2019

An Assessment of Water Quality in the Poesten Kill Watershed

PREPARED FOR:

THE NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
HUDSON RIVER ESTUARY PROGRAM

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Introduction

Increasingly, municipalities, natural resource organizations and agencies, and aquatic researchers are evaluating issues of stream quality from a holistic watershed, or landscape-level, approach by considering both the factors *within* and *around* a stream that could be affecting overall stream health. By evaluating and understanding the interrelatedness of streams to their terrestrial watersheds (and vice versa) and within the context of their watershed, effective restoration and management can be made.

Landscape connectivity refers to the ability of a resource (e.g., nutrients, materials, energy, and/or disturbances) or an organism to move from one location to another (Taylor et al. 1993, Weins 2002). Perhaps one of the most well-known examples of landscape connectivity for riverine systems is the River Continuum Concept, demonstrating that upstream processes and biotic assemblages affect those downstream (Vannote et al. 1980). These longitudinal linkages within a stream are further influenced by the critically important riparian zone and the surrounding terrestrial landscape. Studies addressing the lateral connectivity of streams to the landscape have become increasingly prominent in recent decades and have resulted in the development of the term "riverscape" (Fausch et al. 2002). The recognition of flowing waters as "riverscapes" incorporates all the major components of landscape ecology. It also reinforces the essential need to recognize streams and rivers as continuous and connected systems within a landscape for the effective management, research, and conservation of stream habitat and biota (Fausch et al. 2002). The principles of landscape ecology are the basis for this survey.

The Poesten Kill watershed (249.42 km^2) is a tributary to the Hudson River, and it discharges within the tidal estuary section of the river at the City of Troy in Renssalaer County. Poesten Kill is a comparatively small subwatershed to the Hudson River basin, comprising < 0.01% of the total Hudson River watershed area and only 0.1% of the lower Hudson River watershed (i.e., estuary). However, as a tributary within the Hudson River estuary, the Poesten Kill is of significance to the overall conservation, restoration, and revitalization of the Hudson River ecosystem. Notably, Poesten Kill serves as a valuable tributary for migratory fishes such as American eel (*Anguilla rostrata*) and Alewife (*Alosa pseudoharengus*) (RLT 2009).

Historical surveys by the New York State Department of Environmental Conservation (NYSDEC) have shown the biological condition of Poesten Kill to be relatively unimpacted; with waters classified as suitable for trout spawning [C(TS)] and capable of supporting a trout fishery [C(T)]. However, storm water runoff, urbanization, and impoundments are impacting habitat condition in select areas of the watershed. Most of the area immediately surrounding Poesten Kill, and particularly the lower watershed in the City of Troy, are within designated urbanized, MS4 (Municipal Separate Storm Sewer Systems) regions. Therefore, the need to identify potential unidentified sources of water pollution and habitat degradation that may be associated with anthropogenic alterations (e.g., from illicit discharges, cross-connection, and failing infrastructure) is critical to understanding stream condition and making recommendations for future efforts. The information gathered from such a survey would be valuable to municipalities, regulatory agencies, conservation organizations, and stakeholders in the watershed in developing future storm/wastewater and/or natural resource restoration planning and management efforts.

Project Background

In 2016, the Onondaga Environmental Institute (OEI) was awarded funds through the NYSDEC Hudson River Estuary Program (HREP) to perform an ecological survey of the Poesten Kill watershed (Rensselaer County, NY). The goal of the project was to assess the Poesten Kill through scientific investigation and biological surveys. In order to effectively assess the Poesten Kill Watershed, the major objectives of this project were to: (1) identify and engage key stakeholders, (2) assess stream condition by measuring physical, chemical, and biological parameters, (3) define the watershed and prioritize locations, and (4) identify watershed conservation, restoration, and stewardship goals and objectives. The methods by which the survey was to be developed included a collaborative, adaptive management-based process advanced by regularly scheduled meetings (and/or conference calls) and iterative review processes.

Rationale

As a tributary to the Hudson River, a proper assessment of the Poesten Kill Watershed would help towards achieving the goal of the Hudson River Estuary Action Agenda: “To conserve, restore, and revitalize the estuary and its ecosystem”. The development of a comprehensive ecological survey will help with identifying watershed areas of greatest conservation need, as well as helping to achieve the goals and objectives of multiple plans, visions, and missions of various municipalities and organizations in the watershed:

The Town of Poestenkill’s Comprehensive Plan (2006), specifically

[Goal 1], “foster Poestenkill's sense of community and mutual responsibility, focused on the hamlet as the center of community life, by preserving public safety, promoting recreational opportunities and encouraging access to needed professional services”;

[Goal 2], “conserve its natural wonders including unmarred vistas and waterways consistent with our desire to maintain a rural character”; and

[Goal 4], "maintain, and ensure for the future, a clean water supply and promote the disposal of wastes in a manner that protects Town Water Resources, the aquifer and resident health and property values".

The Town of Berlin's Comprehensive Plan (2011), specifically the natural resources goal to, "inventory and conserve the natural resources of Berlin for community use and tourism".

The Town of Brunswick's Comprehensive Plan (2013), specifically the natural resources goal to, "provide safeguards to protect sensitive environmental areas and waterbodies".

The Rensselaer Plateau Alliance strategic goal to, "expand education, outreach, and communication".

The Dyken Pond Environmental Education Center's mission to, "foster ecological literacy and land stewardship by promoting experiential environmental education, supporting the Dyken Pond Environmental Education Center's programs and protecting the natural resources at and around the Center through financial and volunteer support"

The Rensselaer Land Trust's mission to, "conserve the open spaces, watershed, and natural habitats of Rensselaer County for the benefit of our communities and future generations." The Rensselaer Land Trust envisions Rensselaer County having, "sufficient land to maintain clean water, clean air, wildlife and plant habitats, local farms, working forests, and scenic beauty".

Stakeholders

At the onset of project implementation, OEI engaged stakeholders in Rensselaer County to invite participation in various aspects of the project, including planning, research, monitoring, and reporting. Key Stakeholders initially identified included the Towns of Berlin, Poestenkill and Brunswick, The City of Troy, The Rensselaer Plateau Alliance, The Rensselaer Land Trust, and the Dyken Pond Environmental Education Center (EEC). Engagement with these stakeholders helped to identify other interested participants. On March 21, 2017, a kick-off meeting was held at Poestenkill Town Hall and included 12 participants from eight organizations, including:

- Rensselaer Plateau Alliance
- Rensselaer Land Trust
- Town of Poestenkill
- Hudson River Estuary Program
- Capital District Regional Planning
- Rensselaer County Soil & Water Conservation District
- SUNY College of Environmental Science & Forestry
- Onondaga Environmental Institute

While not in attendance at the meeting, participation via email communication was also maintained with the Dyken Pond Environmental Education Center.

Each of these stakeholders worked with OEI to engage other organizations and individuals interested in participating in the planning, development, and implementation of the ecological assessment of Poesten Kill. With the goal of facilitating consultation with a breadth of representatives in affected communities, OEI was able to engage a variety of local, county, and state officials to generate awareness of this project and to tailor the goals and objectives of this project to the needs and visions of the various stakeholders.

I. Stakeholder Resources

There are numerous stakeholders that have taken a vested interest in the conservation, restoration, management, and education of the natural resources in Rensselaer County; many of which benefit the Poesten Kill watershed. As efforts to protect, conserve, and restore the Poesten Kill continue, it will be important to consider the existing resources available to stakeholders. A list of available resources for stakeholders performing work (current and/or future) in the Poesten Kill watershed is presented in Table 1. It is the aim of this list to provide a comprehensive resource for stakeholders that can be modified and built upon as new resources become available.

Table 1. A summary of available resources for stakeholders in the Poesten Kill Watershed (listed in alphabetical order).

Organization	Website	Resources	Notes
Apiary Studio	Apiary-studio.com	Poesten Kill green infrastructure masterplan	Working with NY State Water Resources Institute, Cornell University, and Princeton Hydro to develop a green infrastructure plan that works to: "1) improve local water quality, 2) reduce flooding impacts, 3) restore ecological systems and 4) improve public access to open space along the Poestenkill waterfront."
Capital District Regional Planning	Cdrpc.org	• Regional maps • Census data • Water quality data	*CDRPC provides objective analysis of data, trends, opportunities and challenges relevant to the Region's economic development and planning communities.*
City of Troy	Troyny.gov	Troy comprehensive plan (2018) Stormwater reports Stormwater management resources	No Combined Sewer Overflow's (CSOs) discharge to Poesten Kill, however CSOs discharge to the Hudson above and below Poesten Kill's outlet. An understanding of existing stormwater infrastructure in Troy is important for future assessments of water quality.
Dyken Pond Environmental Education Center (ECC)	Dykenpond.org	Species guide to birds and mammals found at Dyken Pond and Rensselaer Plateau	The Dyken Pond EEC works to promote environmental education, outdoor recreation, and youth development. As the headwaters to Poesten Kill, this is an ideal location to engage people in the Poesten Kill watershed.
Hudson River Estuary Program (HREP)	Dec.ny.gov/lands/4920.html	2018 HREP Coordinator's annual report Summaries & reports of the various projects occurring in the Hudson River Estuary	The HREP is a NYSDEC program created in 1987 through the Hudson River Estuary Management Act. The mission of the program focuses on 6 benefits: (1) clean water, (2) resilient communities, (3) vital estuary ecosystem, (4) estuary fish, wildlife, and habitats, (5) natural scenery, (6) education, river access, recreation, and inspiration.

Table 1 (continued)

Organization	Website	Resources	Notes
Hudson Riverkeeper	Riverkeeper.org	Water quality data for the Hudson River estuary, as well as tributaries including the Poesten Kill	Citizen science-based sampling has historically (2017) been performed at three locations in the Poesten Kill.
NYS Dept. of Environmental Conservation (DEC)	Dec.ny.gov/chemical/23847.html (Stream Biomonitoring Unit) Dec.ny.gov/chemical/23848.html (Water quality monitoring database)	• Stream biomonitoring database • 30-year trends in water quality report	The DEC Stream Biomonitoring Unit performs routine biological surveys in the Poesten Kill on a 5-year rotation. The next survey is slated for 2022. The DEC's Water Monitoring Data Portal contains historical water quality data for Poesten Kill.
Rensselaer Land Trust (RLT)	Rentrust.org	•Rensselaer County Conservation Plan •Watershed Map •Rensselaer County Hudson River Access Plan •Natural Areas of Rensselaer County •Botanical Inventories	*"The mission of the Rensselaer Land Trust is to conserve the open spaces, watersheds and natural habitats of Rensselaer County for the benefit of our communities and future generations."*
Rensselaer Plateau Alliance (RPA)	Rensselaerplateau.org	• Rensselaer Plateau Conservation Plan • Guides for municipal officials, landowners, and organization • Poesten Kill watershed and flood mitigation assessment report	The goals of the RPA are to, *"(1) Conserve unbroken forests & ecologically important areas, (2) Expand education, outreach & communication, (3) Establish the Plateau as a recreational destination, (4) Establish a community forest for the people, and (5) Increase organizational capacity"*
Town of Berlin	Berlin-ny.us	Comprehensive Plan	Contains information about the most upper reaches of the Poesten Kill watershed.
Town of Brunswick	Townofbrunswick.org	Comprehensive Plan Stormwater annual reports and education information	Contains information about the middle reaches of the Poesten Kill watershed.
Town of Poesten Kill	Townpoestenkill.digitaltowpath.org	Town comprehensive report	Contains information about the upper reaches of the Poesten Kill watershed.

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~ CHAPTER 1 ~
UNDERSTANDING THE POESTEN KILL WATERSHED

Poesten Kill, Planck Rd, north of Blue Factory Rd. Photo credit: OEI, 2019

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I. Introduction

The Poesten Kill watershed has long served as a vitally important resource from both human and ecological perspectives. Prior to European settlement, Mohican Native Americans resided along the Poesten Kill and relied heavily on the watershed for sustenance (Warren 2009). Europeans first settled in the area in 1624 at Fort Orange, located approximately 10 miles south of the Poesten Kill along the Hudson River (Warren 2009). Shortly thereafter, the land around Poesten Kill became one of the first European settlements outside of Fort Orange (Warren 2009). In 1630, the Mohicans sold the land to a Dutch merchant, Kiliaen Van Rensselaer. It was through the Dutch that the Poesten Kill received its name; named so after a Dutch farmer, Jan Barentse Wemp, who had leased land along Poesten Kill and went by Jan Barentse Poest (and *Kill* is Dutch for 'creek').

Fast forward approximately 200 years and the Poesten Kill remained a driving force for both agricultural and urban development. During the industrial revolution, the power that was able to be harnessed from the Poesten Kill played a significant role in the expansion and growth of the City of Troy; helping it to become one of the most important and successful industrial cities during the 19th century (Warren 2009).

From an ecological perspective, the Poesten Kill serves as a vitally important spawning stream for migratory fishes such as American eel (*Anguilla rostrata*) and Alewife (*Alosa pseudoharengus*) (RLT 2009). The linkage between Poesten Kill and the Hudson River estuary, and thus the Atlantic Ocean, make this comparatively small watershed mightily important to the sustainability and health of the overall Hudson River ecosystem (Fig. 1).

To fully understand the Poesten Kill watershed and its significance to the Hudson River estuary, it is the aim of this chapter to provide a comprehensive overview of the many features of the Poesten Kill watershed; including geology, hydrology, land use, current demographics, water usages, and water quality issues.

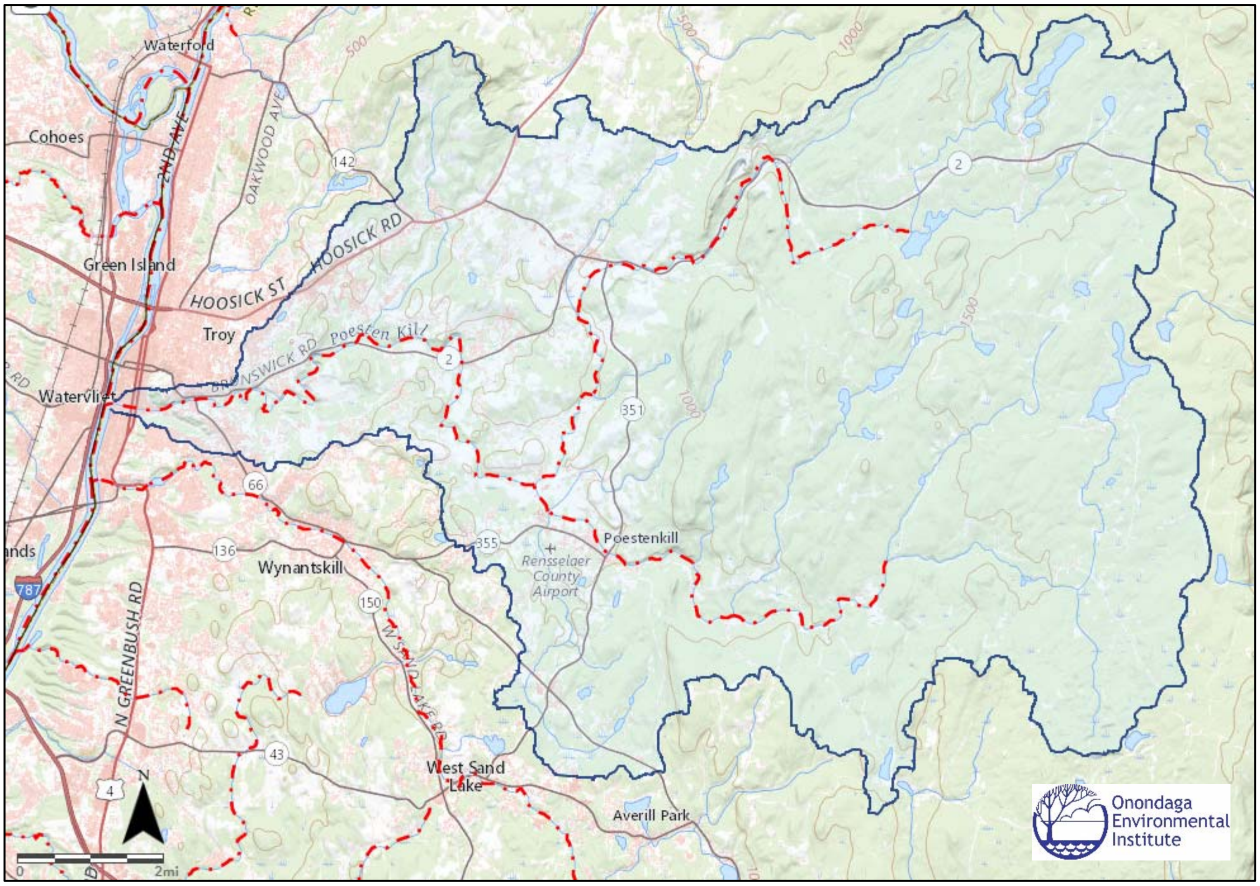

Figure 1. Migratory fish runs in the Poesten Kill watershed.

II. Geology & Topography

The Taconic Mountains, namely the Petersburg Mountains of the Taconic Ridge, and the Rensselaer Plateau are the major geologic features in the watershed. The Taconic Mountain Range spans the eastern edge of the watershed, while the plateau extends through the middle portion of the watershed. The Taconics formed 440 million years ago from continental shifting, which formed a volcanic arc of islands and a deep oceanic trench over the continent. Millions of years of erosion subsequently created the existing Taconic Mountain ridge. The predominant bedrock in the Poesten Kill watershed include Rensselaer Graywacke, black shale, limestone, limestone brecciola, and Snake Hill Shale (Work 1988). Deeper Graywacke layers were shuffled to the west creating the Rensselaer Plateau. Glaciers of the last ice age diverted rich soil from the plateau to the lower elevations of the surrounding valley floors, helping to create a fertile floodplain for farming by Mohicans and later by European settlers (Warren 2009). The Graywacke is considered a valuable resource for hard road surfaces and has been mined in Rensselaer County for such use (Work 1988).

The Rensselaer Plateau is a unique geologic feature in Rensselaer County, comprising the fifth largest intact forest in New York State (rentrust.org). The large (118,000 acres), high-elevation Plateau (1000-1800 ft above sea level) is where the Poesten Kill headwaters originate (Fig. 2), descending approximately 1600 ft in elevation to the mouth of the Hudson River. (RPA 2009). While Poesten Kill is a relatively small tributary to the Hudson with respect to total length (42 km [26 miles]), the change in physical habitat, due to geologic conditions, is quite distinct. The unique features of the Taconic Ridge and Rensselaer Plateau create a headwater ecosystem more like the Adirondacks than the surrounding lowlands including the predominance of nutrient-poor, acidic soils in a rocky landscape (rentrust.org). Downstream of the headwaters, the Poesten Kill flattens through lowland agriculture-rich areas and then again steeply descends through several gorges comprised of rock, shale, and silt (Warren 2009). These gorges helped form five major waterfalls that has contributed to the Poesten Kill's notoriety (please see '*Hydrology*').

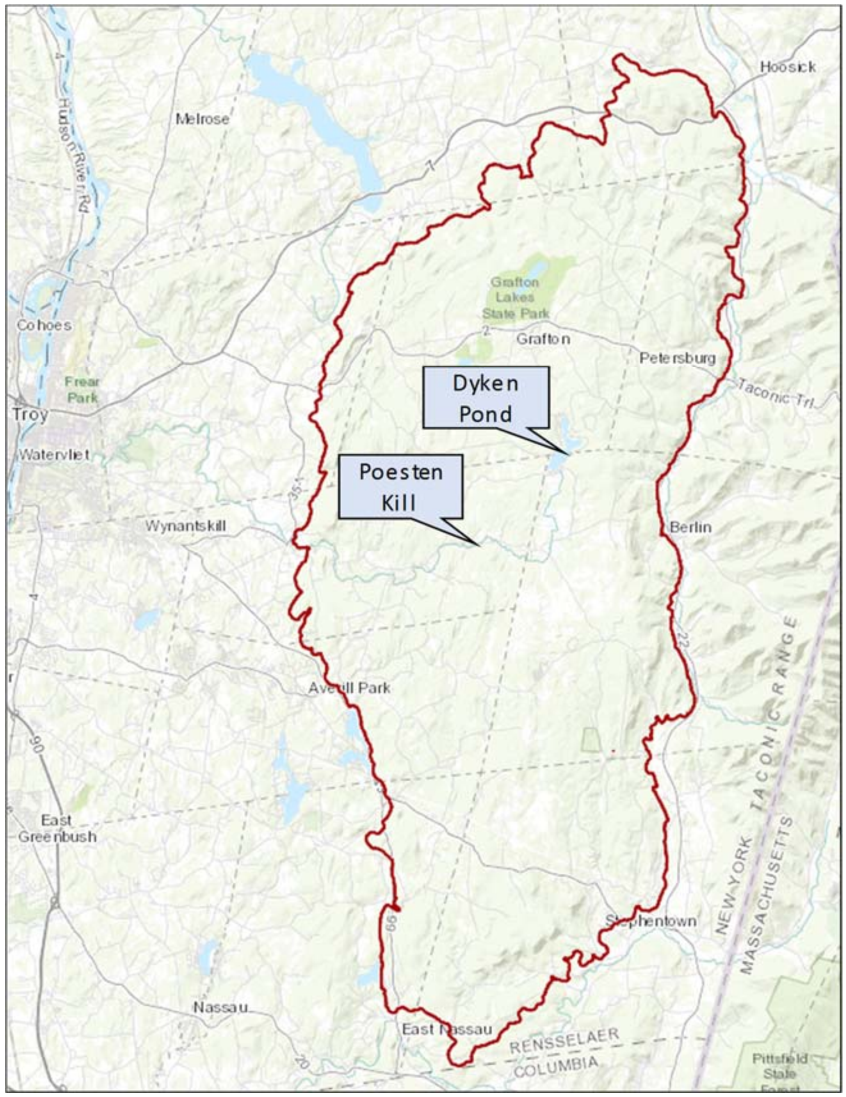

Figure 2. Rensselaer Plateau Region. (Source: databasin.org)

The geology of the area, as well as land use can affect soil conditions. A custom soil survey report was generated using the US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Web Soil Survey application (https://websoilsurvey.sc.egov.usda.gov). The major soil types (≥ 2% total composition) that comprise the Poesten Kill watershed include: Buckland very stony loam (BuC & BuD), Brayton very stony silt loam (BrA), Glover very stony loam (GlD & GlC), Bernardston gravelly silt loam (BeD), Pittstown gravelly silt loam (PtC), Nassau-Manlius complex (NaC), Bernardston-Nassau complex (BnC), and Nassau-Rock outcrop (NrD) (Table 1). Buckland very stony loam, sloping

(BuC) is the most predominant soil type in the Poesten Kill watershed, comprising 26% of the watershed area (Table 1). Overall, the major soil types predominant in the Poesten Kill watershed are generally stony-gravelly in composition (Table 1). Change in soil composition is distinct in Poesten Kill, with a rather abrupt change in predominant soil types between the western and eastern halves of the watershed (Fig. 3). This abrupt change in soil type demarcates the portion of the watershed in the Rensselaer Plateau (east) from the rest of the watershed (west). In the Rensselaer Plateau region, soils are comprised of BuC, BuD, GID, and GIC soil types; very stony loams (Fig. 3). In the western half of the watershed (downstream of the Plateau), predominant soil types (≥ 2%) include BeD, BrA, BnC, and NaC (Fig. 3). The majority of soil types in the western half of the watershed fall into the 'other' category (Fig. 3), collectively comprising 28% of the total area in the watershed (Table 1).

