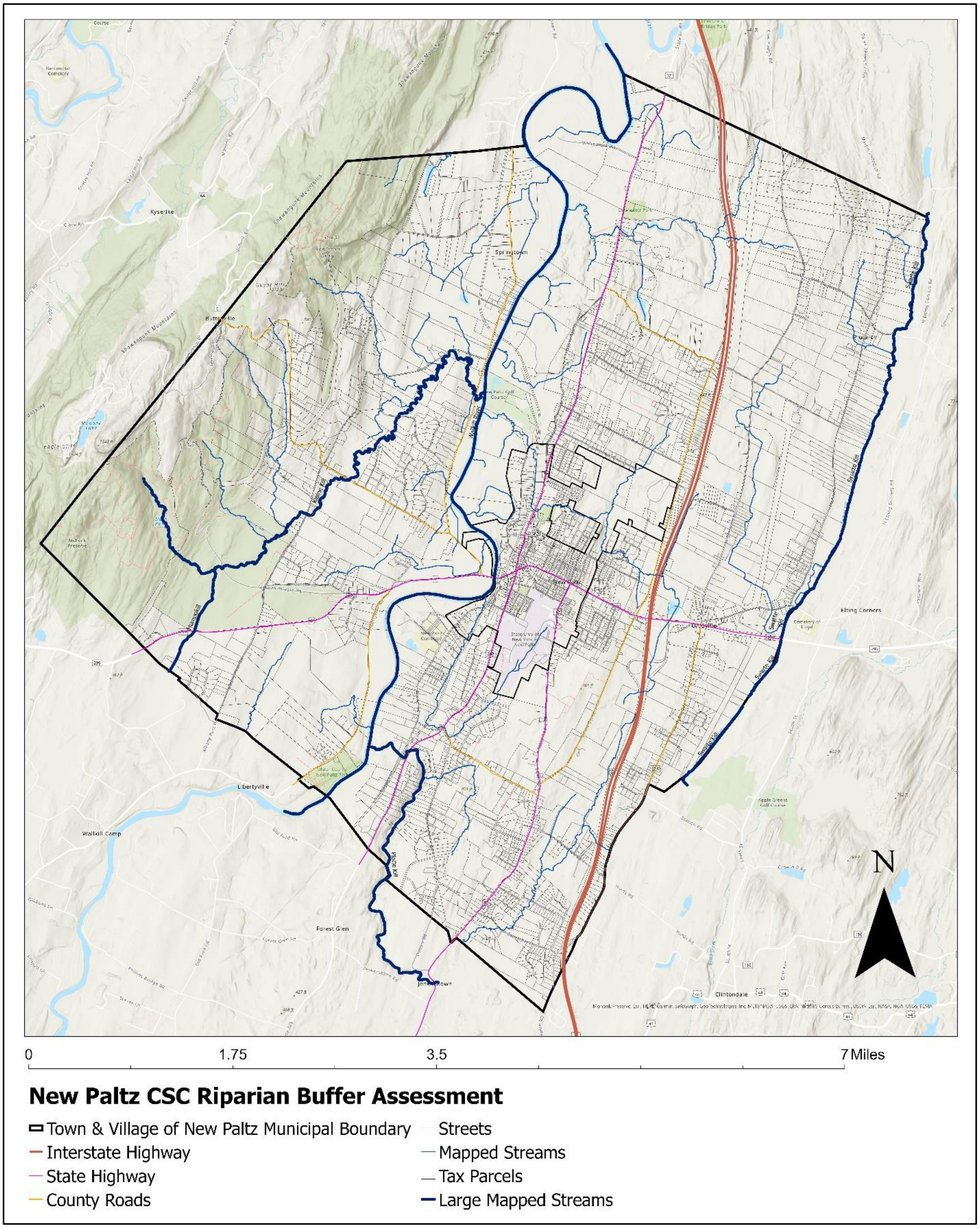


Map 1: Base Layers

I. EXECUTIVE SUMMARY

CCEUC initiated a comprehensive riparian buffer assessment in 2023 to identify and evaluate the current status of riparian buffers within the town and village of New Paltz and identify priority areas for restoration and conservation.

The assessment process gathered information from the NYS Riparian Opportunity Assessment and was analyzed alongside land cover, soil type, water quality, and flood zone data. Based on our findings, we proposed several key recommendations related to potential areas for riparian restoration and protection. In total, 4 protection profiles (3 assessment recommendations, 1 stakeholder recommendation) and 6 restoration profiles (5 assessment recommendations, 1 stakeholder recommendation) were included.

This report was created in an effort to assist in raising awareness among local stakeholders about the importance of riparian buffers, their ecological significance, and the benefits they offer will be crucial for long-term conservation. The assessment serves as a valuable tool for guiding future land management and conservation efforts within the town. By prioritizing restoration and protection focus areas and implementing targeted strategies, the Town and Village of New Paltz can work towards healthier riparian ecosystems, improved water quality, and a more sustainable environment.

II. INTRODUCTION

The Cornell Cooperative Extension Ulster County and the New York State Department of Environmental Conservation's (NYSDEC) Hudson River Estuary Program are seeking to help local decision-makers think more strategically to identify and prioritize sites that would benefit from restoration and conservation planning efforts such as planting native trees and shrubs in riparian buffer zones. The assessment was designed to meet a target goal that aligns with the Pledge Element 7: Riparian Buffers action in the New York State Climate Smart Communities Program (NYS CSC) as well as be flexible enough for use in the prioritization of other restoration and protection efforts such as the implementation of the NYS DEC's Trees for Tribs program.

STUDY AREA AND BACKGROUND

This report aims to evaluate riparian buffers, also known as stream buffers, in the town and village of New Paltz and identify riparian buffer areas that may benefit from tree or shrub planting as well as effective buffers that would benefit from permanent protection efforts. Riparian buffers are the vegetated zones that adjoin streams and rivers (Figure 1). This report focuses on maintaining and restoring forested riparian buffers as a valuable tool to help the Town reduce the impacts associated with the worsening effects of climate change.

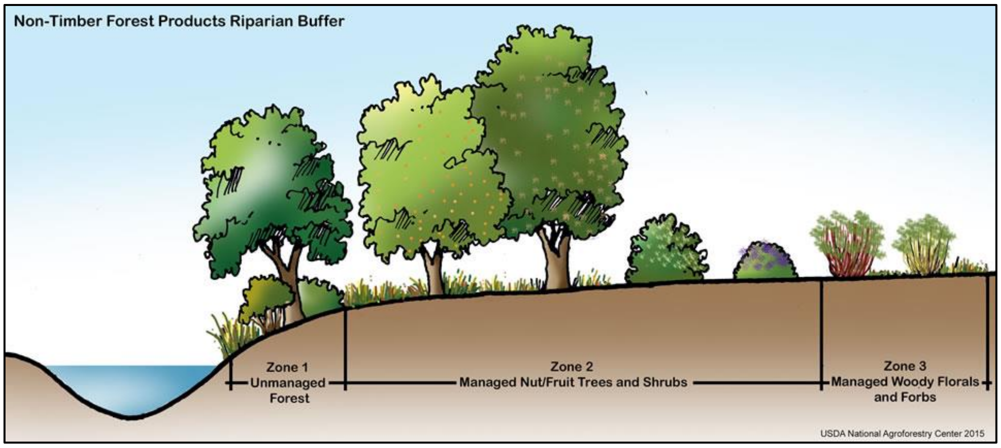


Figure 1: Illustration of a vegetated buffer (USDA National Agroforestry Center, 2015).

A riparian buffer assessment will provide valuable information to the town and village of New Paltz by helping to guide the management and protection of riparian areas within the town. By identifying areas of concern and developing targeted management recommendations, the town can improve the health and function of these important ecological zones, providing benefits to both human communities and the natural environment.

FUNCTIONS AND BENEFITS OF RIPARIAN BUFFERS

According to the U.S. Department of Agriculture's Natural Resources Conservation Service, the primary function of a riparian buffer is to "protect near-stream soils from over-bank flows, trap harmful chemicals or sediment transported by surface and subsurface flows from adjacent land uses, or provide shade, detritus, and large woody debris for the in-stream ecosystem." The planting of vegetation or protection of existing vegetation along streams creates portions of space between the water and upland land uses. The buffers play a significant role in filtering contamination and maintaining water quality in riverine and stream systems.

The installation and continued maintenance of riparian buffers can provide a number of benefits including flood reduction, water quality improvement, filtering agricultural land runoff, bank stabilization, and sediment filtration, shade for streams, and providing a safe and thriving habitat for aquatic organisms and wildlife.

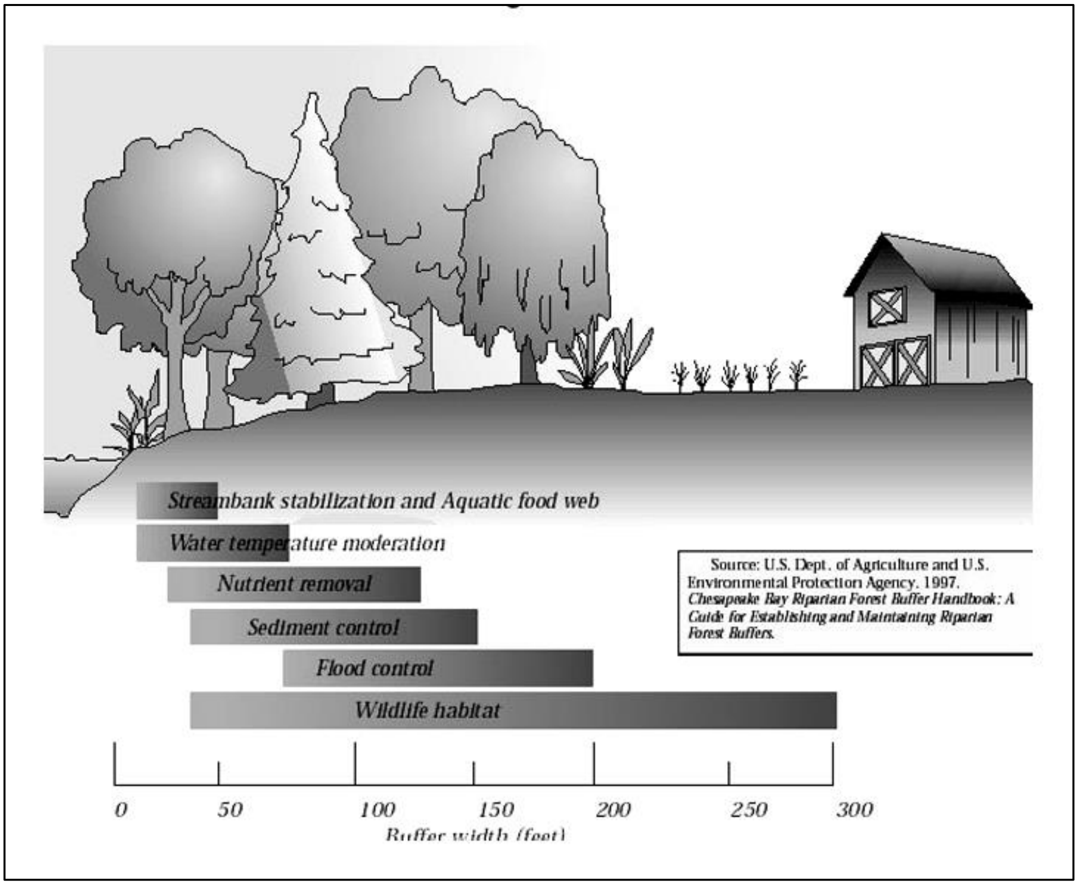


Figure 2: Estimated buffer width required for specific benefit functionality, (United States Department of Agriculture and U.S. Environmental Protection Agency, 1997)

It is particularly important to consider that protecting headwater streams when implementing riparian buffer protection and restoration efforts. Large rivers often receive more attention due to their size and visibility, but smaller streams and tributaries are vital components of the overall watershed ecosystem.

Smaller order streams are the primary sources of water for larger rivers and the overall watershed. Protecting them helps maintain high water quality by filtering and purifying water as it flows through the riparian buffers. Riparian buffers along these smaller waterways can act as "biological filters," removing pollutants, sediments, and excess nutrients from runoff and improving overall water quality downstream. This helps prevent nutrient pollution, eutrophication, and harmful algal blooms downstream, benefiting both the water quality and the overall ecological balance of the watershed.

Headwater streams also serve as critical connectors within the watershed, linking various habitats and supporting the movement of aquatic species. They provide important spawning, nursery, and migration corridors for fish and other aquatic organisms. By protecting and restoring riparian buffers along these smaller waterways, we enhance habitat connectivity and promote the biodiversity and resilience of the entire ecosystem.

HOW DO RIPARIAN BUFFERS INTERACT WITH CLIMATE CHANGE?

Riparian ecosystems remain under stress from climate change, agricultural practices, and urbanization. Yet, a forested riparian buffer, along with various other forest ecosystems, can sequester and store carbon to help mitigate the negative effects of climate change. Wooded riparian buffers can also combat the projected increase in water temperature in riverine systems. An increase in water temperature can lead to habitat degradation for aquatic organisms. A forested buffer can work to provide direct shade to a body of water and reduce an increase in water temperature.

Headwater streams are often more sensitive to climate change impacts, such as increased temperatures, altered precipitation patterns, and drought events. Protecting these waterways through riparian buffer restoration and protection can help mitigate the impacts of climate change by providing shade, regulating water temperature, and maintaining baseflow during dry periods. This resilience is crucial for supporting aquatic life, maintaining ecosystem services, and ensuring the long-term health of the watershed.

RIPARIAN HEALTH

The riparian health of streams varies depending on a range of factors, including land use practices, water flow, and the presence of invasive species or other threats.

The riparian health of streams in the town and village of New Paltz is generally good, with many areas exhibiting healthy riparian vegetation and minimal erosion. However, some areas are impacted by land use practices such as development and agriculture, which can lead to increased sedimentation and nutrient runoff into streams.

Efforts have been made in recent years to improve riparian health in the town and village of New Paltz, including implementing stream restoration projects and establishing riparian buffer zones.

In 2011, the Town of New Paltz adopted Chapter 139: Wetlands and Watercourses, which emphasizes the importance of protecting and safeguarding regulated areas, including wetlands, waterbodies, watercourses, and associated buffer zones. These areas hold ecological, water quality, and recreational importance. In short, the Town of New Paltz oversees activities that could significantly harm these areas' functions or benefits, ensuring the community's health and safety.

In summary, while the riparian health of streams in the town of New Paltz is generally good, there are still areas that are impacted by land use practices and invasive species. Ongoing efforts to restore and enhance riparian zones are important for maintaining water quality and supporting healthy ecosystems in the area.

OBJECTIVES AND GOALS

Our objective was to conduct a comprehensive riparian buffer assessment in alignment with the Riparian Buffers action within Pledge Element 7 of the Climate Smart Communities (CSC) program to enhance climate resilience, protect natural resources, and earn CSC points by engaging stakeholders, enhancing water quality, and informing land use planning. Successful completion of this portion of the action may earn the community 2 points.

To achieve this objective, we developed a report that directs readers to potential priority sites for conservation and revegetation. Through this report, our goal was to 1) engage stakeholders in the assessment process and consider their input, 2) inform land use planning and zoning decisions, and 3) contribute technical assistance in earning points towards the Town and Village's existing designation as a Bronze Certified Climate Smart Community.

Overall, this riparian buffer assessment serves as a tool for municipal officials and environmental stakeholders by providing an understanding of the status and importance of riparian areas. It is intended to aid in effective land use planning, pollution mitigation, and restoration efforts while also engaging and informing landowners about the significance of their role in riparian conservation.

III. EXISTING CONDITIONS IN THE TOWN OF NEW PALTZ

This section provides a concise overview of the current state of New Paltz's natural environment using mapping. It encompasses an overview of water resources, water quality information, and flood zones, as well land resources such as land cover, hydrologic soil groups, and surficial geology. It serves as a foundational understanding of the town's ecological landscape. Through this town-wide analysis and mapping, we gained a foundational understanding of the indicators above within the Town to help us in identifying focus areas for conservation and enhancement.

WATER RESOURCES

WATERSHED BOUNDARIES

Watersheds can be categorized into different scales based on their size and drainage area. The United States Geological Survey (USGS) has developed a classification system for watersheds known as the Hydrologic Unit Code (HUC) system. The system uses a hierarchical numbering scheme to identify watersheds at various scales, with the HUC 2 representing the largest unit and the HUC 16 being the smallest. Watersheds are divided into multiple levels, ranging from large regions to small tributaries.

Hydrologic Unit Code (HUC) watershed boundaries and natural watershed boundaries offer distinct approaches to delineating and understanding watershed areas. HUC boundaries are a standardized system employed by various U.S. government agencies like the U.S. Geological Survey (USGS) and the Environmental Protection Agency (EPA). They divide the United States into nested watershed units for administrative and regulatory purposes. HUCs follow a hierarchical structure, ranging from broad HUC-2 regions to finer HUC-12 subdivisions. These boundaries are established based on the flow of water and may not always align with natural landscape features or political boundaries. They serve as a practical framework for organizing and managing water-related data, making them valuable for government agencies and researchers. To learn more about the Hydrologic Unit Code (HUC) system, visit "What is a Hydrologic Unit Code (HUC)?" developed by the South Dakota State university Extension.

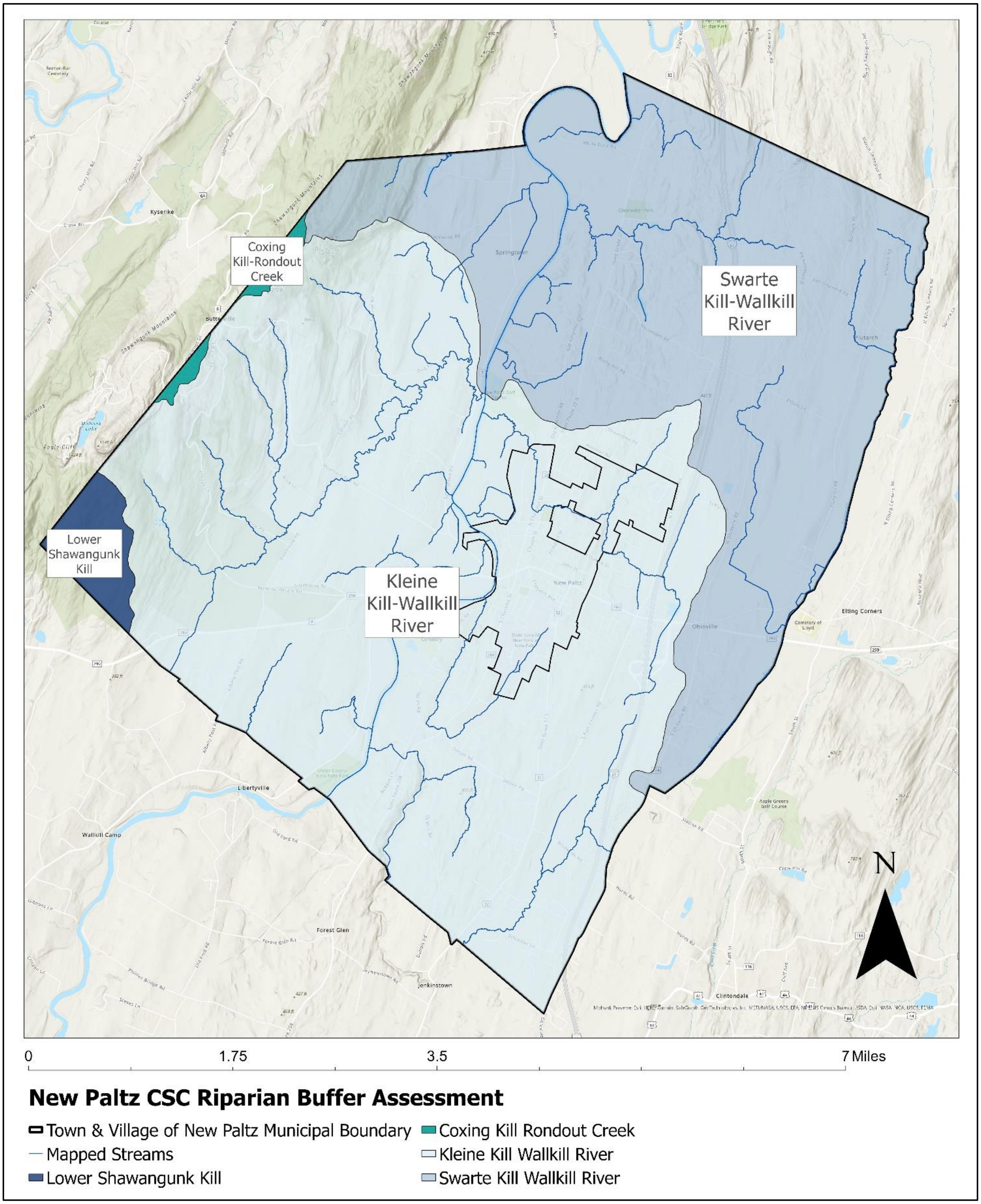
In contrast, natural watershed boundaries are rooted in the actual physical characteristics of the landscape, such as topography, ridgelines, and terrain. They closely follow the contours of the land where water naturally flows, without concern for administrative divisions. These boundaries provide a more ecologically meaningful representation of watersheds, as they align with the hydrological and ecological functions of these areas. Natural boundaries are often used in ecological and environmental studies to investigate the complex relationships between land use, water quality, and ecosystem health. They vary in size and shape, dictated by the unique topography and geology of each region.

For the purposes of this study, the 12-digit HUC watershed scale was utilized to align with the results of the New York State Riparian Opportunity Assessment (ROA) developed by the New York Natural Heritage Program (NYNHP).

A HUC 12 watershed represents a sub-watershed within a larger hydrological unit, such as a HUC 10 or HUC 8 watershed. The HUC 12 watershed has an average size of about 30 square miles. It is used to identify and classify smaller watersheds within a larger watershed system. The HUC 12 is an important unit for local watershed planning and management as it provides a detailed view of the hydrological and ecological characteristics of a specific area.

Within the municipal boundaries of the Town of New Paltz, there are four HUC 12 sub-watersheds. As seen in Map 1 the Swarte Kill and Kleine Kill subwatersheds are the largest subwatersheds within municipal boundaries.

- Swarte Kill-Wallkill River (HUC_020200070407)
- Kleine Kill-Wallkill River (HUC_020200070406)
- Coxing Kill-Rondout Creek (HUC_020200070604)
- Lower Shawangunk Kill (HUC_020200070304)



Map 2: HUC 12 Sub watershed Boundaries

All of the watersheds in New Paltz are part of the Mid Atlantic (HUC_02), Upper Hudson (HUC_0202), Upper Hudson (HUC_020200), and Rondout (HUC_02020007) watersheds. A majority of New Paltz can also be found in the Lower Wallkill River Watershed (HUC_0202000704).

The Wallkill River Watershed is approximately 800 square miles and spans through two states, New York and New Jersey. In Ulster County, the river flows 26 miles draining 170 square miles (Wallkill River Watershed Conservation and Management Plan, pg. 11).

Upon flowing through the Town of New Paltz, the Wallkill River reaches its final destination. It merges with Sturgeon Pool before continuing its journey, joining the Rondout Creek. Ultimately, the combined waters of the Wallkill River and Rondout Creek flow into the Hudson River Estuary, marking the final destination of this interconnected water system.

In New York State, the Wallkill River is fed by 69 tributaries, 14 of which are located in Ulster County. Within the watershed, 12 major tributaries drain to a common outlet, Rondout Creek, and then to the Hudson River Estuary.

MAJOR STREAMS

We estimate that Town of New Paltz has approximately 70 miles of mapped streams (based on the streams in the National Hydrography Dataset) and those streams are surrounded by an estimated 5201 acres of riparian areas or about 24% of the area of the Town (based on the Riparian Buffer layer created for the Riparian Opportunities Assessment).

There are several perennial streams located in the Town of New Paltz, NY. Perennial streams are streams that flow all year round, even during dry periods. The following is a list of major perennial streams in the Town of New Paltz:

- Wallkill River: The Wallkill River is a perennial stream that flows through the Town of New Paltz and originates from Lake Mohawk in Sparta Township, New Jersey.
- Swarte Kill: The Swarte Kill is a perennial stream that flows through the Town of New Paltz and originates from the Shawangunk Ridge.
- Kleine Kill: The Kleine Kill is a perennial stream that flows through the Town of New Paltz and originates from the Shawangunk Ridge.

In addition to the mentioned streams, there are several other noteworthy smaller tributaries that contribute to the Wallkill River within the town of New Paltz. These streams include:

- Platte Kill: The Platte Kill is an important tributary of the Wallkill River. It joins the Wallkill River downstream of New Paltz, contributing to the overall flow and dynamics of the river.
- Tributary 13 (Mill Brook): Tributary 13, also known as Mill Brook, is another significant stream that feeds into the Wallkill River.
- Humpo Kill: The Humpo Kill is a tributary that joins the Kleine Kill, which is itself a tributary of the Wallkill River. The Humpo Kill's confluence with the Kleine Kill adds to the water flow in the larger river system.

- Stony Kill: The Stony Kill is a notable stream that contributes to the Wallkill River. Its waters merge with the main stem of the Wallkill River, increasing its volume and carrying sediment downstream.
- Bonticou Kill: The Bonticou Kill is another significant tributary that joins the Wallkill River. Its waters flow into the main stem of the river, further enhancing its flow and water quality.
- Saw Mill Brook: The Saw Mill Brook is a stream that runs through the campus of SUNY New Paltz. It eventually drains into the Wallkill River at Sojourner Truth Park, influencing the river's water characteristics in that vicinity.

These smaller tributaries contribute to the overall hydrology and ecological health of the Wallkill River system in New Paltz and they should be included in watershed management and conservation efforts aimed at preserving water quality and maintaining the integrity of the Wallkill River and its associated habitats. The New Paltz Natural Resource Inventory (2021) mapper may aid in understanding local watershed boundaries.

Ephemeral streams are streams that only flow during and immediately after precipitation events. They do not have a continuous flow of water throughout the year. As such, they are not well-documented and can be difficult to identify. It is important to note that ephemeral streams are still important features of the landscape as they play a role in water management, flood control, and habitat for aquatic organisms during wet periods.

While are also some ephemeral streams in the Town of New Paltz, NY, there is no comprehensive list available. Identifying these streams would require detailed assessment and field work that is beyond the scope of this report.

FLOOD ZONES

FEMA flood zones provide information about areas prone to flooding, especially during heavy rain, snowmelt, or storm events. Riparian buffers in these zones play a crucial role in reducing flood risk by absorbing excess water and slowing down its flow.

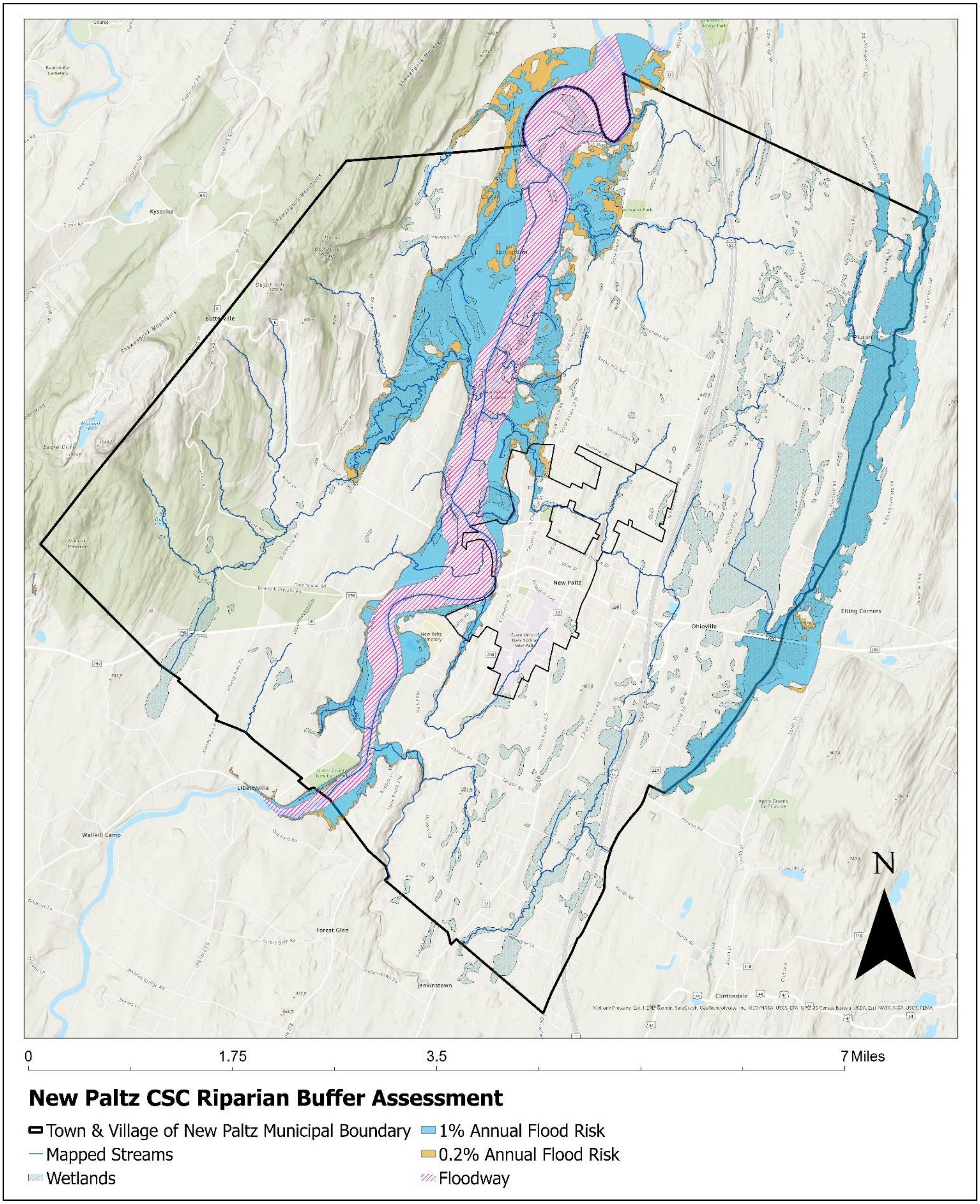
FEMA (Federal Emergency Management Agency) classifies flood zones into several categories, each denoting different levels of flood risk:

Special Flood Hazard Area (SFHA): SFHAs are high-risk flood zones where there is at least a 1% chance of flooding in any given year, commonly referred to as the 100-year floodplain. These areas are prone to significant flooding, and property owners in SFHAs are typically required to have flood insurance if they have a federally backed mortgage. Riparian buffers in SFHAs play a critical role in reducing flood damage by absorbing floodwaters, reducing erosion, and protecting water quality.

Moderate Flood Hazard Areas: These are areas with a lower risk of flooding compared to SFHAs but are still susceptible. They are typically outside the 100-year floodplain but within the 500-year floodplain. Riparian buffers in these areas are essential for minimizing flood damage and maintaining healthy aquatic ecosystems.

Floodway: The floodway is the most critical part of the floodplain, where floodwaters flow with the greatest depth and velocity during a flood event. FEMA regulates development in the floodway to prevent obstructions that could worsen flooding. Riparian buffers within floodways are especially vital as they help control erosion, filter pollutants, and reduce flood velocities, thus mitigating potential damage to properties downstream.

Map 3 shows the flood zones located throughout the Town. It should be noted that the flood zones are most often found surrounding the Wallkill River and surrounding unnamed tributaries, as well as the wetlands surrounding the Swarte Kill.



Map 3: FEMA Flood Zones

FEMA flood classifications are integral to a riparian buffer assessment, offering crucial insights into flood risk levels. By identifying the flood zone of a particular area within the town boundaries, we can tailor riparian buffer strategies accordingly. High-risk flood zones necessitate buffers designed to withstand and mitigate severe flooding impacts, such as erosion control, while lower-risk zones may focus more on enhancing water quality. In essence, FEMA flood classifications guide the development of precise riparian buffer restoration or protection plans, ensuring they align with the specific flood conditions of each area, thereby enhancing the effectiveness of efforts.

WATER QUALITY

CLASSIFICATIONS

The water quality of the bodies of water within the Town of New Paltz can vary depending on various factors such as weather, season, and human activities such as farming and development.

The New York State Department of Environmental Conservation (DEC) assigns water quality classifications in New York State to classified the "existing or expected best usage of each water or waterway segment". The stream classifications range from "AA" (drinking, bathing, fishing, and fish propagation and survival) to "D" (fishing, but waters will not support fish propagation).

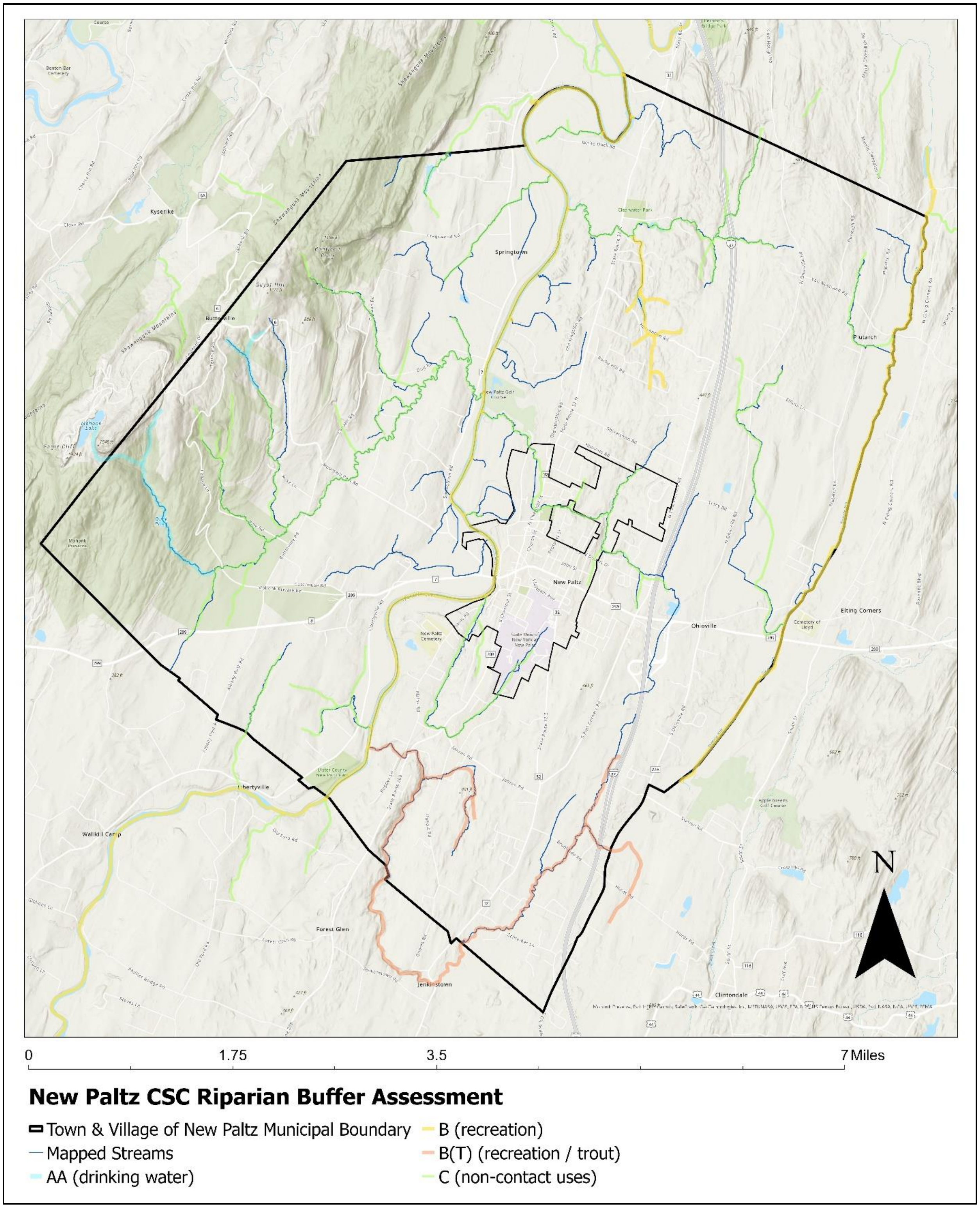
A general description of the classifications are:

- A, AA, A-S and AA-S indicate a best usage for a source of drinking water, swimming and other recreation, and fishing.
- B indicates a best usage for swimming and other recreation, and fishing.
- C indicates a best usage for fishing (non-contact uses).
- D indicates a best usage of fishing, but these waters will not support fish propagation.

Streams that are further designated as (T) are deemed to have good water quality and cool water temperatures suitable for trout habitat and (TS) indicates streams suitable for trout spawning. Trout spawning streams have good water quality, cool temperatures, high dissolved oxygen levels, and relatively unsilted stream bottoms suitable for spawning.

Waters classified as AA, A, B, C(T) or C(TS) are considered "protected streams" in New York and are subject to certain use restrictions. For these streams disturbances to the bed or banks of these streams require a State permit.

In Map 4, the DEC water quality classifications throughout the mapped streams within the Town of New Paltz can be seen. More information on water quality classifications and their interpretations based on catchments can be found in Section V. Findings and Reccomendations.



Map 4: DEC Water Quality Classifications

WATER QUALITY

For specific water quality information, we turned to data from the Environmental Protection Agency (EPA). The How's My Waterway data employs a monitoring framework encompassing the examination of physical, chemical, and biological attributes. These monitoring findings are subsequently evaluated against established water quality benchmarks and criteria approved by the EPA. It is noteworthy that water bodies may, at times, exhibit impairments, rendering them unsuitable for specific uses. Given the dynamic nature of water conditions, it is imperative to recognize that the data provided in How's My Waterway should serve as a general point of reference. For more precise and current insights, it is advisable to consult local or state real-time water quality reports, when available.

The data that we used for this report breaks water quality information into the HUC 12 subwatershed boundaries. In New Paltz, some of the HUC 12 subwatershed boundaries span across Town boundaries. Therefore, the information presented is not entirely specific to the Town of New Paltz. As there were no identified and assessed waterbodies found within the Coxing Kill-Rondout Creek (HUC_020200070604) or Lower Shawangunk Kill (HUC_020200070304) watersheds, the data has been omitted.

There are several indicators assessed individually that allow users to understand the assessment of the best usage of a waterbody including swimming, fishing, and aquatic life. Waterbodies are designated as either good, impaired (polluted), or unassessed. Good waters are waterbodies fully supporting their designated uses under the Clean Water Act. Impaired waters are waterbodies not fully supporting their designated uses under the Clean Water Act. Unassessed Waters are waters that have not yet been assessed and/or monitored by states, territories, and tribes for their physical, chemical, and biological properties to determine whether the waters meet water quality standards. It is important to note that most reported data was last reported in 2018.

The Kleine Kill-Wallkill River (HUC_020200070406) subwatershed consists of 5 major waterbodies, 14 water monitoring locations, and 7 permitted dischargers. Waterbody conditions are classified as either good, impaired, or unknown condition. With the Kleine Kill-Wallkill River, the minor tributaries to the lower Wallkill are considered good and the lower main stem of the Wallkill is classified as impaired. The remaining waterbodies include the Kleine Kill and associated tributaries, the Platte kill and associated tributaries, and an unnamed tributary to the Wallkill and other minor tributaries. These waterbodies are assessed as condition unknown.

It should be noted that 19% of the assessed waters within the Swarte-Kill Wallkill River Watershed are classified as impaired. The main impairments reported include elevated levels of nitrogen and/or phosphorous. These nutrients have the potential to stimulate accelerated growth of aquatic vegetation and microorganisms. This overgrowth can lead to the degradation of waterway vegetation, the development of potentially hazardous algae blooms, and the creation of oxygen-depleted conditions that can adversely affect fish and other aquatic organisms.

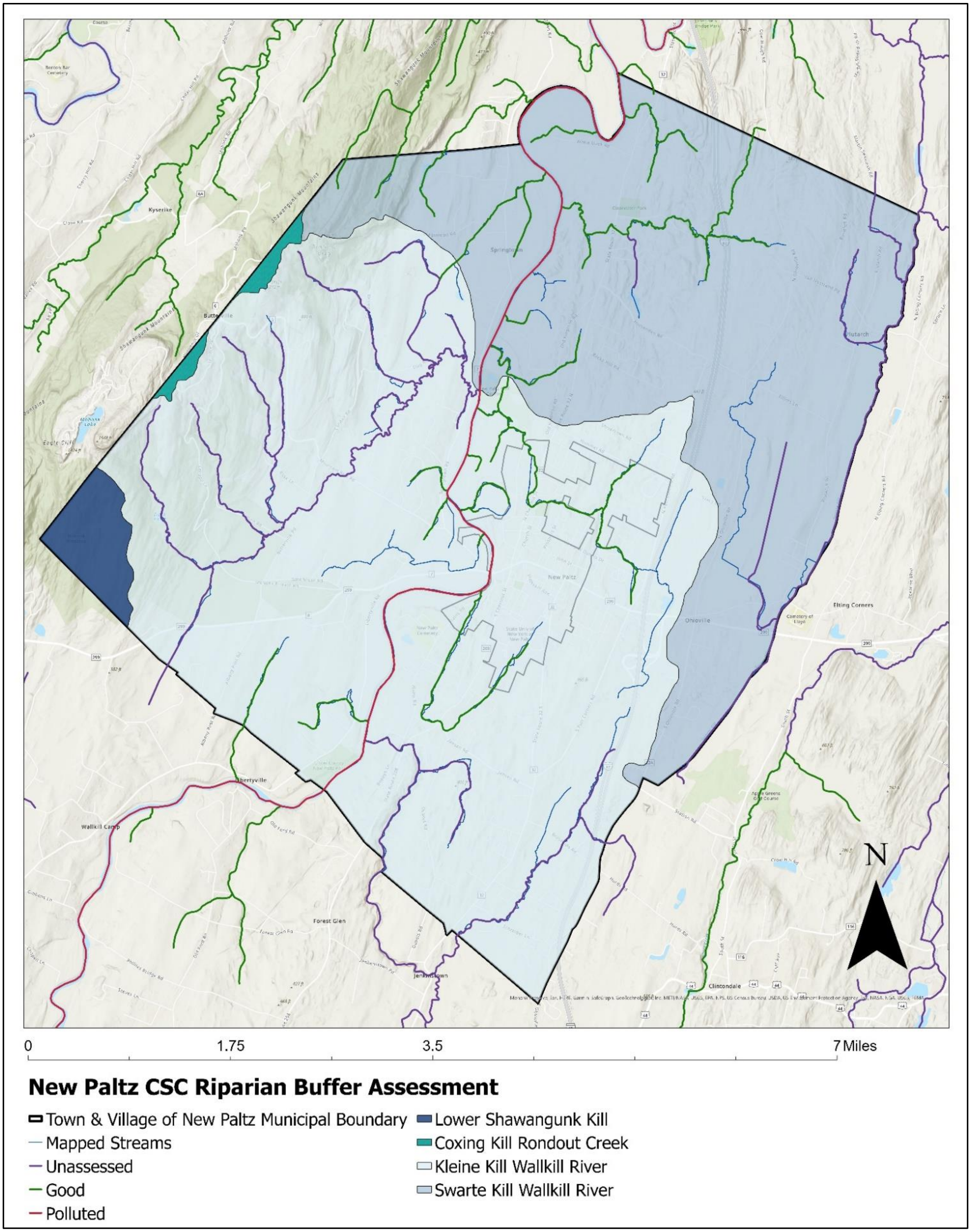
Within the Clean Water Act, located in Section 319: Nonpoint Source Management Program is a federal program aimed at addressing non-point source pollution, which arises from diffuse sources such as runoff from agricultural fields and urban areas. It provides grants to states to support local efforts in managing and reducing this type of pollution to protect and improve water quality in lakes, rivers, and other bodies of water. There are 3 Nonpoint Source projects funded from EPA grants under the Clean Water Act Section 319 that benefit waterbodies in the Kleine Kill-Wallkill River watershed. There are no EPA funded restoration plans in the Kleine Kill-Wallkill River watershed.

The Swarte Kill-Wallkill River (HUC_020200070407) subwatershed consists of 5 major waterbodies, 8 water monitoring locations, and 4 permitted dischargers. The minor tributaries to the lower Wallkill are considered good, while the lower main stem of the Wallkill River is classified as impaired. The remaining waterbodies include Sturgeon Pond, the Swarte Killl and associated tributaries, and an unnamed tributary to the Wallkill and other minor tributaries. These waterbodies are classified as condition unknown.

It should be noted that 11% of the assessed waters within the Swarte-Kill Wallkill River Watershed are classified as impaired. The main impairments reported include elevated levels of nitrogen and/or phosphorous. These nutrients have the potential to stimulate accelerated growth of aquatic vegetation and microorganisms. This overgrowth can lead to the degradation of waterway vegetation, the development of potentially hazardous algae blooms, and the creation of oxygen-depleted conditions that can adversely affect fish and other aquatic organisms.

There are currently no reports of Nonpoint Source projects funded from EPA grants under the Clean Water Act Section 319 or EPA funded restoration plans within the Swarte Kill Wallkill River Watershed.

The following information presented in Map 5 shows water quality grouped by the indicators discussed above. However, it is important to note that water quality can change over time and can be affected by various factors such as pollution and climate change. Therefore, it is always recommended to check with local authorities for the latest water quality information.



Map 5: EPA Water Quality Designation

LAND RESOURCES

GEOLOGY AND SOILS

Geology and surficial geology can play an important role in assessing the health of riparian buffers. The geology of an area can affect the composition of the soil, the availability of water, and the types of vegetation that can grow in the riparian buffer. Surficial geology can also provide information about the types and distribution of sediments in the streambed and along the banks. Understanding the geology and surficial geology of an area can help identify potential issues with riparian buffers and inform strategies to improve their health. By assessing, it is possible to develop effective management strategies to maintain and enhance the function of riparian buffers.

The composition of the soil in riparian buffers can affect their ability to filter pollutants and nutrients from runoff and to stabilize streambanks. For example, soils that are rich in organic matter can absorb more water and nutrients, while soils that are composed of sand or gravel may be less effective at filtering pollutants. The geology of an area can also affect the availability of water in the riparian buffer, which can affect the growth and survival of vegetation.

SURFICIAL GEOLOGY

Surficial geology can provide information about the types and distribution of sediments in the streambed and along the banks, which can affect the stability of the streambank and the habitat available for aquatic species. For example, areas with high levels of erosion may have large amounts of sediment in the stream, which can harm fish and other aquatic species. In addition, the composition of the sediment can affect the types of organisms that can live in the stream.

The surficial geology of New Paltz is shaped by the last glaciation, which occurred around 20,000 years ago. The glacier advanced from the north, bringing with it large amounts of sediment, including sand, gravel, and boulders, which were deposited as the glacier retreated. These sediments form the basis of the local soils and landforms.

Surficial geology encompasses a diverse range of geological materials and formations that hold essential clues to an area's geological history and environmental conditions. There are 7 different materials that can be found throughout the Town, as seen in Map 6: Surficial Geology.

Recent deposits, for instance, consist of the most recently laid down geological materials, including river and stream sediments, wind-blown sands, and coastal deposits. These relatively young deposits are valuable for understanding recent environmental changes. Additionally, the presence of recent deposits can suggest a susceptibility to erosion.

Kame deposits are characterized by their irregular mounds or hills composed of sand and gravel. These formations formed as meltwater streams flowed through openings in retreating glaciers, leaving behind stratified sediments. In contrast, lacustrine silt and clay represent sediments that settled in ancient lakes, dominated by fine-textured particles. They offer insights into regions where glacial lakes once existed.

Outwash sand and gravel are typically well-sorted sediments that suggest well-draining soils. These are deposited by glacial meltwater streams, are typically found in outwash plains beyond the glacier's terminal moraine. On the other hand, swamp deposits consist of organic-rich materials such as peat and muck that have accumulated in wetland environments over time.

As seen in Table 1, a majority of the Town's surficial geology can be classified as Till, indicating geological stability, as it may offer a solid foundation for infrastructure development. Map 6 shows the surficial geology classifications within the municipal boundaries. The fertile till soils often benefit the agricultural sector the most, potentially benefiting local farming practices. Understanding these surficial geology types is crucial for various purposes, from land use planning to environmental assessment, as they provide valuable information about an area's geological history and its past and present environmental conditions. More information on specific surficial geological classifications and their connection to riparian buffers found within the identified restoration and protection focus areas can be found in Section V. Findings and Recommendations.

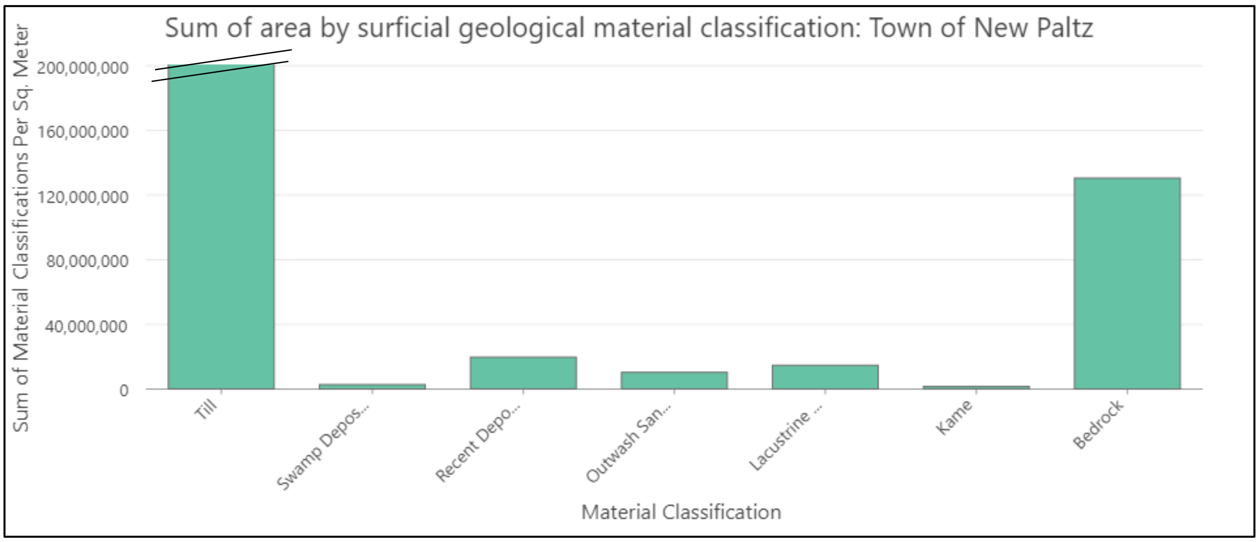
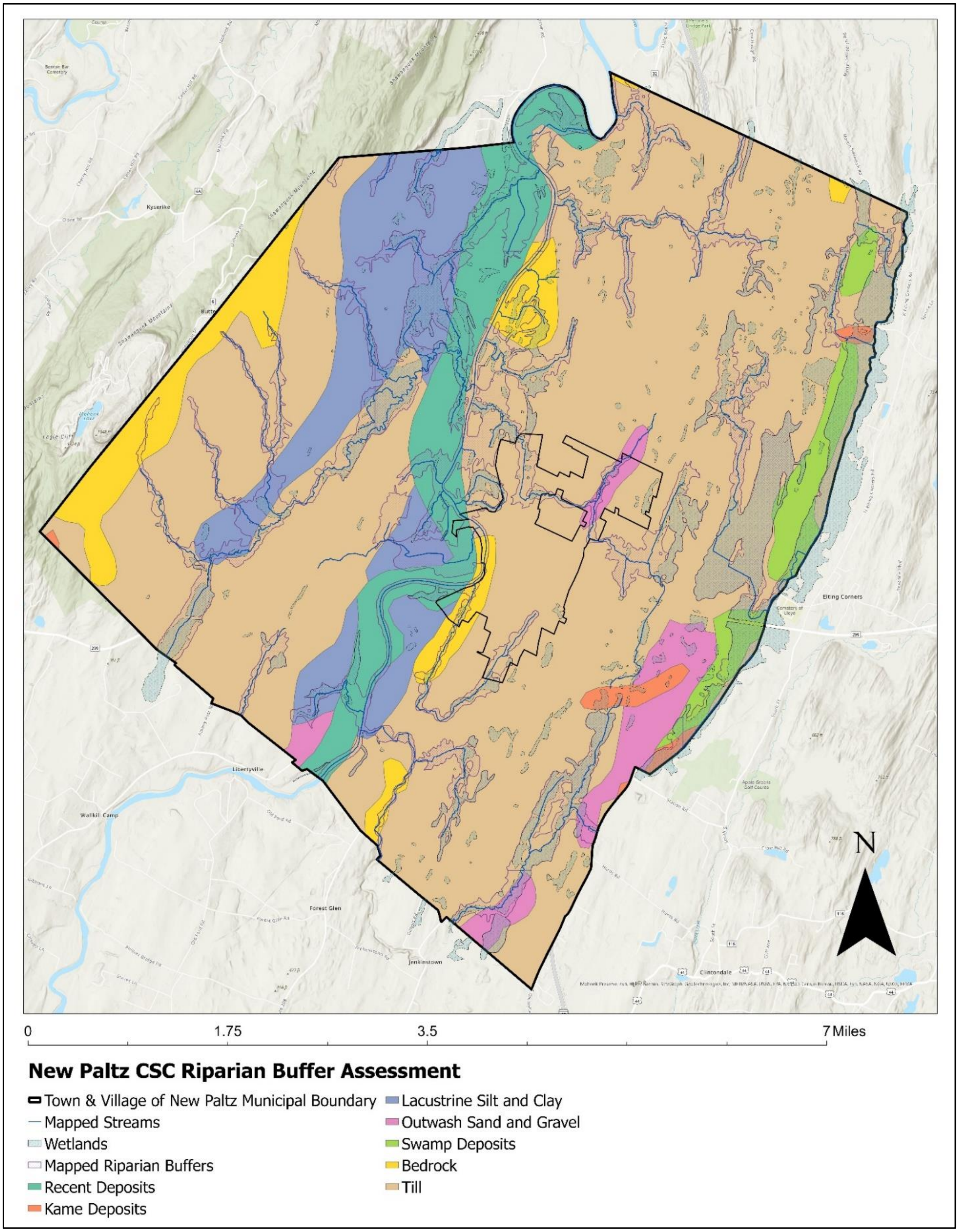


Table 1: Sum of Area by Surficial Geological Material Classification



Map 6: Surficial Geology

SOILS

Soil characteristics such as texture, drainage, and land use directly impact the suitability of a site for native vegetation, erosion control, and water filtration. Understanding the soil's water-holding capacity helps ensure that the buffer can effectively mitigate runoff, reduce sedimentation, and improve water quality. Soil information also guides land use planning, as certain soil types may be better suited for agriculture, urban development, or restoration. By analyzing soil types within riparian zones, restoration strategies can be tailored to the unique needs and limitations of each site, optimizing the buffer's ecological and water quality benefits. Map 7 shows the distribution of hydrologic group classifications within the municipal boundaries. A hydrologic soil group classification categorizes soils based on their ability to transmit water and their response to rainfall events.

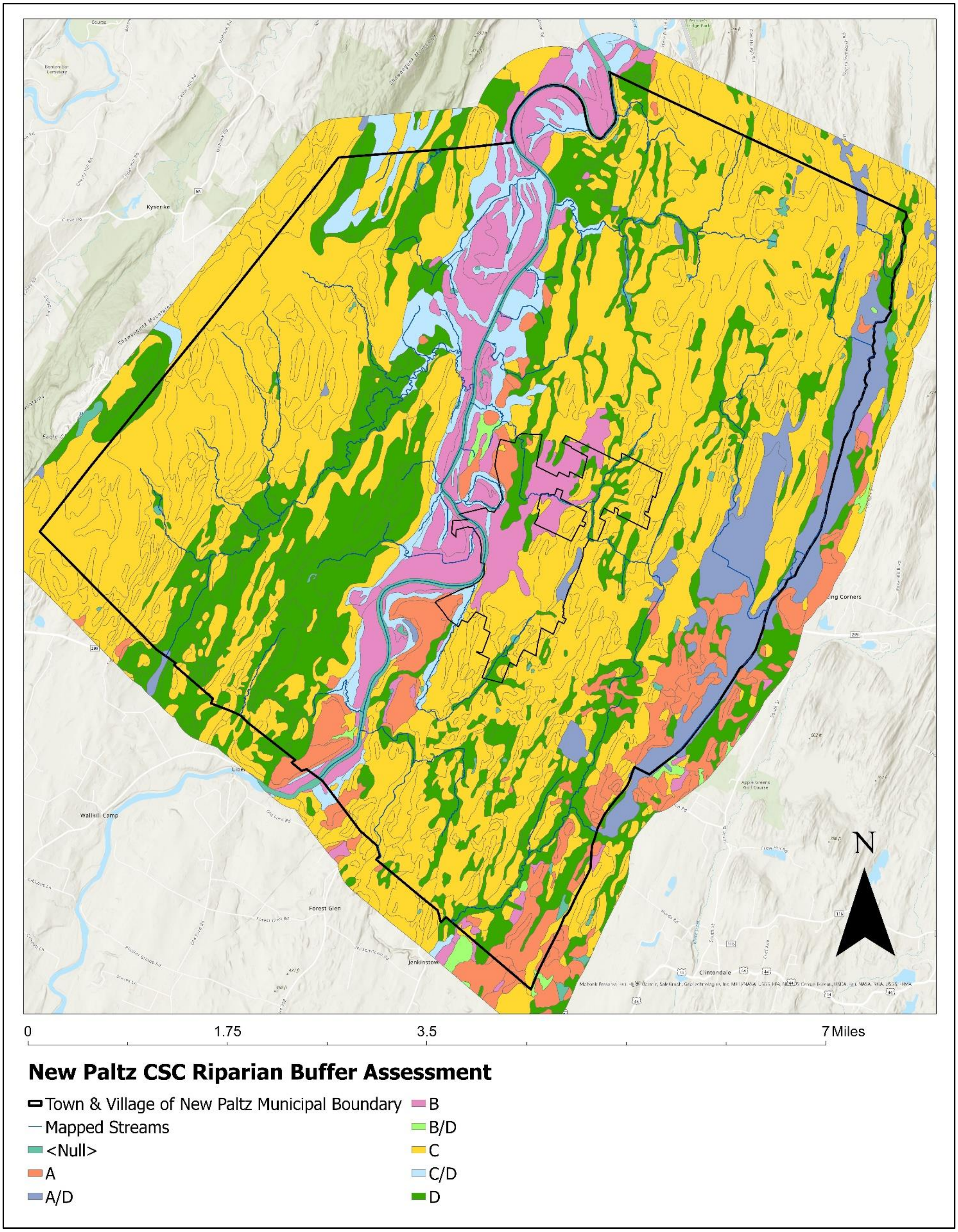
Soils are classified by the Natural Resource Conservation Service into four Hydrologic Soil Groups based on the soil's runoff potential. The four main Hydrologic Soils Groups are A, B, C and D. Where A's generally have the smallest runoff potential and D's the greatest. A soil may also be assigned to a dual hydrologic group (A/D, B/D, or C/D). In this case, the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes. More information about the following indicators and the dual hydrologic soil group classifications can be found in Appendix A.

Group A: Sand, loamy sand or sandy loam types of soils. It has low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well-drained sands or gravels and have a high rate of water transmission.

Group B: Silt loam or loam. It has a moderate infiltration rate when thoroughly wetted and consists chiefly or moderately deep to deep, moderately well to well-drained soils with moderately fine to moderately coarse textures.

Group C: Sandy clay loam. They have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes the downward movement of water and soils with moderately fine to fine structure.

Group D: Clay loam, silty clay loam, sandy clay, silty clay or clay. This HSG has the highest runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material.



Map 7: Hydrologic Soil Groups

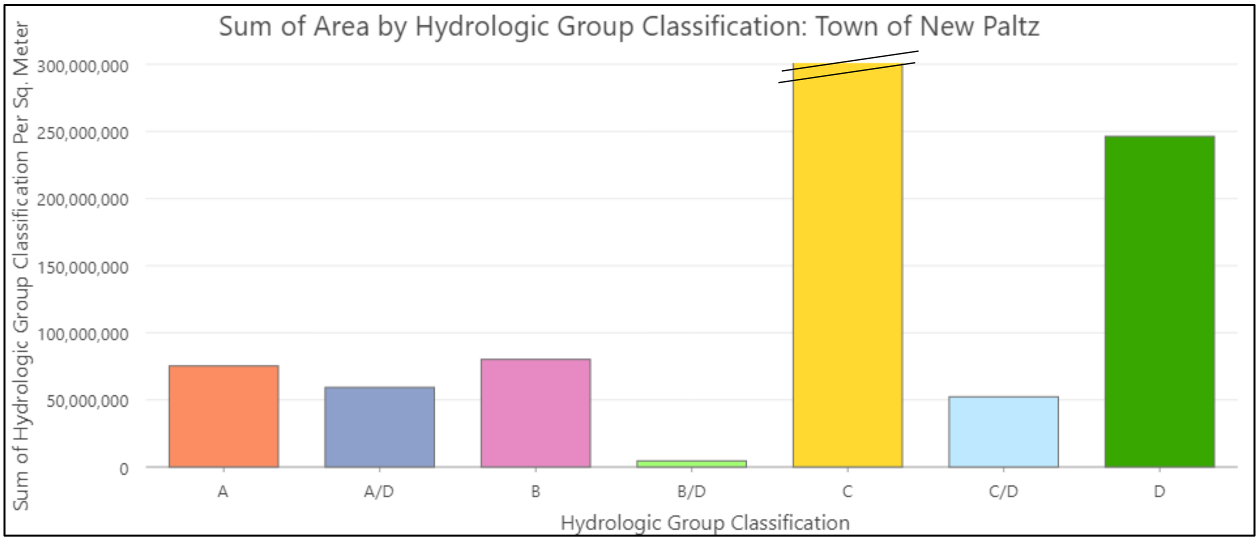


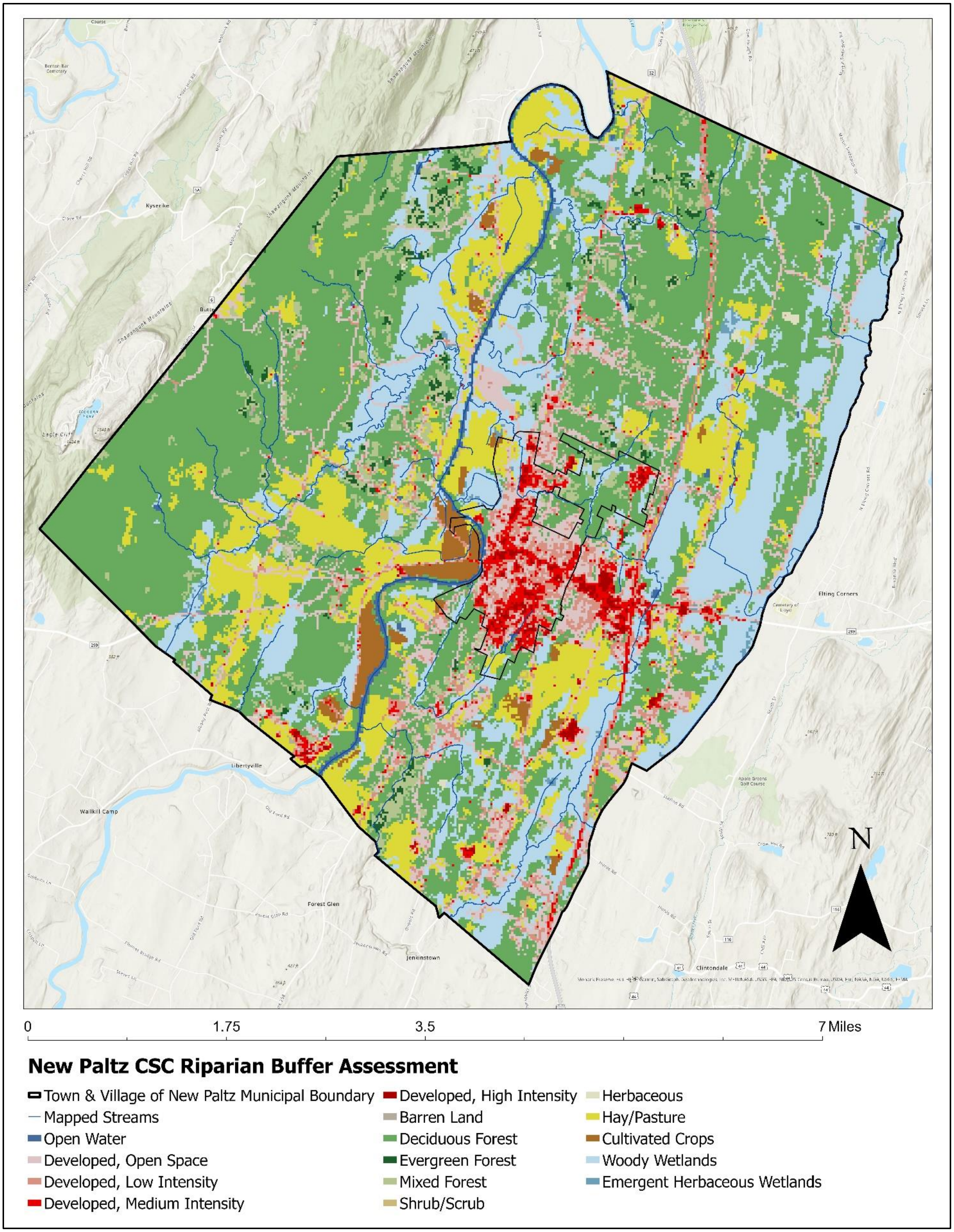
Table 2: Sum of Area by Hydrologic Soil Group Classification

As seen in Table 2, the town is primarily classified as Group C and Group D. This indicates that its soils generally have moderate to low water infiltration rates, which can influence water movement and drainage in the landscape. Group C soils possess moderate infiltration rates and can absorb water at a reasonable pace, making them somewhat suitable for riparian buffer applications. In contrast, Group D soils have low infiltration rates and can quickly become saturated, leading to surface runoff rather than infiltration. This classification suggests that addressing runoff may be essential in future riparian buffer planning for the town.