Table 1. Predominant soil types in the Poesten Kill watershed.

Soil Abbr.	Soil Description	Acres	%
BuC	Buckland very stony loam, sloping	16,047.90	26.00%
BuD	Buckland very stony loam, moderately steep	7,167.10	11.60%
BrA	Brayton very stony silt loam, nearly level	4,756.60	7.70%
GlD	Glover very stony loam, very rocky, moderately steep	4,192.30	6.80%
BeD	Bernardston gravelly silt loam, 15 to 25 percent slopes	2,895.40	4.70%
GlC	Glover very stony loam, very rocky, sloping	2,739.20	4.40%
PtC	Pittstown gravelly silt loam, 8 to 15 percent slopes	2,060.60	3.30%
NaC	Nassau-Manlius complex, rolling	1,690.00	2.70%
BnC	Bernardston-Nassau complex, rolling	1,328.80	2.20%
NrD	Nassau-Rock outcrop complex, hilly	1,242.10	2.00%
	Other[1]	17,545.50	28%
	Totals for Area of Interest	**61,665.40**	**100.00%**

[1]The list of soil types constituting the 'other' category is shown in Appendix A.

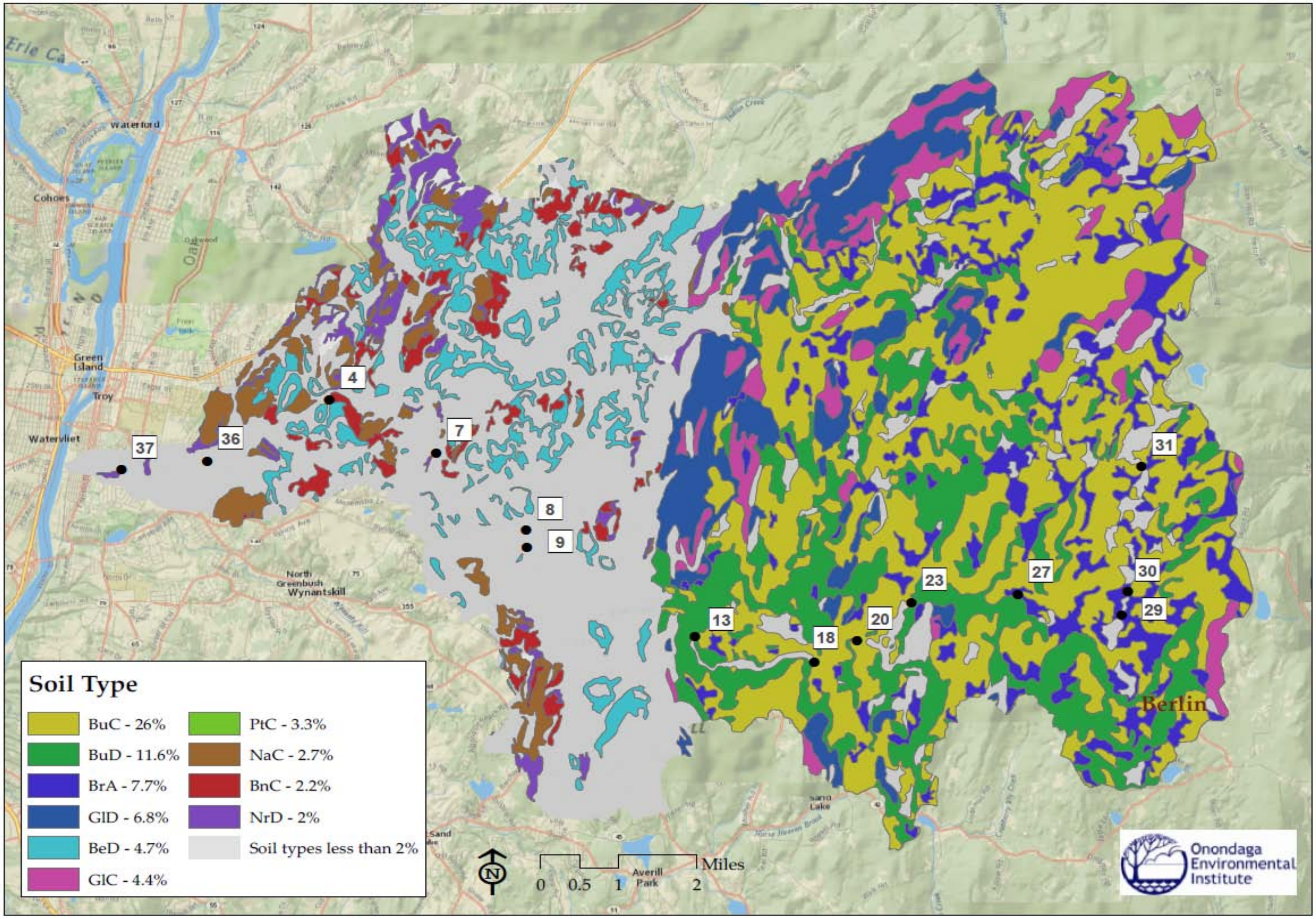

Figure 3. Soil types in the Poesten Kill watershed. Abbreviations are defined in Table 1. Sampling locations are displayed to show predominant soil types relative to sampling sites.

III. Hydrology

The Poesten Kill watershed (249.42 km2) is a minor tributary to the Hudson River watershed, comprising < 0.01% of the total Hudson River watershed area (Fig. 4).

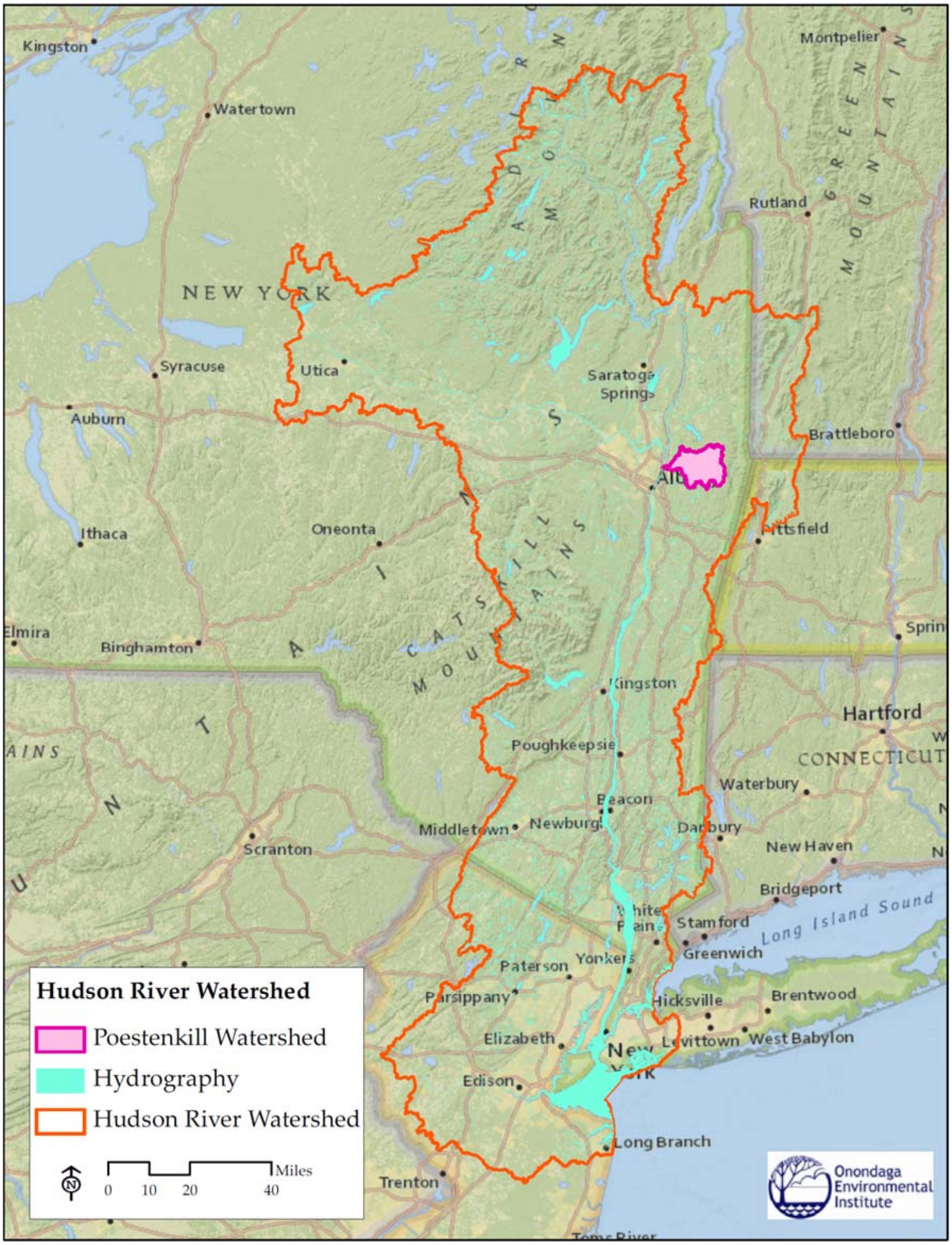

Figure 4. Poesten Kill watershed within the context of the greater Hudson River watershed.

Poesten Kill discharges into the Hudson River within the Lower Hudson River sub-basin, which represents the tidal estuary portion of the river (Fig. 5). The tidal estuary extends up to the City of Troy at the Federal Dam, just below the confluence with the Mohawk River; the Hudson's largest tributary (Freeman 1991). The tidal estuary portion of the river brings saltwater from the Atlantic Ocean approximately 153 miles upstream. The Poesten Kill discharges into the tidal Hudson River Estuary approximately 2.3 miles downstream of the Federal Dam and is the most northerly tributary to the estuary on the east side of the Hudson River (Fig. 5).

Figure 5. The Poesten Kill watershed within the context of the Hudson River estuary.

Water that supplies the Poesten Kill originates in the Rensselaer Plateau region at Dyken Pond (Town of Berlin, Rensselaer County) (Fig. 6) approximately 20 miles east of the Hudson River (Warren 2009) (Fig. 7). Dyken Pond is a stream and spring-fed pond that was historically small until a larger dam, installed by the Manning Paper Company in 1902, enlarged the pond (Warren 2009). The pond is 1,625 feet above sea level and has an area of 134 acres (54 ha). The shoreline length extends 5.1 miles around and is 1.4 miles in total length. The maximum depth is 35 feet with an average depth of 16 feet (NYSDEC 2019). The Manning Paper Company donated the pond and surrounding area to Rensselaer County in 1973, where it currently serves as the site of NYSDEC's Dyken Pond Environmental Education Center (Warren 2009). Stream flow is regulated by the dam and serves to regulate pond levels and downstream flooding (Fig. 8).

Figure 6. Dyken Pond (Source: renscotourism.com)

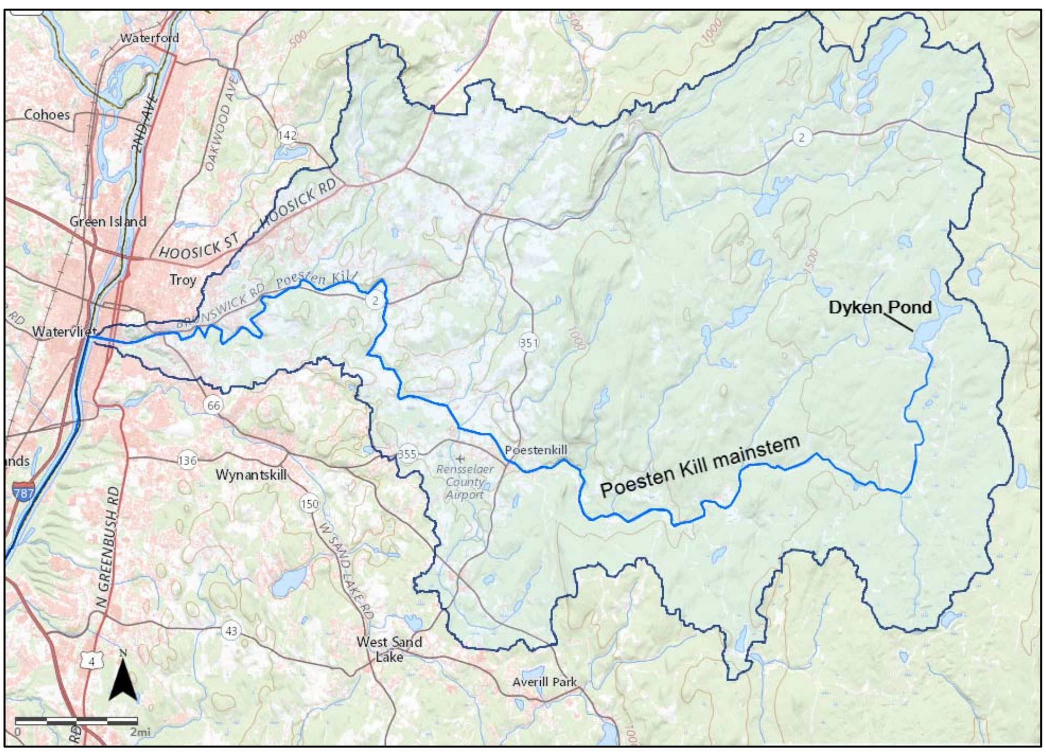

Figure 7. The Poesten Kill watershed, with the mainstem highlighted. Dyken Pond serves as the headwaters for Poesten Kill.

Figure 8. Water control structure at the outlet of Dyken Pond. (Photo credit: OEI)

After leaving Dyken Pond, water flows south through the Town of Berlin before turning west, continuing west until turning slightly north, north-west in the Town of Poestenkill, where it meets the confluence of Newfoundland Creek. Poesten Kill continues in a northerly direction into the village of Eagle Mills, where it then turns west and continues in that direction through the City of Troy, where it ultimately discharges to the Hudson River. From Dyken Pond to the Hudson River, the total length of the Poesten Kill mainstem is 42.2 km (28.8 mi).

There are approximately several dozen tributaries that discharges into Poesten Kill; most of which are minor and unnamed. Of those, four are considered major tributaries to the Poesten Kill: Bonesteel Creek, Newfoundland Creek, Quacken Kill, and Sweet Milk Creek (Fig. 9). The most upstream major tributary is Bonesteel Creek, comprising a watershed area of 22.6 km^2 and representing approximately 9% of the total Poesten Kill watershed (Table 2). From headwaters to the confluence with Poesten Kill, Bonesteel Creek is 8.7 km (5.7 mi) in length. The next major tributary to discharge to Poesten Kill is Newfoundland Creek. This tributary has a watershed area of 15.70 km^2 and comprises 6% of the total Poesten Kill watershed (Table 2). Newfoundland Creek has a total stream length of 5.8 km (3.6 mi). Less than a half mile downstream of where Newfoundland Creek enters Poesten Kill, the Quacken Kill joins the Poesten Kill (Fig. 9). Quacken Kill is the largest tributary to Poesten Kill, originating in the Town of Grafton and flowing a distance of 25.6 km (15.9 mi) to the confluence with Poesten Kill

(Table 2). The Quacken Kill watershed is 80.29 km^2 in area, comprising 32% of the total Poesten Kill watershed (Table 2). Of the major tributaries, Sweet Milk Creek is the most downstream tributary, discharging into the Poesten Kill in the Town of Brunswick (Fig. 9). Sweet Milk Creek is also the smallest of the major tributaries, descending a total length of 4.7 km (2.9 mi) to its confluence with Poesten Kill. Sweet Milk Creek has a total watershed area of 13.44 km^2, comprising 5% of the total Poesten Kill watershed (Table 2).

Table 2. Watershed statistics for the Poesten Kill mainstem and major tributaries.

Parameter[1]	Poesten Kill Mainstem	Bonesteel Creek	Newfoundl-and Creek	Quacken Kill Creek	Sweet Milk Creek
Length (km)	42.20	8.70	5.80	25.60	4.70
watershed Area (km^2)	249.42	22.56	15.70	80.29	13.44
% Poesten Kill Watershed	-	9%	6%	32%	5%
Coordinates at Confluence	-	42.67857 N, -73.52984 W	42.69963 N, -73.58001 W	42.70489 N, -73.58361 W	42.73456 N, -73.62947 W
Municipality @ Discharge Point	Troy	Poestenkill	Poestenkill	Poestenkill	Brunswick
Municipality @ Headwater Point	Berlin	Grafton	Sand Lake	Grafton	Brunswick
Mean Bankfull Depth (m)	1.32	0.80	0.74	1.04	0.72
mean Bankfull Width (m)	27.77	13.78	12.37	19.93	11.83
mean Bankfull Flow (m^3/s)	52.67	10.31	8.07	24.44	7.25

[1]Bankfull estimates were obtained from the USGS Program, StreamStats.

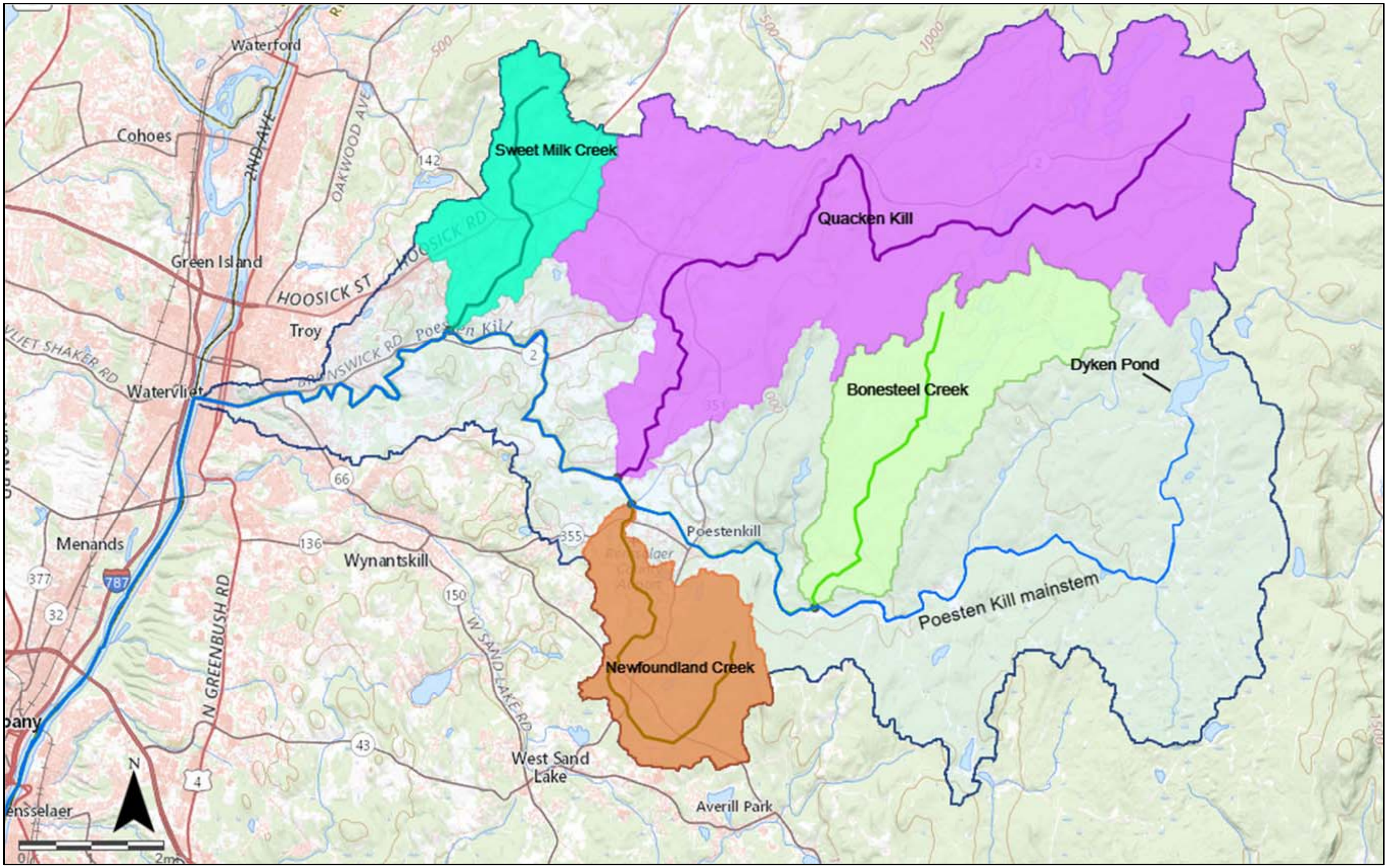

Figure 9. Major subwatersheds of the Poesten Kill watershed.