Each focus area was further researched to better understand the hydrologic soil group and soil type. For the purpose of mapping on a larger scale, we have only mapped the hydrologic soil group types rather than the soil classifications. More information about specific soil type classification and hydrologic soil groups found within each priority focus area can be found in Appendix A.

LAND COVER

Land use refers to how humans use the land, including for activities such as agriculture, urban development, transportation, and mining. Examining current land use patterns is essential for identifying areas where riparian buffers have been impacted by human activities. Prioritizing restoration in areas with intensive agricultural practices, urban development, or other land uses that may have degraded riparian buffers can help restore ecological functions and reduce pollutant runoff into streams. Land cover, on the other hand, describes the physical and biological characteristics of the land, such as forests, grasslands, wetlands and water bodies. Land cover data identifies the types of vegetation and land use present in a specific area. Analyzing land cover data can help identify areas where riparian buffers are missing or degraded. Map 8 shows the land cover data within the municipal boundaries. Definitions for land use and land cover classes shown on the map can be found in Appendix B.



Map 8: Land Cover

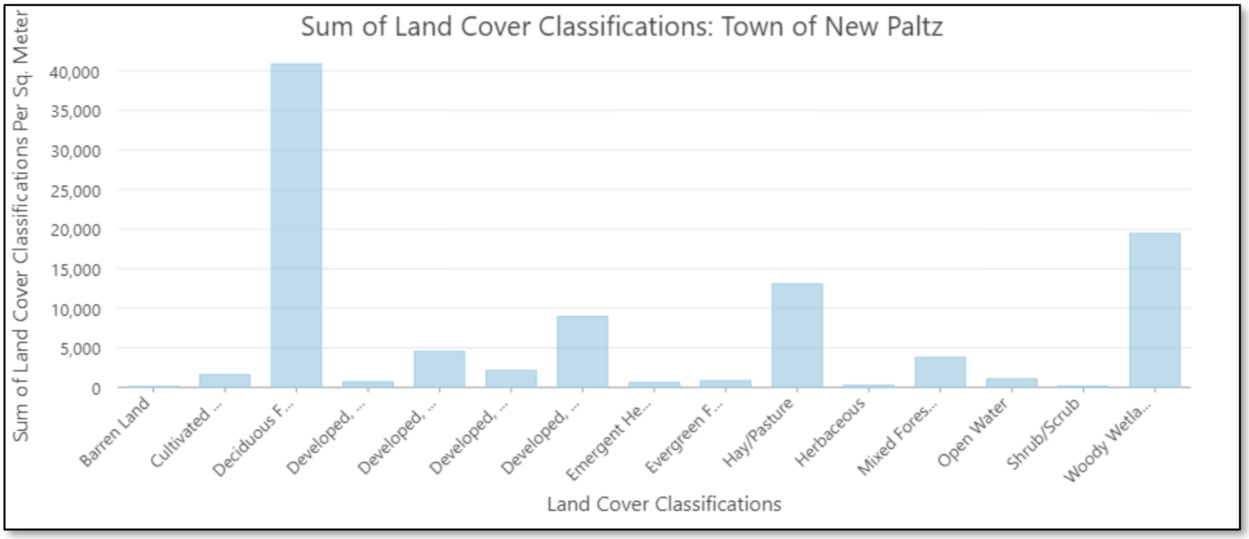


Table 3: Sum of Land Cover Classifications

As seen in Table 3, the town is primarily classified as deciduous forest, woody wetlands, hay/pasture, and developed, open space.

The town having the highest land cover in deciduous forest, woody wetlands, hay/pasture, and developed, open space implies a mix of natural and human-altered environments. Deciduous forests and woody wetlands indicate the presence of diverse native habitats. Hay/pasture highlights agricultural activities, while developed, open space suggests urbanization and human infrastructure. This combination signifies a diverse landscape with various land uses, which can present both opportunities and challenges for riparian buffer restoration and water quality management.

IV. ASSESSMENT METHODS

CLIMATE SMART COMMUNITIES

To ensure accordance with the Climate Smart Communities Program, our assessment process closely followed the action guidance provided within PE 7: Riparian Buffers. We used land cover and other map data (e.g., FEMA), previous watershed assessments, natural resources inventories, aerial photos, and local knowledge alongside the New York State (NYS) Statewide Riparian Opportunity Assessment. With this information, we were able to identify priority riparian buffer areas to conserve and revegetate. We also crafted profiles that showcased the assessment results and incorporated stakeholder input.

USE OF THE RIPARIAN OPPORTUNITY ASSESSMENT

The New York State Riparian Opportunity Assessment (ROA) is a tool developed by the New York Natural Heritage Program (NYNHP) of the State University of New York College of Environmental Science and Forestry (ESF). The ROA helps to identify and prioritize areas where riparian buffers can be enhanced or restored to improve water quality and habitat in the state's streams and rivers.

The assessment presents indicators of the extent and quality of existing riparian buffers, as well as the potential for additional restoration or enhancement. The ROA tool takes into account a variety of factors that influence the effectiveness of riparian buffers, such as land use, soil types, and stream geomorphology. Using this information, the ROA aids the user in discovering potential catchments where riparian buffers can be enhanced or restored to provide the greatest benefits for water quality, habitat, and other ecosystem services.

The ROA is intended to be used by a variety of stakeholders, including local governments, land trusts, conservation organizations, and others interested in restoring and enhancing riparian buffers. The tool can help these stakeholders identify priority areas for restoration and guide the development of riparian restoration projects.

The tool was used to understand the current health and functionality of riparian buffers within the Town and Village of New Paltz. First, we used the ROA data explorer to determine the condition of buffers within the sub watershed (HUC 12) boundaries and then to analyze the overall state of buffers on a *catchment* scale. In the ROA, *catchments* are sub-divisions of the subwatersheds, or "very small drainage areas feeding into each stream segment". For more information on the catchment scale, see pages 11-12 of the ROA report.

SUBWATERSHED SCORES

The Comprehensive Score is a measure of overall condition that takes into account each of the Ecological Health and Stress indicators. It is calculated by subtracting the normalized Ecological Stress score from the normalized Ecological Health score. In theory, the minimum score possible is -1, and the maximum value is 1; in practice, scores in NY range from a minimum of -0.73 to a maximum of 0.88. For more information about the indicators that make up the scores, see Appendix C.

Sub-watershed scores are valuable for making habitat condition comparisons statewide, while catchment scores offer insights into the relative conditions of specific areas within a sub-watershed.

High-quality areas that are important to protect are generally indicated by light blue colors in the top left corner of the chart. These areas may have intact riparian buffers with high vegetation density and good water quality. On the other hand, areas that are degraded or in need of restoration or protection are indicated by red colors in the bottom right corner of the chart. These areas may have low vegetation density, high erosion index, and other factors that indicate the need for action. Outliers on the chart, which may be indicated by red colors, may also indicate areas that are in need of special attention or further investigation.

Below is an overview of the condition of the sub watersheds within the municipal boundaries in relation to sub watersheds throughout the state:

Swarte Kill-Wallkill River (HUC_020200070407)

COMPREHENSIVE: **0.47 (Range: -0.73 - 0.88)**

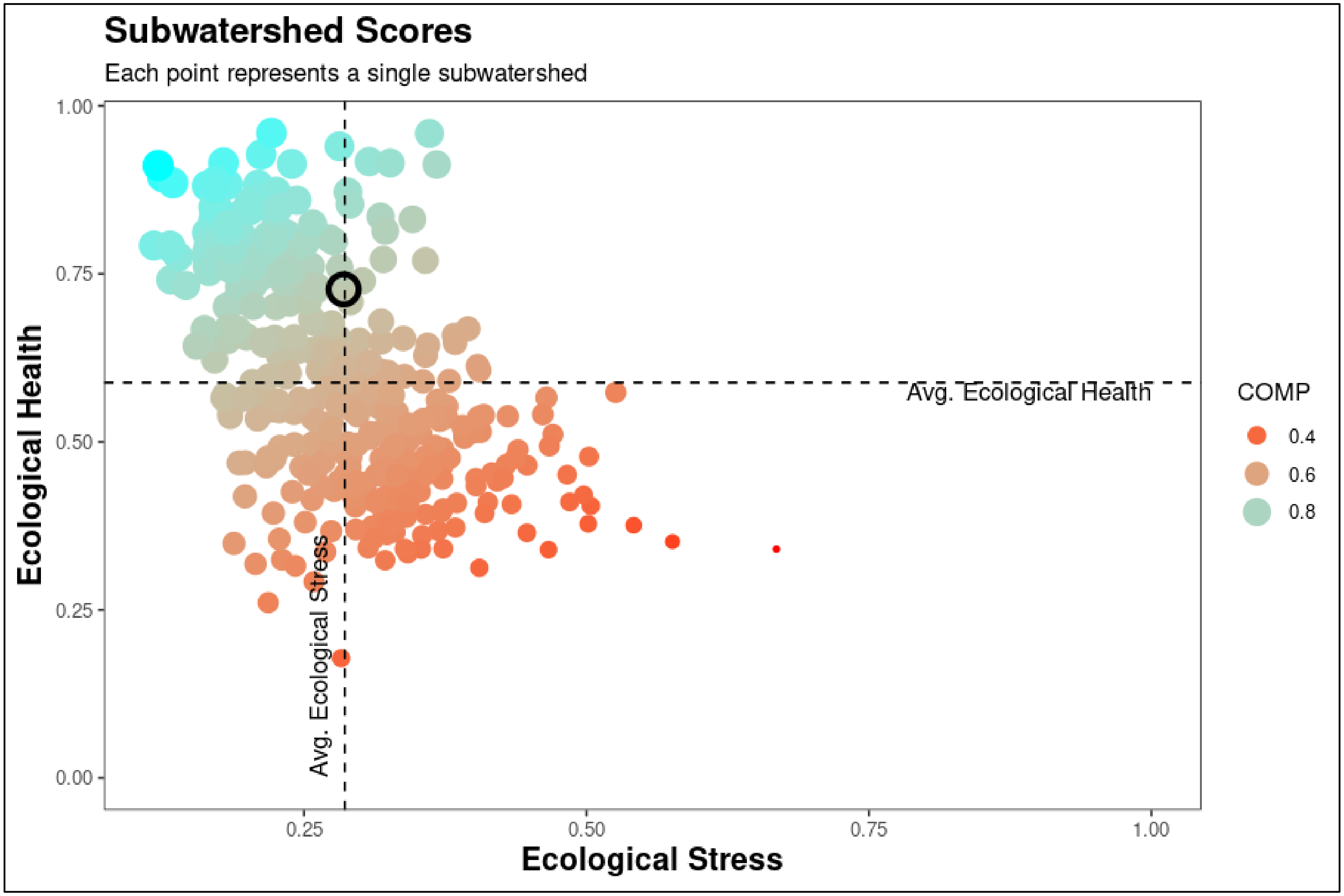


Figure 3: Swarte Kill-Wallkill River Subwatershed scored in relation to Subwatersheds throughout NYS.

ECOLOGICAL HEALTH: **Raw 6.68, Normalized 0.71**

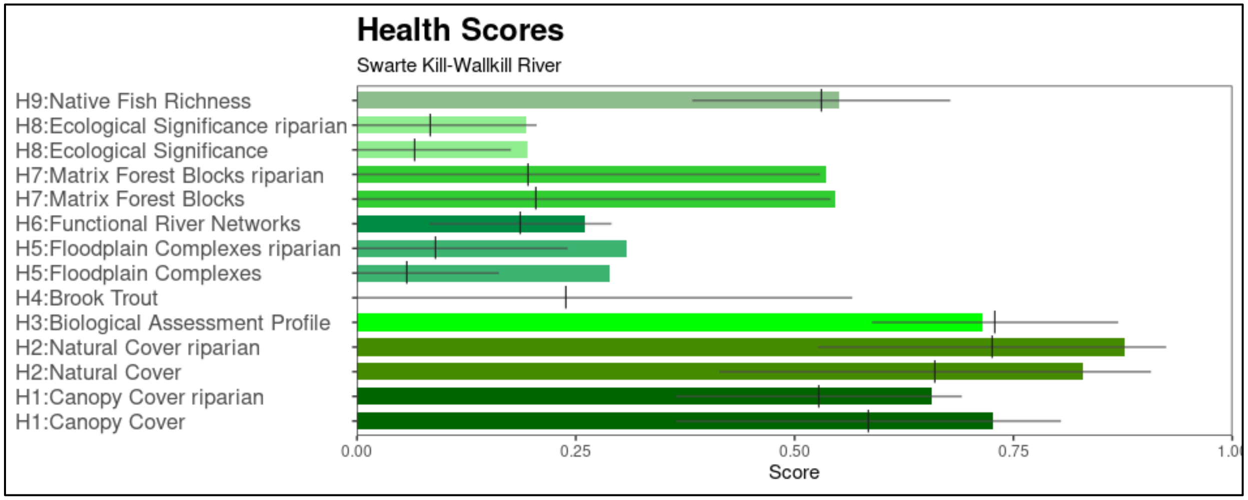


Figure 4: Swarte Kill-Wallkill River Subwatershed Ecological Health Indicators

ECOLOGICAL STRESS: **Raw 1.62, Normalized 0.24**

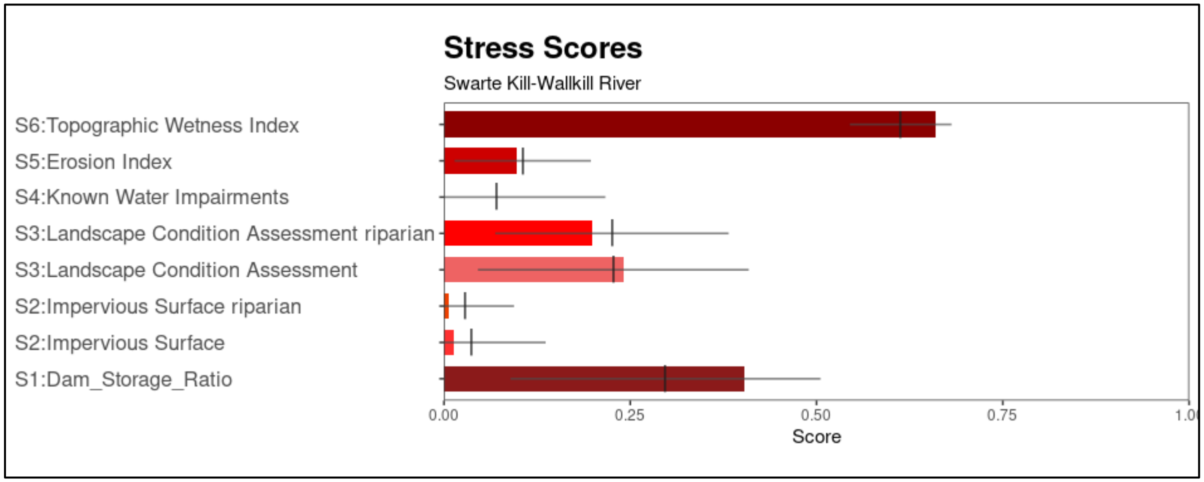


Figure 5: Swarte Kill-Wallkill River Subwatershed Ecological Stress Indicators

Kleine Kill-Wallkill River (HUC_020200070406)

COMPREHENSIVE: **0.21 (Range: -0.73 - 0.88)**

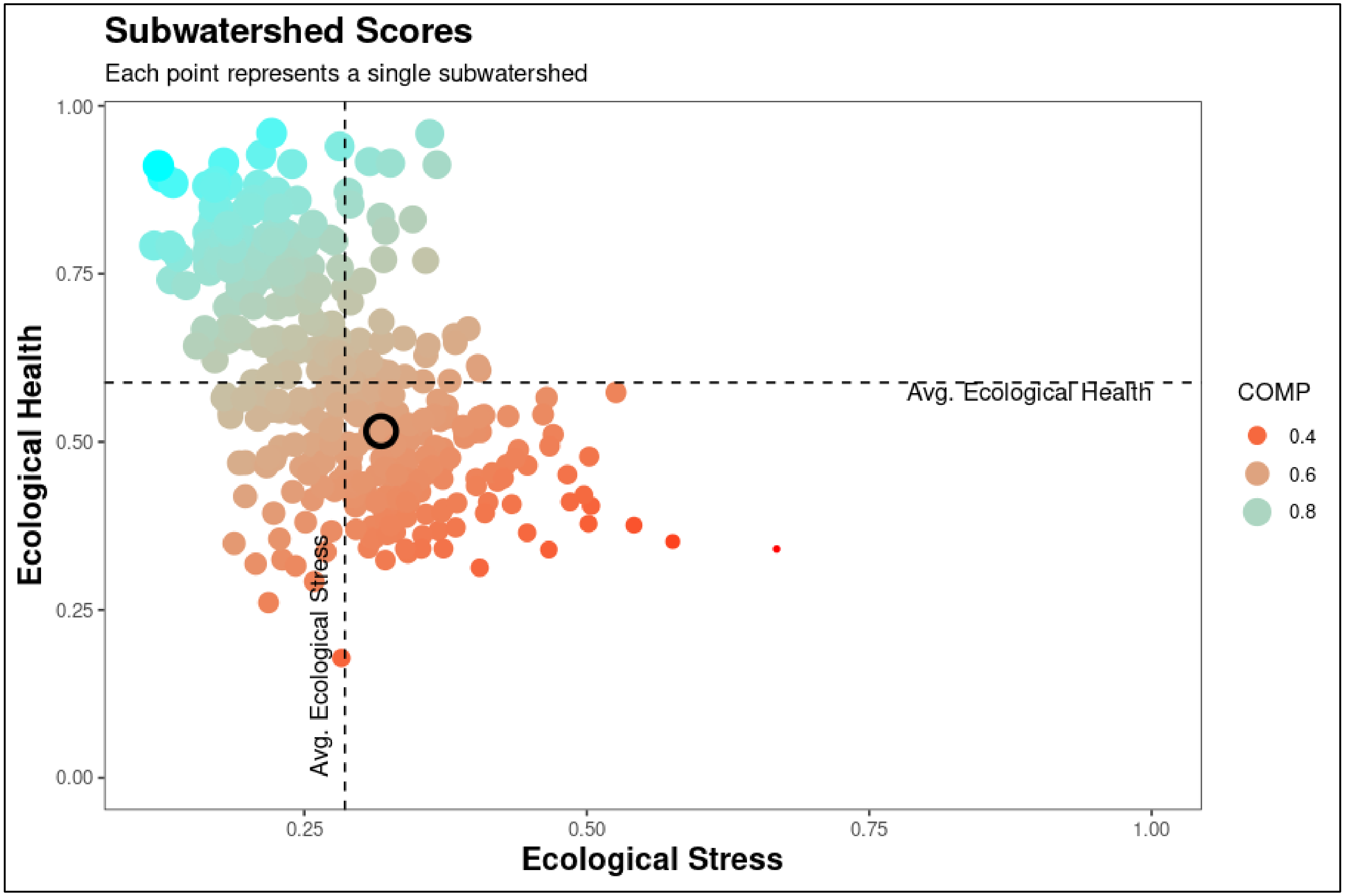


Figure 6: : Kleine Kill-Wallkill River Subwatershed scored in relation to Subwatersheds throughout NYS.

ECOLOGICAL HEALTH: **Raw 4.74, Normalized 0.49**

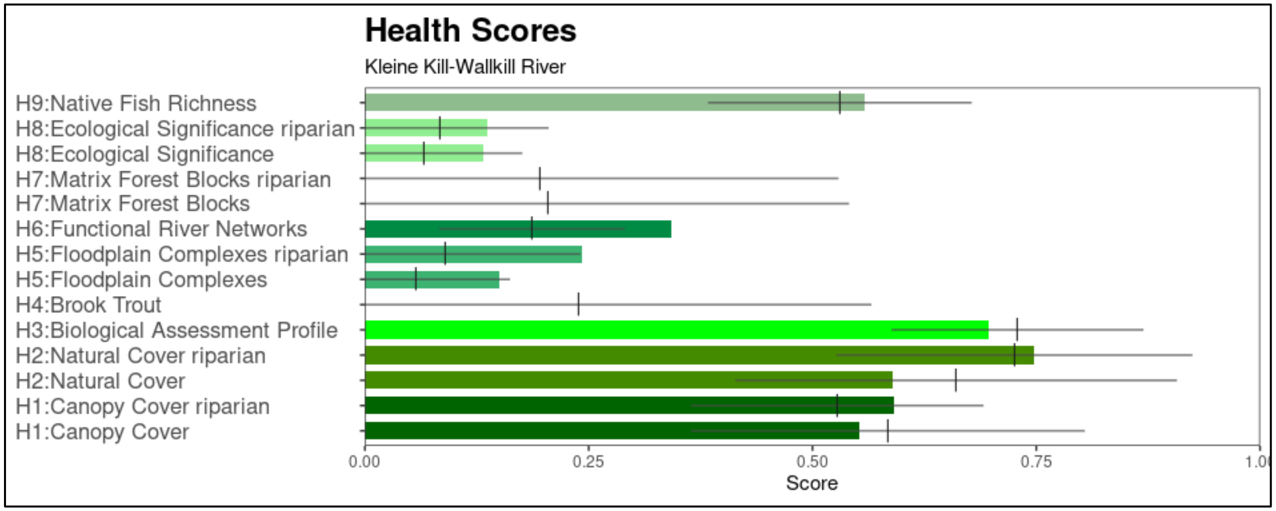


Figure 7: Kleine Kill-Wallkill River Subwatershed Ecological Health Indicators

ECOLOGICAL STRESS: **Raw 1.81, Normalized 0.28**

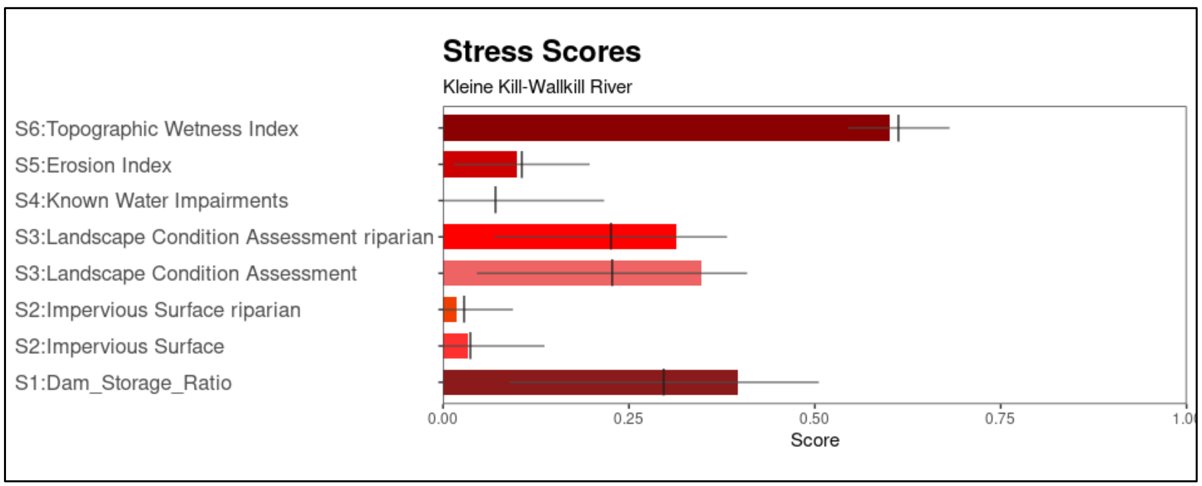


Figure 8: Kleine Kill-Wallkill River Subwatershed Ecological Stress Indicators

Coxing Kill-Rondout Creek (HUC_020200070604)

COMPREHENSIVE: **0.25 (Range: -0.73 - 0.88)**

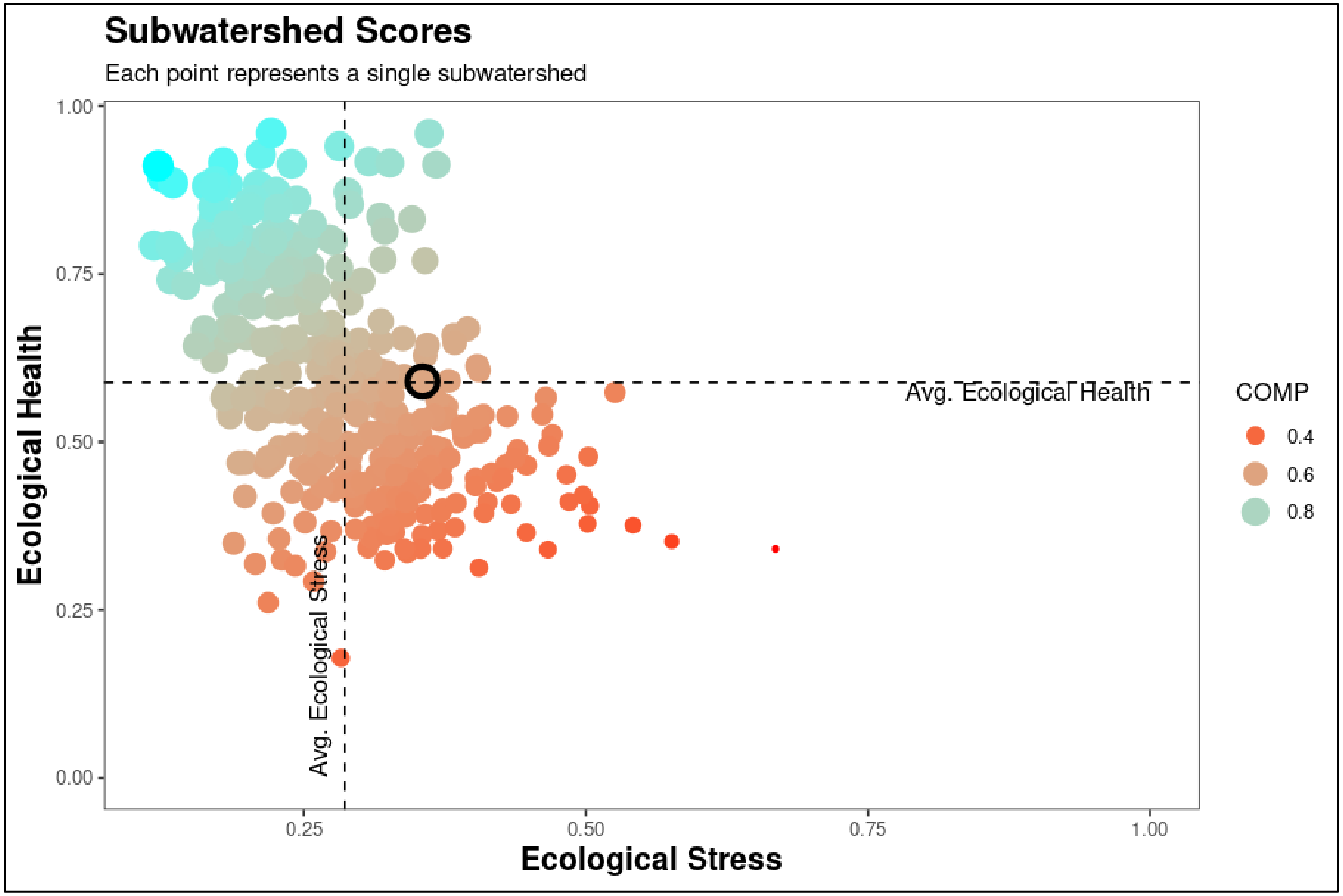


Figure 9: Coxing Kill-Rondout Creek Subwatershed scored in relation to Subwatersheds throughout NYS.

ECOLOGICAL HEALTH: **Raw 5.42, Normalized 0.57**

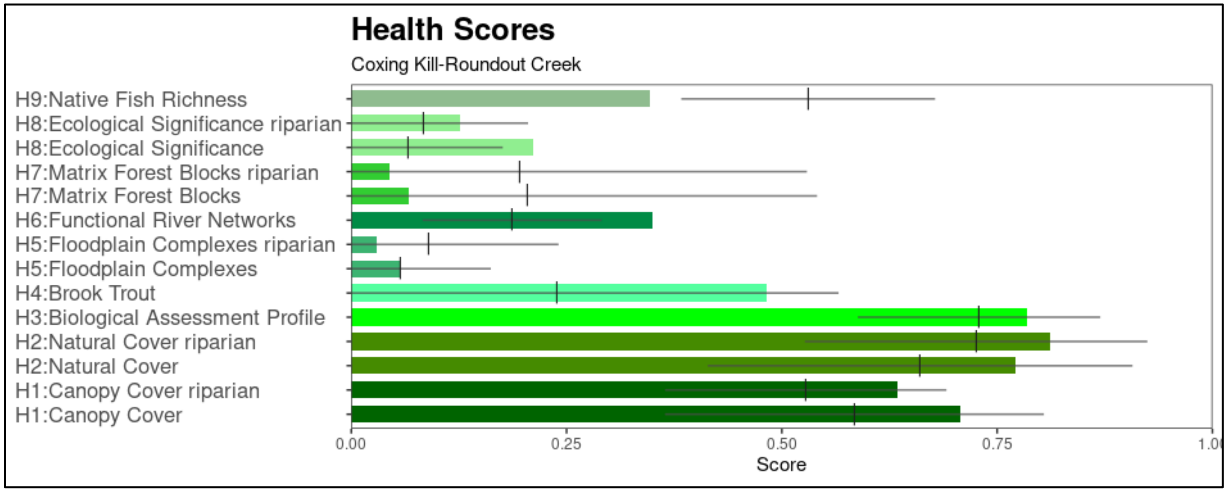


Figure 10: Coxing Kill-Rondout Creek Subwatershed Ecological Health Indicators

ECOLOGICAL STRESS: **Raw 2.02, Normalized 0.32**

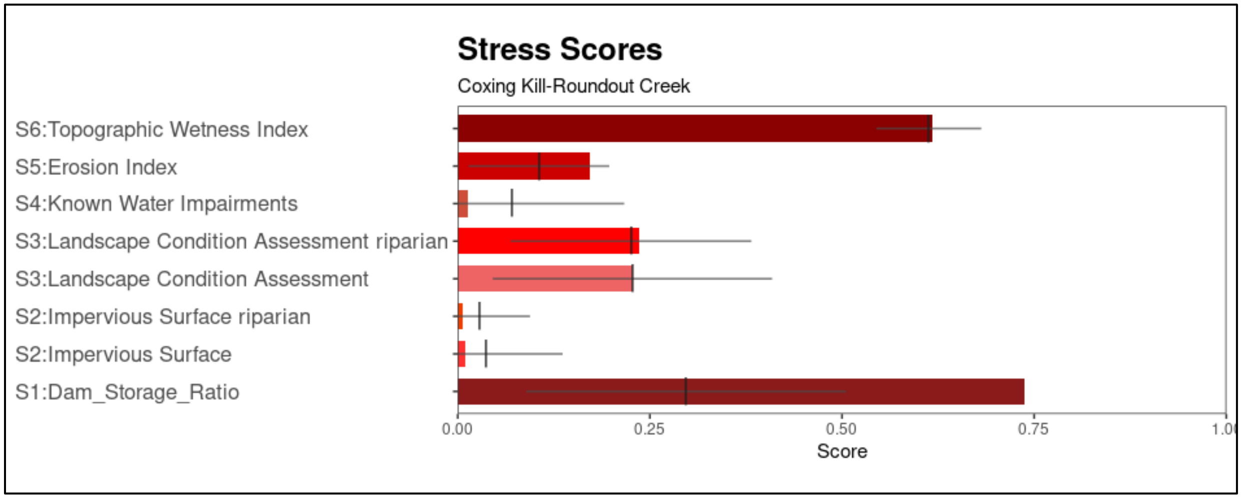


Figure 11: Coxing Kill-Rondout Creek Subwatershed Ecological Stress Indicators

Lower Shawangunk Kill (HUC_020200070304)

COMPREHENSIVE: **0.41 (Range: -0.73 - 0.88)**

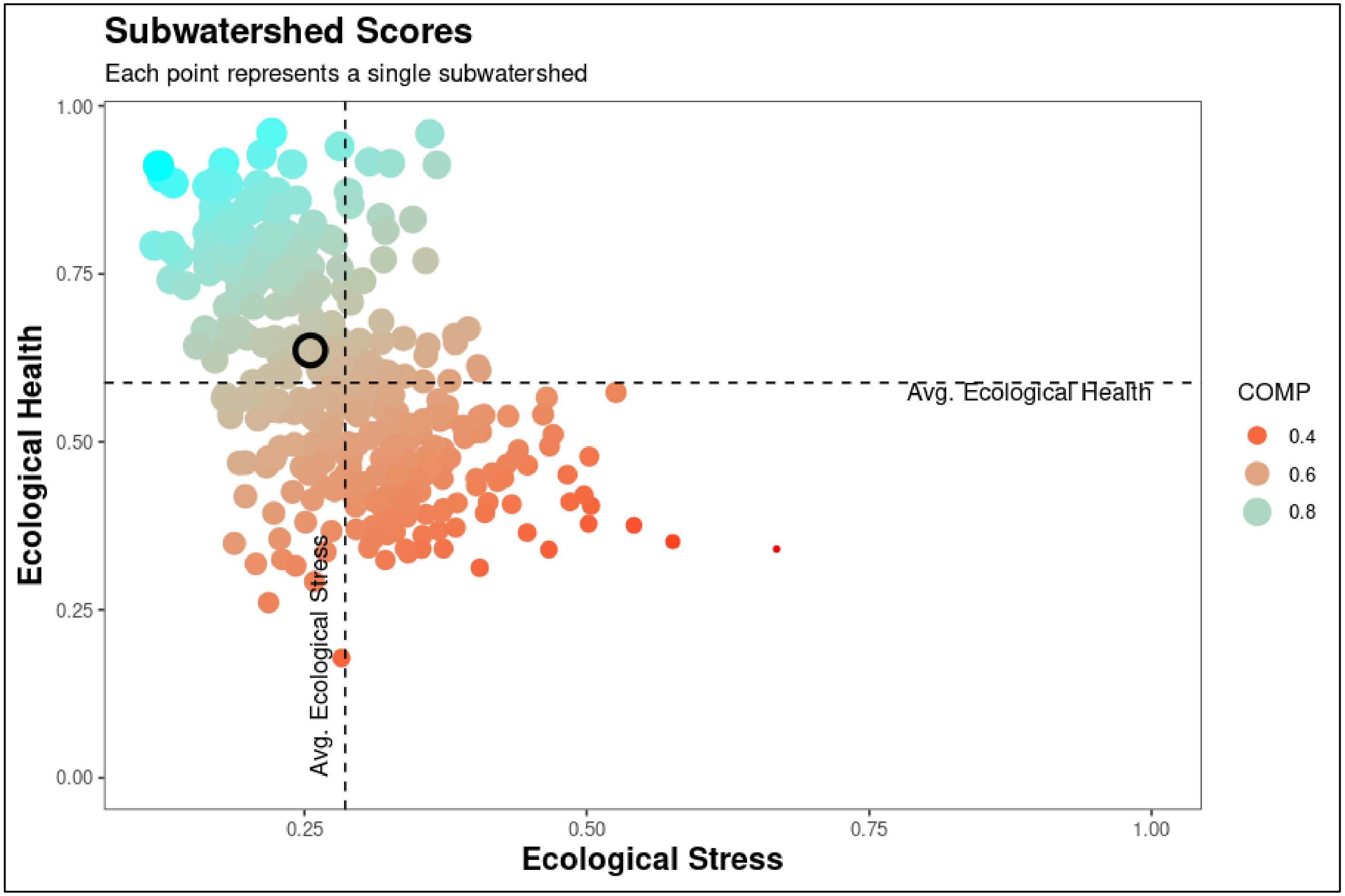


Figure 12: Lower Shawangunk Kill Subwatershed scored in relation to Subwatersheds throughout NYS.