Part of the historical prominence of the Poesten Kill for early settlers through to the industrial revolution was the power generated by the significant change in elevation, descending approximately 1600 feet from the headwaters to the outfall at the Hudson River, and the presence of several prominent waterfalls. Power generated by the steep descent was harnessed via dams, raceways, turbines, waterwheels, and hydroelectric power (Warren 2009). There are four major waterfalls on Poesten Kill: Mount Ida Falls (Poesten Kill High Falls), Barberville Falls (Fig. 10), Eagle Mill Falls, and Buttermilk Falls (Warren 2009) (Table 3).

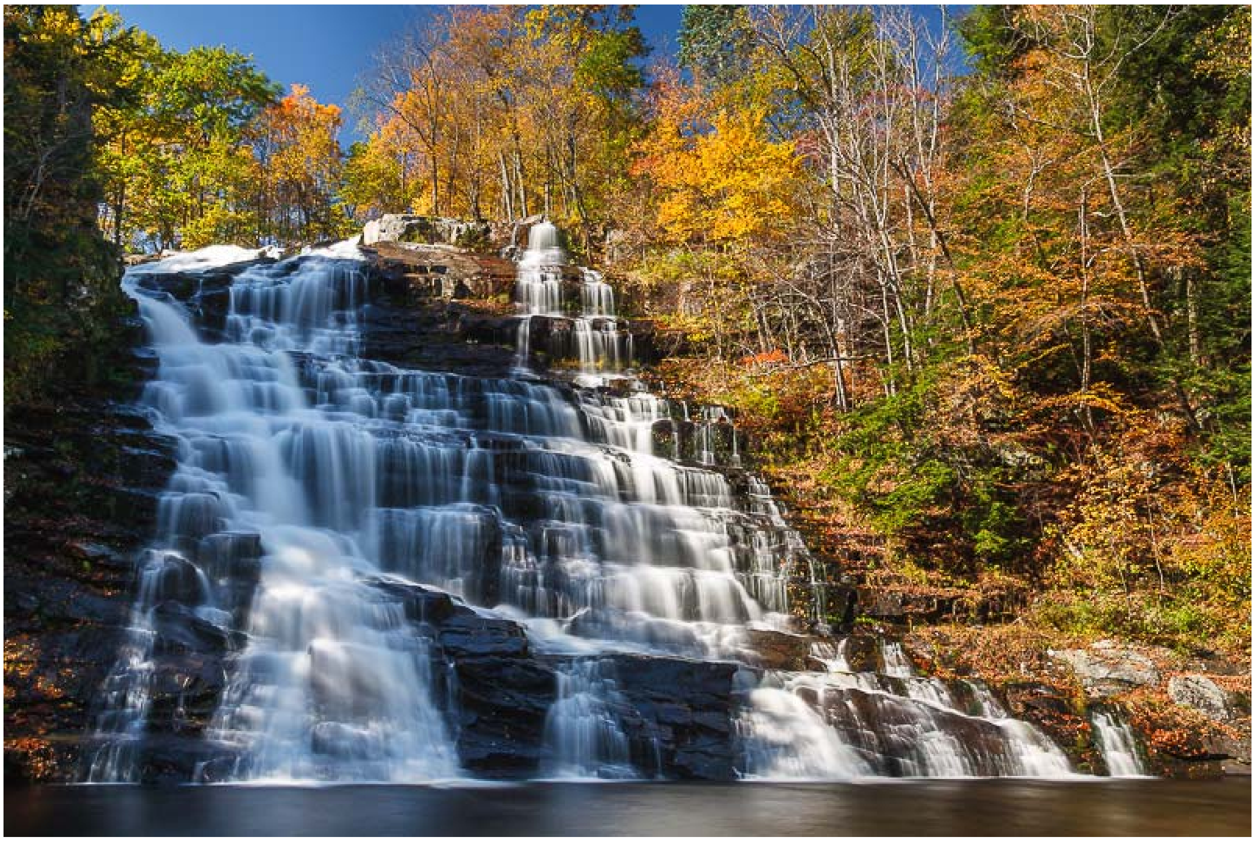

Figure 10. Barberville Falls, located in Poestenkill, NY. This is one of five major waterfalls on the Poesten Kill. (Image obtained from: World Waterfall Database)

Table 3. Major waterfalls on the Poesten Kill. Information obtained from worldwaterfalldatabase.com.

Waterfall	Municipality	GPS Coordinates	Total Height (ft)	Tallest Drop (ft)	Average Width (ft)	Maximum Width (ft)
Barberville Falls	Poestenkill	42.6845N, -73.5399W	92	92	70	95
Eagle Mills Falls	Brunswick	42.72948N, -73.6030W	Information not available			
Buttermilk Falls	Brunswick	Information not available				
Mount Ida Falls (Poesten Kill High Falls)	Troy	42.7214N, -73.6778W	120	30	15	50

IV. Water Usage, Management & Quality

An understanding of how surrounding towns and cities utilize the Poesten Kill is incredibly important to developing a holistic understanding of stream health and the compounding factors that have/could be impairing ecological integrity, recreational opportunities, and restoration and conservation efforts throughout the watershed.

a. Dams

One of the earliest and most notable impacts to the ecological integrity of the Poesten Kill was the presence of dams. After European settlement, dozens of dams were constructed in the Poesten Kill for powering various industries, such as sawmills (Warren 2009). From an ecological perspective, dams significantly affect streams and rivers; altering natural flow regimes, affecting sediment transport, decreasing water quality (e.g., increased temperatures, low dissolved oxygen, increased algae production and sediment retention), impede migration of aquatic organisms, and facilitate the invasion of invasive species (Collier et al. 2000, internationalrivers.org). From a human perspective, dams can affect the aesthetic and recreational value of a stream system. Perhaps even more importantly, however, aging dam structures present the risk for failures; increasing flooding risks and damage to downstream communities.

Specifically, dam failures can be characterized by any breakdown, collapse, or failure of a dam structure that results in an uncontrolled release of impounded water that causes downstream flooding. The NYSDEC classifies dams by their level of hazard if breached. The classifications are:

- Class C - "High Hazard"
- Class B - "Moderate Hazard"
- Class A - "Low Hazard", and
- Class D - "Negligible or No Hazard".

As of 2011, there were 96 total dams recognized in Rensselaer County and 4 locks in Saratoga County that would affect the Rensselaer county side of the Hudson River if they were breached or failed. Of these 100 dams/locks, 10 were classified as Class C, 17 as Class B, 48 as Class A, and 21 as Class D. Of a subset of 28 dams classified as either Class C or B, 18 are located within the Poestenkill watershed. Of those 18, only one is found on the Poestenkill, which is the Dyken Pond Dam where the Poestenkill begins.

In relation to failures, the USGS describes "major dams" as ones which would have the most significant consequences if they were to fail. These dams are characterized by being greater than or equal to 50 feet tall, or with a storage capacity of greater than or equal to 5,000 acre-feet (the amount of water needed to cover one acre of land to a depth of one foot, or approximately 326,000 gallons), or with a maximum storage capacity of greater than or equal to 25,000 acre-feet. Rensselaer county has 4 of these dams, two of which are in the Poestenkill watershed. The Poesten Kill dams are the Bradley Lake Dam located in the City of Troy on the Piscawan Kill, and the Martin Dunham Reservoir Dam in the town of Grafton on the Quacken Kill. One of the other two dams not in the Poesten Kill is the Tomhannock Reservoir Dam in the towns of Pittstown and Schaghticoke along the Tomhannock Creek. This dam is owned by the City of Troy and is a major drinking water supply to the residents in the Poestenkill watershed. Also, this is the only "major dam" that meets the 3 requirements listed by the USGS.

The probability of dam failures in Rensselaer County have been reported to be low due to historical records, but the probability will only increase as the age of these dams increases. The NYSDEC routinely inspects, repairs, and maintains these dams, but there may come a time where reconstruction is needed. Also, the state suffers from decreased cooperation from dam owners. There are 5 dams within the Poestenkill watershed that have the potential to cause a collective total of $701,708,880 in damage across the towns of Grafton, Poestenkill, Brunswick, and the City of Troy, if all dams were to fail at once (URS 2011).

The only dam failure reported on the Poesten Kill, attributed to structural deterioration (as opposed to flooding-induced dam failure), was the Mt. Ida Dam (located in the City of Troy immediately upstream of Pawling Avenue) on June 18th, 1997 (Fig. 11). The failure was attributed to a failed drain which had been caused by age and deterioration. The breach was reported to be 4 feet wide by 6 feet high and resulted in severe sedimentation to the Poesten Kill. Today, the Mt. Ida Dam remains problematic. An emergency inspection of the dam in 2018 found the dam to be structurally unsound; requiring a section of dam be removed in order to alleviate the structural impacts while options for complete removal or rebuilding were being considered. As of June 2019, during the second ecological survey performed by OEI, the dam was still in place. By August 2019, parts of the dam were removed, and the impoundment created by the dam, Ida Lake, was lowered as a result.

Figure 11. Mt. Ida Dam, located on the Poesten Kill in Troy, NY. (Photo credit: OEI)

b. Flooding

Flooding becomes an issue for municipalities as streams are channelized, terrestrial buffers (i.e., wetlands, vegetative plots, riparian vegetation, etc.) are cleared for development, and the amount of impervious surface (e.g., roads, parking lots, etc.) increases. In the Poesten Kill watershed, flooding has been a common occurrence for residents for more than a century, with some of the earliest records dating back to the 1850's (Warren 2009). Historically, flooding occurred during spring runoff; caused by high flows and ice jams. Just as dam failures can cause flooding, flooding can cause dam failures. This has happened multiple times at various dams in the Poesten Kill, including mill ponds in the lower Poesten Kill in the 1940's and 1950's and the dam at Bonesteel Pond in 1890 (Warren 2009).

When it comes to dealing with flooding, there are three main flooding categories made by the Federal Emergency Management Agencies (FEMA) National Flood Insurance Program (NFIP). These are:

- Riverine Flooding: flooding that occurs along a channel,
- Coastal Flooding: flooding that occurs along coasts, the Gulf of Mexico, or large lakes, and
- Shallow Flooding: flooding that occurs in flat areas where a lack of channels means water cannot drain away easily.

The main types of flooding in Rensselaer County are Riverine Flooding and Shallow Flooding; Shallow Flooding being attributed to urban drainage issues and occasional ice jams.

The lowland areas are the places at greatest risk for flooding. Across all municipalities in the Poestenkill watershed, 81-97% of the land is in a low-risk flooding area. The City of Troy represented the highest risk with 15% of the land within a high-risk flooding area. Within high-risk flooding areas, the collective monetary amount of assessed property value that had the potential to be damaged totaled $481,921,512 in 2011 (URS 2011). Since the 1970's, the Poestenkill watershed municipalities have received a total of $514,437 from the NFIP for flood damages. This value represents approximately 35% of the total amount of money paid to Rensselaer County by the NFIP (URS 2011).

c. Water Supply & Usage

The Poesten Kill is not used as a drinking water source. The Towns of Poestenkill, Brunswick, and North Greenbush buy wholesale water from the City of Troy via the Tomhannock Reservoir. The City of Troy is supplied with water from the Tomhannock Reservoir as well. Except for the eastern portion of Brunswick, which supplies water via individual drinking water wells (water quality unknown), all municipalities reported overall good drinking water quality on their most recent (2018) water quality reports (COT 2018, TOB 2018, TONG 2018, TOP 2018). However, several violations were reported by municipalities. The Towns of Poestenkill, North Greenbush, and the City of Troy violated Trihalomethane levels. Trihalomethanes are a by-product of the chlorination process, which is used to disinfect drinking water by killing bacteria and can be harmful to health in high concentrations (WHO 2005). In addition, the Town of Brunswick violated Lead, Copper, and Nitrate regulations; however, violations do not appear to be due to contamination, but rather were attributed to errors in sampling procedure (TOB 2018).

d. Wastewater Treatment

Wastewater treatment in the Poesten Kill watershed is a combination of private septic systems and municipal sewage conveyance to a treatment plant. Wastewater from the Towns of North Greenbush, Sand Lake, and western Brunswick, and the City of Troy is transported to the Rensselaer County Wastewater Treatment plant via municipal sewer lines, where it is treated before being discharged into the Hudson River (RC 2015b, TOB 2013). The eastern part of Brunswick primarily relies on private septic disposal systems for generated wastewater (TOB 2013).

Combined Sewer Overflows (CSO's) were prolific during the early development of municipal sewage conveyance systems, particularly in the Northeastern United States. CSOs are systems that connect both sewage and stormwater pipes. During periods of low flow, sewage is transported to a treatment plant. During periods of high flow, stormwater and sewage become combined in the CSOs, causing an inundation of the system that cannot be handled by the sewage treatment system. As a result, sewage-contaminated stormwater discharges into waterbodies (e.g., lakes, rivers, streams) before treatment, causing significant impairments to water quality; which can pose severe human health hazards and impair the recreational and aesthetic value of waters that receive CSO outfalls. While state and federal agencies have worked closely with municipalities as part of the Municipal Separate Storm Sewer System (MS4) programs (USEPA 2019a) in recent decades to reduce the number of CSO discharges, CSOs remain problematic; in part due to urban expansion, aging infrastructure, reductions in the extent and number of natural storage systems (e.g., wetlands), and climate change (please see below).

The City of Troy has 49 designated CSO outfalls that discharge into the Hudson River. Of those 49, there are seven CSO outfalls north and three CSO outfalls south that are within one mile of where the Poestenkill discharges into the Hudson River. Based off modeling completed in 2010, Troy was estimated to have 4,407 acres of contributing combined sewer area that conveyed 447.3 million gallons of CSO discharge to the Hudson River (APJVT 2010). The annual overflow frequency for a given CSO outfall ranged from 6-65 events per year with discharge volumes ranging from 0.1-55.2 million gallons per year (APJVT 2010). While no CSOs discharge directly into the Poesten Kill, the lower Poesten Kill watershed is partly within the City of Troy's sewershed. Aging infrastructure and potential backflow into Poesten Kill from the Hudson River during CSO events have the potential to impair water quality in the lower reaches of Poesten Kill. Furthermore, direct water quality impairments to the Hudson River could impact populations of aquatic organisms (e.g., eel) that utilize the Poesten Kill during key stages of their life history.

The Towns of Poestenkill, Sand Lake, Brunswick, and North Greenbush, as well as the City of Troy are part of the Rensselaer MS4 community. Being part of the MS4 community entails that each member must comply with the NYSDEC's State Pollution Elimination Discharge System (SPDES) permit requirements by way of the United States Environmental Protection Agencies (USEPA) Phase II Stormwater requirements. Compliance requires each member to implement stormwater management programs which incorporate six minimum control measures. These minimum control measures are:

1) Public Education and Outreach,
2) Public Participation and Involvement,
3) Illicit Discharge Detection and Elimination,
4) Construction Site Run-Off and Control,
5) Post Construction Site Run-Off and Control, and
6) Pollution Prevention and Good Housekeeping for Municipal Operations (RC 2015a).

Additionally, these municipalities have local regulations in place to mitigate erosion and sedimentation issues that could ultimately impair water quality and habitat condition in the Poesten Kill (COT 2008, TOB 2007, TONG 2008, TOP 2008, TOP 2019, TOSL 2007). These local regulations are in place to meet the requirements of the SPDES permit, as it relates to erosion and sedimentation.

e. Water Quality Surveys

The NYSDEC Stream Biomonitoring Unit (SBU) performs routine surveys of streams and rivers throughout the state on a 5-year rotation; performing assessments of *in-situ* water quality, physical habitat, and macroinvertebrate community structure. The collective results of those analyses are used to determine a quantitative measure of water quality, known as the Biological Assessment Profile (BAP) (Duffy et al. 2018). Scores range from 0-10 and provide a categorical measure of stream condition (Fig. 12).

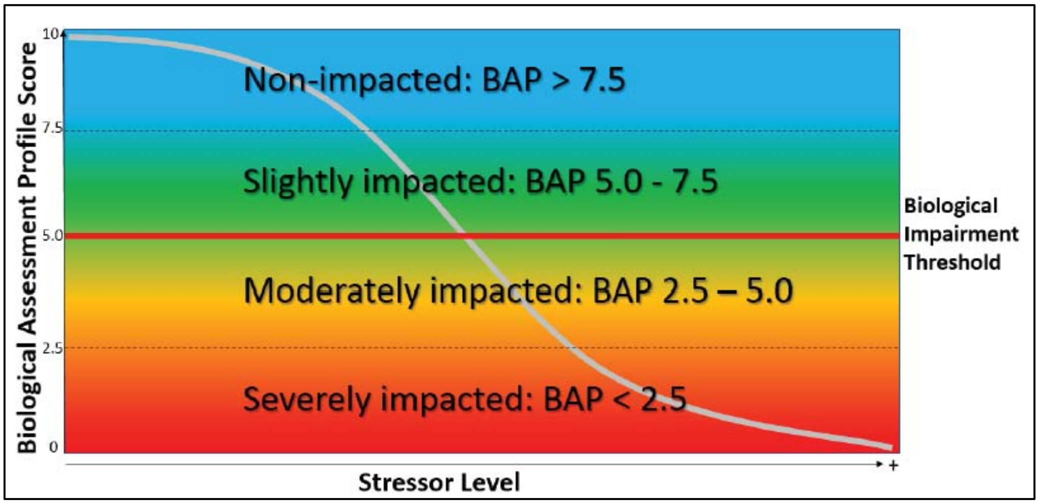

Figure 12. Biological Assessment Profile (BAP) ratings for assessing stream health (NYSDEC 2019b)

Several biological surveys have been conducted in the Poesten Kill watershed (mainstem and tributaries) by the NYSDEC SBU since 1992 (Bode et al. 2004). Limited surveys were performed in the Poesten Kill mainstem in 1992, 1998-1999, 2002, 2007-2008, and 2012-2013, with the most extensive survey conducted in 2001 (Table 4). Since 1992, biological sampling in the Poesten Kill has consistently indicated good water quality, with minimal impacts to stream health. BAP scores ranged between slightly impacted and non-impacted conditions (Fig. 13), with all locations above the biological impairment threshold (Fig. 12). The most upstream location surveyed by NYSDEC SBU has shown stream condition to fluctuate between non-impacted and slightly impacted conditions, with the 2013 survey showing a slight decrease in stream health from 2001, 2007, and 2012 surveys (Table 4). The change in stream condition at this site over the years was attributed to the predominance of nutrient-poor soils and decreased buffering capacity, resulting in lower pH levels (Bode et al. 2004). The most downstream location has also shown a fluctuation in stream health, with the initial survey in 1992 showing no impairment, surveys in 2001-2003 showing a slight decline in stream condition, and then again improving in 2007 (Table 4). Impacts to stream condition at this site were attributed to non-point source runoff and nutrient enrichment (Bode et al. 2004).

Table 4. NYSDEC SBU biotic assessments of water quality in the Poesten Kill mainstem (1992-2007). OEI sampling locations (2017, 2019) at, or in proximity to, NYSDEC sites are shown.

DEC Site	DEC Station ID[1]	OEI Site	1992	1998	1999	2001	2002	2003	2007	2008	2012	2013
Above East Poesten Kill, Route 40	735	~0.3 km downstream of #23	SI[2]	-	-	NI[1]	-	-	NI	-	NI	SI
East Poesten Kill, above bridge at intersection of Co. Rte 40 & 44	1641	#20	-	-	-	NI	-	-	-	-	-	-
Barberville, Route 79	736	#13	NI	-	-	NI	-	-	-	NI	-	-
Poestenkill, above Rte 351 bridge	1291	~2.9 km downstream of #13	-	-	NI	NI	-	-	-	-	-	-
Above Garfield Rd bridge (Poestenkill)	1642	#9	-	-	-	NI	-	-	-	-	-	-
Above Country Club Rd bridge, Troy	1644	~3.5 km upstream of #36	-	-	-	NI	-	-	-	-	-	-
Above Spring Ave bridge, Troy	737	#37	-	NI	-	SI	SI	SI	NI	-	-	-

[1]Station ID's correspond to Figure 13.

[2]SI = Slight impact; NI = Non-impact. Color designations correspond to Figure 12 & 13.

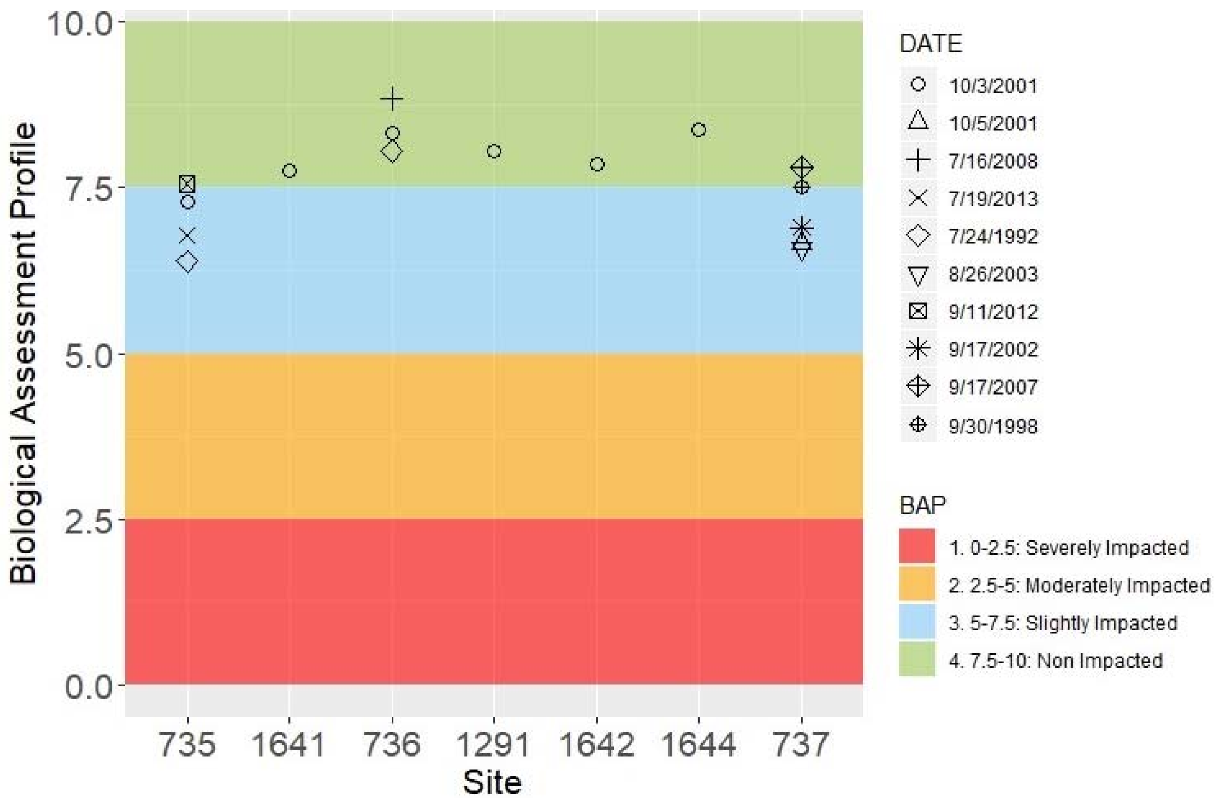

Figure 13. Macroinvertebrate Biological Assessment Profile (BAP) scores for Poesten Kill locations sampled by the NYSDEC (1992-2013). Sites are arranged in downstream order. Site descriptions are provided in Table 4.