ECOLOGICAL HEALTH: **Raw 5.85, Normalized 0.62**

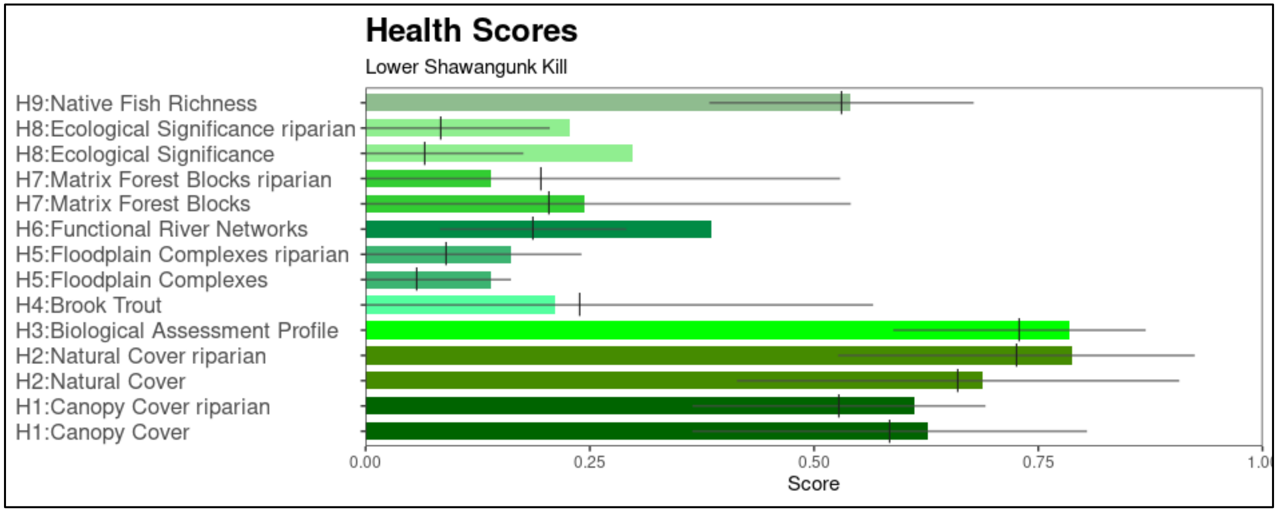


Figure 13: Lower Shawangunk Kill Subwatershed Ecological Health Indicators

ECOLOGICAL STRESS: **Raw 1.45, Normalized 0.21**

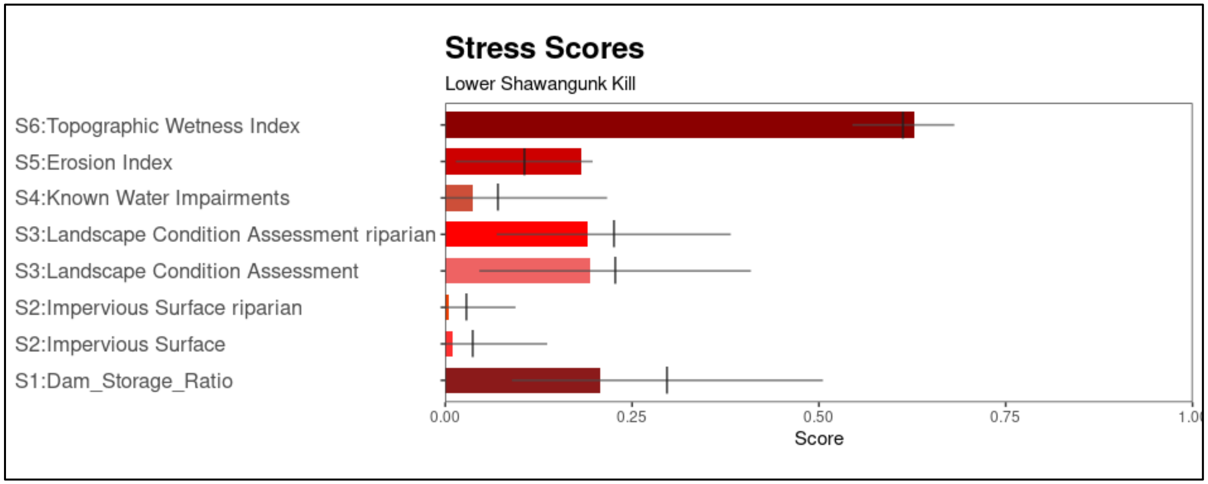


Figure 14: Lower Shawangunk Kill Subwatershed Ecological Stress Indicators

APPROACH: PROTECTION AND RESTORATION AREAS

There are many factors that contribute to an effective riparian buffer. Efforts to ensure the long-term health and ecological functioning of riparian buffers must include both protection and restoration. For this report, we identified priority areas for the community to both protect and restore. This prioritization process is intended to help the town and village to allocate resources and efforts more efficiently to maximize the ecological and hydrological benefits of riparian buffers.

We looked for protection areas for riparian buffers with existing vegetation that is left undisturbed or maintained to support the natural functions of the riparian buffer. These are areas that are important for maintaining the ecological integrity of the riparian area, protecting water quality, and preserving habitat for wildlife. Protection areas may be protected using either formal or informal agreements including things like: regulations, easements, or voluntary agreements with landowners. For the purposes of this report, we considered protection and restoration areas as distinct, but the town should consider restoration areas for protection after they are restored.

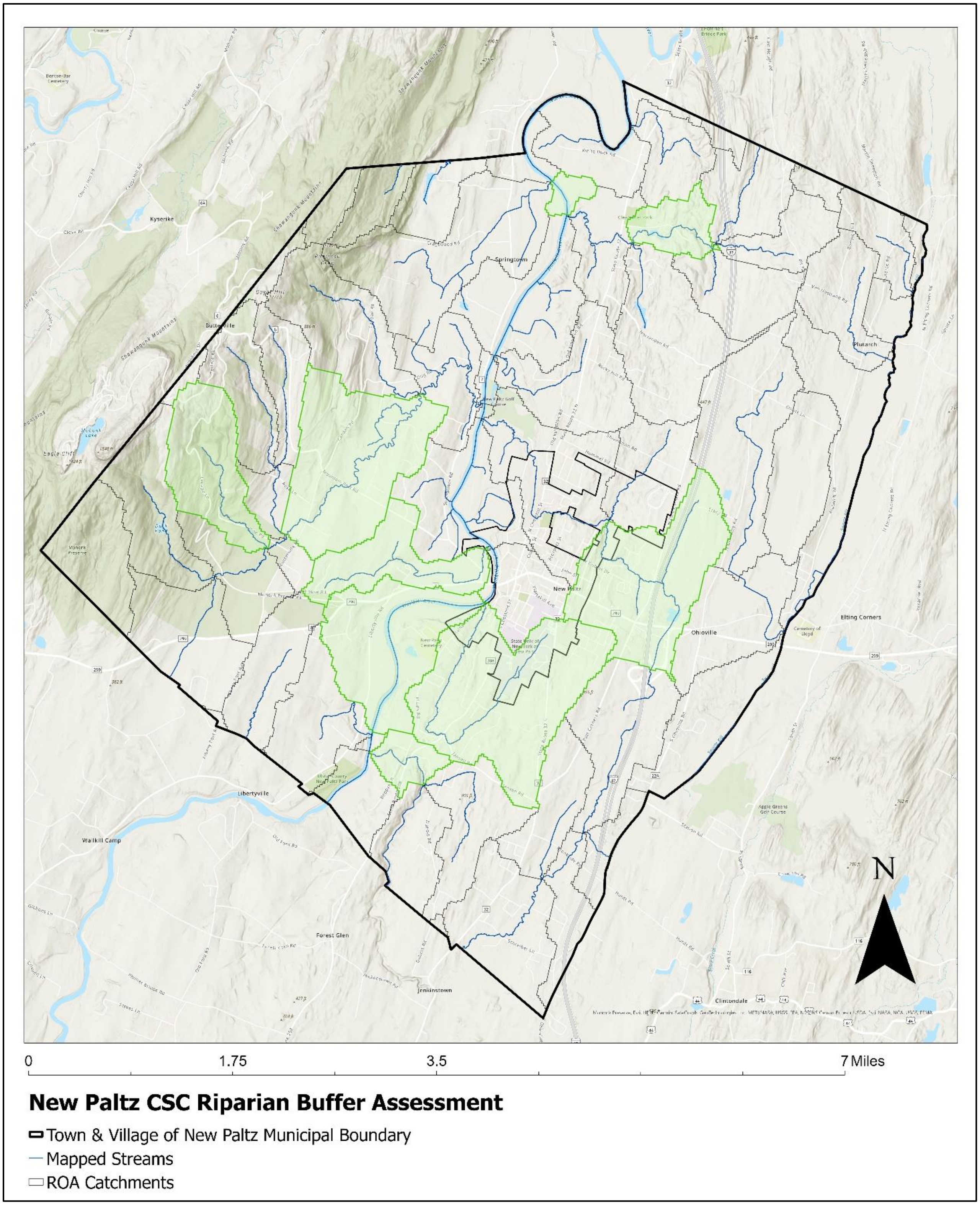
Restoration areas for riparian buffers, on the other hand, are areas where the vegetation has been removed or degraded and requires restoration to improve the ecological functions of the buffer. Restoration efforts may include planting native vegetation, controlling invasive species, and stabilizing eroding streambanks. These areas are important for enhancing the ecological functions of the riparian buffer, improving water quality, and restoring habitat for wildlife.

Sites that allow for long, continuous buffer strips rather than wide, fragmented strips can improve factors such as bank stabilization, decreased habitat fragmentation, erosion, flood risk, and water quality.

We paid special attention to protecting and restoring buffers along smaller headwater streams to ensure the reduction of sedimentation and pollution, as headwater streams can often be a major source of both. Restoration and protection of smaller order streams can create a greater improvement in water quality compared to large order streams. A wide buffer strip along a larger river or stream can do little to improve immediate water quality if improper buffer practices are occurring upstream. Buffers of headwater streams have the greatest potential to cause a change in transporting sediment, slowing the flow of pollutants, decreasing water temperature, and improving surrounding habitat.

RESTORATION SITE PRIORITIZATION

We used the Riparian Opportunity Assessment Tool to conduct an assessment of catchments within town boundaries. To start the process, we used the ROA data to narrow down the catchments with the lowest comprehensive scores and the highest ecological stress scores. The following catchments, Map 9, highlighted in green, were the initial catchments chosen using only the ROA scores in both categories. Catchments with comprehensive scores less than or equal to 0.40 or ecological stress scores greater than or equal to .18 were examined.



Map 9: Initial Restoration Catchments Using ROA

Next, we reviewed aerial imagery to examine the selected catchments to identify riparian zones and their characteristics. We assessed the width and condition of the vegetation in these riparian areas, to aid in determining suitable locations for restoration or protection efforts.

We identified vegetation distribution, particularly in areas where vegetation was lacking in relation to mapped waterbodies. Specifically, we focused on areas lacking trees or shrubs immediately adjacent to the stream, typically spanning a minimum distance of 50-100 feet depending on the width of the waterbody. Furthermore, the imagery was employed to investigate the surrounding land use patterns, shedding light on areas where human activities might be encroaching upon or impacting the health of riparian ecosystems.

Beyond vegetation, we also observed hydrological features, including information related to stream meandering and potential sites susceptible to erosion. We also used the ROA tool to look at various factors such as water quality, habitat condition, and riparian vegetation health to better understand the overall health and functionality of each catchment.

Figure 15: Example of Aerial Imagery Analysis

Figure 15 shows an area on the left with significant vegetation versus an area on the right with a lack of vegetation. The image on the right, located within a catchment that had a high ecological stress score, was chosen as a restoration focus area due to the visible lack of vegetation density and land cover classification.

Areas within each catchment that showed signs of low vegetation density, potentially disruptive land use, visible erosion, and were located near or within a FEMA flood zone were identified as focus areas.

REJECTED CATCHMENTS/FOCUS AREAS:

Not all catchments with a notably low comprehensive score or high ecological stress score were chosen for the assessment. This is due to various factors that allowed us to understand that the picture painted using the ROA did not accurately align with the local circumstances that may have contributed to the overall health or stress of a catchment.

After identifying the focus areas, we reviewed previous conservation reports and information related to public projects and rejected sites that had already been restored. Through verbal communication and the sharing of local knowledge, we were also able to remove focus areas that had proven to be mapped inaccurately. For example, several previously considered focus areas were removed simply because of an incorrectly mapped stream or wetland.

Initially identified areas that may have displayed any of the following characteristics were eliminated from the focus area list presented to local stakeholders:

ROA Score: If the ROA analysis assigns a high ecological health score to a focus area, indicating high ecological health, it might not be a suitable candidate for restoration but rather for protection. High scores suggest that protection efforts in such areas may yield significant ecological benefits, making other sites with lower scores more attractive for restoration. For example, if a catchment was earmarked initially due to its comprehensive score and then further research showed that the ecological health score significantly outweighed the stress score, it was rather considered for protection.

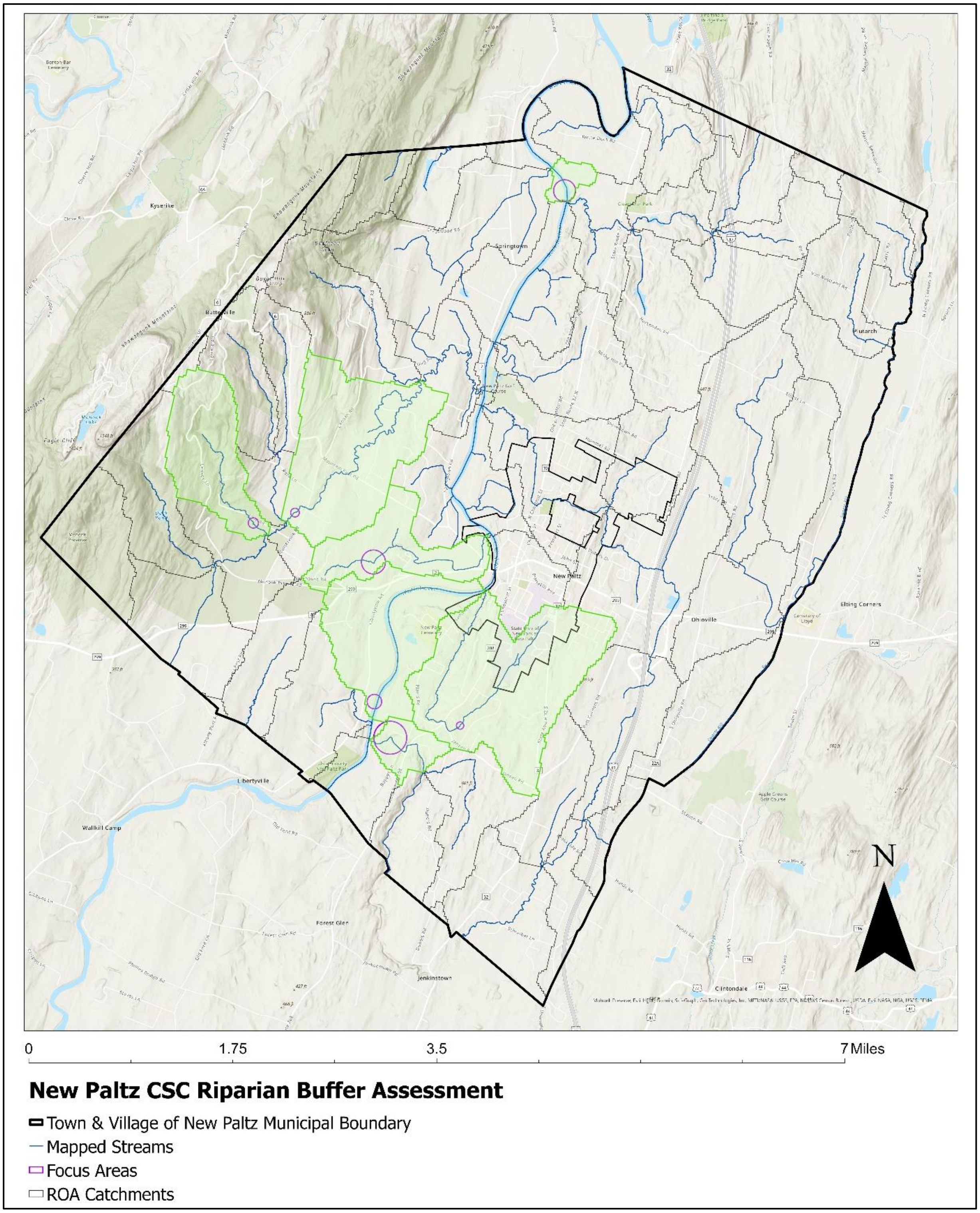
Conflicting Land Use: If a focus area was situated in an area dominated by incompatible land uses, such as intensive agriculture, that make riparian restoration difficult due to conflicting interests, it may have been removed from consideration.

High Human Activity: If aerial imagery shows significant human activity, development, or infrastructure within a focus area, it may not be a prime candidate for restoration. Such areas may face ongoing disturbances that can impede restoration success or may require extensive negotiation and collaboration with landowners.

Limited Access or Connectivity: A focus area's remoteness or lack of connectivity to larger riparian corridors may also influence its potential for restoration. Restoration projects are often more effective when they can contribute to a larger, connected ecosystem. Isolated areas might not provide these benefits.

Resource and Landowner Constraints: Areas that require substantial resources for landowner permissions, access, preparation, or maintenance might be deprioritized in favor of more manageable sites.

We further researched the remaining focus areas using GIS data to gain a better understanding of the information available about a site and a deeper understanding of the circumstances that might shape future restoration strategies. The following catchments, highlighted in green, and focus areas, circled in purple, can be found in Map 10.



Map 10: Restoration Catchments with Focus Areas (Presented to Stakeholders)

The factors used to gain a more holistic understanding of the focus areas chosen included land cover and land use data, surficial geology, hydrologic soil group and soil type, the DEC water quality classifications, and EPA water quality designations. The way we interpreted each factor is described below:

FEMA Flood Zones: FEMA flood zones provide information about areas prone to flooding. Riparian buffers in these zones play a crucial role in reducing flood risk by absorbing excess water and slowing down its flow. Prioritizing riparian buffer restoration in FEMA flood zones can help enhance flood mitigation efforts and protect adjacent properties from flood damage.

Land Cover/Land Use Data: Land cover data identifies the types of vegetation and land use present in a specific area. Analyzing land cover data can help identify areas where riparian buffers are missing or degraded. Prioritizing restoration in areas with sparse or fragmented riparian vegetation can contribute to improving the overall health and connectivity of riparian ecosystems. Examining current land use patterns is essential for identifying areas where riparian buffers have been impacted by human activities. Prioritizing restoration in areas with intensive agricultural practices, urban development, or other land uses that may have degraded riparian buffers can help restore ecological functions and reduce pollutant runoff into streams.

Surficial Geology: Geology plays a significant role in determining the hydrological processes and characteristics of an area. Understanding the geology of a watershed can help identify areas where riparian buffers are particularly important for protecting groundwater recharge or mitigating erosion. Prioritizing riparian buffer restoration in geologically sensitive areas can help preserve water resources and maintain stable streambanks.

Soil Type/Hydrologic Soil Group: Soil characteristics such as texture, drainage, and land use directly impact the suitability of a site for native vegetation, erosion control, and water filtration. Understanding the soil's water-holding capacity helps ensure that the buffer can effectively mitigate runoff, reduce sedimentation, and improve water quality. Soil information also guides land use planning, as certain soil types may be better suited for agriculture, urban development, or restoration. By analyzing soil types within riparian zones, restoration strategies can be tailored to the unique needs and limitations of each focus area, optimizing the buffer's ecological and water quality benefits.

DEC Water Quality Classification: The DEC water quality classifications in New York State are not classified on actual water quality measurements but are rather classified based on "existing or expected best usage of each water or waterway segment". The stream classifications range from "AA" (drinking, bathing, fishing, and fish propagation and survival) to "D" (fishing, but waters will not support fish propagation). Prioritizing restoration in areas with water quality classifications that show room for improvement can help advance aquatic ecosystems, enhance habitat quality, and protect downstream water resources.

EPA Water Quality Designation: The EPA How's My Waterway data employs a monitoring framework encompassing the examination of physical, chemical, and biological attributes. These monitoring findings are subsequently evaluated against established water quality benchmarks and criteria approved by the EPA. Waterbodies are designated as either good, impaired (polluted), or unassessed. Good waters are waterbodies fully supporting their designated uses under the Clean Water Act. Impaired/polluted waters are waterbodies not fully supporting their designated uses under the Clean Water Act. Unassessed Waters are waters that have not yet been assessed and/or monitored by states, territories, and tribes for their physical, chemical, and biological properties to determine whether the waters meet water quality standards. Prioritizing restoration along waterways with impaired/polluted or unassessed designations can increase awareness of potential degradation and encourage water quality considerations for future strategies.

The following focus areas were brought forth to stakeholders:

Focus Area:	**A**	**B**	**C**	**D**	**E**	**F**	**G**
Catchment #	202972694	202973297	202972706	202972655	202971598	202973163	202973156
Sub watershed	Kleine-Kill Wallkill River	Kleine-Kill Wallkill River	Kleine-Kill Wallkill River	Kleine-Kill Wallkill River	Swarte-Kill Wallkill River	Kleine-Kill Wallkill River	Kleine-Kill Wallkill River
Catchment Comp.	0.06	-.25	.27	.40	.40	.24	-.11
Catchment Eco Health	.25	.26	.32	.66	.76	.77	.21
Catchment Eco Stress	.18	.51	.05	.26	.36	.53	.32
Flood Zone (Y/N)	N	Y, SFHA	N	N	Y, Floodway and SFHA	Y, Floodway and SFHA	N
Soil Type	CvA	BnC, Ma, HgD	CvA, Ma	CvA	Wb, Te	Ha	VoB
Hydrologic Soil Group	D	C, D	D	D	C/D, B	B	B
Surficial Geology	Till	Lacustrine Silt and Clay, Till	Lacustrine Silt and Clay	Till	Recent Deposits	Recent Deposits	Till
Land Cover	Hay/Pasture	Hay/Pasture	Hay/Pasture	Hay/Pasture, Woody Wetlands, & Deciduous Forest	Hay/Pasture	Cultivated Crops	Deciduous Forest, & Developed, Open Space
DEC Water Quality Classification	Unavailable	B(T)-recreation/trout	C (non-contact uses)	C (non-contact uses)	B (recreation)	B (recreation)	C

EPA Water Quality Designation	Unassessed	Unassessed	Unassessed	Unassessed	Impaired/Polluted	Impaired/Polluted	Good

Table 4: Restoration Focus Area Data Indicators

These areas were then presented to a group of stakeholders identified with the help of the New Paltz Climate Smart Communities Task Force. More information about the stakeholder prioritization process can be found in the stakeholder workshop section below.

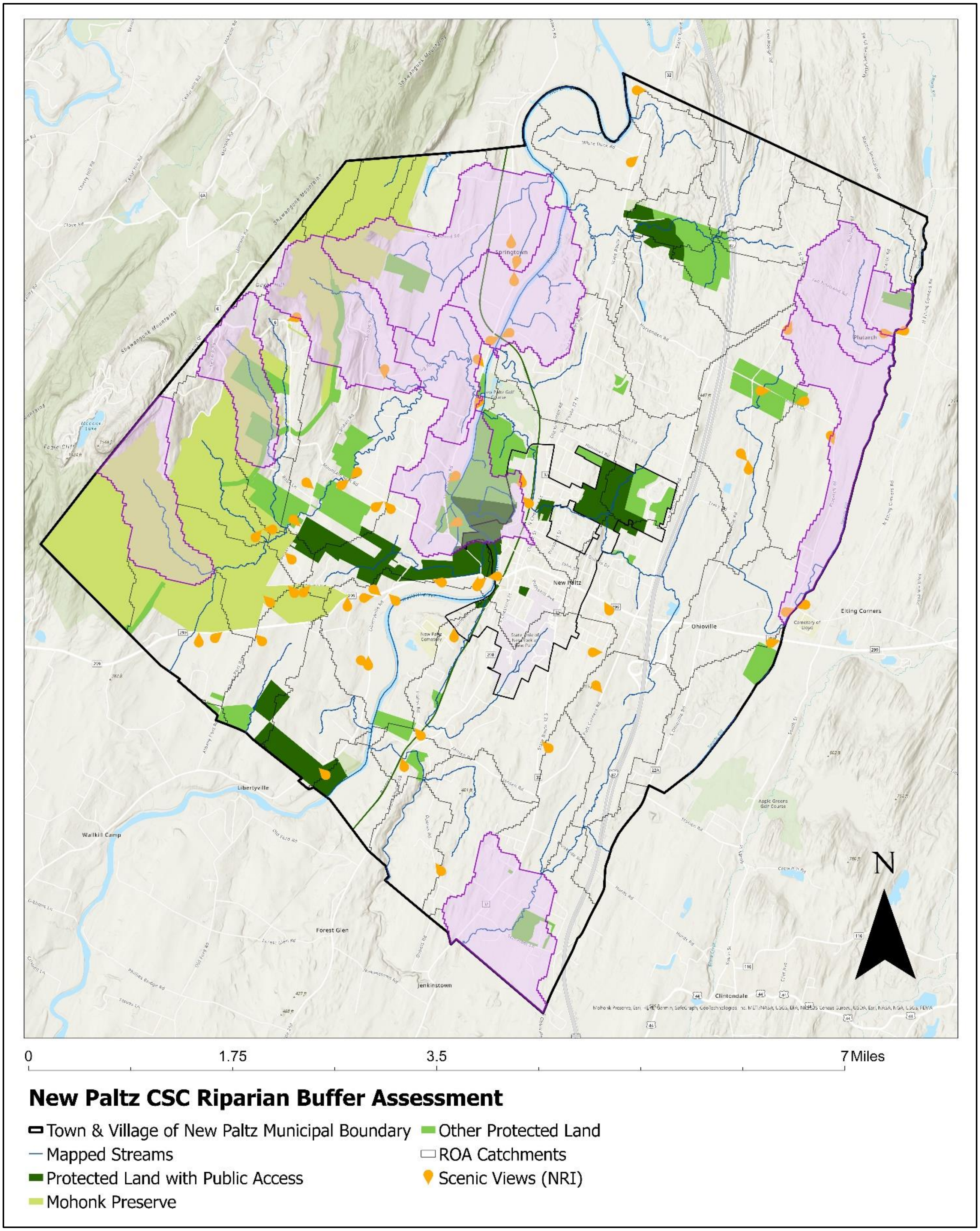
In summary, while assessing focus areas for riparian restoration, it was essential to consider a combination of ecological, logistical, and contextual factors. We used the ROA scores, flood risk, existing vegetation, human activity, connectivity, and resource constraints, to determine the candidates for focus areas.

PROTECTION SITE PRIORITIZATION

The process of identifying priority catchments for protection aimed to select areas that align with conservation objectives and maximize the impact of protective measures. We began desk research by establishing our prioritization methodology.

Next, we utilized the ROA Tool to systematically assess catchments within our defined study area. Our primary focus was on catchments demonstrating high comprehensive scores and high ecological health scores. The ROA includes a range of critical ecological variables, encompassing water quality metrics, habitat conditions, and the overall health of riparian vegetation. Catchments with comprehensive scores higher than .22 and ecological health scores higher than .58 were selected. We chose these cutoff values because they were near the midpoint of the scores (both are slightly higher than the midpoint to enable us to include more catchments). Catchments without mapped water bodies or those that had already been chosen

Map 11 depicts the catchments prioritized for protection with overlays of scenic viewpoints, found in the New Paltz Natural Resource Inventory (2021), and protected land throughout the town.



Map 11: Protection Focus Catchments

Once the protection catchments were identified, we created profiles that delve into deeper insights into each protection catchment (see Final Protection Catchment Profiles section).

The following catchments all met the criteria of having a comprehensive score above .22 and an ecological health score above .58:

Catchment #	Sub watershed	Catchment Comp.	Catchment Eco Health	Catchment Eco Stress	Flood Zone (Y/N)	DEC Water Quality Classification	EPA Water Quality Designation
202972847	Kleine-Kill Wallkill River	.7	.97	.26	N	AA	Unassessed
202972487	Kleine-Kill Wallkill River	.49	.59	.1	N	Upstream: AA Downstream: C	Unassessed
202972210	Kleine-Kill Wallkill River	.71	.74	.04	Y	C	Unassessed
202971889	Kleine-Kill Wallkill River	.58	.59	.01	Y	C	Upstream: Unassessed Downstream: Good
202972202	Kleine-Kill Wallkill River	.78	1	.22	Y	C	Unassessed
202972054	Swarte-Kill Wallkill River	.55	.89	.34	Y	B	Polluted
202972577	Kleine-Kill Wallkill River	.44	.82	.38	Y	B	Wallkill Main Stem: Polluted Tributaries: Good
202971805	Swarte-Kill Wallkill River	.43	.7	.27	Y	C	Unassessed
202971765	Swarte-Kill Wallkill River	.39	.73	.33	Y	B	Unassessed
202972624	Swarte-Kill Wallkill River	.51	.83	.32	Y	B	Unassessed
202973862	Kleine-Kill Wallkill River	.24	.58	.34	N	B(T)	Unassessed

Table 5: Protection Focus Catchment Data Indicators

Geospatial analysis, driven by Geographic Information Systems (GIS) technology, is integral to this process as it aided in organizing and analyzing spatial data, providing a visual representation of ecological features that may have been present. Various GIS layers, encompassing factors like land use, hydrology, soils, and flood zones, were overlaid to pinpoint areas with the greatest conservation potential.

STAKEHOLDER WORKSHOP

The Stakeholder Workshop on October 3rd, 2023 served as the first major feedback component in our riparian restoration initiative, seeking our engagement with community stakeholders. This event was structured to facilitate inclusive discussions among participants representing various interests and backgrounds.

The workshop commenced with an introduction to the overarching goals and objectives of our riparian restoration and protection initiative. We shared information about the fundamental importance of riparian zones in preserving ecological integrity, enhancing water quality, and contributing to community well-being. This foundational knowledge set the stage for informed discussions.

We presented the specific focus areas that we had identified for riparian restoration. We did not present protection focus areas, because they were not delineated at the time of the meeting. Seven focus area profiles were presented to provide stakeholders with a understanding of the ecological and contextual factors that guided the selection process. We presented information about why these particular areas were prioritized and how they aligned with the goals of ecological conservation and community resilience.