Water quality impairments in the Poesten Kill watershed have been attributed to localized effects (e.g., runoff, natural conditions of the Rensselaer Plateau), as well as regional effects; as evidenced by the survey performed in 2007. In 2007, eight locations in the Poesten Kill watershed were assessed by the NYSDEC SBU, including two sites in the Poesten Kill mainstem, two sites in the Quacken Kill, one site at Mill Pond, one site at Forest Lake, and one site at Dunham Reservoir. Of those locations, six locations were determined to have "No Known Impact", and two were designated as "Impaired Segments". Both locations on the Poesten Kill, 150 m upstream of Spring St bridge (OEI sampling site #37) and Plank Rd (approximately 0.2 miles downstream of OEI site #23), did not have any known impacts to water quality (NYSDEC 2008). The two impaired segments were Dunham Reservoir, located in the town of Grafton, and Dyken Pond, located in the town of Berlin. It was determined that Dunham Reservoir was impaired by mercury contamination from atmospheric deposition. It was further stated that the source of the mercury laden deposition was unknown. The New York State Department of Health (NYSDOH) recommended that anglers not eat walleye or more than one smallmouth bass meal a month. The mercury levels in this reservoir were higher than most lakes in the region affected by mercury contamination. Due to this impairment, the reservoir was listed on the DEC's 303(d) List of Impaired Waters. Similarly, to Dunham Reservoir, Dyken Pond was also determined to be impaired by mercury contamination from atmospheric deposition of unknown origin; fish advisories were subsequently put into effect. The fish advisory included limiting smallmouth bass consumption to one meal per month. Dyken Pond is included on the 303(d) list, but there is consideration for delisting due to coverage under a TMDL (Total Maximum Daily Load) model (NYSDEC 2008).

V. Land use

Land use is the management and/or modification of natural landscapes for the purpose of human use and development. Terrestrial changes in land use can have profound, often deleterious, effects on aquatic systems (Wang et al. 1997). In 1991, the USGS determined that the lower Hudson was experiencing point and nonpoint source pollution of hazardous chemicals, nutrients, and salts attributed to urban and agricultural runoff. Acid rain was also determined to be affecting poorly buffered headwater streams and lakes (Freeman 1991).

In the Poesten Kill watershed, much of the landcover is natural, undisturbed habitat. The predominant land use in the Poesten Kill watershed is mixed forest, comprising nearly 42% of land cover (Fig. 14). The Poesten Kill exhibits a distinct rural-urban gradient, where the upper watershed is largely undeveloped, containing a mix of forest, open water, and wetland land uses (Fig. 14). At the approximate western boundary of the Rensselaer Plateau, land use changes from a predominance of forested land use to a predominance of agricultural land uses (hay/pasture, cultivated crops) (Fig. 14). The low-gradient, fertile soils of the middle Poesten Kill has made this a suitable area for farming for centuries (Warren 2009) and remains so today. While urban development in the Poesten Kill watershed represents < 10% of total land use, it is almost wholly concentrated in the lower Poesten Kill in the City of Troy (Fig. 14).

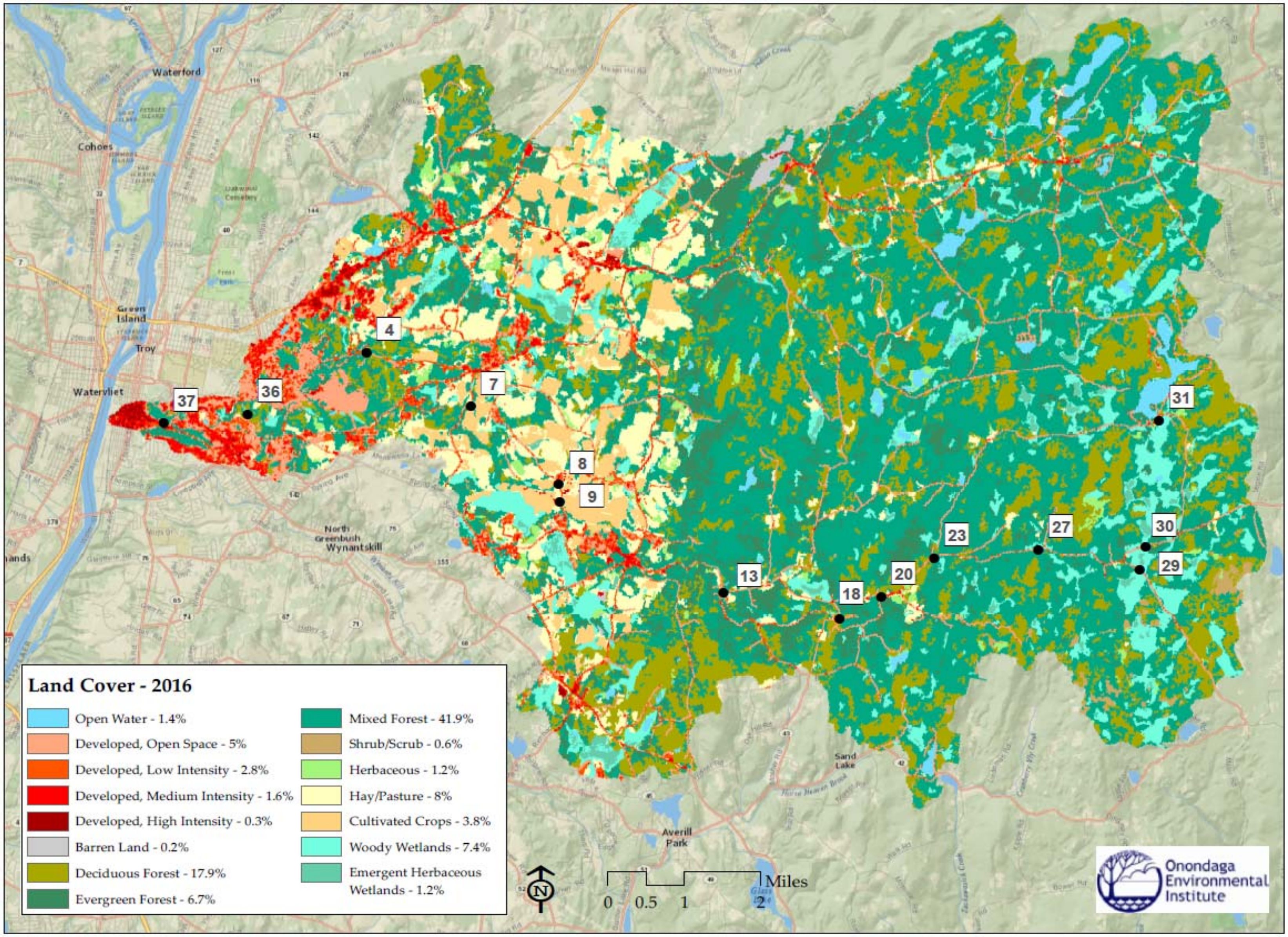

Figure 14. Land use in the Poesten Kill watershed. Land use was calculated from the 2016 National Land Cover Database (NLCD).

VI. Municipalities & Demographics

The Poesten Kill watershed falls within six municipalities (Fig. 15). The Towns of Berlin and Grafton are where Poesten Kill (and Quacken Kill) originate. The majority of the Poesten Kill mainstem is within the Town of Poesten Kill. Downstream of the confluence with the Quacken Kill, Poesten Kill flows into the Town of Brunswick. From Brunswick, Poesten Kill flows into the City of Troy, where it discharges to the Hudson River. Most of Poesten Kill flows through low population density areas, with all municipalities upstream of the City of Troy having densities of < 300 people/mi^2 (Table 5). Concurrent with land use, the Poesten Kill exhibits a distinct rural-urban gradient, with population densities increasing downstream. The median age of residents in each municipality also exhibits a rural-urban trend, with residents in rural locations having a higher median age. In the suburban and rural municipalities, upstream of Troy, the median age ranges between 43.5-49.4 years (Table 5). In the City of Troy, the median age is substantially lower, at 30.6 years (Table 5). These statistics could be useful for stakeholders interested in developing education and outreach programs in specific areas of the watershed. By understanding population demographics, such programs can be tailored in a manner that will most successfully engage residents.

Table 5. 2017 Census data for municipalities within the Poesten Kill watershed. These statistics are not exclusively within the Poesten Kill watershed boundary, but rather for the entire municipality.

2017 Census Data	**Town/City**					
Variable	Berlin	Grafton	Poestenkill	Sand Lake	Brunswick	Troy[1]
Total Population	1,565	2,438	4,508	8,476	12,499	49,881
Population Density (people/mi^2)	26	55	139	242	282	4,816
2010-2017 Population Change (%)	-16.80%	14.50%	-0.50%	-0.60%	4.70%	-0.50%
Median Age	49.4	45.1	43.5	45	47.5	30.6
Median Age: Male	50.1	44	44.2	44.6	46.9	29
Median Age: Female	48.7	46.8	42.6	45.4	48.2	32.1

[1]Troy numbers are based off 2016 data. Towncharts.com data.

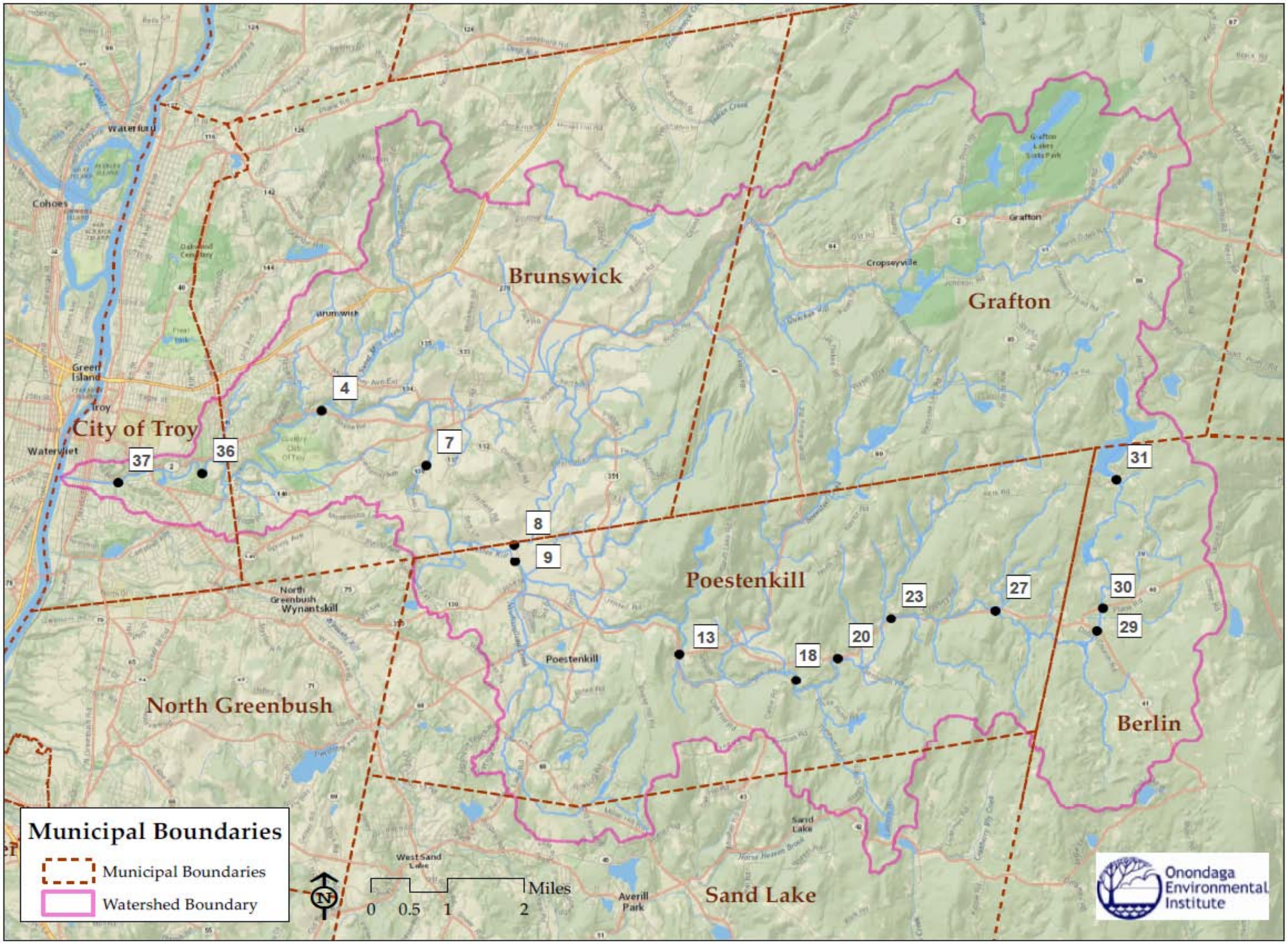

Figure 15. Municipalities within the Poesten Kill watershed.

VII. Climate change impacts

The effects of climate change are being felt all around the globe, and the Northeast United States is no exception. With the topics of geology, hydrology, water usage, and land use previously discussed, it is, therefore, important to understand how climate change could impact these variables; ultimately affecting future planning, conservation, restoration, and management efforts in the Poesten Kill watershed. As the effects of climate change persist, the amount of precipitation in the Northeastern United States is predicted to increase; including increases in the frequency, intensity, and duration of precipitation events; all of which are being observed today. Between 1958 and 2012, the amount of precipitation that fell during individual heavy rain events increased by 70%; more than any other region in the United States (USEPA 2019b). Notably, increases in large precipitation events during the spring and winter months, in combination with higher temperatures that will accelerate snow melt, have the potential to exacerbate drought conditions in the summer by increasing rates of evaporation (USEPA 2019b).

With such changes already occurring in the Northeast, and the predicted increase in such extreme weather, it will be important for future endeavors in the Poesten Kill to build climate resiliency into such projects. The NYSDEC has a climate change program for the Hudson River estuary that works to provide educational information and funding for communities to bolster climate resiliency (NYSDEC 2019). This program can serve as a valuable resource for stakeholders and municipalities in the Poesten Kill watershed seeking to implement projects that also improve climate resiliency.

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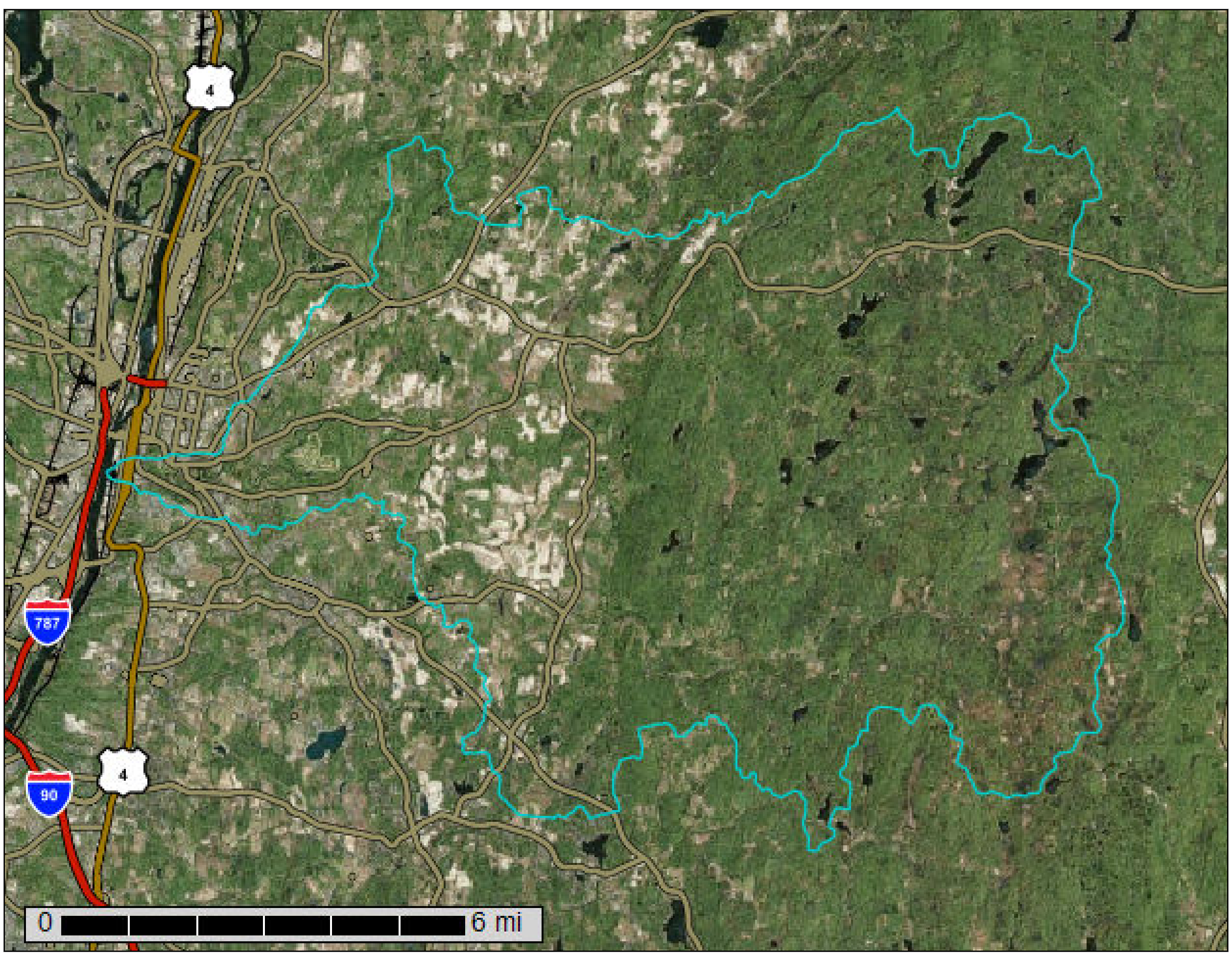
United States Department of Agriculture

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Rensselaer County, New York

Poesten Kill Soils Report



October 14, 2019

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

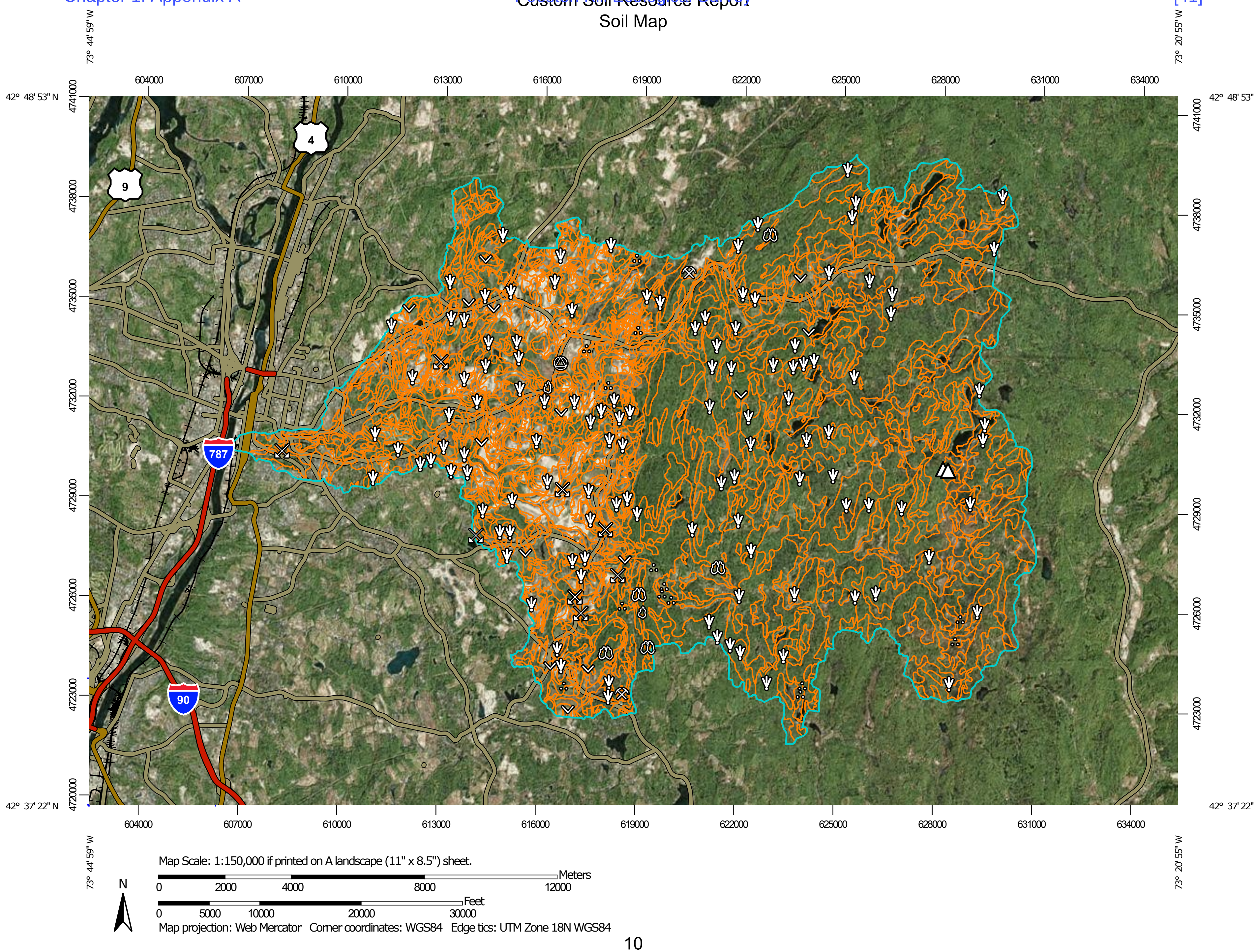
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Rensselaer County, New York
Survey Area Data: Version 16, Sep 16, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jan 1, 1999—Dec 31, 2003