The focal point of the workshop was our stakeholder prioritization process. Through facilitated discussions, participants actively engaged with key criteria for prioritization from the profiles. Using the dot voting method, stakeholders were invited to share their opinions about which catchments they considered a priority. Participants were also invited to recommend additional focus areas for protection and restoration. Profiles for additional area recommendations can be found at the end of each profile section.

This process allowed us to share more about the multifaceted factors influencing conservation efforts such as the ecological urgency of restoration against other goals that we were not able to include using mapped data, like the potential for community involvement and the significance of preserving iconic landscapes.

Through the dot voting, we narrowed down the riparian restoration focus areas that reflected the ecological importance of each catchment and the values and priorities of our stakeholder group. The outcome was a narrowed down to a list of 5 focus areas earmarked for restoration. Below is a brief vote count:

	FOCUS AREA A	**FOCUS AREA B**	**FOCUS AREA C**	**FOCUS AREA D**	**FOCUS AREA E**	**FOCUS AREA F**	**FOCUS AREA G**
1st Round Stakeholder Voting	0	7	5	3	5	7	5

2nd Round Stakeholder Voting		1	1				1

Table 6: Stakeholder Workshop Restoration Focus Area Dot Voting Results

The insights, passion, and expertise of our stakeholders enriched our decision-making process. The profiles for each of the 5 focus areas chosen for restoration can be found in Section V. Findings and Recommendations.

V. FINDINGS AND RECOMMENDATIONS

DATA INTERPRETATION

FINAL PROTECTION CATCHMENT PROFILES

The protection focus area profiles provide broad details about each area, including the catchment comprehensive score, ecological health score, and ecological stress score. In additon to the Riparian Opportunity Assessment data that was used to prioritize these catchment areas, we also identified whether catchment contained areas designated as FEMA Flood Zones, DEC Water Quality Classification, EPA water quality designations, and surficial geology. This information can help inform decision-making in developing effective protection strategies. The ecological health scores identify potential strengths, while the ecological stress score highlights potential stressors. FEMA Flood Zone status aids in planning for flood resilience. The DEC water quality classification informs about intended water usage, while the EPA water quality designation gives insight into conditions and potential issues that may be contributing to water quality degradation.

We provide profiles below for the three catchments with the highest comprehensive score and highest ecological health score combined. While these are the top three in ranking from the ROA, we feel that all of the catchments that all catchments chosen for protection should be equally considered depending on the conservation goals for future projects (see list of all protection catchments in Table 5). Unlike the restoration areas, we designated protection areas catchment-wide scale rather than zoomed in area. Because this area is larger and includes a more diverse the following information has not been included in profiles: soil type, hydrologic soil group, surficial geology, and land cover. Since this particular data is often most useful for site-specific analysis, we have chosen not to include this information within the protection focus area profiles. This data should be researched in-depth when selected areas within the catchments are chosen for protection efforts.

Protection Focus Area A: Catchment #202972847

The major water body within this catchment is the Kleine Kill, a tributary to the Wallkill River.

Catchment Comprehensive Score (0.70):

A comprehensive score of 0.70 falls on the positive end of the scale, which typically ranges from -1 to 1. This suggests that the assessed riparian area is in good ecological health and functioning well, as it significantly exceeds the midpoint of the scale at 0.

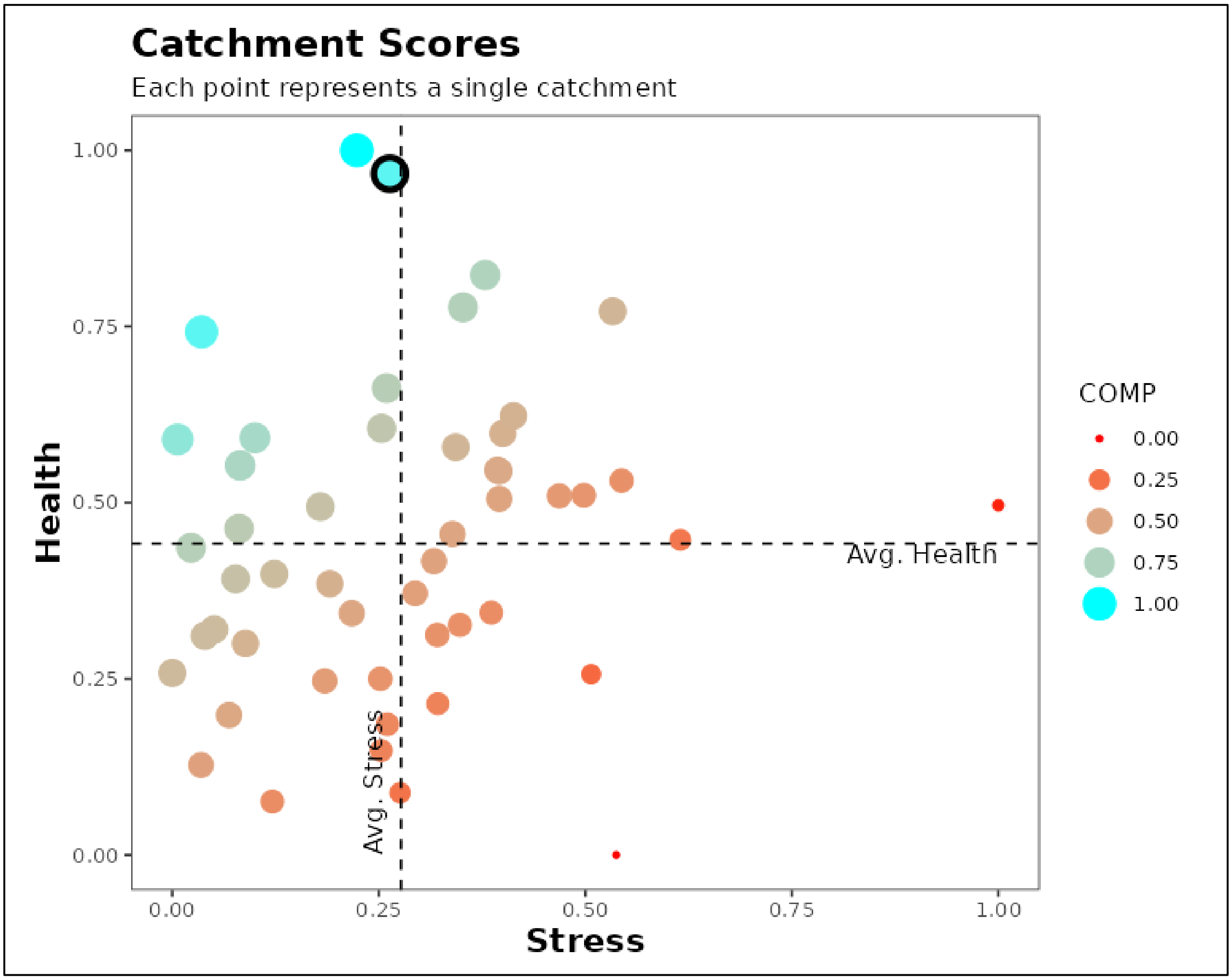


Figure 16: Catchment #202972847 in relation to the other catchments located within the Kleine Kill-Wallkill River Subwatershed.

Catchment Ecological Health Score (0.97):
An ecological health score of 0.97 indicates a high level of ecological health within the assessed riparian area. On the scale typically ranging from 0 to 1, this score is very close to the maximum possible value of 1. This suggests that the riparian ecosystem is thriving, with minimal ecological stressors and optimal conditions for supporting overall ecosystem function. The following indicators contributed the most to the ecological health score:

Brook Trout: A significant score in this indicator is a promising sign. It suggests that a portion of the focus area's catchment is occupied by Brook Trout, which are indicators of healthy stream habitats. Their presence often signifies good water quality.

Biological Assessment Profile (BAP): A high score in BAP is indicates that there was a rich diversity of freshwater insects at the closest sampling point to this catchment, indicating good water quality and a healthy instream ecosystem nearby. This is a positive contributor to the focus area's ecological health score.

Natural Areas: The presence of a high percentage of natural areas in the catchment is another positive sign. Natural areas typically include undisturbed habitats that support biodiversity.

Catchment Ecological Stress Score (0.26):
An ecological stress score of 0.26 suggests a moderate level of ecological stress within the assessed riparian area. On the typical scale ranging from 0 to 1, this score is closer to the lower end, indicating that while there may be some stressors present, they are not severe enough to significantly harm the ecosystem's health. However, this score does suggest the presence of certain ecological challenges that may require attention. The following indicators contributed the most to the ecological stress score:

Dam Storage Ratio: This indicator estimates how much of each river's mean annual flow was potentially stored by upstream impoundments. A high score indicates a higher risk of flow disruption which can be detrimental to the natural flow of streams and rivers.

Topographic Wetness Index: A substantial score in this indicator points to areas where water accumulates and flows as sheets, potentially leading to erosion and water-related issues. This adds to the overall ecological stress in the focus area.

Erosion Index: A high score in this category indicates a greater risk of erosion. Erosion can lead to sedimentation in water bodies, impacting riparian habitat and water quality.

Flood Zone:
This focus area is not situated within a FEMA Flood Zone. This designation implies a lower risk of substantial flooding at the site. The major water body within this catchment is the Kleine Kill, a major tributary to the Wallkill River.

DEC Water Quality Classification:
The stream within Focus Area A is classified as AA and is characterized by its best usage as a source of drinking water, swimming and other recreation, and fishing.

EPA Water Quality Designation:
The waterbody within Focus Area A is classified as unassessed.

Stakeholder Input:

N/A

Protection Focus Area B: Catchment #202972210

The major tributary within catchment B also feeds directly into the Kleine Kill, a tributary to the Wallkill River.

Catchment Comprehensive Score (0.71):

A comprehensive score of 0.71 indicates a relatively high level of overall health and functionality within the assessed riparian area. On the typical scale ranging from -1 to 1, this score is notably positive, suggesting that the ecosystem is in good condition. However, some minor ecological challenges or stressors may still be present, but they are not significant enough to substantially detract from the overall health of the ecosystem.

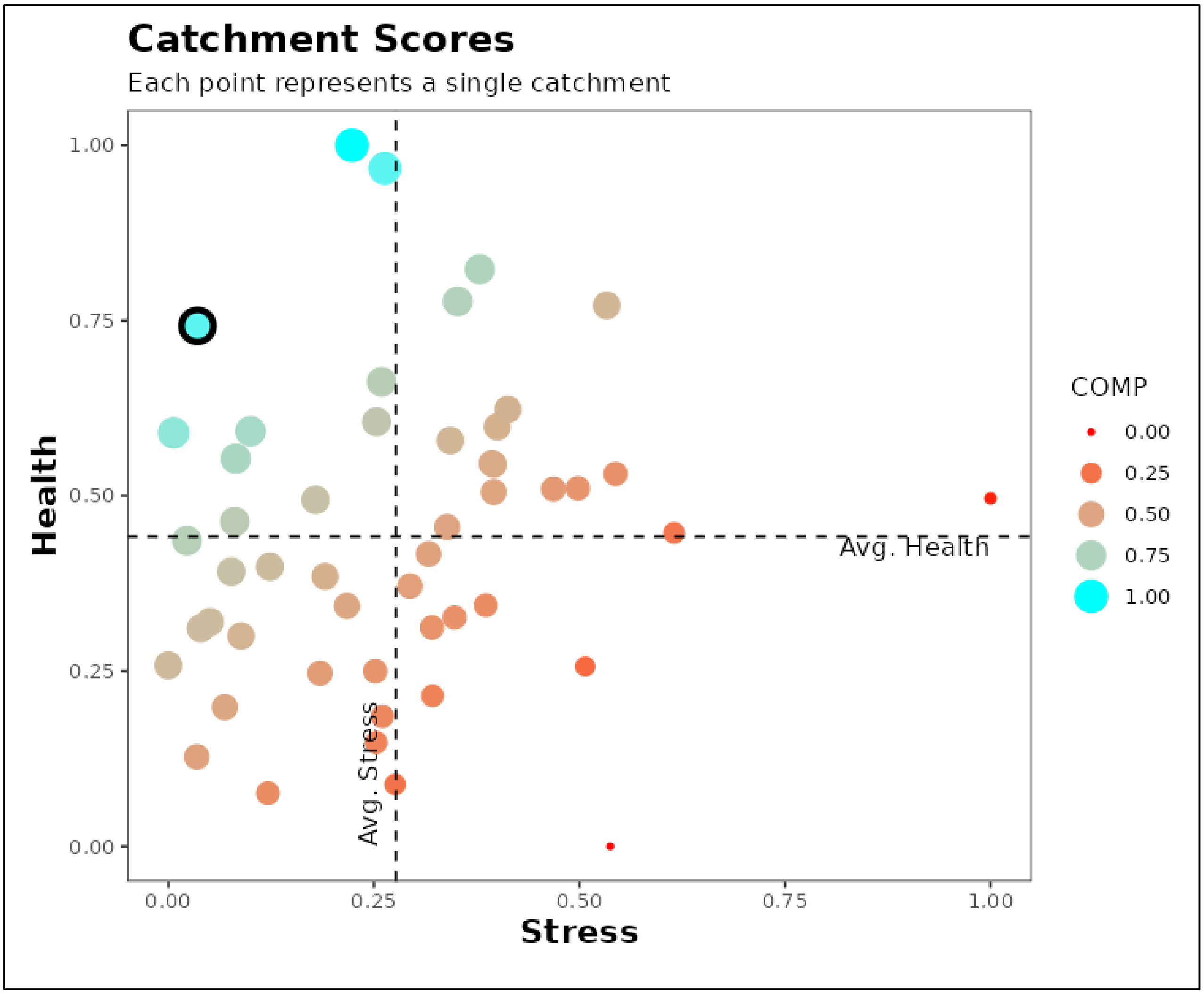


Figure 17: Catchment #202972210 in relation to the other catchments located within the Kleine Kill-Wallkill River Subwatershed.

Catchment Ecological Health Score (0.74):

An ecological health score of 0.74 indicates a relatively high level of ecological health within the assessed riparian area. On the typical scale ranging from 0 to 1, this score is notably positive, suggesting that the ecosystem is in good condition. Minor ecological challenges may exist, but they are not significant enough to substantially detract from the overall health and functionality of the ecosystem. The following indicators contributed the most to the ecological health score:

Natural Areas: The presence of a high percentage of natural areas in the catchment is another positive sign. Natural areas typically include undisturbed habitats that support biodiversity.

Canopy Cover: The presence of a relatively healthy canopy cover is a positive sign. It indicates that there's a substantial amount of vegetation in this area. This vegetation helps protect water quality by intercepting pollutants, sequestering carbon, and providing habitat for various species.

Ecological Significance: A strong score in ecological significance means that this area is home to rare species and high-quality habitats. The presence of rare species often indicates a healthy and biodiverse ecosystem.

Catchment Ecological Stress Score (0.04):

An ecological stress score of 0.04 indicates a low level of ecological stress within the assessed riparian area. On the typical scale ranging from 0 to 1, this score is on the lower end which suggests that the ecosystem is under minimal stress, with little to no significant environmental disturbances or factors negatively impacting its health. Overall, a stress score of 0.04 implies that the riparian ecosystem is in a favorable and resilient condition. The following indicators contributed the most to the ecological stress score:

Topographic Wetness Index: A substantial score in this indicator points to areas where water accumulates and flows as sheets, potentially leading to erosion and water-related issues. This adds to the overall ecological stress in the focus area.

Erosion Index: A high score in this category indicates a greater risk of erosion. Erosion can lead to sedimentation in water bodies, impacting riparian habitat and water quality.

Landscape Condition Assessment: A high score in this indicator suggests that the landscape condition of the focus area might be compromised. It implies there are stressors related to land use and development, which can adversely impact the environment.

Flood Zone:
This focus area is situated within a Special Flood Hazard Area (SFHA). The SFHA is located downstream which implies a higher risk of substantial flooding due to an elevation change. The tributary within the catchment also feeds directly into the Kleine Kill, a major tributary to the Wallkill River.

DEC Water Quality Classification:
The DEC water quality classification for this area is C, signifying that the designated best use is non-contact uses such as fishing.

EPA Water Quality Designation:
The waterbody within Focus Area A is classified as unassessed.

Stakeholder Input:

N/A

Protection Focus Area C: Catchment #202972202

The major water body within this catchment is the Kleine Kill, a tributary to the Wallkill River.

Catchment Comprehensive Score (0.78):

A comprehensive score of 0.78 indicates a high level of overall ecological health and function within the assessed riparian area. On the typical scale ranging from -1 to 1, this score is significantly positive. This score implies that the area is relatively undisturbed by environmental stressors, making it a valuable and resilient natural habitat. A comprehensive score of 0.78 signifies that the riparian zone is functioning exceptionally well in terms of its ecological health and vitality.

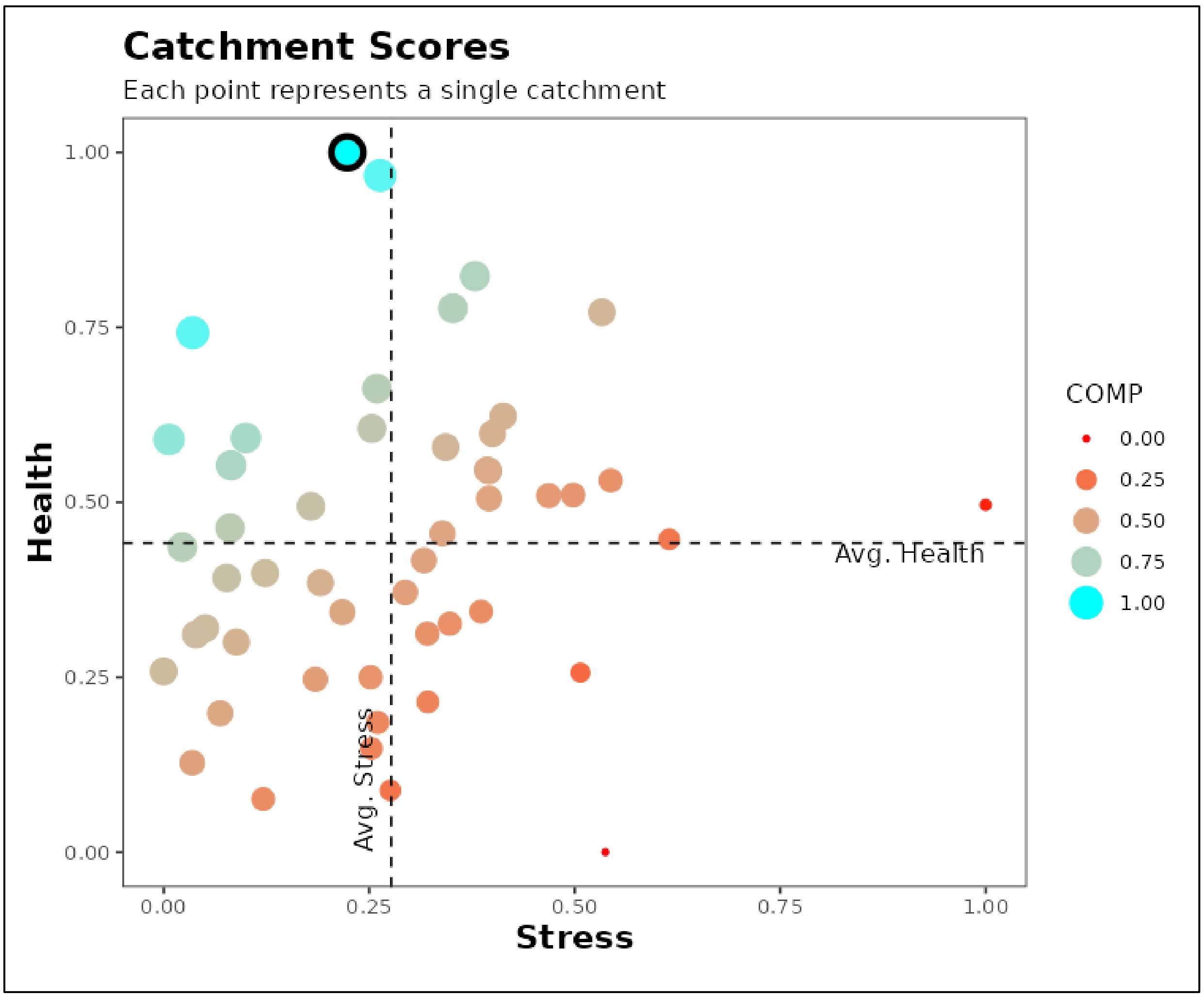


Figure 18: Catchment #202972202 in relation to the other catchments located within the Kleine Kill-Wallkill River Subwatershed.

Catchment Ecological Health Score (1):

An ecological health score of 1 represents the highest level of ecological health and vitality achievable within the assessment framework. On a scale typically ranging from 0 to 1, this score is at the maximum positive end, indicating that the riparian ecosystem is in a near-natural state. Such a score signifies an environment where ecological interactions are intact, and the ecosystem provides essential functions and services at its fullest potential. In essence, an ecological health score of 1 represents the epitome of ecological well-being and function for the assessed riparian area. The following indicators contributed the most to the ecological health score:

Biological Assessment Profile (BAP): A high score in BAP is indicates that there was a rich diversity of freshwater insects at the closest sampling point to this catchment, indicating good water quality and a healthy instream ecosystem nearby. This is a positive contributor to the focus area's ecological health score.

Floodplain Complex: The presence of a floodplain complex is another positive sign. Floodplain complexes describe larger natural upland and wetland patches along streams. They indicate good vegetative and riparian connectivity.

Natural Areas: The presence of a high percentage of natural areas in the catchment is another positive sign. Natural areas typically include undisturbed habitats that support biodiversity.

Catchment Ecological Stress Score (.22):

An ecological stress score of 0.22 suggests a moderate level of ecological stress within the assessed riparian area. On a scale typically ranging from 0 to 1, this score indicates that there are some stressors or disturbances affecting the riparian ecosystem, but they are not severe enough to cause significant ecological harm. While there is room for improvement, an ecological stress score of 0.22 implies that the overall ecological health of the area is relatively stable. The following indicators contributed the most to the ecological stress score:

Dam Storage Ratio: This indicator estimates how much of each river's mean annual flow was potentially stored by upstream impoundments. A high score indicates a higher risk of flow disruption which can be detrimental to the natural flow of streams and rivers.

Topographic Wetness Index: A substantial score in this indicator points to areas where water accumulates and flows as sheets, potentially leading to erosion and water-related issues. This adds to the overall ecological stress in the focus area.

Flood Zone:

This focus area is situated within a Special Flood Hazard Area (SFHA). The SFHA is located downstream which implies a higher risk of substantial flooding due to an elevation change. The major water body within this catchment is the Kleine Kill, a major tributary to the Wallkill River.

DEC Water Quality Classification:

The DEC water quality classification for this area is C, signifying that the designated best use is non-contact uses such as fishing.

EPA Water Quality Designation:
The waterbody within Focus Area A is classified as unassessed.

Stakeholder Input:

N/A

Stakeholder Recommendation- Protection Focus Area D: Catchment #202973328

The major water body within this catchment is a tributary to the Platte Kill, a tributary to the Wallkill River.

Catchment Comprehensive Score (0.21):

A comprehensive score of 0.21 suggests that the area or site is experiencing challenges in terms of its overall ecological health. A score of 0.21 falls on the lower end of the scale, indicating suboptimal ecological conditions but still scores above 0, the midpoint. It may reflect the need for interventions to address any issues such as conservation measures to restore and maintain the area's ecological balance.

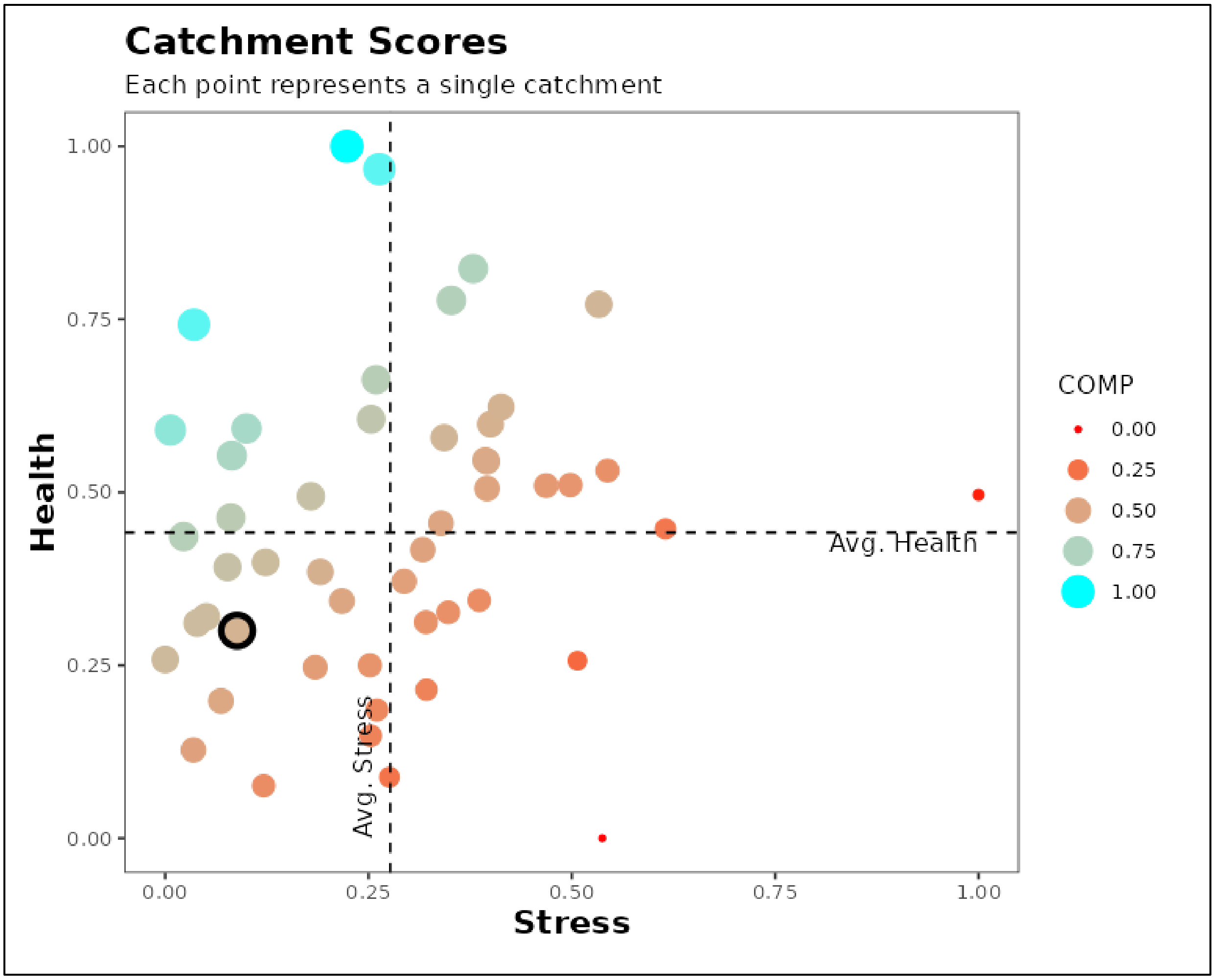


Figure 19: Catchment #202973328 in relation to the other catchments located within the Kleine Kill-Wallkill River Subwatershed.

Catchment Ecological Health Score (0.30):

An ecological health score of 0.30 suggests that the assessed ecosystem is moderately healthy but has room for improvement as this score is below the midpoint. This score indicates that the area exhibits some positive ecological characteristics. However, there are also noticeable stressors or challenges that may be affecting its overall health. The following indicators contributed the most to the ecological health score:

Natural Areas: The presence of a high percentage of natural areas in the catchment is another positive sign. Natural areas typically include undisturbed habitats that support biodiversity.

Canopy Cover: The presence of a relatively healthy canopy cover is a positive sign. It indicates that there's a substantial amount of vegetation in this area. This vegetation helps protect water quality by intercepting pollutants, sequestering carbon, and providing habitat for various species.

Catchment Ecological Stress Score (0.09):

An ecological stress score of 0.09 indicates a relatively low level of ecological stress in the assessed area. This score suggests that the ecosystem is experiencing minimal environmental pressures or disturbances that could negatively impact its health and functionality. It implies that the area is relatively free from environmental stressors, therefore, conservation efforts may be the best fit. The following indicators contributed the most to the ecological stress score:

Topographic Wetness Index: A substantial score in this indicator points to areas where water accumulates and flows as sheets, potentially leading to erosion and water-related issues. This adds to the overall ecological stress in the focus area.

Landscape Condition Assessment: A high score in this indicator suggests that the landscape condition of the focus area might be compromised. It implies there are stressors related to land use and development, which can adversely impact the environment.

Flood Zone:
This focus area is not situated within a FEMA Flood Zone. This designation implies a lower risk of substantial flooding at the site. The major water body within this catchment is a tributary to the Platte Kill, a tributary to the Wallkill River.

DEC Water Quality Classification:
The stream within this catchment is classified as "B(t) Recreation/Trout" is characterized by its suitability for recreational activities, particularly those related to trout fishing.

EPA Water Quality Designation:
The waterbody within this catchment is classified as unassessed.

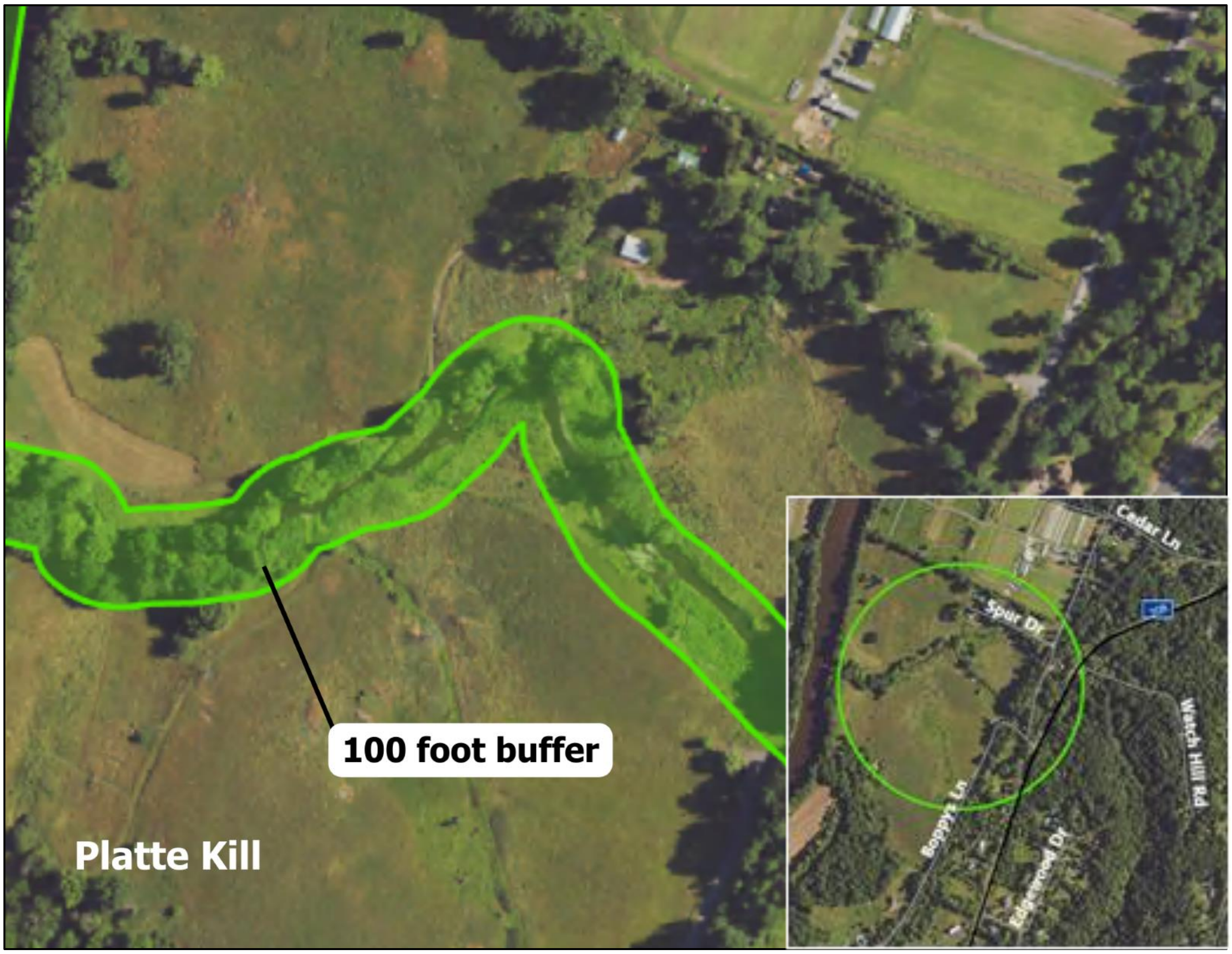
Stakeholder Input:

This catchment was recommended by stakeholders due to current and future development pressures that could have potential effects on the ecological health and functioning of the area.