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AlB	Albrights silt loam, 3 to 8 percent slopes	280.2	0.5%
AlC	Albrights silt loam, 8 to 15 percent slopes	599.0	1.0%
AlD	Albrights silt loam, 15 to 25 percent slopes	258.4	0.4%
AmC	Albrights very stony silt loam, 3 to 15 percent slopes	300.9	0.5%
AmD	Albrights very stony silt loam, 15 to 40 percent slopes	691.6	1.1%
AnA	Alden silt loam, 0 to 3 percent slopes	762.9	1.2%
AoA	Alden very stony silt loam, 0 to 3 percent slopes	19.5	0.0%
BeB	Bernardston gravelly silt loam, 3 to 8 percent slopes	136.5	0.2%
BeC	Bernardston gravelly silt loam, 8 to 15 percent slopes	659.5	1.1%
BeD	Bernardston gravelly silt loam, 15 to 25 percent slopes	2,895.4	4.7%
BeE	Bernardston gravelly silt loam, 25 to 35 percent slopes	343.2	0.6%
BfC	Bernardston very stony silt loam, 3 to 15 percent slopes	7.4	0.0%
BfD	Bernardston very stony silt loam, 15 to 40 percent slopes	44.2	0.1%
BnB	Bernardston-Nassau complex, undulating	533.6	0.9%
BnC	Bernardston-Nassau complex, rolling	1,328.8	2.2%
BnD	Bernardston-Nassau complex, hilly	233.7	0.4%
BrA	Brayton very stony silt loam, nearly level	4,756.6	7.7%
BuC	Buckland very stony loam, sloping	16,047.9	26.0%
BuD	Buckland very stony loam, moderately steep	7,167.1	11.6%
BuF	Buckland very stony loam, very steep	136.8	0.2%
CaA	Catden muck, 0 to 2 percent slopes	670.4	1.1%
CbA	Castile gravelly silt loam, 0 to 5 percent slopes	250.8	0.4%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
ChB	Chenango very gravelly loam, 3 to 8 percent slopes	33.5	0.1%
CkB	Chenango gravelly loam, fan, 3 to 8 percent slopes	150.0	0.2%
Du	Dumps, landfill	8.0	0.0%
ElB	Elmridge very fine sandy loam, 3 to 8 percent slopes	56.1	0.1%
FlA	Fluvaquents-Udifluvents complex, 0 to 3 percent slopes	1,161.2	1.9%
FrA	Fredon silt loam, 0 to 4 percent slopes	255.9	0.4%
GlC	Glover very stony loam, very rocky, sloping	2,739.2	4.4%
GlD	Glover very stony loam, very rocky, moderately steep	4,192.3	6.8%
GmF	Glover-Rock outcrop complex, very steep	795.6	1.3%
HaA	Hamlin silt loam, 0 to 3 percent slopes	149.0	0.2%
HbA	Haven silt loam, 0 to 3 percent slopes	81.4	0.1%
HbB	Haven silt loam, 3 to 8 percent slopes	18.0	0.0%
HoA	Hoosic gravelly sandy loam, 0 to 3 percent slopes	177.1	0.3%
HoB	Hoosic gravelly sandy loam, 3 to 8 percent slopes	1,075.2	1.7%
HoC	Hoosic gravelly sandy loam, rolling	809.8	1.3%
HoD	Hoosic gravelly sandy loam, hilly	754.6	1.2%
HoE	Hoosic gravelly sandy loam, steep	210.2	0.3%
HuC	Hudson silt loam, 8 to 15 percent slopes	17.4	0.0%
HuD	Hudson silt loam, hilly	5.2	0.0%
HuE	Hudson silt loam, steep	190.4	0.3%
LmA	Limerick silt loam, 0 to 3 percent slopes	401.3	0.7%
LoA	Loxley and Beseman mucks, 0 to 1 percent slopes	960.0	1.6%
MbA	Madalin silt loam, 0 to 3 percent slopes	11.8	0.0%
NaB	Nassau-Manlius complex, undulating	330.5	0.5%
NaC	Nassau-Manlius complex, rolling	1,690.0	2.7%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
NrC	Nassau-Rock outcrop, complex, rolling	238.5	0.4%
NrD	Nassau-Rock outcrop complex, hilly	1,242.1	2.0%
NtA	Natchaug muck, 0 to 2 percent slopes	42.8	0.1%
Pg	Pits, gravel	50.1	0.1%
PtB	Pittstown gravelly silt loam, 3 to 8 percent slopes	1,073.7	1.7%
PtC	Pittstown gravelly silt loam, 8 to 15 percent slopes	2,060.6	3.3%
RaA	Raynham silt loam, 0 to 5 percent slopes	62.2	0.1%
RkA	Riverhead fine sandy loam, 0 to 3 percent slopes	7.2	0.0%
RkB	Riverhead fine sandy loam, 3 to 8 percent slopes	145.6	0.2%
RkC	Riverhead fine sandy loam, rolling	14.5	0.0%
Sa	Saprists and Aquents, ponded	180.2	0.3%
ScB	Scio very fine sandy loam, 3 to 8 percent slopes	11.6	0.0%
SrA	Scriba silt loam, 0 to 3 percent slopes	17.4	0.0%
SrB	Scriba silt loam, 3 to 8 percent slopes	538.6	0.9%
StB	Scriba very stony silt loam, 3 to 8 percent slopes	8.5	0.0%
TeA	Teel silt loam, 0 to 3 percent slopes	425.5	0.7%
Ud	Udorthents, loamy	134.0	0.2%
Ur	Urban land	113.8	0.2%
W	Water	895.7	1.5%
WnC	Windsor loamy sand, 8 to 15 percent slopes	4.8	0.0%
Totals for Area of Interest		**61,665.4**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Rensselaer County, New York

AlB—Albrights silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9v0x
Elevation: 500 to 1,500 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Albrights and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Albrights

Setting

Landform: Till plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Loamy till or colluvium derived from reddish shale, siltstone, and fine-grained sandstone

Typical profile

H1 - 0 to 9 inches: silt loam
H2 - 9 to 19 inches: channery silty clay loam
H3 - 19 to 60 inches: channery silt loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 18 to 30 inches to fragipan
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Pittstown

Percent of map unit: 5 percent
Hydric soil rating: No

Scriba

Percent of map unit: 5 percent
Hydric soil rating: No

Bernardston

Percent of map unit: 5 percent
Hydric soil rating: No

Albrights, gravelly surface

Percent of map unit: 3 percent
Hydric soil rating: No

Nassau

Percent of map unit: 2 percent
Hydric soil rating: No

AlC—Albrights silt loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 9v0y
Elevation: 500 to 1,500 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Albrights and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Albrights

Setting

Landform: Till plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Loamy till or colluvium derived from reddish shale, siltstone, and fine-grained sandstone

Typical profile

H1 - 0 to 9 inches: silt loam
H2 - 9 to 19 inches: channery silty clay loam
H3 - 19 to 60 inches: channery silt loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 18 to 30 inches to fragipan
Natural drainage class: Moderately well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Bernardston

Percent of map unit: 5 percent
Hydric soil rating: No

Pittstown

Percent of map unit: 3 percent
Hydric soil rating: No

Scriba

Percent of map unit: 3 percent
Hydric soil rating: No

Albrights, gravelly surface

Percent of map unit: 2 percent
Hydric soil rating: No

Nassau

Percent of map unit: 2 percent
Hydric soil rating: No

AlD—Albrights silt loam, 15 to 25 percent slopes

Map Unit Setting

National map unit symbol: 9v0z
Elevation: 500 to 1,500 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition

Albrights and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Albrights

Setting

Landform: Till plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Loamy till or colluvium derived from reddish shale, siltstone, and fine-grained sandstone

Typical profile

H1 - 0 to 9 inches: silt loam
H2 - 9 to 19 inches: channery silty clay loam
H3 - 19 to 60 inches: channery silt loam

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 18 to 30 inches to fragipan
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Unnamed soils, steep

Percent of map unit: 5 percent
Hydric soil rating: No

Bernardston

Percent of map unit: 5 percent
Hydric soil rating: No

Albrights, gravelly surface

Percent of map unit: 3 percent
Hydric soil rating: No

Nassau

Percent of map unit: 2 percent
Hydric soil rating: No

AmC—Albrights very stony silt loam, 3 to 15 percent slopes

Map Unit Setting

National map unit symbol: 9v10
Elevation: 800 to 1,500 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition

Albrights, very stony, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Albrights, Very Stony

Setting

Landform: Till plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Loamy till or colluvium derived from reddish shale, siltstone, and fine-grained sandstone

Typical profile

H1 - 0 to 9 inches: silt loam
H2 - 9 to 19 inches: channery silty clay loam
H3 - 19 to 60 inches: channery silt loam

Properties and qualities

Slope: 8 to 15 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 18 to 30 inches to fragipan
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Manlius

Percent of map unit: 5 percent
Hydric soil rating: No

Bernardston

Percent of map unit: 5 percent
Hydric soil rating: No

Pittstown

Percent of map unit: 5 percent
Hydric soil rating: No

Albrights, non-stony

Percent of map unit: 3 percent
Hydric soil rating: No

Nassau

Percent of map unit: 2 percent
Hydric soil rating: No

AmD—Albrights very stony silt loam, 15 to 40 percent slopes

Map Unit Setting

National map unit symbol: 9v11
Elevation: 800 to 1,500 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition

Albrights, very stony, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Albrights, Very Stony

Setting

Landform: Till plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Loamy till or colluvium derived from reddish shale, siltstone, and fine-grained sandstone

Typical profile

H1 - 0 to 9 inches: silt loam
H2 - 9 to 19 inches: channery silty clay loam

H3 - 19 to 60 inches: channery silt loam

Properties and qualities

Slope: 15 to 25 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 18 to 30 inches to fragipan
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Manlius

Percent of map unit: 5 percent
Hydric soil rating: No

Bernardston

Percent of map unit: 5 percent
Hydric soil rating: No

Pittstown

Percent of map unit: 5 percent
Hydric soil rating: No

Albrights, non-stony

Percent of map unit: 3 percent
Hydric soil rating: No

Nassau

Percent of map unit: 2 percent
Hydric soil rating: No

AnA—Alden silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 9v12
Elevation: 300 to 1,500 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition

Alden and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Alden

Setting

Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: A silty mantle of local deposition overlying loamy till

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 40 inches: silty clay loam
H3 - 40 to 60 inches: gravelly silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.57 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: High (about 9.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: C/D
Hydric soil rating: Yes

Minor Components

Scriba

Percent of map unit: 8 percent
Hydric soil rating: No

Nassau

Percent of map unit: 5 percent
Hydric soil rating: No

Alden, mucky surface

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Fluvaquents

Percent of map unit: 2 percent
Landform: Flood plains
Hydric soil rating: Yes

AoA—Alden very stony silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 9v13
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition

Alden, very stony, and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Alden, Very Stony

Setting

Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: A silty mantle of local deposition overlying loamy till

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 40 inches: silty clay loam
H3 - 40 to 60 inches: gravelly silt loam

Properties and qualities

Slope: 0 to 3 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.57 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: High (about 9.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C/D
Hydric soil rating: Yes

Minor Components

Scriba
Percent of map unit: 10 percent
Hydric soil rating: No

Alden, mucky surface
Percent of map unit: 8 percent
Landform: Depressions
Hydric soil rating: Yes

Nassau
Percent of map unit: 5 percent
Hydric soil rating: No

Fluvaquents
Percent of map unit: 2 percent
Landform: Flood plains
Hydric soil rating: Yes

BeB—Bernardston gravelly silt loam, 3 to 8 percent slopes

Map Unit Setting
National map unit symbol: 9v14
Elevation: 0 to 1,000 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: All areas are prime farmland

Map Unit Composition
Bernardston and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bernardston

Setting
Landform: Hills, till plains, drumlinoid ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy, acid, dense till derived mainly from phyllite, shale, slate, and schist

Typical profile
H1 - 0 to 8 inches: gravelly silt loam
H2 - 8 to 30 inches: gravelly loam
H3 - 30 to 60 inches: gravelly loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 15 to 30 inches to densic material
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Manlius

Percent of map unit: 5 percent
Hydric soil rating: No

Albrights

Percent of map unit: 5 percent
Hydric soil rating: No

Pittstown

Percent of map unit: 5 percent
Hydric soil rating: No

Scriba

Percent of map unit: 5 percent
Hydric soil rating: No

Nassau

Percent of map unit: 3 percent
Hydric soil rating: No

Bernardston, very stony

Percent of map unit: 2 percent
Hydric soil rating: No

BeC—Bernardston gravelly silt loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 9v15
Elevation: 0 to 1,000 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Bernardston and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bernardston

Setting

Landform: Till plains, drumlinoid ridges, hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy, acid, dense till derived mainly from phyllite, shale, slate, and schist

Typical profile

H1 - 0 to 8 inches: gravelly silt loam
H2 - 8 to 30 inches: gravelly loam
H3 - 30 to 60 inches: gravelly loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 15 to 30 inches to densic material
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Pittstown

Percent of map unit: 5 percent
Hydric soil rating: No

Albrights

Percent of map unit: 3 percent
Hydric soil rating: No

Manlius

Percent of map unit: 3 percent
Hydric soil rating: No

Scriba

Percent of map unit: 3 percent
Hydric soil rating: No

Nassau

Percent of map unit: 2 percent

Hydric soil rating: No

Bernardston, very stony

Percent of map unit: 2 percent
Hydric soil rating: No

Bernardston, eroded

Percent of map unit: 2 percent
Hydric soil rating: No

BeD—Bernardston gravelly silt loam, 15 to 25 percent slopes

Map Unit Setting

National map unit symbol: 9v16
Elevation: 0 to 1,000 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition

Bernardston and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bernardston

Setting

Landform: Hills, till plains, drumlinoid ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy, acid, dense till derived mainly from phyllite, shale, slate, and schist

Typical profile

H1 - 0 to 8 inches: gravelly silt loam
H2 - 8 to 30 inches: gravelly loam
H3 - 30 to 60 inches: gravelly loam

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 15 to 30 inches to densic material
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Manlius

Percent of map unit: 5 percent
Hydric soil rating: No

Pittstown

Percent of map unit: 5 percent
Hydric soil rating: No

Nassau

Percent of map unit: 3 percent
Hydric soil rating: No

Albrights

Percent of map unit: 3 percent
Hydric soil rating: No

Bernardston, very stony

Percent of map unit: 2 percent
Hydric soil rating: No

Bernardston, eroded

Percent of map unit: 2 percent
Hydric soil rating: No

BeE—Bernardston gravelly silt loam, 25 to 35 percent slopes

Map Unit Setting

National map unit symbol: 9v17
Elevation: 0 to 1,000 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition

Bernardston and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bernardston

Setting

Landform: Drumlinoid ridges, hills, till plains
Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy, acid, dense till derived mainly from phyllite, shale, slate, and schist

Typical profile

H1 - 0 to 8 inches: gravelly silt loam
H2 - 8 to 30 inches: gravelly loam
H3 - 30 to 60 inches: gravelly loam

Properties and qualities

Slope: 25 to 35 percent
Depth to restrictive feature: 15 to 30 inches to densic material
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Nassau

Percent of map unit: 5 percent
Hydric soil rating: No

Albrights

Percent of map unit: 5 percent
Hydric soil rating: No

Manlius

Percent of map unit: 5 percent
Hydric soil rating: No

Bernardston, eroded

Percent of map unit: 3 percent
Hydric soil rating: No

Bernardston, very stony

Percent of map unit: 2 percent
Hydric soil rating: No

BfC—Bernardston very stony silt loam, 3 to 15 percent slopes

Map Unit Setting

National map unit symbol: 9v18
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition

Bernardston, very stony, and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bernardston, Very Stony

Setting

Landform: Drumlinoid ridges, hills, till plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy, acid, dense till derived mainly from phyllite, shale, slate, and schist

Typical profile

H1 - 0 to 8 inches: gravelly silt loam
H2 - 8 to 30 inches: gravelly loam
H3 - 30 to 60 inches: gravelly loam

Properties and qualities

Slope: 8 to 15 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 15 to 30 inches to densic material
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 6 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Pittstown
Percent of map unit: 5 percent
Hydric soil rating: No

Scriba
Percent of map unit: 5 percent
Hydric soil rating: No

Albrights
Percent of map unit: 5 percent
Hydric soil rating: No

Manlius
Percent of map unit: 5 percent
Hydric soil rating: No

Nassau
Percent of map unit: 3 percent
Hydric soil rating: No

Bernardston, extremely stony
Percent of map unit: 2 percent
Hydric soil rating: No

BfD—Bernardston very stony silt loam, 15 to 40 percent slopes

Map Unit Setting
National map unit symbol: 9v19
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition
Bernardston, very stony, and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bernardston, Very Stony

Setting
Landform: Till plains, drumlinoid ridges, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy, acid, dense till derived mainly from phyllite, shale, slate, and schist

Typical profile

H1 - 0 to 8 inches: gravelly silt loam
H2 - 8 to 30 inches: gravelly loam
H3 - 30 to 60 inches: gravelly loam

Properties and qualities

Slope: 25 to 35 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 15 to 30 inches to densic material
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 6 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Albrights

Percent of map unit: 5 percent
Hydric soil rating: No

Pittstown

Percent of map unit: 5 percent
Hydric soil rating: No

Manlius

Percent of map unit: 5 percent
Hydric soil rating: No

Scriba

Percent of map unit: 5 percent
Hydric soil rating: No

Nassau

Percent of map unit: 3 percent
Hydric soil rating: No

Bernardston, extremely stony

Percent of map unit: 2 percent
Hydric soil rating: No

BnB—Bernardston-Nassau complex, undulating

Map Unit Setting

National map unit symbol: 9v1b
Elevation: 0 to 1,800 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Bernardston and similar soils: 45 percent
Nassau and similar soils: 30 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bernardston

Setting

Landform: Drumlinoid ridges, hills, till plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy, acid, dense till derived mainly from phyllite, shale, slate, and schist

Typical profile

H1 - 0 to 8 inches: gravelly silt loam
H2 - 8 to 30 inches: gravelly loam
H3 - 30 to 60 inches: gravelly loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 15 to 30 inches to densic material
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C/D
Hydric soil rating: No

Description of Nassau

Setting

Landform: Benches, ridges, till plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Channery loamy till derived mainly from local slate or shale

Typical profile

H1 - 0 to 7 inches: very channery silt loam
H2 - 7 to 15 inches: very channery loam
H3 - 15 to 19 inches: unweathered bedrock

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Manlius

Percent of map unit: 10 percent
Hydric soil rating: No

Unnamed soils

Percent of map unit: 5 percent
Hydric soil rating: No

Pittstown

Percent of map unit: 5 percent
Hydric soil rating: No

Scriba

Percent of map unit: 5 percent
Hydric soil rating: No

BnC—Bernardston-Nassau complex, rolling

Map Unit Setting

National map unit symbol: 9v1c
Elevation: 0 to 1,800 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Bernardston and similar soils: 45 percent
Nassau and similar soils: 35 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bernardston

Setting

Landform: Drumlinoid ridges, hills, till plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy, acid, dense till derived mainly from phyllite, shale, slate, and schist

Typical profile

H1 - 0 to 8 inches: gravelly silt loam
H2 - 8 to 30 inches: gravelly loam
H3 - 30 to 60 inches: gravelly loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 15 to 30 inches to densic material
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C/D
Hydric soil rating: No

Description of Nassau

Setting

Landform: Ridges, till plains, benches
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Channery loamy till derived mainly from local slate or shale

Typical profile

H1 - 0 to 7 inches: very channery silt loam
H2 - 7 to 15 inches: very channery loam
H3 - 15 to 19 inches: unweathered bedrock

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Manlius

Percent of map unit: 10 percent
Hydric soil rating: No

Unnamed soils

Percent of map unit: 5 percent
Hydric soil rating: No

Pittstown

Percent of map unit: 3 percent
Hydric soil rating: No

Scriba

Percent of map unit: 2 percent
Hydric soil rating: No

BnD—Bernardston-Nassau complex, hilly

Map Unit Setting

National map unit symbol: 9v1d
Elevation: 0 to 1,800 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition

Bernardston and similar soils: 40 percent
Nassau and similar soils: 30 percent
Minor components: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bernardston

Setting

Landform: Drumlinoid ridges, hills, till plains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy, acid, dense till derived mainly from phyllite, shale, slate, and schist

Typical profile

H1 - 0 to 8 inches: gravelly silt loam
H2 - 8 to 30 inches: gravelly loam
H3 - 30 to 60 inches: gravelly loam

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 15 to 30 inches to densic material
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C/D
Hydric soil rating: No

Description of Nassau

Setting

Landform: Till plains, benches, ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Channery loamy till derived mainly from local slate or shale

Typical profile

H1 - 0 to 7 inches: very channery silt loam
H2 - 7 to 15 inches: very channery loam
H3 - 15 to 19 inches: unweathered bedrock

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Manlius

Percent of map unit: 10 percent
Hydric soil rating: No

Unnamed soils

Percent of map unit: 10 percent
Hydric soil rating: No

Pittstown

Percent of map unit: 5 percent
Hydric soil rating: No

Scriba

Percent of map unit: 5 percent
Hydric soil rating: No

BrA—Brayton very stony silt loam, nearly level

Map Unit Setting

National map unit symbol: 9v1g
Elevation: 10 to 2,500 feet
Mean annual precipitation: 42 to 48 inches
Mean annual air temperature: 43 to 45 degrees F
Frost-free period: 105 to 135 days
Farmland classification: Not prime farmland

Map Unit Composition

Brayton, poorly drained, and similar soils: 50 percent
Brayton, somewhat poorly drained, and similar soils: 35 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Brayton, Poorly Drained

Setting

Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Loamy till derived mainly from granite, phyllite, schist, slate, and shale

Typical profile

H1 - 0 to 11 inches: gravelly silt loam
H2 - 11 to 19 inches: gravelly loam
H3 - 19 to 60 inches: gravelly loam

Properties and qualities

Slope: 0 to 3 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 13 to 24 inches to fragipan
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Hydric soil rating: Yes

Description of Brayton, Somewhat Poorly Drained

Setting

Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Loamy till derived mainly from granite, phyllite, schist, slate, and shale

Typical profile

H1 - 0 to 11 inches: gravelly silt loam
H2 - 11 to 19 inches: gravelly loam
H3 - 19 to 60 inches: gravelly loam

Properties and qualities

Slope: 0 to 3 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 13 to 24 inches to fragipan
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Buckland

Percent of map unit: 5 percent
Hydric soil rating: No

Brayton, extremely stony

Percent of map unit: 3 percent
Hydric soil rating: Yes

Brayton, gently sloping

Percent of map unit: 3 percent
Hydric soil rating: No

Unnamed soils, loamy sand surface

Percent of map unit: 2 percent
Hydric soil rating: Unranked

Unnamed soils, mucky surface

Percent of map unit: 2 percent
Hydric soil rating: Yes

BuC—Buckland very stony loam, sloping

Map Unit Setting

National map unit symbol: 9v1h
Elevation: 400 to 2,500 feet
Mean annual precipitation: 42 to 48 inches
Mean annual air temperature: 43 to 45 degrees F
Frost-free period: 105 to 135 days
Farmland classification: Not prime farmland

Map Unit Composition

Buckland, very stony, and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Buckland, Very Stony

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy till derived mainly from phyllite and schist with a small amount of limestone

Typical profile

H1 - 0 to 2 inches: loam
H2 - 2 to 22 inches: gravelly loam
H3 - 22 to 60 inches: gravelly loam

Properties and qualities

Slope: 8 to 15 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 18 to 36 inches to fragipan
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Glover

Percent of map unit: 10 percent
Hydric soil rating: No

Brayton

Percent of map unit: 10 percent
Hydric soil rating: No

Buckland, extremely stony

Percent of map unit: 5 percent
Hydric soil rating: No

BuD—Buckland very stony loam, moderately steep

Map Unit Setting

National map unit symbol: 9v1j
Elevation: 400 to 2,500 feet
Mean annual precipitation: 42 to 48 inches
Mean annual air temperature: 43 to 45 degrees F
Frost-free period: 105 to 135 days
Farmland classification: Not prime farmland

Map Unit Composition

Buckland, very stony, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Buckland, Very Stony

Setting

Landform: Hills, ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy till derived mainly from phyllite and schist with a small amount of limestone

Typical profile

H1 - 0 to 2 inches: loam
H2 - 2 to 22 inches: gravelly loam
H3 - 22 to 60 inches: gravelly loam

Properties and qualities

Slope: 25 to 35 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 18 to 36 inches to fragipan
Natural drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Brayton

Percent of map unit: 5 percent
Hydric soil rating: No

Buckland, extremely stony

Percent of map unit: 5 percent
Hydric soil rating: No

Glover

Percent of map unit: 5 percent
Hydric soil rating: No

BuF—Buckland very stony loam, very steep

Map Unit Setting

National map unit symbol: 9v1k
Elevation: 400 to 2,500 feet
Mean annual precipitation: 42 to 48 inches
Mean annual air temperature: 43 to 45 degrees F
Frost-free period: 105 to 135 days
Farmland classification: Not prime farmland

Map Unit Composition

Buckland, very stony, and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Buckland, Very Stony

Setting

Landform: Hills, ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex

Parent material: Loamy till derived mainly from phyllite and schist with a small amount of limestone

Typical profile

H1 - 0 to 2 inches: loam
H2 - 2 to 22 inches: gravelly loam
H3 - 22 to 60 inches: gravelly loam

Properties and qualities

Slope: 35 to 50 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 18 to 36 inches to fragipan
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Brayton

Percent of map unit: 10 percent
Hydric soil rating: No

Glover

Percent of map unit: 10 percent
Hydric soil rating: No

Buckland, extremely stony

Percent of map unit: 5 percent
Hydric soil rating: No

CaA—Catden muck, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2t2qk
Elevation: 0 to 1,430 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Catden and similar soils: 80 percent

Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Catden

Setting

Landform: Fens, depressions, depressions, swamps, bogs, marshes, kettles, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed herbaceous organic material and/or highly decomposed woody organic material

Typical profile

Oa1 - 0 to 2 inches: muck
Oa2 - 2 to 79 inches: muck

Properties and qualities

Slope: 0 to 1 percent
Percent of area covered with surface fragments: 0.0 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water storage in profile: Very high (about 26.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Canandaigua

Percent of map unit: 5 percent
Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Natchaug

Percent of map unit: 5 percent
Landform: Depressions, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Alden

Percent of map unit: 5 percent
Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Timakwa

Percent of map unit: 5 percent
Landform: Swamps
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Hydric soil rating: Yes

CbA—Castile gravelly silt loam, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 9v1m
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Castile and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Castile

Setting

Landform: Valley trains, terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Gravelly loamy glaciofluvial deposits over sandy and gravelly glaciofluvial deposits, derived mainly from sandstone, shale, and siltstone

Typical profile

H1 - 0 to 10 inches: gravelly silt loam
H2 - 10 to 32 inches: very gravelly sandy loam
H3 - 32 to 60 inches: very gravelly sand

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 5.95 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: A/D
Hydric soil rating: No

Minor Components

Chenango

Percent of map unit: 5 percent
Hydric soil rating: No

Hoosic

Percent of map unit: 5 percent
Hydric soil rating: No

Fredon

Percent of map unit: 5 percent
Hydric soil rating: No

ChB—Chenango very gravelly loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9v1p
Elevation: 600 to 1,800 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Chenango and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chenango

Setting

Landform: Terraces, valley trains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Convex

Across-slope shape: Convex
Parent material: Gravelly loamy glaciofluvial deposits over sandy and gravelly glaciofluvial deposits, derived mainly from sandstone, shale, and siltstone

Typical profile

H1 - 0 to 7 inches: very gravelly loam
H2 - 7 to 43 inches: very gravelly loam
H3 - 43 to 78 inches: extremely gravelly loamy sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Available water storage in profile: Low (about 5.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Hoosic

Percent of map unit: 3 percent
Hydric soil rating: No

Riverhead

Percent of map unit: 3 percent
Hydric soil rating: No

Castile

Percent of map unit: 3 percent
Hydric soil rating: No

Unadilla

Percent of map unit: 3 percent
Hydric soil rating: No

Fredon

Percent of map unit: 1 percent
Hydric soil rating: No

Palms

Percent of map unit: 1 percent
Landform: Swamps, marshes
Hydric soil rating: Yes

Carlisle

Percent of map unit: 1 percent
Landform: Marshes, swamps
Hydric soil rating: Yes

CkB—Chenango gravelly loam, fan, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9v1q
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Chenango, fan, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chenango, Fan

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Gravelly loamy glaciofluvial deposits over sandy and gravelly glaciofluvial deposits, derived mainly from sandstone, shale, and siltstone

Typical profile

H1 - 0 to 10 inches: gravelly loam
H2 - 10 to 24 inches: very gravelly loam
H3 - 24 to 60 inches: extremely gravelly loamy sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 5.95 in/hr)
Depth to water table: About 36 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Fredon

Percent of map unit: 5 percent
Hydric soil rating: No

Castile

Percent of map unit: 5 percent
Hydric soil rating: No

Hoosic

Percent of map unit: 5 percent
Hydric soil rating: No

Chenango, strongly sloping

Percent of map unit: 5 percent
Hydric soil rating: No

Du—Dumps, landfill

Map Unit Setting

National map unit symbol: 9v1r
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition

Dumps: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dumps

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: No

ElB—Elmridge very fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9v1s
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Elmridge and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Elmridge

Setting

Landform: Lake plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Loamy over clayey glaciolacustrine or marine deposits

Typical profile

H1 - 0 to 9 inches: very fine sandy loam
H2 - 9 to 36 inches: fine sandy loam
H3 - 36 to 60 inches: stratified silty clay to very fine sand to clay

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 18 to 40 inches to strongly contrasting textural stratification
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Available water storage in profile: Moderate (about 6.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Shaker

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Windsor

Percent of map unit: 5 percent
Hydric soil rating: No

Elmridge, nearly level

Percent of map unit: 3 percent
Hydric soil rating: No

Unnamed soils, vfsl substratum

Percent of map unit: 2 percent
Hydric soil rating: No

FlA—Fluvaquents-Udifluvents complex, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 9v1t
Elevation: 100 to 3,000 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition

Fluvaquents and similar soils: 45 percent
Udifluvents and similar soils: 35 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fluvaquents

Setting

Landform: Flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Alluvium with highly variable texture

Typical profile

H1 - 0 to 6 inches: silt loam
H2 - 6 to 60 inches: gravelly silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 5.95 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Frequent
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 5 percent
Available water storage in profile: Moderate (about 6.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: A/D
Hydric soil rating: Yes

Description of Udifluvents

Setting

Landform: Flood plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Talf
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Alluvium with a wide range of texture

Typical profile

H1 - 0 to 9 inches: gravelly fine sandy loam
H2 - 9 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to very high (0.06 to 19.98 in/hr)
Depth to water table: About 36 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Limerick

Percent of map unit: 5 percent
Landform: Flood plains
Hydric soil rating: Yes

Teel

Percent of map unit: 5 percent
Hydric soil rating: No

Saprists

Percent of map unit: 5 percent
Landform: Marshes, swamps
Hydric soil rating: Yes

Fredon

Percent of map unit: 3 percent
Hydric soil rating: No

Unnamed soils, moderately deep

Percent of map unit: 2 percent
Hydric soil rating: Unranked

FrA—Fredon silt loam, 0 to 4 percent slopes

Map Unit Setting

National map unit symbol: 9v1v
Elevation: 250 to 1,200 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Fredon, poorly drained, and similar soils: 50 percent
Fredon, somewhat poorly drained, and similar soils: 35 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fredon, Poorly Drained

Setting

Landform: Valley trains, terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Loamy over sandy and gravelly glaciofluvial deposits

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 23 inches: gravelly silt loam
H3 - 23 to 60 inches: sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Low (about 5.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Description of Fredon, Somewhat Poorly Drained

Setting

Landform: Terraces, valley trains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Loamy over sandy and gravelly glaciofluvial deposits

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 23 inches: gravelly silt loam
H3 - 23 to 60 inches: sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Low (about 5.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: B/D
Hydric soil rating: No

Minor Components

Castile

Percent of map unit: 10 percent
Hydric soil rating: No

Unnamed soils, mucky surface

Percent of map unit: 5 percent
Hydric soil rating: Yes

GlC—Glover very stony loam, very rocky, sloping

Map Unit Setting

National map unit symbol: 9v1w
Elevation: 500 to 1,750 feet
Mean annual precipitation: 42 to 48 inches
Mean annual air temperature: 43 to 45 degrees F

Frost-free period: 105 to 135 days
Farmland classification: Not prime farmland

Map Unit Composition

Glover, very stony, and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Glover, Very Stony

Setting

Landform: Hillsides or mountainsides
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy till derived mainly from interbedded schist and phyllite

Typical profile

H1 - 0 to 2 inches: loam
H2 - 2 to 18 inches: loam
H3 - 18 to 22 inches: unweathered bedrock

Properties and qualities

Slope: 8 to 15 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Buckland

Percent of map unit: 5 percent
Hydric soil rating: No

Rock outcrop

Percent of map unit: 5 percent
Hydric soil rating: Unranked

Unnamed soils, moderately deep and deep

Percent of map unit: 5 percent
Hydric soil rating: No

Brayton

Percent of map unit: 5 percent
Hydric soil rating: No

Beseman

Percent of map unit: 3 percent
Landform: Bogs, swamps, marshes
Hydric soil rating: Yes

Loxley

Percent of map unit: 2 percent
Landform: Swamps, marshes, bogs
Hydric soil rating: Yes

GlD—Glover very stony loam, very rocky, moderately steep

Map Unit Setting

National map unit symbol: 9v1x
Elevation: 500 to 1,750 feet
Mean annual precipitation: 42 to 48 inches
Mean annual air temperature: 43 to 45 degrees F
Frost-free period: 105 to 135 days
Farmland classification: Not prime farmland

Map Unit Composition

Glover, very stony, and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Glover, Very Stony

Setting

Landform: Hillsides or mountainsides
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy till derived mainly from interbedded schist and phyllite

Typical profile

H1 - 0 to 2 inches: loam
H2 - 2 to 18 inches: loam
H3 - 18 to 22 inches: unweathered bedrock

Properties and qualities

Slope: 15 to 25 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Available water storage in profile: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Unnamed soils, moderately deep and deep

Percent of map unit: 5 percent
Hydric soil rating: No

Brayton

Percent of map unit: 5 percent
Hydric soil rating: No

Buckland

Percent of map unit: 5 percent
Hydric soil rating: No

Rock outcrop

Percent of map unit: 5 percent
Hydric soil rating: Unranked

Beseman

Percent of map unit: 3 percent
Landform: Bogs, marshes, swamps
Hydric soil rating: Yes

Loxley

Percent of map unit: 2 percent
Landform: Bogs, marshes, swamps
Hydric soil rating: Yes

GmF—Glover-Rock outcrop complex, very steep

Map Unit Setting

National map unit symbol: 9v1y
Elevation: 500 to 1,750 feet
Mean annual precipitation: 36 to 48 inches
Mean annual air temperature: 43 to 48 degrees F
Frost-free period: 105 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition

Glover and similar soils: 55 percent
Rock outcrop: 20 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Glover

Setting

Landform: Hillsides or mountainsides
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy till derived mainly from interbedded schist and phyllite

Typical profile

H1 - 0 to 2 inches: loam
H2 - 2 to 18 inches: loam
H3 - 18 to 22 inches: unweathered bedrock

Properties and qualities

Slope: 35 to 45 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: No

Description of Rock Outcrop

Properties and qualities

Depth to restrictive feature: 0 inches to lithic bedrock

Minor Components

Unnamed soils, moderately deep and deep

Percent of map unit: 15 percent
Hydric soil rating: No

Buckland

Percent of map unit: 10 percent
Hydric soil rating: No

HaA—Hamlin silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 9v1z
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Hamlin and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hamlin

Setting

Landform: Flood plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Silty alluvium mainly from areas of siltstone, shale, and limestone

Typical profile

H1 - 0 to 9 inches: silt loam
H2 - 9 to 34 inches: silt loam
H3 - 34 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 36 to 72 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Available water storage in profile: High (about 11.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 1
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Limerick
Percent of map unit: 5 percent
Landform: Flood plains
Hydric soil rating: Yes

Teel
Percent of map unit: 5 percent
Hydric soil rating: No

Hamlin, gravelly substratum
Percent of map unit: 3 percent
Hydric soil rating: No

Unnamed soils, very poorly drained
Percent of map unit: 1 percent
Hydric soil rating: Yes

Udifluvents, frequently flooded
Percent of map unit: 1 percent
Hydric soil rating: No

HbA—Haven silt loam, 0 to 3 percent slopes

Map Unit Setting
National map unit symbol: 9v20
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: All areas are prime farmland

Map Unit Composition
Haven and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Haven

Setting
Landform: Outwash plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy glaciofluvial deposits over sandy and gravelly glaciofluvial deposits

Typical profile
H1 - 0 to 10 inches: silt loam
H2 - 10 to 30 inches: silt loam

H3 - 30 to 60 inches: stratified gravelly loamy sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 1
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Riverhead

Percent of map unit: 10 percent
Hydric soil rating: No

Chenango

Percent of map unit: 5 percent
Hydric soil rating: No

Hoosic

Percent of map unit: 5 percent
Hydric soil rating: No

HbB—Haven silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9v21
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Haven and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Haven

Setting

Landform: Outwash plains
Landform position (two-dimensional): Summit

Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy glaciofluvial deposits over sandy and gravelly glaciofluvial deposits

Typical profile

H1 - 0 to 10 inches: silt loam
H2 - 10 to 30 inches: silt loam
H3 - 30 to 60 inches: stratified gravelly loamy sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Riverhead

Percent of map unit: 10 percent
Hydric soil rating: No

Hoosic

Percent of map unit: 5 percent
Hydric soil rating: No

Chenango

Percent of map unit: 5 percent
Hydric soil rating: No

HoA—Hoosic gravelly sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 9v22
Elevation: 100 to 1,100 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Hoosic and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hoosic

Setting

Landform: Deltas, outwash plains, terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy and gravelly glaciofluvial deposits

Typical profile

H1 - 0 to 9 inches: gravelly sandy loam
H2 - 9 to 23 inches: very gravelly sandy loam
H3 - 23 to 60 inches: very gravelly sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (1.98 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Castile

Percent of map unit: 5 percent
Hydric soil rating: No

Chenango

Percent of map unit: 5 percent
Hydric soil rating: No

Fredon

Percent of map unit: 3 percent
Hydric soil rating: No

Unnamed soils, sandy surface

Percent of map unit: 2 percent
Hydric soil rating: No

HoB—Hoosic gravelly sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9v23
Elevation: 100 to 1,100 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Hoosic and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hoosic

Setting

Landform: Deltas, outwash plains, terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy and gravelly glaciofluvial deposits

Typical profile

H1 - 0 to 9 inches: gravelly sandy loam
H2 - 9 to 23 inches: very gravelly sandy loam
H3 - 23 to 60 inches: very gravelly sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (1.98 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Chenango
Percent of map unit: 5 percent
Hydric soil rating: No

Castile
Percent of map unit: 5 percent
Hydric soil rating: No

Fredon
Percent of map unit: 3 percent
Hydric soil rating: No

Unnamed soils, sandy surface
Percent of map unit: 2 percent
Hydric soil rating: No

HoC—Hoosic gravelly sandy loam, rolling

Map Unit Setting
National map unit symbol: 9v24
Elevation: 100 to 1,100 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Hoosic and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hoosic

Setting
Landform: Deltas, outwash plains, terraces
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy and gravelly glaciofluvial deposits

Typical profile
H1 - 0 to 9 inches: gravelly sandy loam
H2 - 9 to 23 inches: very gravelly sandy loam
H3 - 23 to 60 inches: very gravelly sand

Properties and qualities
Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches

Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (1.98 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Windsor

Percent of map unit: 5 percent
Hydric soil rating: No

Riverhead

Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed soils, silty surface

Percent of map unit: 5 percent
Hydric soil rating: No

HoD—Hoosic gravelly sandy loam, hilly

Map Unit Setting

National map unit symbol: 9v25
Elevation: 100 to 1,100 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition

Hoosic and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hoosic

Setting

Landform: Outwash plains, terraces, deltas
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Riser
Down-slope shape: Convex
Across-slope shape: Convex

Parent material: Sandy and gravelly glaciofluvial deposits

Typical profile

H1 - 0 to 9 inches: gravelly sandy loam
H2 - 9 to 23 inches: very gravelly sandy loam
H3 - 23 to 60 inches: very gravelly sand

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (1.98 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Riverhead

Percent of map unit: 5 percent
Hydric soil rating: No

Windsor

Percent of map unit: 5 percent
Hydric soil rating: No

Hoosic, severely eroded

Percent of map unit: 3 percent
Hydric soil rating: No

Unnamed soils, sandy surface

Percent of map unit: 2 percent
Hydric soil rating: No

HoE—Hoosic gravelly sandy loam, steep

Map Unit Setting

National map unit symbol: 9v26
Elevation: 100 to 1,100 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition

Hoosic and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hoosic

Setting

Landform: Deltas, outwash plains, terraces
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Riser
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy and gravelly glaciofluvial deposits

Typical profile

H1 - 0 to 9 inches: gravelly sandy loam
H2 - 9 to 23 inches: very gravelly sandy loam
H3 - 23 to 60 inches: very gravelly sand

Properties and qualities

Slope: 25 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (1.98 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Windsor

Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed soils, sandy surface

Percent of map unit: 5 percent
Hydric soil rating: No

Riverhead

Percent of map unit: 5 percent
Hydric soil rating: No

Hoosic, very steep

Percent of map unit: 5 percent
Hydric soil rating: No

Hoosic, severely eroded

Percent of map unit: 5 percent
Hydric soil rating: No

HuC—Hudson silt loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 9v28
Elevation: 300 to 1,800 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Hudson and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hudson

Setting

Landform: Lake plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Clayey and silty glaciolacustrine deposits

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 16 inches: silty clay
H3 - 16 to 28 inches: silty clay
H4 - 28 to 60 inches: silty clay

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Rhinebeck
Percent of map unit: 10 percent
Hydric soil rating: No

Scio
Percent of map unit: 5 percent
Hydric soil rating: No

Nassau
Percent of map unit: 3 percent
Hydric soil rating: No

Unnamed soils, gravelly or lfs surface
Percent of map unit: 2 percent
Hydric soil rating: No

HuD—Hudson silt loam, hilly

Map Unit Setting
National map unit symbol: 9v29
Elevation: 300 to 1,800 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition
Hudson and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hudson

Setting
Landform: Lake plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Riser
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Clayey and silty glaciolacustrine deposits

Typical profile
H1 - 0 to 8 inches: silt loam
H2 - 8 to 16 inches: silty clay
H3 - 16 to 28 inches: silty clay
H4 - 28 to 60 inches: silty clay

Properties and qualities
Slope: 15 to 25 percent

Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Unnamed soils, gravelly or lfs surface