FINAL RESTORATION FOCUS AREA PROFILES

The restoration focus profiles encompass critical details about each area, including the catchment comprehensive score, ecological health score, and ecological stress score. Outside of the Riparian Opportunity Assessment data, we also utilized data for the FEMA Flood Zone classification, soil type, hydrologic soil group, land cover, DEC water quality classification, EPA water quality designations, and surficial geology. This comprehensive information forms the foundation for informed decision-making in developing effective restoration strategies. The ecological health scores identify potential strengths, while the ecological stress score highlights potential stressors. FEMA Flood Zone status aids in planning for flood resilience. Soil type and hydrologic soil group help determine water retention and drainage capabilities. Land cover indicates current land use, and surficial geology provides insights into geological influences. The DEC water quality classification informs about current water usage, while the EPA water quality designation gives insight into waterbody conditions and potential issues that may be contributing to water quality degradation. Together, this data guides tailored restoration actions, ensuring resources are allocated efficiently for maximum ecological and water quality benefits.

Restoration Focus Area B:



Focus area B is located within the Kleine Kill-Wallkill River Subwatershed. More specifically, it is a part of the Platte Kill Brook, located in the southeastern quadrant of New Paltz.

Catchment Comprehensive Score (-0.25):
This focus area is located within a catchment with a comprehensive score of -0.25, in a scale that ranges from -1 (low) to 1 (high). This catchment falls into the lower end of the scale, indicating that it is in relatively poor overall ecological condition. This score suggests that the stream faces challenges and may benefit from restoration or conservation efforts.
The Comprehensive score is calculated by subtracting the Ecological Stress Score,0.51 , from the Ecological Health Score, 0.26.

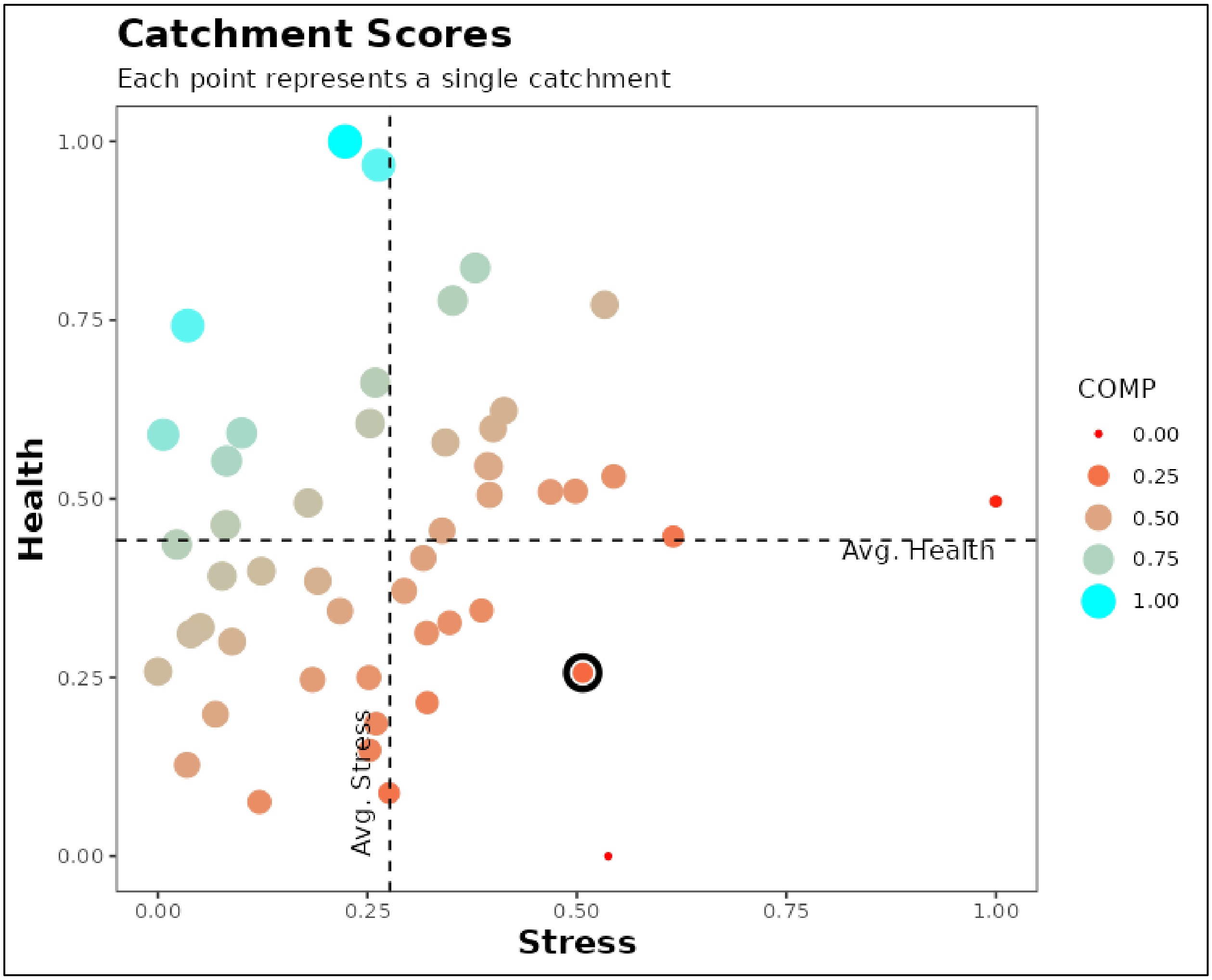


Figure 20: Catchment #202973297 in relation to the other catchments located within the the Kleine Kill-Wallkill River Subwatershed.

Catchment Ecological Health Score (0.26):
A score of 0.26 implies a relatively moderate level of ecological health in the catchment. While it falls within the range of 0 (low) to 1 (high), this score suggests that the riparian area has some positive ecological attributes but also room for improvement. The following indicators contributed the most to the ecological health score:

Biological Assessment Profile (BAP): A high score in BAP is indicates that there was a rich diversity of freshwater insects at the closest sampling point to this catchment, indicating good water quality and a healthy instream ecosystem nearby. This is a positive contributor to the focus area's ecological health score.

Natural Areas: The presence of a high percentage of natural areas in the catchment is another positive sign. Natural areas typically include undisturbed habitats that support biodiversity.

Catchment Ecological Stress Score (0.51):
The ecological stress score, with a value of 0.51, is relatively high in the range from 0 (low) to 1 (high). This score indicates that the catchment is experiencing substantial ecological stressors.

The following indicators contributed the most to the ecological stress score:

Landscape Condition Assessment: A high score in this indicator suggests that the landscape condition of the focus area might be compromised. It implies there are stressors related to land use and development, which can adversely impact the environment.

Dam Storage Ratio: This indicator estimates how much of each river's mean annual flow was potentially stored by upstream impoundments. A high score indicates a higher risk of flow disruption which can be detrimental to the natural flow of streams and rivers. The DEC Environmental Resource mapper shows three dams in the area upstream of this catchment, which may have affected this score.

Topographic Wetness Index: A substantial score in this indicator points to areas where water accumulates and flows as sheets, potentially leading to erosion and water-related issues. This adds to the overall ecological stress in the focus area.

Flood Zone:
Focus area B is located within a Special Flood Hazard Area (SFHA). This designation signifies that this particular region is susceptible to flooding, which is often associated with high-risk flood events. While SFHAs are inherently prone to flooding, they also play a pivotal role in natural flood regulation, risk reduction and water quality maintenance. Prioritizing the restoration of riparian buffers within SFHAs can enhance the area's resilience to floods, improve water quality, and protect against potential flood-related risks.

Additionally, SFHAs are often areas where human communities are at a higher risk of flooding, thus prioritizing riparian buffer restoration here not only benefits the environment but also enhances community resilience. By mitigating flooding impacts and safeguarding water quality, well-maintained riparian buffers in SFHAs can help reduce damage to infrastructure, protect homes, and ensure the safety of residents during flood events. This dual benefit of ecological and human well-being underscores the importance of selecting SFHAs as priority focus areas for riparian buffer restoration efforts, aligning conservation objectives with the broader goal of disaster risk reduction and community protection in flood-prone regions.

Soil Type:
There are 3 soil classifications that make up the circled area of Focus Area B:

The BnC, or Bath-Nassau complex, is characterized by soils that are well-drained and composed primarily of loam, silt, clay, and gravel. These soils exhibit moderate fertility and possess good tilth, making them versatile for various land uses. Typically found on landscapes with slopes ranging from 8 to 25 percent, the moderate slope of the Bath-Nassau complex offers effective drainage while retaining adequate moisture for vegetation, rendering it adaptable for a range of purposes. These soils exhibit a balanced water-holding capacity, retaining enough moisture to support plant life during drier periods while ensuring proper drainage to prevent waterlogging. Consequently, the Bath-Nassau complex is well-suited for agricultural and horticultural activities as well as residential development, owing to its moderate slope and optimal water characteristics that facilitate both effective rainwater drainage and diverse land utilization.

Madalin silty clay loam is primarily composed of fine-textured soils, with a significant proportion of silty clay. These soils are exceptionally fertile and excel in retaining essential nutrients.

Typically found on nearly level to gently sloping landscapes, with slopes ranging from 0 to 3 percent, the terrain featuring Madalin silty clay loam is characterized by a flat to gently rolling topography. Thanks to their fine texture, these soils possess a high water-holding capacity, effectively retaining moisture and accommodating a wide range of vegetation. Their drainage characteristics strike a balance between moisture retention and efficient drainage, making them versatile for various land uses. Madalin silty clay loam is commonly employed in agriculture, including the cultivation of grains, vegetables, and forage crops. Additionally, these soils are well-suited for residential and urban development, offering a stable foundation and fertile properties conducive to diverse land utilization.

The following soil type can be found surrounding the Madalin soil, located directly above the horseshoe curve.

Hoosic gravelly loam, characterized by its coarse-textured soils rich in gravel and mixed with loam, exhibits relatively low water-holding capacity. Typically found on moderately steep slopes ranging from 15 to 25 percent, the terrain featuring Hoosic gravelly loam is marked by pronounced inclines. These soils, owing to their coarse texture, possess limited moisture retention capabilities but compensate with excellent drainage, effectively preventing waterlogging and promoting rapid runoff. While Hoosic gravelly loam is less suitable for traditional agriculture due to its texture and steep slopes, it finds value in specific applications such as cultivating specialty crops, supporting forestry, or serving as pastureland. Additionally, this soil type may be well-suited for recreational or conservation purposes that leverage the unique characteristics of the landscape.

In summary, the suitability of these soil types for riparian buffer restoration varies based on their characteristics. Bath-Nassau Complex and Mandalin Silty Clay Loam are well-suited due to their moderate slopes, water-holding capacity, and fertility. Hoosic Gravelly Loam presents challenges but could still find use in specific buffer applications with appropriate planning and management.

Hydrologic Soil Group:
Focus Area B is composed primarily of Hydrologic Soil Groups C and D. Soils categorized under Group C have moderate infiltration rates and typically consist of moderately fine-textured soils. They can absorb water at a moderate pace, making them somewhat suitable for riparian buffer applications. However, they might not be as effective at slowing down and retaining water as Group A or B soils, which have better infiltration rates.

Group D soils, on the other hand, have low infiltration rates and usually consist of fine-textured soils like clays. These soils tend to become quickly saturated, leading to surface runoff rather than infiltration. In a riparian buffer context, Group D soils can pose challenges as they may not effectively capture and slow down stormwater runoff. Instead, water could flow over the surface, potentially carrying sediment and pollutants into water bodies.

Therefore, a focus area dominated by Hydrologic Soil Groups C and D suggests that careful consideration is needed when planning riparian buffer restoration. Buffer designs should account for the soil's water infiltration characteristics, and additional measures might be necessary to ensure the buffer effectively filters and manages runoff.

Surficial Geology:

Focus Area B is located in an area with surficial geology characterized by lacustrine silt and clay, as well as till deposits, it signifies a unique geological context that has a substantial influence on the hydrology and ecological dynamics of the riparian zone.
Lacustrine silt and clay deposits typically indicate the historical presence of a lake or large, slow-moving body of water in the region. These fine-textured sediments are often associated with water-retaining properties, which can affect groundwater flow patterns and soil moisture levels. In such areas, water may be more prone to pooling, leading to potentially waterlogged conditions.

The presence of till deposits in the focus area indicates the legacy of glacial activity, as till is a mixture of clay, silt, sand, and gravel that glaciers deposited as they advanced and retreated. Tills often have good drainage characteristics due to their mix of particle sizes, which allows water to infiltrate more readily compared to finer-textured soils. This geological aspect can affect the availability of water and nutrients in the riparian zone and may influence the choice of plant species and restoration methods to optimize ecosystem recovery.

Land Cover:
The land use/land cover map data indicates that is area is Hay and pasture. Hay and Pasture lands are often associated with agricultural activities, typically the grazing of livestock or cultivation of forage crops like grasses.

The presence of hay or pasture land in a focus area suggests that the surrounding landscape is subject to activities that could impact water quality and the health of riparian ecosystems. Livestock grazing, in particular, can lead to issues such as soil compaction, increased nutrient loading from manure, and the trampling of streambanks. These activities can contribute to sedimentation and nutrient runoff into nearby water bodies, leading to water quality degradation.

In the context of riparian buffer restoration, addressing the effects of hay or pasture land cover involves designing buffers that effectively mitigate these impacts. This may include planting vegetation that can filter pollutants from runoff, stabilizing eroding streambanks, and controlling nutrient inputs. Additionally, engagement with landowners and agricultural stakeholders is crucial to promote sustainable land management practices that reduce the environmental footprint of hay and pasture operations while supporting agricultural livelihoods. Ultimately, restoring riparian buffers in areas with hay or pasture land cover is a targeted effort to enhance both water quality and the ecological health of these vital ecosystems.

DEC Water Quality Classification:
The stream within Focus Area B is classified as "B(t) Recreation/Trout" is characterized by its suitability for recreational activities, particularly those related to trout fishing.

EPA Water Quality Classification:
The stream within Focus Area B is classified as unassessed.

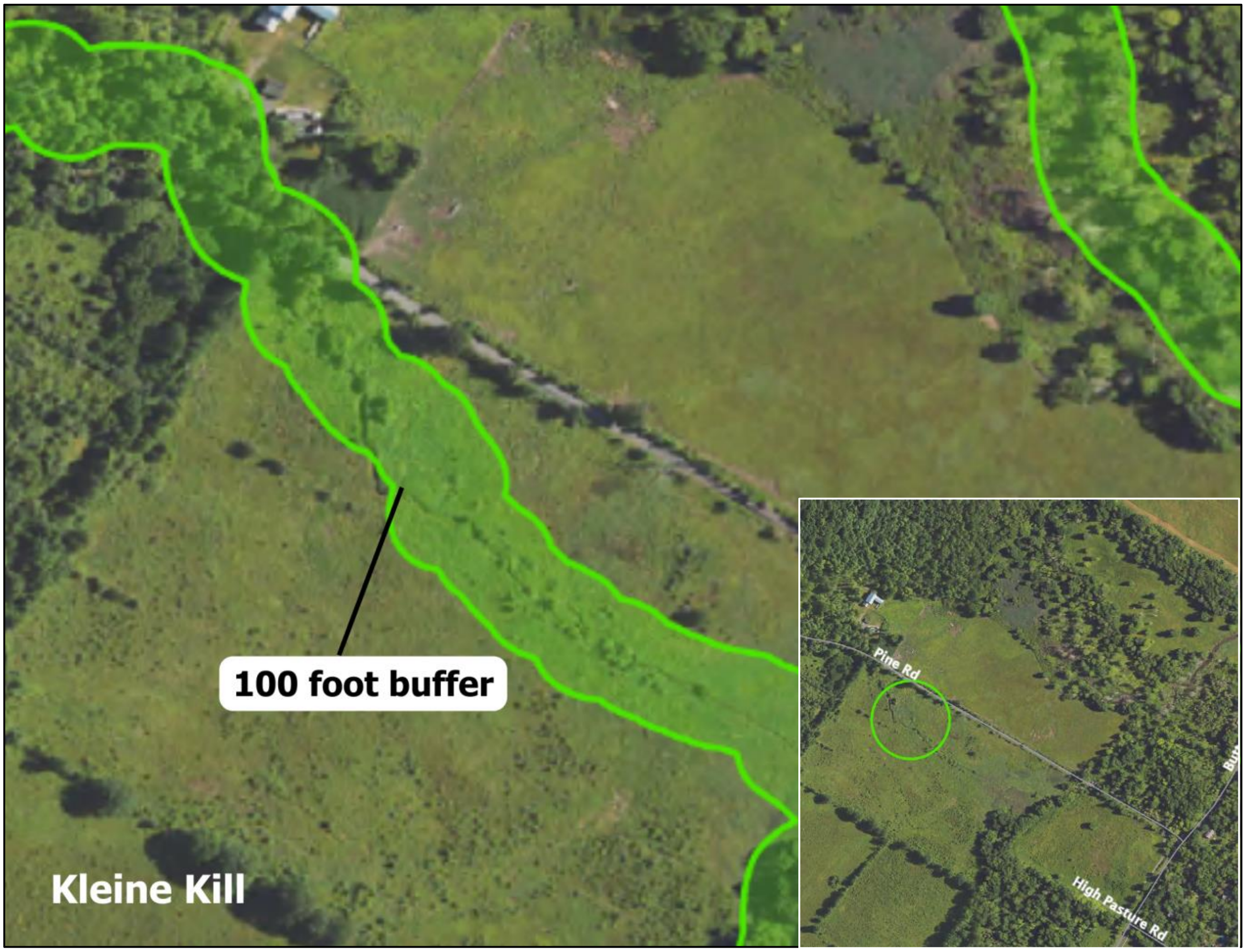
Stakeholder Input:
The following information was collected through stakeholder meetings and surveys:

Multiple stakeholders identified the Plattekill Brook in New Paltz as a tributary with relatively minimal disturbances but a degraded riparian zone, particularly in its lower stretch. This location holds recognition due to its exposure from a Wallkill Valley Rail Trail bridge, offering an iconic view of the Mohonk Skytop Tower in the backdrop. Many local residents are familiar with this spot and its scenic view.

There is a proposal to enhance this area with riparian restoration efforts, suggesting the potential installation of an interpretive sign on the Rail Trail bridge. This sign would serve as a means of public education, raising awareness about the significance of riparian vegetation and restoration projects. Furthermore, this location is deemed suitable for a buffer due to its susceptibility to erosion, and it's notable that the proposed buffer wouldn't obstruct the popular view enjoyed by the masses.

Stakeholders emphasized that cooperation and compromise with local farmers, given the agricultural nature of the land, would be central in implementing such a buffer. Additionally, this property has been designated as a high-priority area for preservation by the Town, OSI (Open Space Institute), and WVLT (Wallkill Valley Land Trust). This underscores the shared commitment to protecting and enhancing the ecological and scenic value of this location.

Restoration Focus Area C:



Focus area C is located within the Kleine Kill-Wallkill River Subwatershed. More specifically, it is located along the Kleine Kill, located in the southwestern quadrant of New Paltz.

Catchment Comprehensive Score (0.27):
The comprehensive score for this focus area's catchment is 0.27, indicating a relatively favorable overall ecological condition. This score falls slightly above the midpoint in the range from -1 to 1. It suggests that, overall, the ecological condition of this focus area is fairly balanced, with some room for improvement.

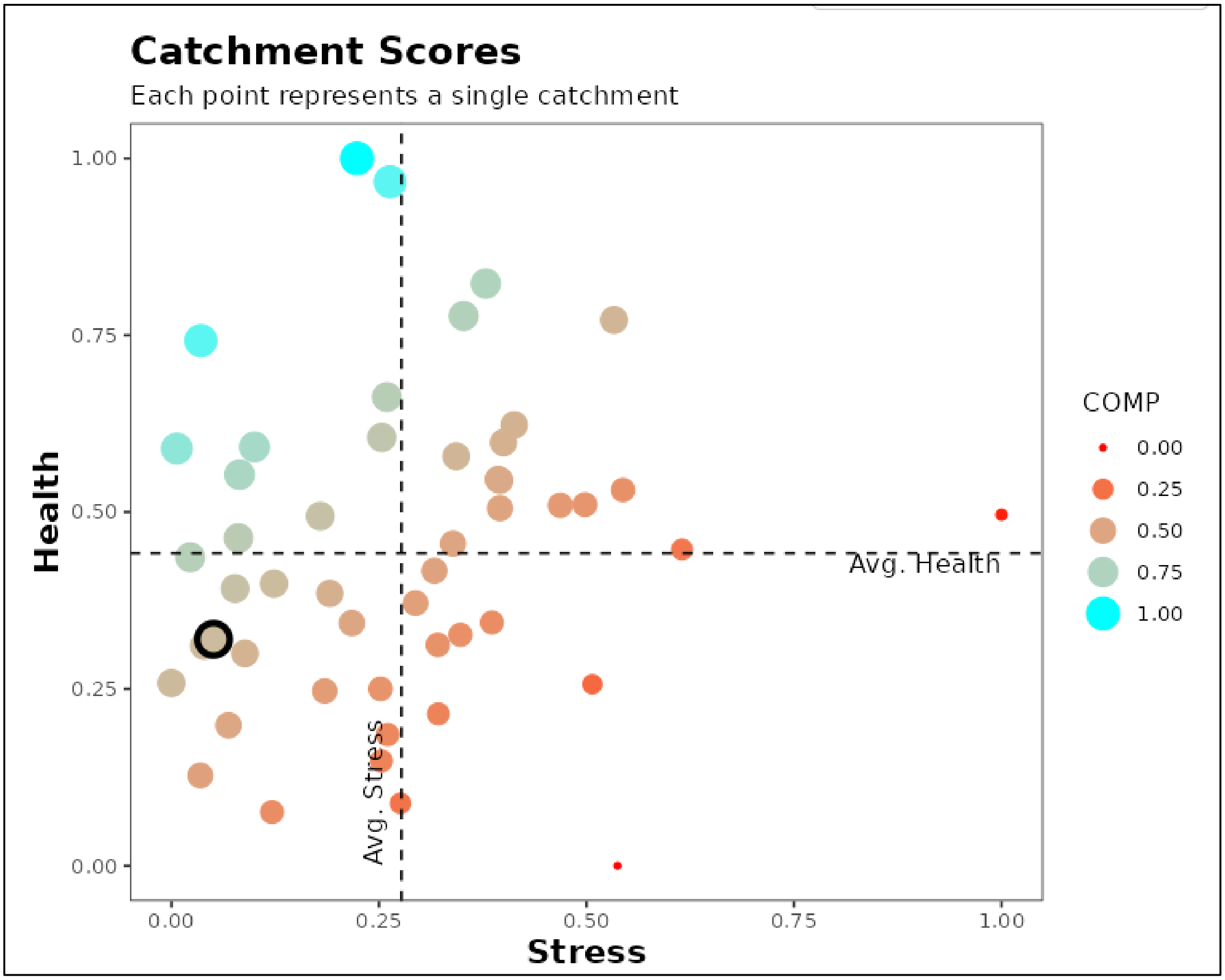


Figure 21: Catchment #202972706 in relation to the other catchments located within the Kleine Kill-Wallkill River Subwatershed.

Catchment Ecological Health Score (0.32):
With an ecological health score of 0.32, this catchment demonstrates a moderate to good level of ecological health. The score is above the midpoint, indicating a relatively healthy ecosystem in this focus area. A score of .32 suggests that the area has some positive ecological attributes. The following indicators contributed the most to the ecological health score:

Brook Trout: A significant score in this indicator is a promising sign. It suggests that a portion of the focus area's catchment is occupied by Brook Trout, which are indicators of healthy stream habitats. Their presence often signifies good water quality.

Canopy Cover: High canopy cover is beneficial as it indicates that the area has a dense tree canopy. This not only provides shade to streams, maintaining cooler water temperatures, but also offers habitat for various species.

Natural Areas: The presence of natural areas indicates that there are undisturbed habitats within the focus area. These areas can support diverse flora and fauna, contributing to the overall ecological health.

Catchment Ecological Stress Score (0.05):
The ecological stress score of 0.05 indicates relatively low ecological stressors within the catchment. In essence, the ecosystem in this area is experiencing fewer disturbances or pressures. The following indicators contributed the most to the ecological stress score:

Erosion Index: A high score in this category indicates a greater risk of erosion. Erosion can lead to sedimentation in water bodies, impacting riparian habitat and water quality.

Topographic Wetness Index: A substantial score in this indicator points to areas where water accumulates and flows as sheets, potentially leading to erosion and water-related issues. This adds to the overall ecological stress in the focus area.

Flood Zone:
This focus area is not situated within a FEMA Flood Zone. This designation implies a lower risk of substantial flooding at the site, but because it is a smaller stream enhancing the riparian buffer could help reduce the amount of water that moves quickly downstream.

Soil Type:
The presence of Churchville silt loam (CvA) soils in the riparian buffer area signifies favorable conditions for riparian vegetation and, by extension, the effectiveness of riparian buffers. These soils are composed of fine-textured, silty materials with fertility. Their water-holding capacity, combined with their nearly level to gently sloping landscape, makes them ideal for supporting diverse plant life along the riparian zone. Their ability to retain moisture over extended periods ensures a consistent water source for vegetation. Additionally, the drainage characteristics prevent waterlogging, which can be detrimental to plant growth. Churchville silt loam soils are generally well-suited for riparian buffer restoration, offering a foundation for planting and maintaining riparian vegetation that can effectively filter pollutants, reduce erosion, and enhance water quality in the adjacent water bodies.

Mandalin silty clay loam (Ma) soils are primarily composed of fine-textured materials. They are also typically found on nearly level to gently sloping landscapes, aligning with the slope conditions for buffer planting and maintenance. The high water-holding capacity of Mandalin silty clay loam soils ensures a reliable moisture source for riparian vegetation, contributing to the overall health and vitality of the buffer zone. While their drainage characteristics strike a balance between moisture retention and effective drainage, they provide an environment conducive to various plant species. Mandalin silty clay loam soils offer an solid foundation for riparian buffer restoration, where the goal is to establish and sustain vegetation that can significantly contribute to water quality improvement, habitat enhancement, and erosion control along the water's edge.

Hydrologic Soil Group:
Focus Area C is composed of hydrologic soil group D, mainly consisting of clay loam, silty clay loam, sandy clay, silty clay or clay. This group has the highest runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface and shallow soils over nearly impervious material.

Surficial Geology:
Focus Area C is located in an area with surficial geology characterized by lacustrine silt and clay. These deposits typically indicate the historical presence of a lake or large, slow-moving body of water in the region. These fine-textured sediments are often associated with water-retaining properties, which can affect groundwater flow patterns and soil moisture levels. In such areas, water may be more prone to pooling, leading to potentially waterlogged conditions.

Land Cover:
The land use/land cover map data indicates that is area is Hay and pasture. Hay and Pasture lands are often associated with agricultural activities, typically the grazing of livestock or cultivation of forage crops like grasses.

The presence of hay or pasture land in a focus area suggests that the surrounding landscape is subject to activities that could impact water quality and the health of riparian ecosystems. Livestock grazing, in particular, can lead to issues such as soil compaction, increased nutrient loading from manure, and the trampling of streambanks. These activities can contribute to sedimentation and nutrient runoff into nearby water bodies, leading to water quality degradation.

In the context of riparian buffer restoration, addressing the effects of hay or pasture land cover involves designing buffers that effectively mitigate these impacts. This may include planting vegetation that can filter pollutants from runoff, stabilizing eroding streambanks, and controlling nutrient inputs. Additionally, engagement with landowners and agricultural stakeholders is crucial to promote sustainable land management practices that reduce the environmental footprint of hay and pasture operations while supporting agricultural livelihoods. Ultimately, restoring riparian buffers in areas with hay or pasture land cover is a targeted effort to enhance both water quality and the ecological health of these vital ecosystems.

DEC Water Quality Classification:
The DEC water quality classification for this area is C, signifying that the designated best use is non-contact uses such as fishing.

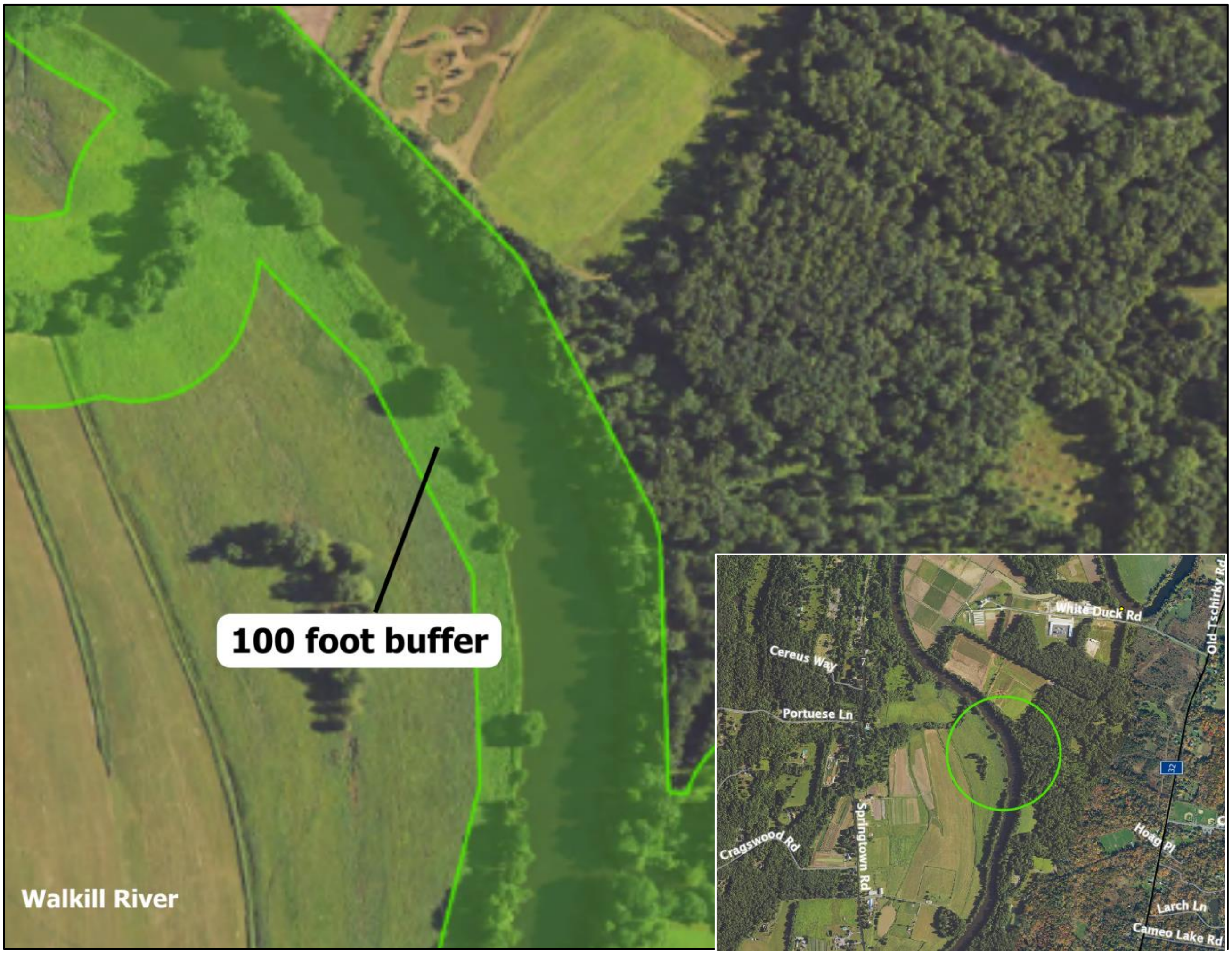
EPA Water Quality Designation:
The stream within Focus Area C is classified as unassessed.

Stakeholder Input:
The following information was collected through stakeholder meetings and surveys:

One prominent concern raised by stakeholders is the preservation of scenic views, which is a significant factor in the selection of buffer restoration sites. To address this concern, some stakeholders suggested a balanced approach that reinforces existing buffers where at least 50% of the area is already forested. This approach ensures that no additional views are obstructed while enhancing the ecological functionality of existing buffers. It demonstrates a collaborative effort to harmonize conservation goals with community aesthetics, demonstrating sensitivity to local perspectives.

Furthermore, stakeholders have highlighted the accessibility and predominantly agricultural nature of the area, emphasizing the potential for productive partnerships with non-profit landowners such as Mohonk Preserve.

Restoration Focus Area E:



Focus area E is located within the Swarte Kill-Wallkill River Subwatershed. More specifically, it is located along the Wallkill River, located in the Northwestern quadrant of New Paltz.

Catchment Comprehensive Score (0.40):
This score is slightly above the midpoint in the range from -1 to 1. It suggests that the overall ecological condition of this focus area is fairly balanced, with some positive aspects.

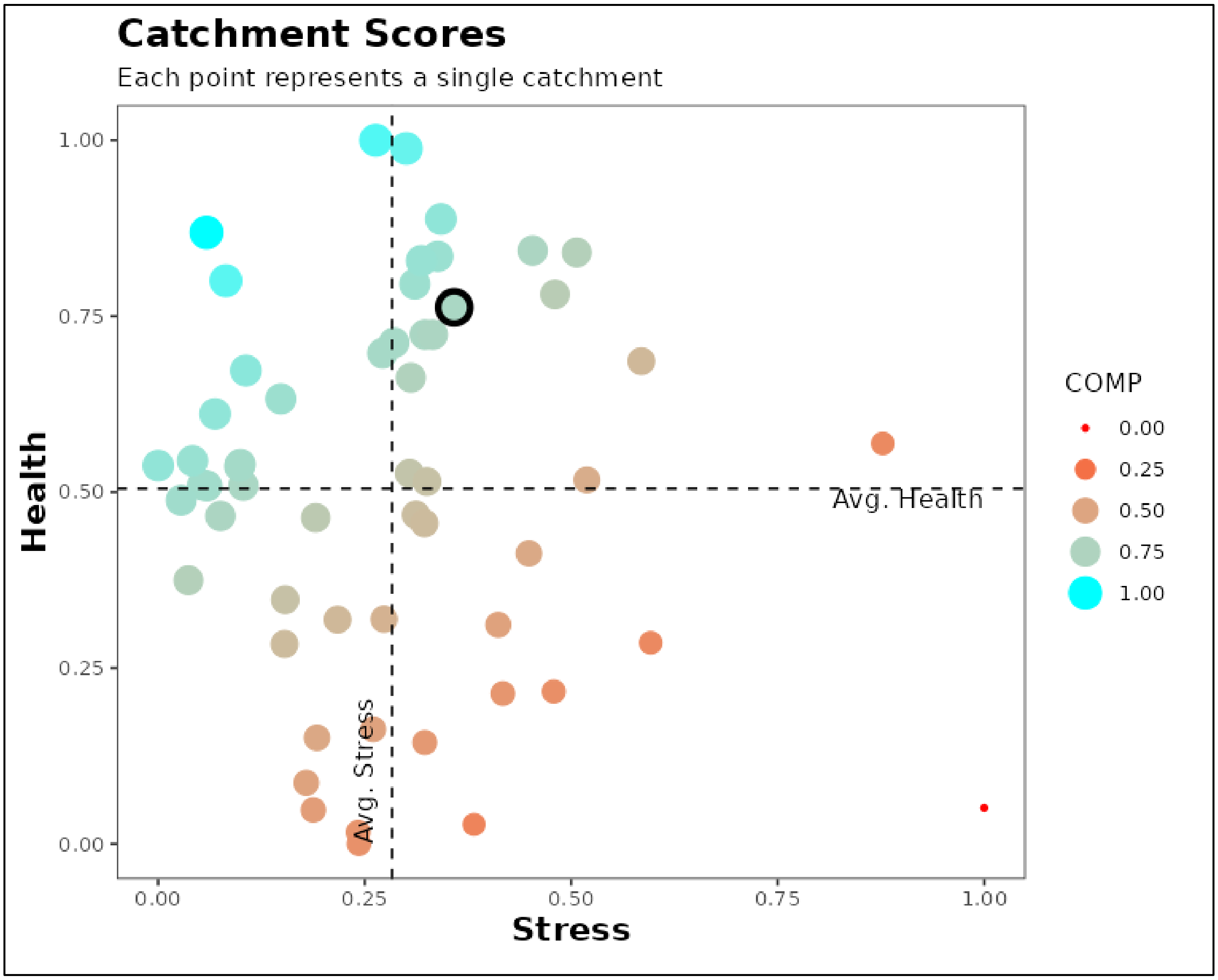


Figure 22: Catchment #202971598 in relation to the other catchments located within the Swarte Kill-Wallkill River Subwatershed.

Catchment Ecological Health Score (0.76):
The ecological health score is notably above the midpoint, indicating a robust and healthy ecosystem. A score of .76 signifies that this area possesses several strong ecological attributes. The following indicators contributed the most to the ecological health score:

Native Fish Richness: A high score here implies that the focus area is home to a rich diversity of native fish species. Native fish are often considered indicators of good water quality and a healthy aquatic ecosystem.

Floodplain Complex: The presence of a floodplain complex is another positive sign. Floodplain complexes describe larger natural upland and wetland patches along streams. They indicate good vegetative and riparian connectivity.

Natural Areas: The presence of natural areas indicates that there are undisturbed habitats within the focus area. These areas can support diverse flora and fauna, contributing to the overall ecological health.

Catchment Ecological Stress Score (0.36):
The stress score is also above the midpoint, indicating the presence of some ecological stressors. However, it's not excessively high, suggesting that these stressors may be manageable. The following indicators contributed the most to the ecological stress score:
Dam Storage Ratio: This indicator estimates how much of each river’s mean annual flow was potentially stored by upstream impoundments. A high score indicates a higher risk of flow disruption which can be detrimental to the natural flow of streams and rivers.

Topographic Wetness Index: A substantial score in this indicator points to areas where water accumulates and flows as sheets, potentially leading to erosion and water-related issues. This adds to the overall ecological stress in the focus area.

Flood Zone:
Focus area E is located within a SFHA. This designation signifies that this particular region is susceptible to flooding, which is often associated with high-risk flood events. While SFHAs are inherently prone to flooding, they also play a pivotal role in natural flood regulation, risk reduction and water quality maintenance. Prioritizing the restoration of riparian buffers within SFHAs can enhance the area’s resilience to floods, improve water quality, and protect against potential flood-related risks.

Additionally, SFHAs are often areas where human communities are at a higher risk of flooding, thus prioritizing riparian buffer restoration here not only benefits the environment but also enhances community resilience. By mitigating flooding impacts and safeguarding water quality, well-maintained riparian buffers in SFHAs can help reduce damage to infrastructure, protect homes, and ensure the safety of residents during flood events. This dual benefit of ecological and human well-being underscores the importance of selecting SFHAs as priority focus areas for riparian buffer restoration efforts, aligning conservation objectives with the broader goal of disaster risk reduction and community protection in flood-prone regions.

Soil Type:
Teel silt loam, composed of fine-textured soils with moderate water-holding capacity and drainage characteristics, presents favorable conditions for riparian buffers. This soil type can effectively support a variety of vegetation commonly used in buffer restoration projects, ensuring adequate moisture retention without the risk of waterlogging. Its versatile nature extends to agricultural and residential land uses, making it well-suited for buffer projects that harmonize with existing land activities while contributing to ecological improvement.

Wayland silt loam, primarily consisting of fine-textured soils with moderate water-holding capacity and drainage properties, also provides conducive conditions for riparian buffer initiatives. These soils can support a range of vegetation typically employed in buffer restoration, facilitating moisture retention without the concern of excessive water accumulation. Their adaptability extends to agricultural purposes and residential development, emphasizing the potential for buffer projects that complement prevailing land uses while delivering ecological enhancements.

Hydrologic Soil Group:

Focus Area E is primarily composed of the soil groups C/D and B, which signifies a mixed soil composition with varying water infiltration capabilities. Soil group C is composed of sandy clay loam. They have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine structure. Soil group D is composed of clay loam, silty clay loam, sandy clay, silty clay or clay. This HSG has the highest runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface and shallow soils over nearly impervious material.

Soil group C/D indicates that these soils may have a seasonal high water table within 60 centimeters (24 inches) of the surface, making them potentially wet or poorly drained under natural conditions. However, if adequately drained, they can perform similarly to soils in group C regarding water infiltration.

Soil group B, on the other hand, is made up of silt loam or loam. It has a moderate infiltration rate when thoroughly wetted and consists chiefly or moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures.

This diversity in soil conditions suggests that riparian buffer restoration should consider both adequate drainage measures and suitable vegetation to optimize water management and ecological functions in this dynamic landscape.

Surficial Geology:
Focus Area E has recent deposits as the surficial geology classification. This indicates that the area has relatively new sedimentary layers on the surface. These deposits are typically composed of loose and unconsolidated materials like sand, silt, clay, gravel, or a mixture of these. Recent deposits suggest a landscape that has experienced recent geological activity, such as sediment deposition from water or wind processes, glaciation, or alluvial deposition. Since this focus area is located directly along the Wallkill River, it's location is likely the reason for this classification.

Land Cover:
The land use/land cover map data indicates that is area is Hay and pasture. Hay and Pasture lands are often associated with agricultural activities, typically the grazing of livestock or cultivation of forage crops like grasses.

The presence of hay or pasture land in a focus area suggests that the surrounding landscape is subject to activities that could impact water quality and the health of riparian ecosystems. Livestock grazing, in particular, can lead to issues such as soil compaction, increased nutrient loading from manure, and the trampling of streambanks. These activities can contribute to sedimentation and nutrient runoff into nearby water bodies, leading to water quality degradation.

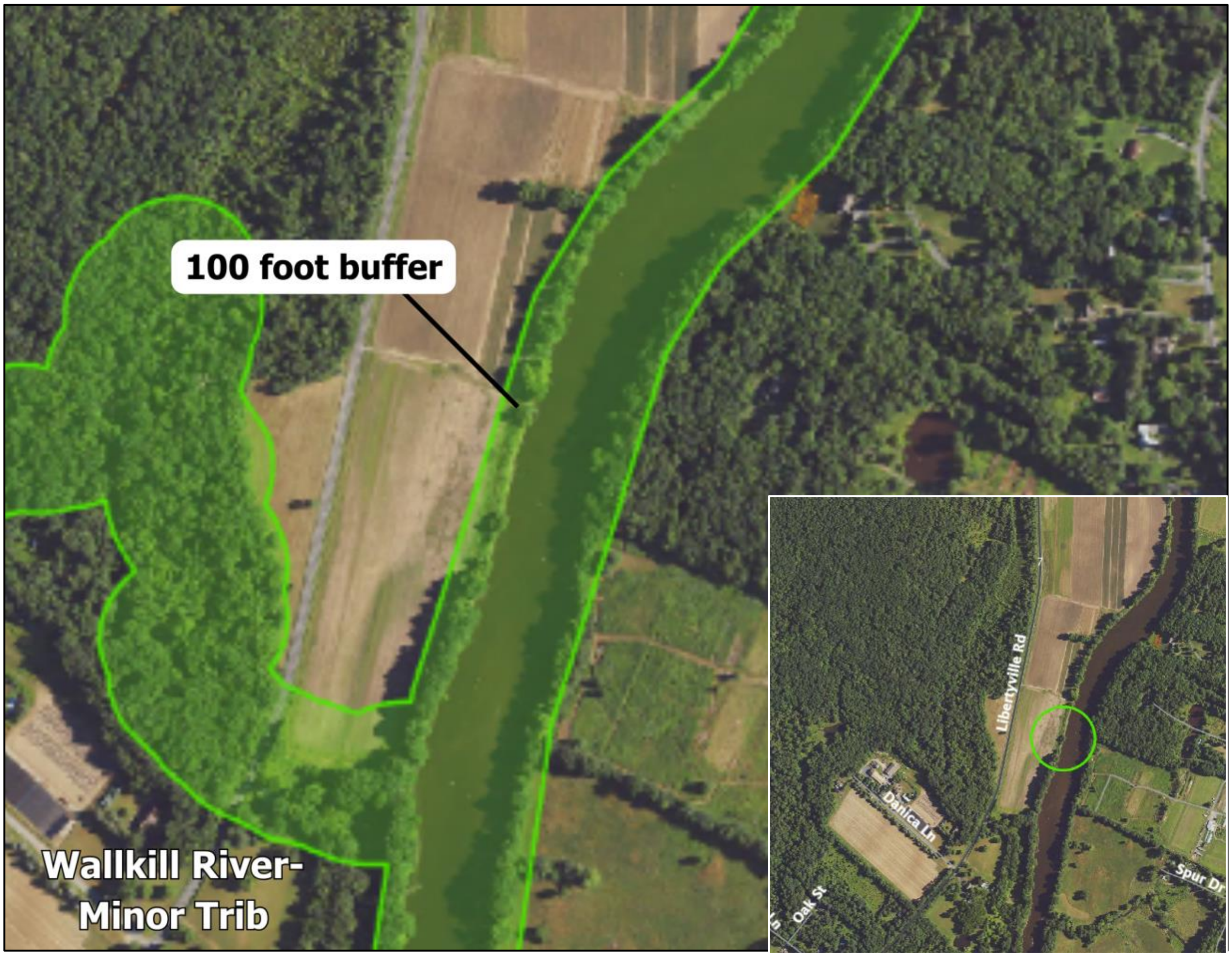
In the context of riparian buffer restoration, addressing the effects of hay or pasture land cover involves designing buffers that effectively mitigate these impacts. This may include planting vegetation that can filter pollutants from runoff, stabilizing eroding streambanks, and controlling nutrient inputs. Additionally, engagement with landowners and agricultural stakeholders is crucial to promote sustainable land management practices that reduce the environmental footprint of hay and pasture operations while supporting agricultural livelihoods. Ultimately, restoring riparian buffers in areas with hay or pasture land cover is a targeted effort to enhance both water quality and the ecological health of these vital ecosystems.

DEC Water Quality Classification:
The stream within Focus Area E is classified as B and is characterized by its suitability for recreational activities.

EPA Water Quality Designation:
The waterbody within Focus Area E is classified as impaired/polluted.

Stakeholder Input:
The following information was collected through stakeholder meetings and surveys:

Restoration Focus Area F:



Focus area F is located within the Kleine Kill-Wallkill River Subwatershed. More specifically, it is located along the Wallkill River, located in the southwestern quadrant of New Paltz.

Catchment Comprehensive Score (0.24):
This score falls below the midpoint in the range from -1 to 1. It suggests that the overall ecological condition of this focus area is leaning slightly towards the negative side. While it's not severely distressed, there are may be concerns.

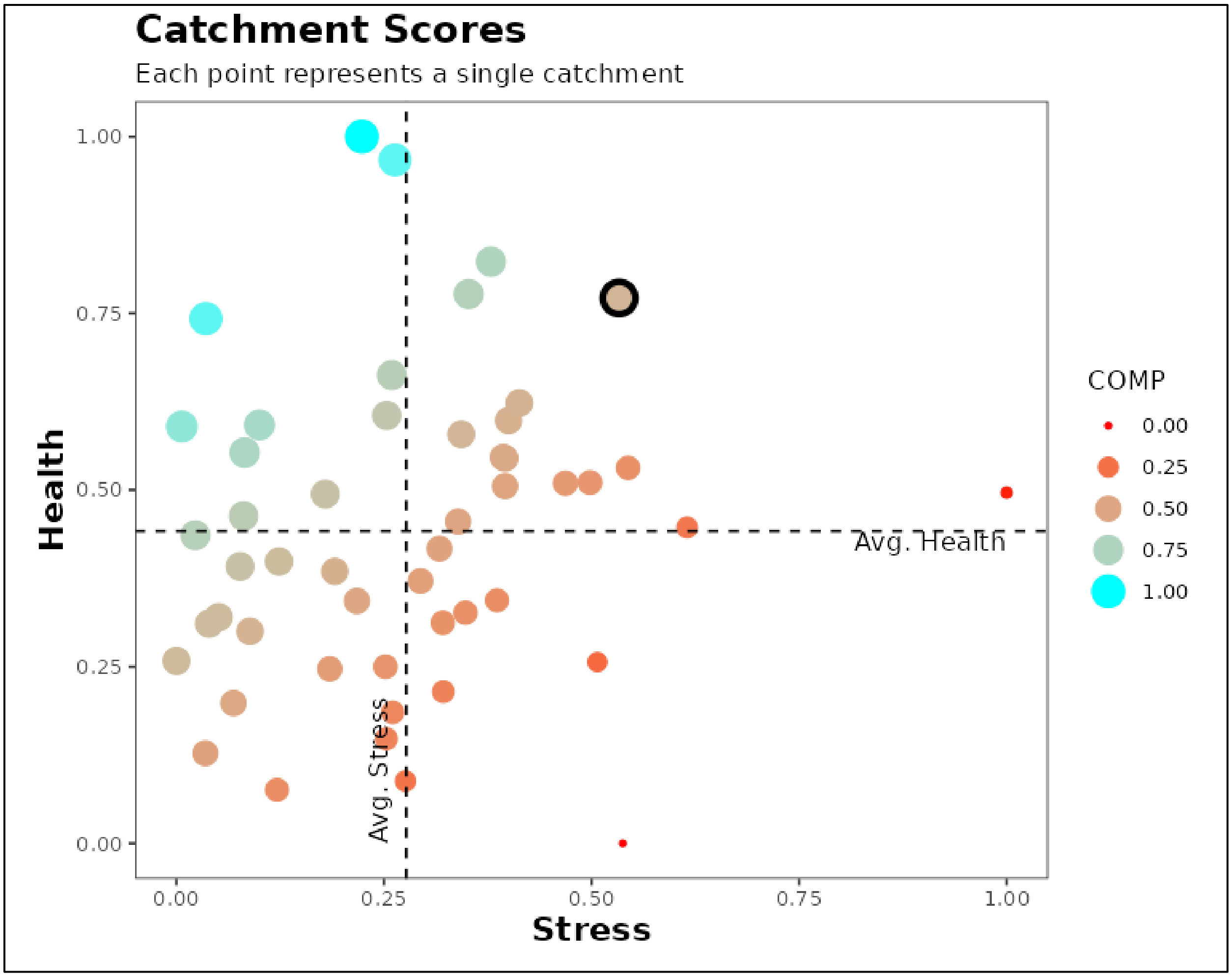


Figure 23: Catchment #202973163 in relation to the other catchments located within the Kleine Kill-Wallkill River Subwatershed.

Catchment Ecological Health Score (0.77):
The ecological health score is notably above the midpoint, indicating a very healthy ecosystem. A score of .77 implies that this area possesses numerous strong ecological attributes. The following indicators contributed the most to the ecological health score:

Biological Assessment Profile (BAP): A high score in BAP is indicates that there was a rich diversity of freshwater insects at the closest sampling point to this catchment, indicating good water quality and a healthy instream ecosystem nearby. This is a positive contributor to the focus area's ecological health score.

Ecological Significance: A strong score in ecological significance means that this area is home to rare species and high-quality habitats. The presence of rare species often indicates a healthy and biodiverse ecosystem.

Natural Areas: The presence of a high percentage of natural areas in the catchment is another positive sign. Natural areas typically include undisturbed habitats that support biodiversity.

Catchment Ecological Stress Score (0.53):

The stress score is also above the midpoint, suggesting the presence of several ecological stressors. This score indicates that these stressors are moderately impactful. The following indicators contributed the most to the ecological stress score:
Dam Storage Ratio: This indicator estimates how much of each river's mean annual flow was potentially stored by upstream impoundments. A high score indicates a higher risk of flow disruption which can be detrimental to the natural flow of streams and rivers.

Landscape Condition Assessment: A high score in this indicator suggests that the landscape condition of the focus area might be compromised. It implies there are stressors related to land use and development, which can adversely impact the environment.

Topographic Wetness Index: A substantial score in this indicator points to areas where water accumulates and flows as sheets, potentially leading to erosion and water-related issues. This adds to the overall ecological stress in the focus area.

Flood Zone:
Focus area F is located within a SFHA. This designation signifies that this particular region is susceptible to flooding, which is often associated with high-risk flood events. While SFHAs are inherently prone to flooding, they also play a pivotal role in natural flood regulation, risk reduction and water quality maintenance. Prioritizing the restoration of riparian buffers within SFHAs can enhance the area's resilience to floods, improve water quality, and protect against potential flood-related risks.

Additionally, SFHAs are often areas where human communities are at a higher risk of flooding, thus prioritizing riparian buffer restoration here not only benefits the environment but also enhances community resilience. By mitigating flooding impacts and safeguarding water quality, well-maintained riparian buffers in SFHAs can help reduce damage to infrastructure, protect homes, and ensure the safety of residents during flood events. This dual benefit of ecological and human well-being underscores the importance of selecting SFHAs as priority focus areas for riparian buffer restoration efforts, aligning conservation objectives with the broader goal of disaster risk reduction and community protection in flood-prone regions.

Soil Type:
Hamlin silt loam is composed of fine-textured soils containing silt, clay, and sand, known for their good nutrient retention. Typically found on gently sloping to nearly level landscapes (0-3% slope), these soils have a moderate to high water-holding capacity and adequate drainage, making them versatile for various land uses. Common applications include agriculture, including the cultivation of grains, soybeans, and hay, as well as suitability for residential and urban development due to their stable foundation and favorable properties for construction and landscaping.

Hydrologic Soil Group:
Focus Area F is classified as hydrologic soil group B, which is primarily composed of silt loam or loam. It has a moderate infiltration rate when thoroughly wetted and consists chiefly or moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures.

Surficial Geology:

Focus Area F has recent deposits as the surficial geology classification. This indicates that the area has relatively new sedimentary layers on the surface. These deposits are typically composed of loose and unconsolidated materials like sand, silt, clay, gravel, or a mixture of these. Recent deposits suggest a landscape that has experienced recent geological activity, such as sediment deposition from water or wind processes, glaciation, or alluvial deposition. This focus area is also located directly along the Wallkill River, therefore it's location is likely the reason for this classification.

Land Cover:
The land use/land cover map data indicates that is area is cultivated crops. This designation signifies the active use of the land for agriculture. Areas with this designation have crop vegetation that accounts for greater than 20% of total vegetation. This class includes all land being actively tilled.

Cultivated crops designation typically involves the regular cultivation of crops such as grains, vegetables, or other agricultural produce. This land use implies the potential for agricultural runoff, which may include sediment and nutrient inputs into nearby water bodies, potentially affecting water quality and riparian ecosystem health.

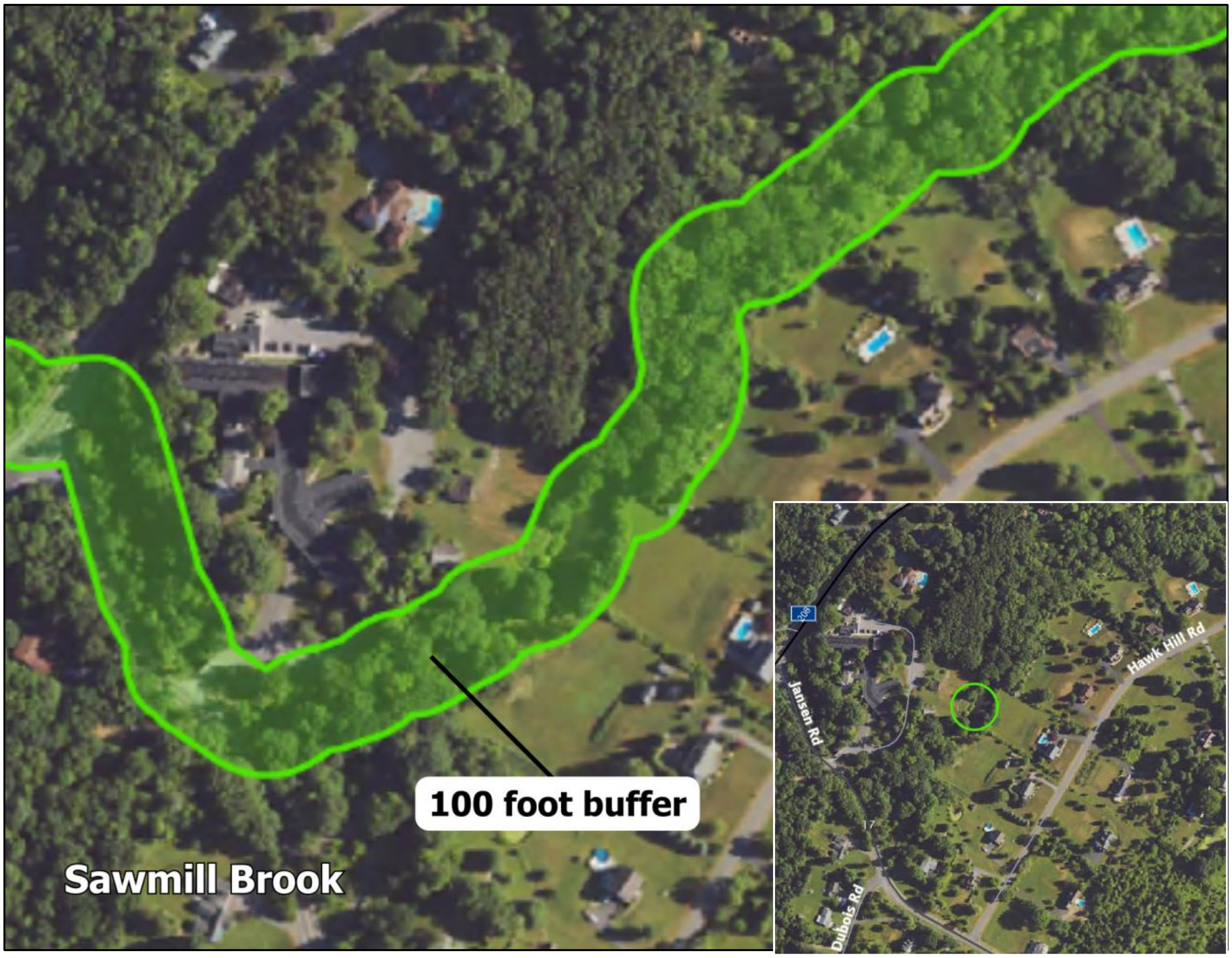
DEC Water Quality Classification:
The stream within Focus Area F is classified as B and is characterized by its suitability for recreational activities.

EPA Water Quality Classification:
The waterbody within Focus Area F is classified as impaired/polluted.

Stakeholder Input:
The following information was collected through stakeholder meetings and surveys:

Stakeholder input highlights the accessibility and potential effectiveness of utilizing the riparian area as a farmland buffer. The accessibility factor implies that this option could be readily implemented and managed. Moreover, stakeholders indicated it may deliver substantial water quality benefits. However, some stakeholders also expressed concerns about the existing land use, particularly the presence of shadows on the agricultural field, which may limit the choice of vegetation to shrubs or short trees for planting.

Restoration Focus Area G:



Focus area G is located within the Kleine Kill-Wallkill River Subwatershed. More specifically, it is located along the Sawmill Brook located in the southwestern quadrant of New Paltz.

Catchment Comprehensive Score (-0.11):
This score falls below the midpoint in the range from -1 to 1. It suggests that the overall ecological condition of this focus area leans towards the negative side. It indicates that there are concerns in this area, particularly related to ecological health and stress.

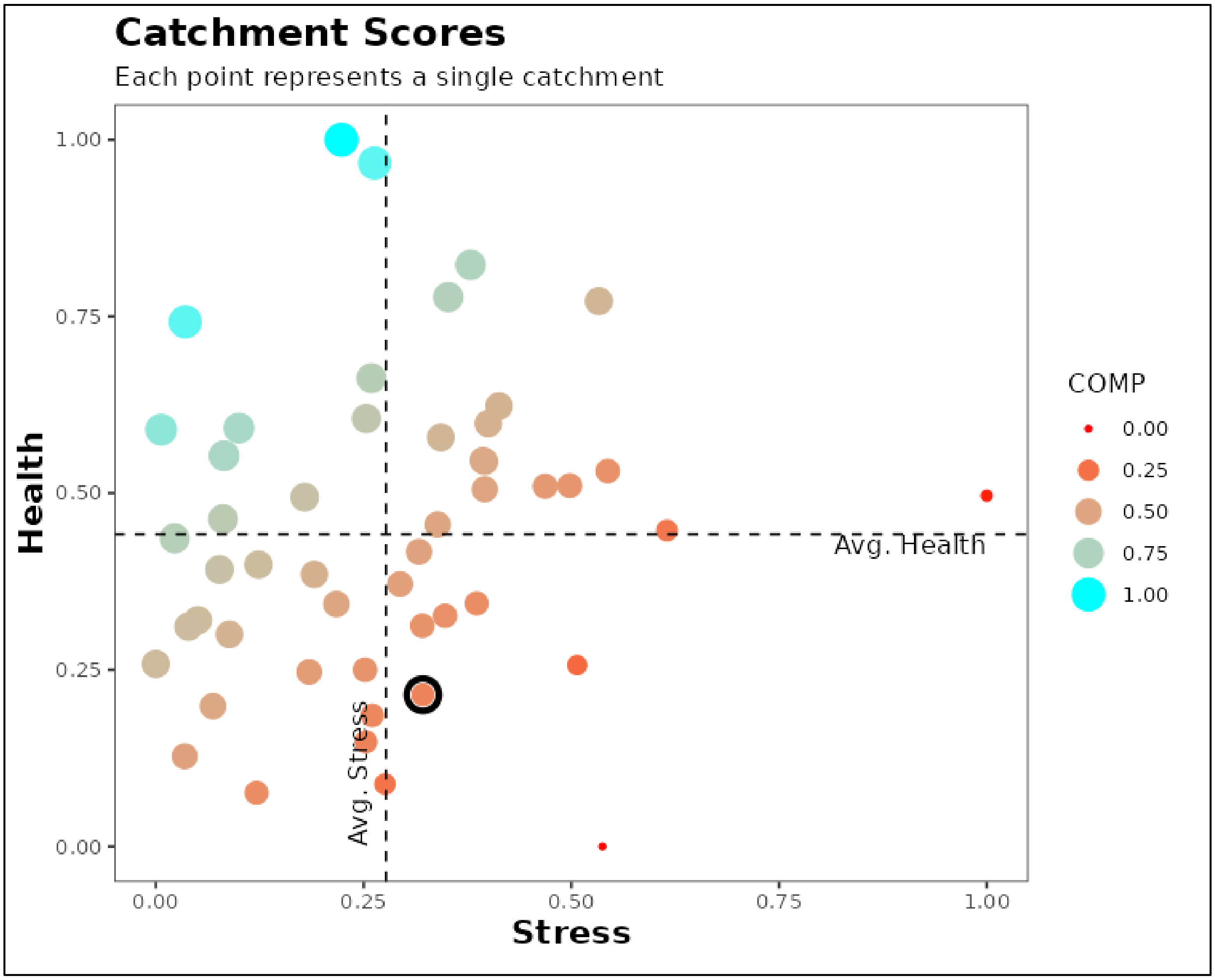


Figure 24: Catchment #202973156 in relation to the other catchments located within the Kleine Kill-Wallkill River Subwatershed.

Catchment Ecological Health Score (0.21):
The ecological health score is on the lower side, indicating that this area has some ecological challenges. While it's not severely distressed, it suggests that there is room for improvement in terms of the overall health of the ecosystem. The following indicators contributed the most to the ecological health score:

Canopy Cover: The presence of a relatively healthy canopy cover is a positive sign. It indicates that there's a substantial amount of vegetation in this area. This vegetation helps protect water quality by intercepting pollutants, sequestering carbon, and providing habitat for various species.

Ecological Significance: A strong score in ecological significance means that this area is home to rare species and high-quality habitats. The presence of rare species often indicates a healthy and biodiverse ecosystem.

Natural Areas: The presence of a high percentage of natural areas in the catchment is another positive sign. Natural areas typically include undisturbed habitats that support biodiversity.

Catchment Ecological Stress Score (0.32):
The stress score is above the midpoint, suggesting the presence of several ecological stressors. This score indicates that these stressors have a moderate impact on the ecosystem. The following indicators contributed the most to the ecological stress score:
Landscape Condition Assessment: A high score in this indicator suggests that the landscape condition of the focus area might be compromised. It implies there are stressors related to land use and development, which can adversely impact the environment.

Impervious Surface: The presence of impervious surfaces, such as roads and pavement, is a known stressor for ecosystems. These surfaces increase the speed and volume of runoff, potentially carrying pollutants into water bodies.

Topographic Wetness Index: A substantial score in this indicator points to areas where water accumulates and flows as sheets, potentially leading to erosion and water-related issues. This adds to the overall ecological stress in the focus area.

Flood Zone:
This focus area is not situated within a FEMA Flood Zone. This designation implies a lower risk of substantial flooding.

Soil Type:
Focus Area G is primarily composed of Volusia gravelly silt loam with slopes ranging from 3 to 8 percent have moderately fertile soils with a capacity to retain moisture, although their drainage is only moderate. This soil type presents versatility for different land uses, including agriculture and residential development. However, given the moderately sloping terrain, effective water management measures would be essential to mitigate drainage and erosion challenges, ensuring that riparian buffer performance is optimized.

Hydrologic Soil Group:
Focus Area F is classified as hydrologic soil group B, which is primarily composed of silt loam or loam. It has a moderate infiltration rate when thoroughly wetted and consists chiefly or moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures.

Surficial Geology:
Focus Area G is composed of hydrologic soil group D, mainly consisting of clay loam, silty clay loam, sandy clay, silty clay or clay. This group has the highest runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface and shallow soils over nearly impervious material.

Land Cover:
Focus Area G is primarily characterized by deciduous forest and developed, open space. This classification indicates the presence of a combination of mature trees and human-built structures in close proximity to the waterbody. This signifies a dynamic landscape where natural tree canopies provide shade and habitat for wildlife, while human activities and structures may influence water quality through potential runoff and alteration of the riparian environment.

Restoration measures should work to enhance the ecological functions of the forested areas while addressing potential challenges associated with nearby development.

DEC Water Quality Classification:
The DEC water quality classification for this area is C, signifying suitability for non-contact uses such as fishing.

EPA Water Quality Classification:
The waterbody within Focus Area G is classified as good.