Percent of map unit: 10 percent
Hydric soil rating: No

Nassau

Percent of map unit: 5 percent
Hydric soil rating: No

Hudson, severely eroded

Percent of map unit: 5 percent
Hydric soil rating: No

HuE—Hudson silt loam, steep

Map Unit Setting

National map unit symbol: 9v2b
Elevation: 300 to 1,800 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition

Hudson and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hudson

Setting

Landform: Lake plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Riser

Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Clayey and silty glaciolacustrine deposits

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 16 inches: silty clay
H3 - 16 to 28 inches: silty clay
H4 - 28 to 60 inches: silty clay

Properties and qualities

Slope: 25 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Unadilla

Percent of map unit: 5 percent
Hydric soil rating: No

Hudson, severely eroded

Percent of map unit: 5 percent
Hydric soil rating: No

Windsor

Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed soils, gravelly surface

Percent of map unit: 4 percent
Hydric soil rating: No

Unnamed soils, alluvial

Percent of map unit: 1 percent
Hydric soil rating: Unranked

LmA—Limerick silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 9v2c
Elevation: 50 to 500 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition

Limerick and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Limerick

Setting

Landform: Flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Alluvium that is dominantly silt and very fine sand

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water storage in profile: Very high (about 13.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Unnamed soils, gravelly or sandy surface

Percent of map unit: 5 percent

Hydric soil rating: Yes

Teel

Percent of map unit: 5 percent
Hydric soil rating: No

Hamlin

Percent of map unit: 3 percent
Hydric soil rating: No

Saprists

Percent of map unit: 2 percent
Landform: Swamps, marshes
Hydric soil rating: Yes

LoA—Loxley and Beseman mucks, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 9v2d
Elevation: 500 to 2,600 feet
Mean annual precipitation: 42 to 48 inches
Mean annual air temperature: 43 to 45 degrees F
Frost-free period: 105 to 135 days
Farmland classification: Not prime farmland

Map Unit Composition

Loxley and similar soils: 60 percent
Beseman and similar soils: 25 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Loxley

Setting

Landform: Marshes, swamps
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Talf
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Organic material

Typical profile

H1 - 0 to 60 inches: muck

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 5.95 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None

Frequency of ponding: Frequent
Available water storage in profile: Very high (about 23.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A/D
Hydric soil rating: Yes

Description of Beseman

Setting

Landform: Depressions
Landform position (two-dimensional): Toeslope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Organic material over loamy glacial drift

Typical profile

H1 - 0 to 38 inches: muck
H2 - 38 to 60 inches: gravelly loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Occasional
Available water storage in profile: Very high (about 26.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: C/D
Hydric soil rating: Yes

Minor Components

Fluvaquents

Percent of map unit: 5 percent
Landform: Flood plains
Hydric soil rating: Yes

Brayton

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: No

Fredon

Percent of map unit: 4 percent
Hydric soil rating: No

Castile

Percent of map unit: 1 percent
Hydric soil rating: No

MbA—Madalin silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 9v2j
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Madalin and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Madalin

Setting

Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Clayey and silty glaciolacustrine deposits

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 39 inches: silty clay
H3 - 39 to 60 inches: silty clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Moderate (about 8.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: C/D
Hydric soil rating: Yes

Minor Components

Madalin

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Madalin

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Fluvaquents

Percent of map unit: 5 percent
Landform: Flood plains
Hydric soil rating: Yes

Rhinebeck

Percent of map unit: 5 percent
Hydric soil rating: No

NaB—Nassau-Manlius complex, undulating

Map Unit Setting

National map unit symbol: 9v2k
Elevation: 200 to 1,800 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Nassau and similar soils: 45 percent
Manlius and similar soils: 30 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nassau

Setting

Landform: Benches, ridges, till plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Channery loamy till derived mainly from local slate or shale

Typical profile

H1 - 0 to 7 inches: very channery silt loam
H2 - 7 to 15 inches: very channery loam
H3 - 15 to 19 inches: unweathered bedrock

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Hydric soil rating: No

Description of Manlius

Setting

Landform: Ridges, till plains, benches
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy till derived mainly from local acid shale bedrock

Typical profile

H1 - 0 to 8 inches: channery silt loam
H2 - 8 to 23 inches: very channery silt loam
H3 - 23 to 30 inches: very channery silt loam
H4 - 30 to 34 inches: unweathered bedrock

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Bernardston

Percent of map unit: 10 percent
Hydric soil rating: No

Scriba

Percent of map unit: 5 percent
Hydric soil rating: No

Hudson

Percent of map unit: 4 percent
Hydric soil rating: No

Rhinebeck

Percent of map unit: 4 percent
Hydric soil rating: No

Palms

Percent of map unit: 1 percent
Landform: Swamps, marshes
Hydric soil rating: Yes

Carlisle

Percent of map unit: 1 percent
Landform: Marshes, swamps
Hydric soil rating: Yes

NaC—Nassau-Manlius complex, rolling

Map Unit Setting

National map unit symbol: 9v2l
Elevation: 200 to 1,800 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition

Nassau and similar soils: 45 percent
Manlius and similar soils: 25 percent
Minor components: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nassau

Setting

Landform: Benches, ridges, till plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Channery loamy till derived mainly from local slate or shale

Typical profile

H1 - 0 to 7 inches: very channery silt loam

H2 - 7 to 15 inches: very channery loam
H3 - 15 to 19 inches: unweathered bedrock

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Hydric soil rating: No

Description of Manlius

Setting

Landform: Ridges, till plains, benches
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy till derived mainly from local acid shale bedrock

Typical profile

H1 - 0 to 8 inches: channery silt loam
H2 - 8 to 23 inches: very channery silt loam
H3 - 23 to 30 inches: very channery silt loam
H4 - 30 to 34 inches: unweathered bedrock

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Scriba

Percent of map unit: 10 percent
Hydric soil rating: No

Bernardston

Percent of map unit: 10 percent
Hydric soil rating: No

Rhinebeck

Percent of map unit: 4 percent
Hydric soil rating: No

Hudson

Percent of map unit: 4 percent
Hydric soil rating: No

Carlisle

Percent of map unit: 1 percent
Landform: Marshes, swamps
Hydric soil rating: Yes

Palms

Percent of map unit: 1 percent
Landform: Swamps, marshes
Hydric soil rating: Yes

NrC—Nassau-Rock outcrop, complex, rolling

Map Unit Setting

National map unit symbol: 9v2m
Elevation: 600 to 1,800 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition

Nassau and similar soils: 40 percent
Rock outcrop: 30 percent
Minor components: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nassau

Setting

Landform: Till plains, benches, ridges
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Channery loamy till derived mainly from local slate or shale

Typical profile

H1 - 0 to 7 inches: very channery silt loam

H2 - 7 to 15 inches: very channery loam
H3 - 15 to 19 inches: unweathered bedrock

Properties and qualities
Slope: 8 to 15 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.5 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Hydric soil rating: No

Description of Rock Outcrop

Properties and qualities
Depth to restrictive feature: 0 inches to lithic bedrock

Minor Components

Manlius
Percent of map unit: 10 percent
Hydric soil rating: No

Bernardston
Percent of map unit: 10 percent
Hydric soil rating: No

Unnamed soils, very shallow
Percent of map unit: 8 percent
Hydric soil rating: No

Alden
Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Palms
Percent of map unit: 1 percent
Landform: Swamps, marshes
Hydric soil rating: Yes

NrD—Nassau-Rock outcrop complex, hilly

Map Unit Setting

National map unit symbol: 9v2n
Elevation: 600 to 1,800 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition

Nassau and similar soils: 40 percent
Rock outcrop: 35 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nassau

Setting

Landform: Benches, ridges, till plains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Channery loamy till derived mainly from local slate or shale

Typical profile

H1 - 0 to 7 inches: very channery silt loam
H2 - 7 to 15 inches: very channery loam
H3 - 15 to 19 inches: unweathered bedrock

Properties and qualities

Slope: 25 to 35 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: No

Description of Rock Outcrop

Properties and qualities

Depth to restrictive feature: 0 inches to lithic bedrock

Minor Components

Bernardston

Percent of map unit: 10 percent
Hydric soil rating: No

Manlius

Percent of map unit: 10 percent
Hydric soil rating: No

Unnamed soils, very shallow

Percent of map unit: 3 percent
Hydric soil rating: No

Alden

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Palms

Percent of map unit: 1 percent
Landform: Marshes, swamps
Hydric soil rating: Yes

NtA—Natchaug muck, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2w68z
Elevation: 0 to 1,550 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Natchaug and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Natchaug

Setting

Landform: Depressions, depressions, depressions
Down-slope shape: Concave
Across-slope shape: Concave

Parent material: Highly decomposed organic material over loamy glaciofluvial deposits and/or loamy glaciolacustrine deposits and/or loamy till

Typical profile

Oa1 - 0 to 12 inches: muck
Oa2 - 12 to 31 inches: muck
2Cg1 - 31 to 39 inches: silt loam
2Cg2 - 39 to 79 inches: fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.01 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 25 percent
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Very high (about 17.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Catden

Percent of map unit: 8 percent
Landform: Depressions, depressions, depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Limerick

Percent of map unit: 5 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Sun

Percent of map unit: 4 percent
Landform: Hills, depressions
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Halsey

Percent of map unit: 3 percent
Landform: Terraces

Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Pg—Pits, gravel

Map Unit Setting

National map unit symbol: 9v2r
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition

Pits, gravel: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pits, Gravel

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: No

Minor Components

Udorthents, loamy and clayey

Percent of map unit: 10 percent
Hydric soil rating: No

PtB—Pittstown gravelly silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9v2s
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Pittstown and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pittstown

Setting

Landform: Till plains, drumlinoid ridges, hills
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Loamy till

Typical profile

H1 - 0 to 9 inches: gravelly silt loam
H2 - 9 to 24 inches: gravelly silt loam
H3 - 24 to 60 inches: gravelly silt loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 15 to 30 inches to densic material
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Albrights

Percent of map unit: 5 percent
Hydric soil rating: No

Bernardston

Percent of map unit: 5 percent
Hydric soil rating: No

Manlius

Percent of map unit: 4 percent
Hydric soil rating: No

Scriba

Percent of map unit: 4 percent
Hydric soil rating: No

Alden

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Nassau

Percent of map unit: 1 percent
Hydric soil rating: No

PtC—Pittstown gravelly silt loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 9v2t
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Pittstown and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pittstown

Setting

Landform: Till plains, drumlinoid ridges, hills
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Loamy till

Typical profile

H1 - 0 to 9 inches: gravelly silt loam
H2 - 9 to 24 inches: gravelly silt loam
H3 - 24 to 60 inches: gravelly silt loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 15 to 30 inches to densic material
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Bernardston

Percent of map unit: 5 percent

Hydric soil rating: No

Albrights

Percent of map unit: 5 percent
Hydric soil rating: No

Manlius

Percent of map unit: 4 percent
Hydric soil rating: No

Scriba

Percent of map unit: 4 percent
Hydric soil rating: No

Nassau

Percent of map unit: 1 percent
Hydric soil rating: No

Alden

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

RaA—Raynham silt loam, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 9v2w
Elevation: 50 to 500 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Raynham, poorly drained, and similar soils: 50 percent
Raynham, somewhat poorly drained, and similar soils: 30 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Raynham, Poorly Drained

Setting

Landform: Lake plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Glaciolacustrine, eolian, or old alluvial deposits, comprised mainly of silt and very fine sand

Typical profile

H1 - 0 to 14 inches: silt loam

H2 - 14 to 26 inches: loam
H3 - 26 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 6 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Available water storage in profile: High (about 11.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: C/D
Hydric soil rating: Yes

Description of Raynham, Somewhat Poorly Drained

Setting

Landform: Lake plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Glaciolacustrine, eolian, or old alluvial deposits, comprised mainly of silt and very fine sand

Typical profile

H1 - 0 to 14 inches: silt loam
H2 - 14 to 26 inches: loam
H3 - 26 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 6 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Available water storage in profile: High (about 11.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Unadilla
Percent of map unit: 5 percent
Hydric soil rating: No

Rhinebeck
Percent of map unit: 5 percent
Hydric soil rating: No

Scio
Percent of map unit: 5 percent
Hydric soil rating: No

Madalin
Percent of map unit: 3 percent
Landform: Depressions
Hydric soil rating: Yes

Unnamed soils, lfs substratum
Percent of map unit: 2 percent
Hydric soil rating: No

RkA—Riverhead fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 9v2z
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Riverhead and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Riverhead

Setting
Landform: Deltas, terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy glaciofluvial deposits overlying stratified sand and gravel

Typical profile
H1 - 0 to 6 inches: fine sandy loam
H2 - 6 to 35 inches: sandy loam

H3 - 35 to 50 inches: gravelly loamy sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Hoosic

Percent of map unit: 5 percent
Hydric soil rating: No

Haven

Percent of map unit: 5 percent
Hydric soil rating: No

Riverhead, shallow substratum

Percent of map unit: 5 percent
Hydric soil rating: No

Chenango

Percent of map unit: 5 percent
Hydric soil rating: No

RkB—Riverhead fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9v30
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Riverhead and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Riverhead

Setting

Landform: Terraces, deltas
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy glaciofluvial deposits overlying stratified sand and gravel

Typical profile

H1 - 0 to 6 inches: fine sandy loam
H2 - 6 to 35 inches: sandy loam
H3 - 35 to 50 inches: gravelly loamy sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Riverhead, shallow substratum

Percent of map unit: 5 percent
Hydric soil rating: No

Haven

Percent of map unit: 5 percent
Hydric soil rating: No

Chenango

Percent of map unit: 5 percent
Hydric soil rating: No

Hoosic

Percent of map unit: 5 percent
Hydric soil rating: No

RkC—Riverhead fine sandy loam, rolling

Map Unit Setting

National map unit symbol: 9v31
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Riverhead and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Riverhead

Setting

Landform: Terraces, deltas
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy glaciofluvial deposits overlying stratified sand and gravel

Typical profile

H1 - 0 to 6 inches: fine sandy loam
H2 - 6 to 35 inches: sandy loam
H3 - 35 to 50 inches: gravelly loamy sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Windsor

Percent of map unit: 5 percent

Hydric soil rating: No

Chenango

Percent of map unit: 5 percent
Hydric soil rating: No

Riverhead, shallow substratum

Percent of map unit: 5 percent
Hydric soil rating: No

Hoosic

Percent of map unit: 5 percent
Hydric soil rating: No

Haven

Percent of map unit: 5 percent
Hydric soil rating: No

Sa—Saprists and Aquents, ponded

Map Unit Setting

National map unit symbol: 9v32
Elevation: 10 to 2,400 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition

Saprists and similar soils: 50 percent
Aquents and similar soils: 40 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Saprists

Setting

Landform: Depressions
Landform position (two-dimensional): Toeslope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Organic material

Typical profile

H1 - 0 to 18 inches: muck
H2 - 18 to 60 inches: fine sandy loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Very high (about 14.8 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Description of Aquents

Setting
Landform: Flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave

Typical profile
H1 - 0 to 7 inches: mucky silt loam
H2 - 7 to 60 inches: gravelly silt loam

Properties and qualities
Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.57 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water storage in profile: Moderate (about 7.7 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: C/D
Hydric soil rating: Yes

Minor Components

Fluvaquents
Percent of map unit: 5 percent
Landform: Flood plains
Hydric soil rating: Yes

Unnamed soils
Percent of map unit: 5 percent
Hydric soil rating: Yes

ScB—Scio very fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9v34
Elevation: 100 to 1,000 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Scio and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Scio

Setting

Landform: Lake plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Glaciolacustrine deposits, eolian deposits, or old alluvium, comprised mainly of silt and very fine sand

Typical profile

H1 - 0 to 12 inches: very fine sandy loam
H2 - 12 to 41 inches: very fine sandy loam
H3 - 41 to 60 inches: sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Available water storage in profile: High (about 10.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B/D
Hydric soil rating: No

Minor Components

Raynham
Percent of map unit: 5 percent
Hydric soil rating: No

Unadilla
Percent of map unit: 5 percent
Hydric soil rating: No

Hudson
Percent of map unit: 2 percent
Hydric soil rating: No

Rhinebeck
Percent of map unit: 2 percent
Hydric soil rating: No

Windsor
Percent of map unit: 1 percent
Hydric soil rating: No

SrA—Scriba silt loam, 0 to 3 percent slopes

Map Unit Setting
National map unit symbol: 9v35
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Scriba and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Scriba

Setting
Landform: Drumlins, till plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Loamy till dominated by sandstone, with lesser amounts of limestone and shale

Typical profile
H1 - 0 to 10 inches: silt loam
H2 - 10 to 21 inches: silt loam
H3 - 21 to 50 inches: gravelly silt loam

H4 - 50 to 60 inches: gravelly silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 12 to 21 inches to fragipan
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Low (about 3.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Pittstown

Percent of map unit: 5 percent
Hydric soil rating: No

Alden

Percent of map unit: 3 percent
Landform: Depressions
Hydric soil rating: Yes

Manlius

Percent of map unit: 2 percent
Hydric soil rating: No

Unnamed soils

Percent of map unit: 2 percent
Hydric soil rating: No

Raynham

Percent of map unit: 2 percent
Hydric soil rating: No

Nassau

Percent of map unit: 2 percent
Hydric soil rating: No

Bernardston

Percent of map unit: 2 percent
Hydric soil rating: No

Scriba, very stony

Percent of map unit: 2 percent
Hydric soil rating: No

SrB—Scriba silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9v36
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Scriba and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Scriba

Setting

Landform: Till plains, drumlins
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Loamy till dominated by sandstone, with lesser amounts of limestone and shale

Typical profile

H1 - 0 to 10 inches: silt loam
H2 - 10 to 21 inches: silt loam
H3 - 21 to 50 inches: gravelly silt loam
H4 - 50 to 60 inches: gravelly silt loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 12 to 21 inches to fragipan
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Low (about 3.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Pittstown

Percent of map unit: 5 percent
Hydric soil rating: No

Alden

Percent of map unit: 3 percent
Landform: Depressions
Hydric soil rating: Yes

Bernardston

Percent of map unit: 2 percent
Hydric soil rating: No

Raynham

Percent of map unit: 2 percent
Hydric soil rating: No

Unnamed soils

Percent of map unit: 2 percent
Hydric soil rating: No

Manlius

Percent of map unit: 2 percent
Hydric soil rating: No

Nassau

Percent of map unit: 2 percent
Hydric soil rating: No

Scriba, very stony

Percent of map unit: 2 percent
Hydric soil rating: No

StB—Scriba very stony silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9v37
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition

Scriba and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Scriba

Setting

Landform: Drumlins, till plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Loamy till dominated by sandstone, with lesser amounts of limestone and shale

Typical profile

H1 - 0 to 10 inches: silt loam
H2 - 10 to 21 inches: silt loam
H3 - 21 to 50 inches: gravelly silt loam
H4 - 50 to 60 inches: gravelly silt loam

Properties and qualities

Slope: 3 to 8 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 12 to 21 inches to fragipan
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Low (about 3.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Alden

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Bernardston

Percent of map unit: 5 percent
Hydric soil rating: No

Pittstown

Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed soils

Percent of map unit: 2 percent
Hydric soil rating: No

Manlius

Percent of map unit: 2 percent
Hydric soil rating: No

Raynham

Percent of map unit: 2 percent
Hydric soil rating: No

Nassau

Percent of map unit: 2 percent
Hydric soil rating: No

Scriba, non-stony

Percent of map unit: 2 percent
Hydric soil rating: No

TeA—Teel silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 9v3b
Elevation: 600 to 1,800 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Teel and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Teel

Setting

Landform: Flood plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Talf
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Silty alluvium

Typical profile

H1 - 0 to 12 inches: silt loam
H2 - 12 to 40 inches: silt loam
H3 - 40 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: Occasional
Frequency of ponding: None

Calcium carbonate, maximum in profile: 1 percent
Available water storage in profile: High (about 9.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: B/D
Hydric soil rating: No

Minor Components

Hamlin

Percent of map unit: 5 percent
Hydric soil rating: No

Limerick

Percent of map unit: 5 percent
Landform: Flood plains
Hydric soil rating: Yes

Unnamed soils, very poorly drained

Percent of map unit: 3 percent
Hydric soil rating: Yes

Teel, gravelly surface

Percent of map unit: 2 percent
Hydric soil rating: No

Ud—Udorthents, loamy

Map Unit Setting

National map unit symbol: 9v3c
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents, loamy, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents, Loamy

Typical profile

H1 - 0 to 60 inches: loam

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 36 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Unnamed soils, fragmental

Percent of map unit: 3 percent
Hydric soil rating: No

Udorthents, intermittently ponded

Percent of map unit: 2 percent
Hydric soil rating: No

Udorthents, sandy

Percent of map unit: 2 percent
Hydric soil rating: No

Udorthents, clayey

Percent of map unit: 2 percent
Hydric soil rating: No

Urban land

Percent of map unit: 1 percent
Hydric soil rating: Unranked

Ur—Urban land

Map Unit Setting

National map unit symbol: 9v3j
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Minor Components

Udorthents, loamy

Percent of map unit: 10 percent
Hydric soil rating: No

W—Water

Map Unit Setting

National map unit symbol: 9v3k
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 115 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

WnC—Windsor loamy sand, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2svkq
Elevation: 0 to 1,260 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Windsor and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Windsor

Setting

Landform: — error in exists on —
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, riser
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Loose sandy glaciofluvial deposits derived from granite and/or loose sandy glaciofluvial deposits derived from schist and/or loose sandy glaciofluvial deposits derived from gneiss

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material

Ap - 1 to 11 inches: loamy sand
Bw - 11 to 31 inches: loamy sand
C - 31 to 65 inches: sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Hinckley

Percent of map unit: 10 percent
Landform: Outwash plains, eskers, kames, deltas
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Crest, head slope, nose slope, side slope, rise
Down-slope shape: Convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Deerfield

Percent of map unit: 5 percent
Landform: Outwash plains, terraces, deltas
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

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~ Chapter 2 ~
Ecological Survey of Poesten Kill (2017-2019)

Poesten Kill, north of Elmwood Hill Cemetery. Photo credit: OEI, 2019

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I. Introduction

The ecological survey occurred in the Poesten Kill Watershed (Rensselaer County, NY) (Fig. 1).