Stakeholder Input:
The following information was collected through stakeholder meetings and surveys:

Stakeholder input for this particular area highlights potential challenges due to numerous landowners with backyards. In this case, stakeholders encouraged the need for engagement with local property owners to encourage altered mowing practices and the introduction of smaller, aesthetically appealing trees. This approach acknowledges the need for a balanced aesthetic and ecological focus in riparian buffer planning.

Moreover, stakeholders identified Saw Mill Brook as having high Enterococcus levels in the tributary, as reported by citizen water quality data from Riverkeeper. Enterococcus levels in a tributary indicate poor water quality and potential contamination, suggesting compromised buffer health and a heightened need for riparian restoration. The likely sources of contamination could include faulty septic systems or urban pollution. The data indicates potential water quality issues that could be mitigated through strategic buffer implementation.

Stakeholder Recommendation- Restoration Focus Area H: Catchment #202973163

*Restoration Focus Area H was recommended as a catchment from stakeholders. Due to the scale of the recommendation, the following information has been collected to reflect the area on a catchment scale.

The major water body within this catchment is the Wallkill River. The catchment is located within the Kleine Kill-Wallkill River Subwatershed. More specifically, it is located along the Wallkill River, located in the southwestern quadrant of New Paltz.

Catchment Comprehensive Score (0.24):
This score falls below the midpoint in the range from -1 to 1. It suggests that the overall ecological condition of this focus area is leaning slightly towards the negative side. While it's not severely distressed, there are may be concerns.

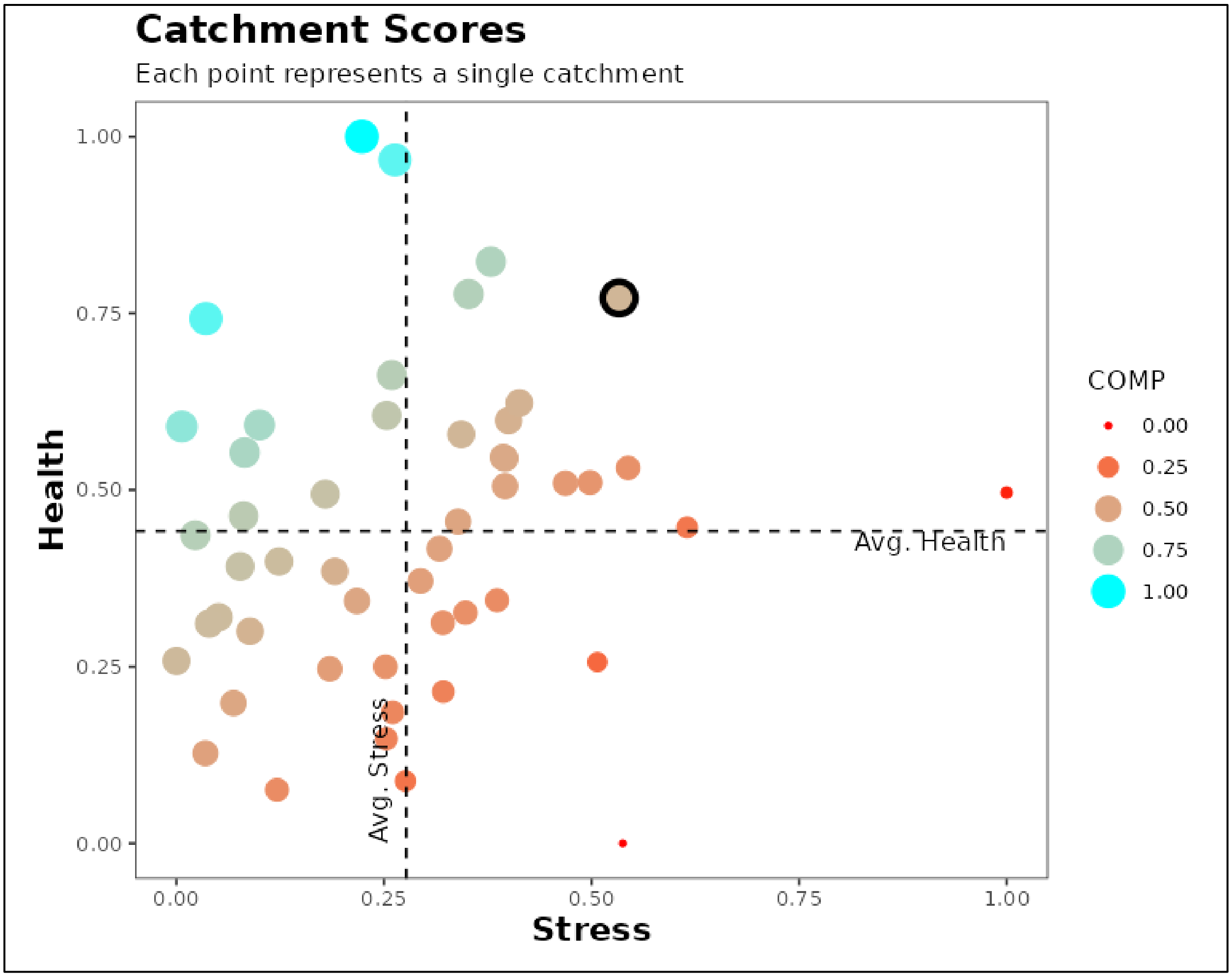


Figure 25: Catchment #202973163 in relation to the other catchments located within the Kleine Kill-Wallkill River Subwatershed.

Catchment Ecological Health Score (0.77):
The ecological health score is notably above the midpoint, indicating a very healthy ecosystem. A score of .77 implies that this area possesses numerous strong ecological attributes. The following indicators contributed the most to the ecological health score:

Biological Assessment Profile (BAP): A high score in BAP is indicates that there was a rich diversity of freshwater insects at the closest sampling point to this catchment, indicating good water quality and a healthy instream ecosystem nearby. This is a positive contributor to the focus area's ecological health score.

Ecological Significance: A strong score in ecological significance means that this area is home to rare species and high-quality habitats. The presence of rare species often indicates a healthy and biodiverse ecosystem.

Natural Areas: The presence of a high percentage of natural areas in the catchment is another positive sign. Natural areas typically include undisturbed habitats that support biodiversity.

Catchment Ecological Stress Score (0.53):

The stress score is also above the midpoint, suggesting the presence of several ecological stressors. This score indicates that these stressors are moderately impactful. The following indicators contributed the most to the ecological stress score:
Dam Storage Ratio: This indicator estimates how much of each river's mean annual flow was potentially stored by upstream impoundments. A high score indicates a higher risk of flow disruption which can be detrimental to the natural flow of streams and rivers.

Landscape Condition Assessment: A high score in this indicator suggests that the landscape condition of the focus area might be compromised. It implies there are stressors related to land use and development, which can adversely impact the environment.

Topographic Wetness Index: A substantial score in this indicator points to areas where water accumulates and flows as sheets, potentially leading to erosion and water-related issues. This adds to the overall ecological stress in the focus area.

Flood Zone:
A significant portion of this catchment is located within the floodway. This implies that the area may be susceptible to period flooding events. This area may benefit from riparian buffer restoration as it can play a critical role in mitigating flood risk by absorbing excess water and slowing its flow, thereby safeguarding the adjacent properties from flood damage.

DEC Water Quality Classification:
The waterbody within this catchment is classified as B and is characterized by its suitability for recreational activities.

EPA Water Quality Classification:
The waterbody within this catchment is classified as impaired/polluted.

Stakeholder Input:
The following information was collected through stakeholder meetings and surveys:

Stakeholder input highlights that the riverside section within this catchment, commonly frequented by local residents accessing it via the village boat launch on Plains Road, faces erosion issues and requires the expansion of its buffer zone. Given that Focus Area F falls within this catchment, it should be noted that restoration efforts spanning the entire catchment could effectively address these concerns by rejuvenating broader and more extensive buffer strips along the Wallkill River.

VI. NEXT STEPS AND FURTHER RESOURCES

HOW TO USE THIS PLAN

In the sections above, we presented priority focus areas for restorations and priority catchment areas for protection. These are intended as a general guide to the areas that appear to be more most beneficial for action, however, we acknowledge that this process was mainly based on mapped data and there are many other riparian areas in the town and village that would benefit from restoration and protection. These areas should not be rejected just because they are not highlighted in this report.

The restoration focus areas identified in this report could be used as a guide for where to focus initial efforts for gaining permission and funding for restoration. Other riparian sites that have similar conditions (lacking long and wide strips of native vegetation) may also be good candidates for future restoration efforts, especially where landowners are interested in supporting these efforts. It is important that any effort to restore riparian vegetation includes a long-term plan to maintain the area and plants to ensure that the site can be maintained and protected in the restored state.

For protection efforts, the priority catchments can be used a guide for the first areas to consider for further investigation. This investigation could include consideration of individual parcels that include high-quality riparian buffers or restoration potential and how they can have more permanent protection in place.

To assure a more holistic approach to restoration and protection of riparian areas, municipalities should include information about riparian areas in their Natural Resource Inventories, Open Space Plans, Comprehensive Plans, wetland, watercourse protection laws and other local environment protection and restoration planning efforts. New Paltz has already included riparian in areas these main planning documents. The town and village should revisit these plans and laws periodically to assure that they still communicate and enforce the goals of the town in relation to riparian protection and restoration.

In this section of the report, we are providing some examples and resources to move forward with restoration and protection of riparian areas in the town and village.

RESOURCES TO LEARN MORE

Below links for resources lists related to restoration and protection of riparian buffers, including basic guidance individual landowners as well as more detailed resource for designing and implementing plans for restoration and protection:

- Cornell Water Resources Institute: Riparian Buffers and Floodplains – This site includes a sortable table with resources for learning more about riparian areas and taking action
- Catskill Stream Buffer Initiative: Riparian Buffers - This site includes plant lists and links to many additional resources for learning more about riparian buffers and taking action.

You may also find additional resources by reaching out to local agencies and organizations that support planting projects. Some local and regional resources may include:

- Ulster county Soil and Water Conservation District – for agricultural riparian areas
- NYSDEC - Hudson Estuary Trees for Tribs Staff – for non-agricultural riparian areas
- Cornell Cooperative Extension Master Gardeners - for help with understanding the existing plants and other species that would be appropriate in Riparian Areas.

For additional resources, see table 7 below:

Category	Suggested Resources	Resource Description
Learning about Riparian Buffers	US Forest Service	Overview of riparian forest buffers.
	Penn State Extension	Video and information on riparian buffers.
	University of Maryland Extension	Riparian Buffer Systems general information.
	UMN Extension	General information on riparian buffers.
Maintaining Riparian Buffers	Natural Resources Conservation Service (NRCS)	Conservation practice standard for riparian forest buffers.
	New York State Department of Environmental Conservation	Information on planting and maintenance of riparian buffers.
	Land Studies	Article on riparian buffer maintenance.
Restoring Riparian Buffers	University of Maryland Extension	Soil bioengineering for riparian forest buffers.
	West Virginia Department of Environmental Protection	Riparian restoration techniques.
	Cornell Cooperative Extension Thompkins County	Workshop on riparian buffers and restoration practices.
Planning for Riparian Buffers	Natural Resources Conservation Service (NRCS)	General planning for riparian forest buffers.
	Ashokan Watershed Stream Management Program	Guide on design and native plant selection (Catskills).
	Cornell Cooperative Extension Thompkins County	Stream Buffer planting guide.
	Trout Unlimited	Guide on planning a riparian buffer planting.

Table 7: Further Resources on Riparian Buffers

POTENTIAL STATE FUNDING SOURCES

Restoration and protection require resources both in time and funding. Table ___ provides a list of New York State funding and technical assistance resources for restoration and protection efforts (based on information gathered in 2023).

Funding Opportunity	Description	Eligibility	Funding Amount	Deadline
Environmental Quality Incentives Program (EQIP)	Financial and technical assistance to agricultural producers to address natural resource concerns, including installation of riparian buffers	Agricultural producers	Varies	Ongoing
Conservation Reserve Enhancement Program (CREP)	Partnership between USDA FSA and NYS DEC to improve water quality through establishment of riparian buffers and wetlands on agricultural lands	Agricultural landowners	Varies	Ongoing
Water Quality Improvement Projects (WQIP)	Funding for projects addressing water quality impairments in priority watersheds, including installation of riparian buffers and Land Acquisition for Source Water Protection (including acquisition of riparian buffers)	Municipalities, soil and water conservation districts, non-profit organizations, others	Up to $2 million	Varies; typically annual
Hudson River Estuary Program	Funding for projects to restore and enhance ecological health of Hudson River and tributaries, including installation of riparian buffers	Non-profit organizations, local governments, academic institutions, others	Varies	Announced periodically
Hudson Estuary Trees for Tribs	Free plants, plant protection, and technical assistance to revegetate riparian buffers.	Anyone who owns or manage property near a stream in the Hudson River Estuary Program focus area or anyone working with those owners.	No funding - Free plants and protection and technical assistance	Biannually in the Spring and Fall

Buffer in a Bag	One free bag of native bareroot plants for planting along a stream or waterbody	Anyone who owns or manages land in New York State with at least 50 feet along a stream or waterbody	~25 free plants send to applicant in the mail with planting instructions	Annual
Green Innovation Grant Program	Funding for projects that improve water quality and mitigate the effects of climate change through the implementation of one or more of the following green practices: Green Stormwater Infrastructure, Energy Efficiency, Water Efficiency and Environmental Innovation.	Local governments	Varies	Annual
Non-Agricultural Nonpoint Source Planning and MS4 Mapping Grant	Funding to help pay for the initial planning of nonagricultural nonpoint source water quality improvement projects.	Municipalities, Soil and Water Conservation Districts	Varies	Annual
Climate Smart Communities Grant	Improve or facilitate conservation, management, and/or restoration of natural floodplain areas and/or wetland systems	Municipalities	Varies	Annual
Funding Finder Tool	This tool provides current funding sources. The tool enables grant seekers to filter grant opportunities based on criteria that meets their specific goals.	Varies	Varies	Varies

Table 8: Potential State Funding Sources

EXAMPLE PLANTING PLAN

After you have decided on a area to focus your energy for restoration and you identify funding or other resources, you will need to create a plan for planting an maintenance. Below is one example of a planting plan that was used to successfully revegetate a riparian buffer along the Wallkill River in the Town of Gardiner. This project harnessed state resources from the Hudson Estuary Trees for Tribs program and local volunteer power to earned the Town 4 Climate Smart Communities points.

Spring 2021 Planting Plan
Gardiner Riverbend Park

Approximate Planting Location

Planting Area Description:

The planting area is along the Wallkill River on a parcel of land owned by the Town of Gardiner. The Spring 2021 planting area (marked in pink on the map) extends ~320 feet from the opening in the forest near the southern border of the property towards the river bend. There are currently no native trees or shrubs growing in this area. The planting area meets the requirements of a Climate Smart Community Action for a larger riparian buffer revegetation (4 Points) by extending the existing buffer width by more than 100 ft and covering more than 20,000 sq ft in area. Measurements in this plan are based on GPS points taken on site. Partners from Climate Smart Gardiner are interested in extending the planting along more of the ~2,000 feet of riverfront in the future.

- **Sun Exposure:** Sun to Part Shade
- **Wetness**: Moist with occasional flooding
- **Existing native woody plants around the proposed area:** Silver Maple, Red Cedar, Sycamore, Shagbark Hickory, Bitternut Hickory, Pignut Hickory, White Oak, Black Cherry, Box Elder, Ash, Basswood.
- **Length Planted Along River:** 320 ft.
- **Buffer Width**: 120 ft.
- **Square Feet of Planted Area**: 38,400 sq ft.
- **Invasive plants in and around site**:
    - Mugwort and tall grasses
    - Multiflora rose
    - Japanese Barberry
    - Tree of Heaven
    - Autumn Olive
    - Honeysuckle vine

Plant List:

Trees and shrubs species are native to New York and were selected for this site based on the site conditions described above and the spring plant availability from Hudson Estuary Trees for Tribs program. The quantities of each species used will be determined based on availability and considerations of conditions.

- **Total Plants**: 300 (Plant all seedlings with ~10 ft spacing)
- **Trees**: 170
- **Shrubs**: 130

Trees: (170)

- Red Maple (*Acer rubrum)*
- Sugar Maple (*Acer saccharum)*
- Silver Maple (*Acer sacccharinum)*
- Serviceberry (*Amelanchier canadensis)*
- River Birch (*Betula nigra)*
- Ironwood/ Blue beech (*Carpinus caroliniana)*
- Eastern Redbud (*Cercis canadensis)*

- Flowering Dogwood (*Cornus florida)*
- Butternut (*Juglans cinerea)*
- Black Walnut (*Juglans nigra)*
- Red cedar (*Juniperus virginiana)*
- Tulip Tree (*Liriodendron tulipifera)*
- Black Gum (*Nyssa sylvatica)*
- White Pine (*Pinus strobus)*
- Sycamore (*Plantanus occidentalis)*
- Swamp White Oak (*Quercus bicolor)*
- Red Oak (*Quercus rubra)*
- Basswood (*Tilia americana)*

Shrubs: (130)

- Silky Dogwood (*Cornus amomum*)
- Red-Osier Dogwood (*Cornus sericea)*
- Hazelnut (*Corylus americana)*
- Witch hazel (*Hamamelis virginiana)*
- American Plum (*Prunus americana)*
- Swamp Rose (*Rosa palustris)*
- Pussy Willow (*Salix discolor*)
- Elderberry (*Sambucus nigra)*
- Arrowwood (*Viburnum dentatum)*
- Nannyberry *(Viburnum lentago)*

Materials:

Plant protection:

Tree tubes (5ft tall) will be installed on all trees and shrubs to provide protection from deer and other animal damage.

Two Trees for Tribs sign will be posted on the property to inform trail users of the purpose for planting.

This planting guide provides for more details on planting and installation

Event Details:

- **Date of planting event:** TBD – Spring 2021
- **Estimated volunteer hours needed:** ~275 hours including site prep
- **Volunteer recruitment:** Climate Smart Gardiner will recruit volunteers for prep and planting.
- **Preparation for planting:** Mow or brush hog existing vegetation from the area of the planting in advance of the delivery date.

Regular Maintenance After Planting:

Maintenance is essential to assure the long-term success of your plants and the overall strength of your new stream buffer. Plan to spend time each month of the first few years caring for your new trees and shrubs to ensure their successful establishment. We recommend that you watch for invasive plants and control them, at least to the extent that they interfere with the growth of your new native seedlings.

Please see our Maintenance Guide and Calendar for step-by-step instructions:

- Maintenance Guide
- Maintenance Calendar
- Invasive Management

VII. APPENDICES

APPENDIX A: Soil Indicators

HYDROLOGIC SOIL GROUP CLASSIFICATION:

Details of this classification can be found in ‘Urban Hydrology for Small Watersheds’ published by the Engineering Division of the Natural Resource Conservation Service, United States Department of Agriculture, Technical Release–55.

Group A: Sand, loamy sand or sandy loam types of soils. It has low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well-drained sands or gravels and have a high rate of water transmission.

Group B: Silt loam or loam. It has a moderate infiltration rate when thoroughly wetted and consists chiefly or moderately deep to deep, moderately well to well-drained soils with moderately fine to moderately coarse textures.

Group C: Sandy clay loam. They have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes the downward movement of water and soils with moderately fine to fine structure.

Group D: Clay loam, silty clay loam, sandy clay, silty clay or clay. This HSG has the highest runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material.

The dual hydrologic soil group classifications are a categorization system used to describe the hydraulic properties of soils in both drained and undrained conditions. The system uses two letters to represent these conditions, with the first letter indicating the drained condition and the second letter indicating the undrained condition.

1. A, B, C, or D (First Letter - Drained Condition):
   - A: Well-drained soils that allow water to move through relatively easily.
   - B: Moderately well-drained soils that have some restrictions on water movement.
   - C: Moderately poorly drained soils that have limited water movement.
   - D: Poorly drained soils that hinder water movement significantly.

2. A, B, C, or D (Second Letter - Undrained Condition):
   - A: Well-drained soils that remain well-drained even in natural (undrained) conditions.

- B: Moderately well-drained soils that remain moderately well-drained in natural conditions.
- C: Moderately poorly drained soils that remain moderately poorly drained in natural conditions.
- D: Poorly drained soils that remain poorly drained in natural conditions

SOIL TYPE CLASSIFICATION:

BnC, Bath-Nassau complex, 8 to 25 percent slopes

- *Material*: The Bath-Nassau complex consists of well-drained soils that primarily contain a mixture of loam, silt, clay, and gravel. These soils are typically moderately fertile and have good tilth, making them suitable for various land uses.
- *Slope:* This soil complex is typically found on landscapes with slopes ranging from 8 to 25 percent. The moderate slope provides good drainage while retaining enough moisture for vegetation, making it versatile for different land uses.
- *Water Holding Capacity and Drainage Characteristics:* Bath-Nassau soils have moderate water-holding capacity. They can retain enough moisture to support vegetation during dry periods but also have sufficient drainage to prevent waterlogging. This balance is beneficial for many agricultural and horticultural purposes.
- *Land Use:* The Bath-Nassau complex is well-suited for a range of land uses, including agriculture, horticulture, and residential development. Its moderate slope and balanced water characteristics make it suitable for various crops and gardening while allowing for effective rainwater drainage.

CvA, Churchville silt loam, 0 to 3 percent slopes

- *Material:* Churchville silt loam is composed of fine-textured, silty soils with good fertility. These soils have a high proportion of silt and clay, making them excellent for retaining nutrients and moisture.
- *Slope:* Typically found on nearly level to gently sloping landscapes with slopes ranging from 0 to 3 percent, Churchville silt loam soils are well-suited for various land uses due to their minimal slope.
- *Water Holding Capacity and Drainage Characteristics: These* soils have a high water-holding capacity due to their fine-textured nature. They can retain moisture for extended periods, providing a consistent water source for vegetation. Additionally, they have adequate drainage, which prevents waterlogging and supports healthy plant growth.
- *Land Use:* Churchville silt loam, with its high fertility, optimal moisture retention, and nearly level slopes, is ideal for a wide range of land uses. It is commonly utilized for agriculture, including the cultivation of crops such as grains, vegetables, and forage. These soils are also suitable for residential and urban development due to their favorable characteristics and ease of construction.

Ha, Hamlin silt loam

- *Material:* Hamlin silt loam is primarily composed of fine-textured, silty soils with a mix of silt, clay, and sand. These soils are known for their good nutrient retention.
- *Slope:* Hamlin silt loam soils are typically found on gently sloping to nearly level landscapes, with slopes ranging from 0 to 3 percent. This nearly level terrain allows for easy land management.

- *Water Holding Capacity and Drainage Characteristics:* These soils have a moderate to high water-holding capacity, capable of retaining moisture for sustained periods. They also offer adequate drainage, preventing waterlogging and supporting healthy vegetation growth.
- *Land Use:* Hamlin silt loam is versatile and suitable for a variety of land uses. It is commonly utilized for agriculture, particularly for growing crops such as grains, soybeans, and hay. Additionally, these soils are suitable for residential and urban development, providing a stable foundation for construction and landscaping.

HgD, Hoosic gravelly loam, 15 to 25 percent slopes

- *Material*: Hoosic gravelly loam consists of coarse-textured soils with a significant proportion of gravel, mixed with loam. These soils have relatively low water-holding capacity.
- *Slope*: Hoosic gravelly loam soils are typically found on moderately steep slopes, with slopes ranging from 15 to 25 percent. The terrain is characterized by pronounced inclines.
- *Water Holding Capacity and Drainage Characteristics:* These soils have low water-holding capacity due to their coarse texture, which limits their ability to retain moisture. They have excellent drainage capabilities, which help prevent waterlogging and promote rapid runoff.
- *Land Use:* Hoosic gravelly loam, with its coarse texture and steep slopes, is less suitable for traditional agriculture. However, it can be utilized for certain specialty crops, forestry, or pastureland. It may also be suitable for recreational uses or conservation purposes that capitalize on the landscape's unique characteristics.

Ma, Madalin silty clay loam

- *Material:* Mandalin silty clay loam is primarily composed of fine-textured soils with a significant proportion of silty clay. These soils are highly fertile and have excellent nutrient retention.
- *Slope:* Mandalin silty clay loam soils are typically found on nearly level to gently sloping landscapes, with slopes ranging from 0 to 3 percent. The terrain is generally flat to gently rolling.
- *Water Holding Capacity and Drainage Characteristics:* These soils have a high water-holding capacity due to their fine texture. They can retain moisture effectively, making them suitable for a wide range of vegetation. Drainage characteristics are moderate, striking a balance between moisture retention and effective drainage.
- *Land Use:* Mandalin silty clay loam is versatile and suitable for various land uses. It is commonly used for agriculture, particularly for growing crops like grains, vegetables, and forage. These soils are also well-suited for residential and urban development due to their stable foundation and fertile properties.

Te, Teel silt loam

- *Material:* Teel silt loam consists of fine-textured soils dominated by silt, with some clay and sand content. These soils typically offer good fertility and nutrient retention.
- *Slope:* Teel silt loam soils are commonly found on nearly level to gently sloping landscapes, with slopes ranging from 0 to 3 percent. The terrain is typically flat to gently rolling.
- *Water Holding Capacity and Drainage Characteristics:* These soils have a moderate water-holding capacity due to their fine texture, retaining moisture well while also providing reasonable drainage. They strike a balance between moisture retention and preventing waterlogging.
- *Land Use:* Teel silt loam is versatile and suitable for various land uses. It is often utilized for agriculture, including the cultivation of crops like grains, soybeans, and hay. Additionally, these soils are well-suited for residential and urban development due to their stable foundation and favorable properties for construction and landscaping.

VoB, Volusia gravelly silt loam, 3 to 8 percent slopes

- *Material:* Volusia gravelly silt loam is primarily composed of fine-textured soils with a notable presence of gravel. These soils offer moderate fertility and nutrient retention.
- *Slope:* Volusia gravelly silt loam soils are typically found on moderately sloping landscapes, with slopes ranging from 3 to 8 percent. The terrain exhibits gentle to moderately steep inclines.
- *Water Holding Capacity and Drainage Characteristics*: These soils have moderate water-holding capacity due to their fine texture and some gravel content. They can retain moisture reasonably well while also providing moderate drainage, which helps prevent waterlogging.
- *Land Use:* Volusia gravelly silt loam is suitable for various land uses. It can be utilized for agriculture, including the cultivation of certain crops and pastureland. Additionally, these soils may support residential and urban development, but proper management practices are required to address drainage and erosion concerns associated with the moderate slopes.

Wb, Wayland silt loam

- *Material:* Wayland silt loam primarily consists of fine-textured soils dominated by silt, with varying proportions of clay and sand. These soils tend to be moderately fertile and have good nutrient retention.
- *Slope:* Wayland silt loam soils are typically found on nearly level to gently sloping landscapes, with slopes ranging from 0 to 3 percent. The terrain is generally flat to gently rolling.
- *Water Holding Capacity and Drainage Characteristics:* These soils have a moderate water-holding capacity due to their fine texture, retaining moisture reasonably well. Drainage characteristics are typically moderate, allowing for a balance between moisture retention and effective drainage.
- *Land Use:* Wayland silt loam is versatile and suitable for various land uses. It is often utilized for agriculture, including the cultivation of crops like grains, vegetables, and forage. These soils are also favorable for residential and urban development due to their stable foundation and moderate moisture control properties.

APPENDIX B: Land Cover Indicators

Definitions for land use and land cover classes as noted by the National Land Cover Database:

*Please note that the classification system used by NLCD is modified from the Anderson Land Cover Classification System.

Open Water- areas of open water, generally with less than 25% cover of vegetation or soil.

Developed, Open Space- areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.

Developed, Low Intensity- areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% percent of total cover. These areas most commonly include single-family housing units.

Developed, Medium Intensity -areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units.

Developed High Intensity-highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80% to 100% of the total cover.

Barren Land (Rock/Sand/Clay) - areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.

Deciduous Forest- areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species shed foliage simultaneously in response to seasonal change.

Evergreen Forest- areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage.

Mixed Forest- areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75% of total tree cover.

Shrub/Scrub- areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.

Grassland/Herbaceous- areas dominated by gramanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.

Pasture/Hay-areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20% of total vegetation.

Cultivated Crops -areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20% of total vegetation. This class also includes all land being actively tilled.

Woody Wetlands- areas where forest or shrubland vegetation accounts for greater than 20% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

Emergent Herbaceous Wetlands- Areas where perennial herbaceous vegetation accounts for greater than 80% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

APPENDIX C: Riparian Opportunity Assessment (ROA) Indicators

ECOLOGICAL HEALTH

The Ecological Health score is calculated by taking the sum of the normalized scores of all 14 ecological health indicators. Scores are normalized to control for different scales of measurement, adjusted so that all scores range from a minimum value of 0 to a maximum value of 1. Normalized values range from 0 (low) to 1 (high) at both scales. The indicators that contributed to the ecological health score of each subwatershed are as follows:

Canopy Cover: Canopy cover refers to the amount of vegetation cover overhead. High canopy cover can provide shade to the watercourse, which can reduce water temperature and improve water quality by reducing the growth of harmful algae. Canopy cover can also help regulate the amount of sunlight reaching the riparian zone and provide habitat for birds and other wildlife.

Natural Cover: Natural cover refers to the amount of natural vegetation in the buffer zone. Natural cover can provide habitat for many wildlife species, including birds, amphibians, and reptiles, and also provide a source of food and shelter for many other species. It can also reduce erosion and sedimentation, helping to maintain water quality.

Biological Assessment Profile: The Biological Assessment Profile (BAP) is a measure of the health of a stream or river, based on the diversity and abundance of aquatic organisms. A healthy riparian buffer can provide a variety of habitats and food sources for aquatic organisms, leading to a higher BAP score and a healthier ecosystem.

Brook Trout: Brook trout are a species of native fish that are particularly sensitive to changes in water quality and habitat conditions. Healthy riparian buffers can provide the shade, food, and habitat that brook trout need to survive and thrive. By maintaining a healthy riparian buffer, we can help support the populations of this important species.

Floodplain Complexes: Floodplain complexes refer to the areas surrounding a river or stream that are periodically flooded. These areas can provide important habitat for many species and help to regulate water flow and quality. Healthy riparian buffers can help support healthy floodplain complexes, leading to a more resilient ecosystem.

Function River Networks: Functional river networks are interconnected systems of streams and rivers that provide important habitat and support biodiversity. Riparian buffers can help maintain the connectivity of these systems, providing a critical habitat and a corridor for species movement.

Matrix Forest Blocks: Matrix forest blocks refer to the larger forested areas surrounding a riparian buffer. These forests can provide important habitat for wildlife, support water quality, and provide other ecosystem services. Maintaining a healthy riparian buffer can help support healthy matrix forest blocks and maintain the overall ecological health of the area.

Ecological Significance: Riparian buffers are ecologically significant because they are transitional zones between aquatic and terrestrial ecosystems, providing critical habitat and support for a variety of species. By maintaining a healthy riparian buffer, we can help support the health of the surrounding ecosystem and protect the many benefits it provides.

Native Fish Richness: Native fish richness refers to the number of native fish species found in a stream or river. Healthy riparian buffers can provide important habitat and food sources for native fish species, leading to a higher richness of native fish and a more diverse and resilient ecosystem.

ECOLOGICAL STRESS

The Ecological Stress score is calculated by taking the sum of the normalized scores of all 8 ecological stress indicators. Scores are normalized to control for different scales of measurement, adjusted so that all scores range from a minimum value of 0 to a maximum value of 1. Normalized values range from 0 (low) to 1 (high) at both scales. The indicators that contributed to the ecological health score of each subwatershed are as follows:

Dam Storage Ratio: This indicator estimates how much of each river's mean annual flow was potentially stored by upstream impoundments. A high score indicates a higher risk of flow disruption which can be detrimental to the natural flow of streams and rivers.

Impervious Surface: Impervious surfaces are areas of land covered by materials such as concrete, asphalt, or rooftops that prevent water from soaking into the soil. This can lead to increased runoff and erosion, which can harm the riparian buffer and the surrounding aquatic ecosystem. Impervious surfaces can also contribute to water pollution by carrying pollutants such as oil, pesticides, and fertilizers into nearby waterways.

Landscape Condition Assessment: A landscape condition assessment is an evaluation of the overall health of a landscape, including factors such as land use, vegetation cover, and soil quality. A poor landscape condition assessment can indicate that the riparian buffer is experiencing stress from factors such as pollution, erosion, or habitat fragmentation.

Known Water Impairments: Water impairments are conditions that negatively impact the health of the aquatic ecosystem, including fish kills, excessive algae growth, and low dissolved oxygen levels. When there are known water impairments in the surrounding area, it is likely that the riparian buffer is also experiencing ecological stress.

Erosion Index: The erosion index is a measure of the potential for soil erosion in a given area. High erosion index values can indicate that the riparian buffer is at risk of erosion, which can harm vegetation and aquatic habitat and contribute to sedimentation in nearby waterways.

Topographic Wetness Index: The topographic wetness index is a measure of how wet a landscape is based on factors such as slope and soil type. When the topographic wetness index is high, it can indicate that the riparian buffer is experiencing high levels of moisture, which can contribute to erosion and sedimentation.

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