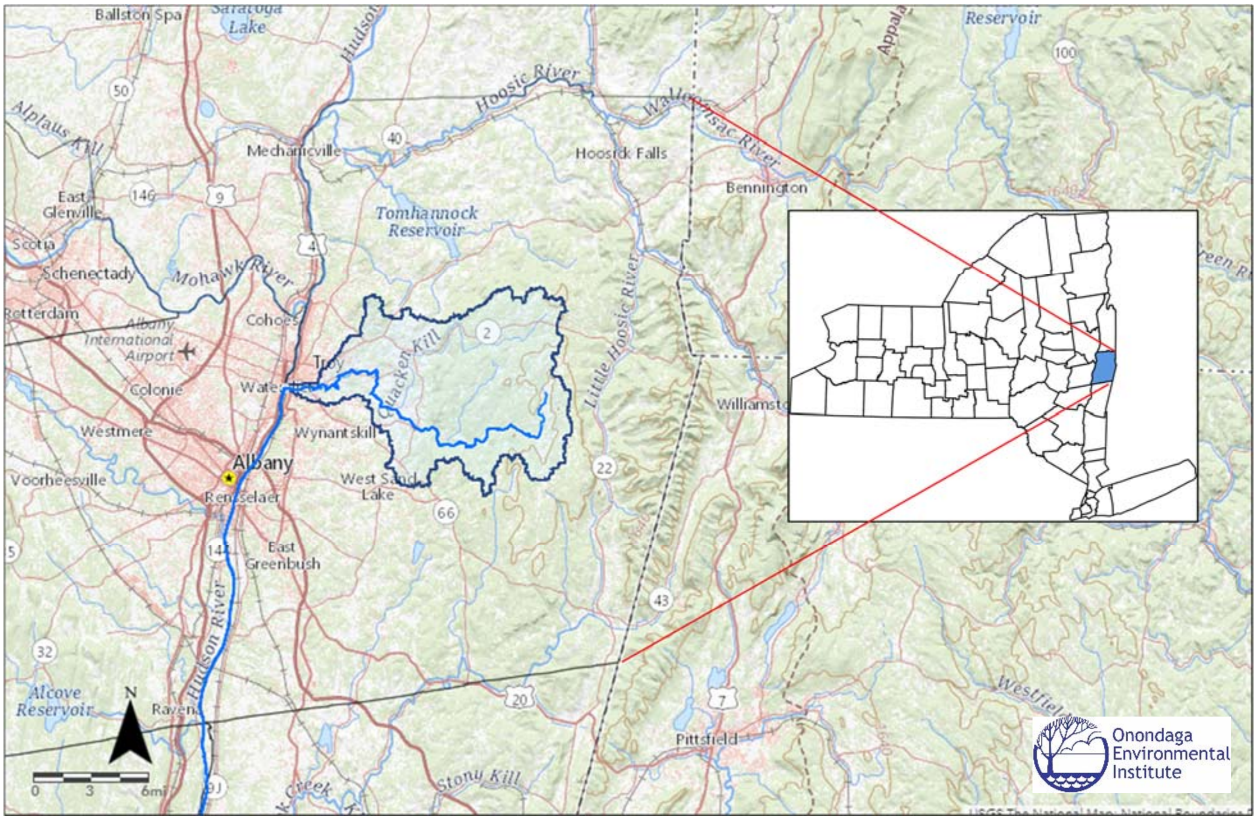


Figure 1. Poesten Kill watershed boundary within Rensselaer County.

The Poesten Kill is tributary to the Hudson River, located within the most upper reach of the tidal estuary section of the Hudson River (Fig. 2). Poesten Kill originates in the Town of Berlin at Dyken Pond and discharges to the Hudson River in Troy. The watershed is 232 km^2 in area and has a total stream length of 42 km. Municipalities within the watershed include the Towns of Grafton, Berlin, Poestenkill, Sand Lake, Brunswick, and North Greenbush, as well as the City of Troy (Fig. 3). Four major tributaries to Poesten Kill are Newfoundland Creek, Quacken Kill, Bonesteel Creek, and Sweet Milk Creek (Fig. 4). All sampling occurred in the mainstem of Poesten Kill and did not include surveys in the tributaries.

Figure 2. Poesten Kill watershed in relation to the Hudson River estuary watershed.

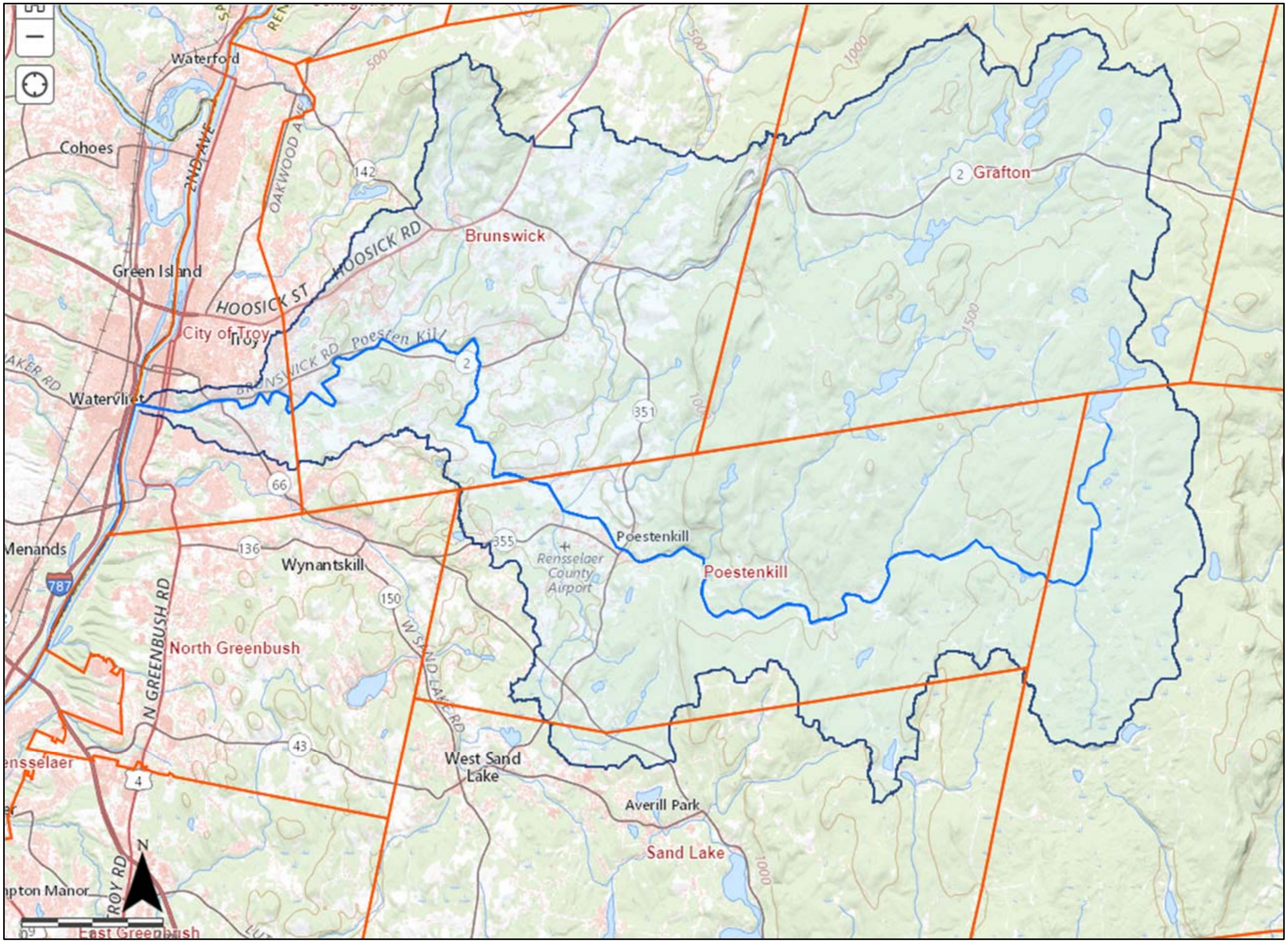


Figure 3. Municipal boundaries in the Poesten Kill watershed.

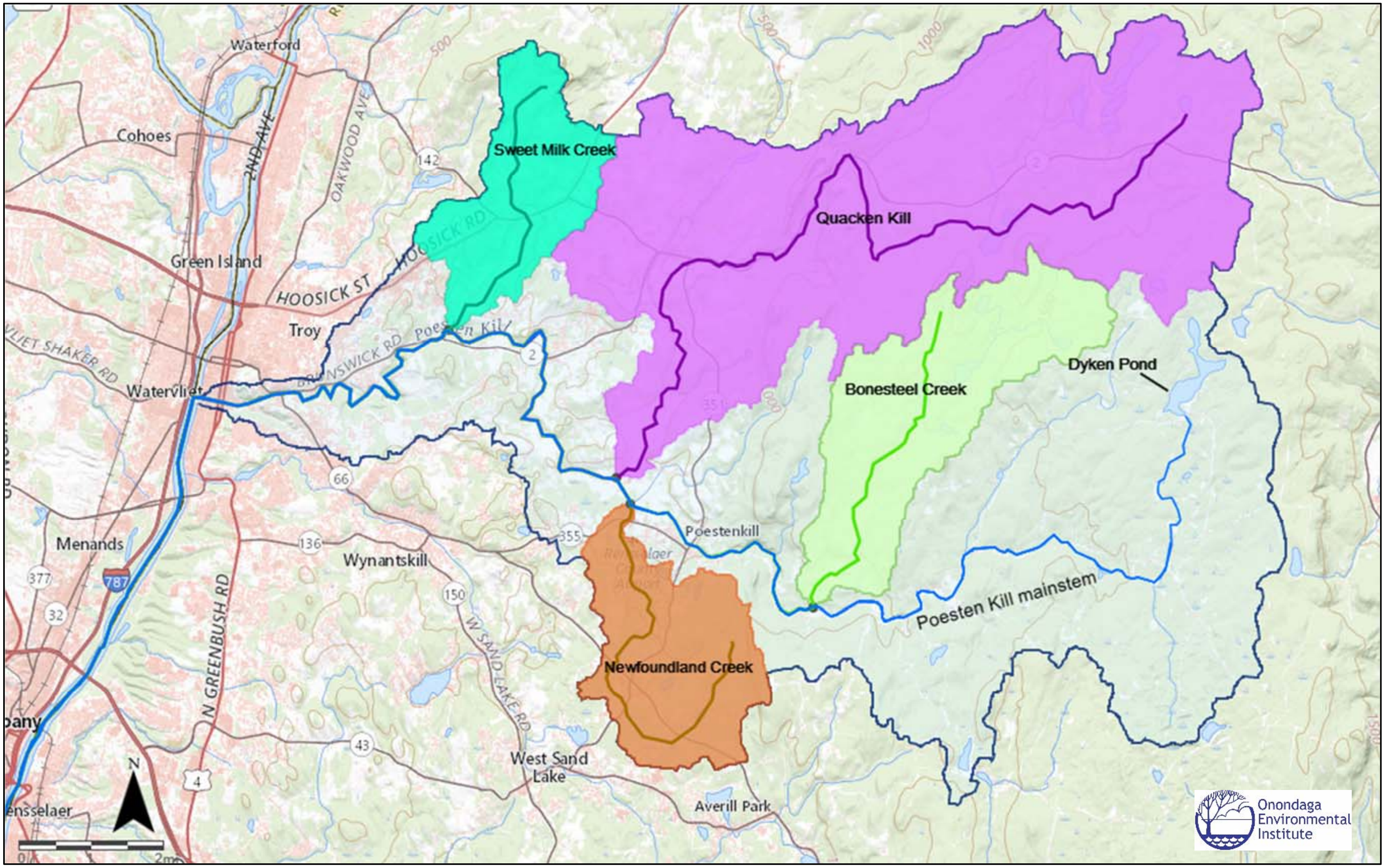


Figure 4. Major tributaries in the Poesten Kill watershed.

The major aim of this survey was to provide a comprehensive assessment of the Poesten Kill that would provide a holistic understanding of stream health; which could then be used to inform stakeholders about conservation, restoration, and/or management issues, as well as guide future efforts in the watershed.

To achieve the goal of this project, two ecological surveys were performed; one in 2017 and one in 2019. Sampling was conducted between June 21st-23rd at 14 sites in 2017 and between June 18th-20th at 13 sites in 2019. Sites were surveyed for water quality, physical in-stream and riparian habitat, and fish and aquatic macroinvertebrate community composition. The results of these surveys are presented herein.

II. Methods

a. Site Selection

A total of 14 locations were sampled between the two surveys (Table 1). The uppermost site was sampled at the origin of the Poesten Kill, at the outlet of Dyken Pond (Town of Berlin). The lowermost site was sampled approximately 1300 meters upstream from the mouth of Poesten Kill, where it discharges into the Hudson River in the City of Troy (Fig. 5). In 2017, fish and macroinvertebrate sampling were not performed at Site #20, due to accessibility issues. In 2019, Site #20 was able to be fully accessed, and fish and macroinvertebrate sampling was performed. In 2019, accessibility at Site #13 was not achievable, and therefore, no sampling of any kind was performed at this site (Table 1).

Several criteria were used for site selection of stream reach sampling sites:

1. Sampling locations must be easily available, with safe access and owner permission (if private land).
2. The stream reach must be wadeable for personnel to safely traverse.
3. Water clarity must be well enough that stunned fish can be seen and captured during electrofishing.
4. The stream reach should include all representative habitat (i.e., riffle, run, and pool), whenever possible (Barbour et al., 1999).
5. Sampling should occur upstream of any bridge abutments or road crossing, so as to minimize the hydrological effects on habitat quality (Bode et al., 2002; Barbour et al., 1999).
6. Sites distributions should encompass as much of the total stream length as possible in order to capture a longitudinal gradient in stream conditions representative of the entire Poesten Kill.

Table 1. Sampling location site descriptions in Poesten Kill, by year.

No.	Coordinates (N, W)	Site Description	2017[1]	2019[2]
31	42.71704, -73.42780	Below Dyken Pond at Fifty-Six Rd.	x	x
30	42.69155, -73.43182	Planck Rd, approximately 450 m north of Site 29.	x	x
29	42.68668, -73.43312	Dutch Church Rd, approximately 300 m east of Plank Rd.	x	x
27	42.69102, -73.45925	Planck Rd, just west of Dodge City Rd.	x	x
23	42.68987, -73.48589	Fifty-Six Rd, immediately north of the intersection with Planck Rd.	x	x
20	42.68181, -73.49943	Columbia Hill Rd, immediately south of the intersection with Plank Rd.	/	x
7	42.71778, -73.60834	Creek Rd Public Fishing Access, 0.5 miles south of Brunswick Rd.	x	x
18	42.67720, -73.51074	Powers Rd, just east of the intersection of Catlin and Planck Rds.	x	x
13	42.68382, -73.54057	Planck Rd, just north of the intersection with Blue Factory Rd.	x	
9	42.70163, -73.58137	Garfield Rd, 400 m north of Main St and the Poestenkill Fire Dept.	x	x
8	42.70457, -73.58498	Quacken Kill Public Fishing Access on Garfield Rd. Sampling occurred in Poesten Kill, downstream of the confluence with Quacken Kill.	x	x
4	42.73293, -73.63136	Located north of Brunswick Rd (Rte 2) & Shippey Lane intersection.	x	x
36	42.72135, -73.66551	North of the Elmwood Hill Cemetery, located off Pinewoods Ave.	x	x
37	42.71952, -73.68353	Located at end of Hill St, northwest of Poesten Kill Gorge Park.	x	x

[1]Site #20 was partially sampled for water and habitat quality. No biological data was collected.
[2]Site #13 was not sampled due to inaccessibility.

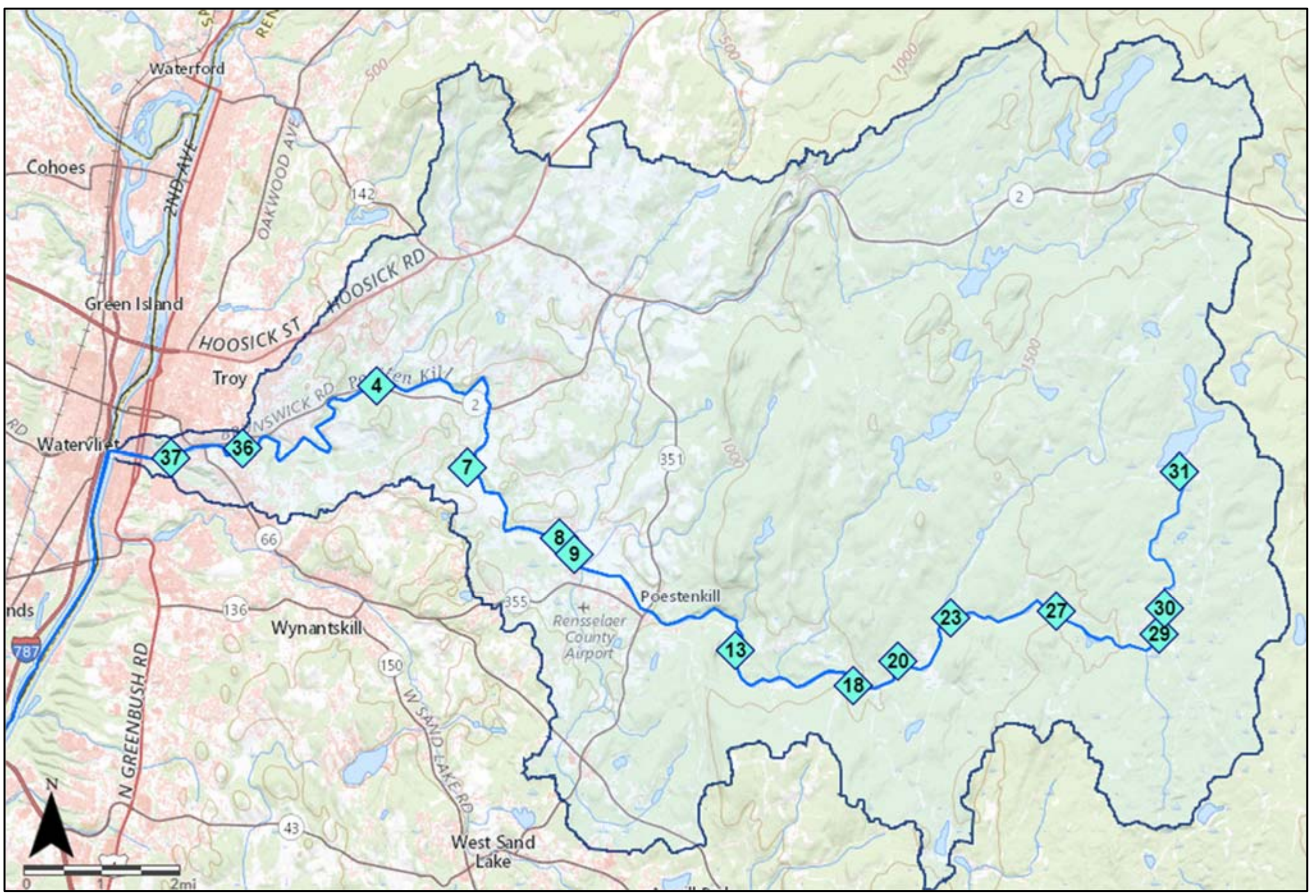


Figure 5. Poesten Kill sampling locations (2017 & 2019).

For a comprehensive understanding of habitat quality and complimentary use of data, macroinvertebrate sampling occurred in riffle(s) within the fish sampling area. Where possible, sites were representative of the location, and therefore, comparable to conditions (i.e. substrate type, current, canopy, etc.) upstream and downstream of the sampling site (Smith et al., 2009).

b. Meteorological Conditions

In the original Scope of Work, only one stream survey was proposed to be completed in 2017. However, it was determined in 2018 that the efficient use of grant funds permitted a second biological survey. While performing stream surveys during consecutive years (i.e., 2017 and 2018) has advantages (e.g., shorter duration between events for major changes to landscape, such as development, to occur and modify stream condition), it was ultimately decided to perform the second survey in June of 2019 at approximately the same time of month as the 2017 survey. Like most life on earth, the life cycles of aquatic organisms are largely driven by seasonal effects (e.g., temperature, stream flow, precipitation, etc.) (Merritt et al. 2019). For fish, this can include changes to community composition driven by reproductive behaviors (e.g., spawning migrations), as well as seasonal changes in food availability and physical habitat requirements. Likewise, for aquatic macroinvertebrates, lifecycles are greatly affected by season, with changes in stream temperature being a major driver of changes to macroinvertebrate density, diversity, and distribution (Merritt et al. 2019). Therefore, sampling at different times of the year could skew assessments of stream health that could be improperly attributed to anthropogenic effects rather than natural processes and conditions. The New York State Department of Environmental Conservation (NYSDEC) Stream Biomonitoring Unit recommends that multi-year surveys of the same stream should be performed at approximately the same time of year as previous surveys; preferably using temperature degree-days over calendar days to better align with lifecycles (Duffy et al. 2018).

Temperatures and rainfall data were obtained from the weather station housed at Albany International Airport (wunderground.com); located approximately 10 miles west of the City of Troy and the mouth of the Poesten Kill. Temperature was reported as a daily average in degrees Celsius (°C) and rainfall was reported as total daily rainfall in inches.

In 2017, sampling occurred between June 21-23. Average daily air temperatures ranged between 11.8°C (53.2°F) and 27.1°C (80.8°F), with a monthly average of 19.8°C (67.7°F) (Fig. 6). During the sampling period, the average daily temperature was 22.4°C (72.3°F). A total of 4.65 inches of rainfall was recorded for the month, with 3.82 inches of rainfall (82% of total month) recorded between June 1-20 (Fig. 7). During the 2017 survey period, 0.08 inches of rainfall was recorded at the Albany weather station; however, all sampling was performed during dry-weather conditions.

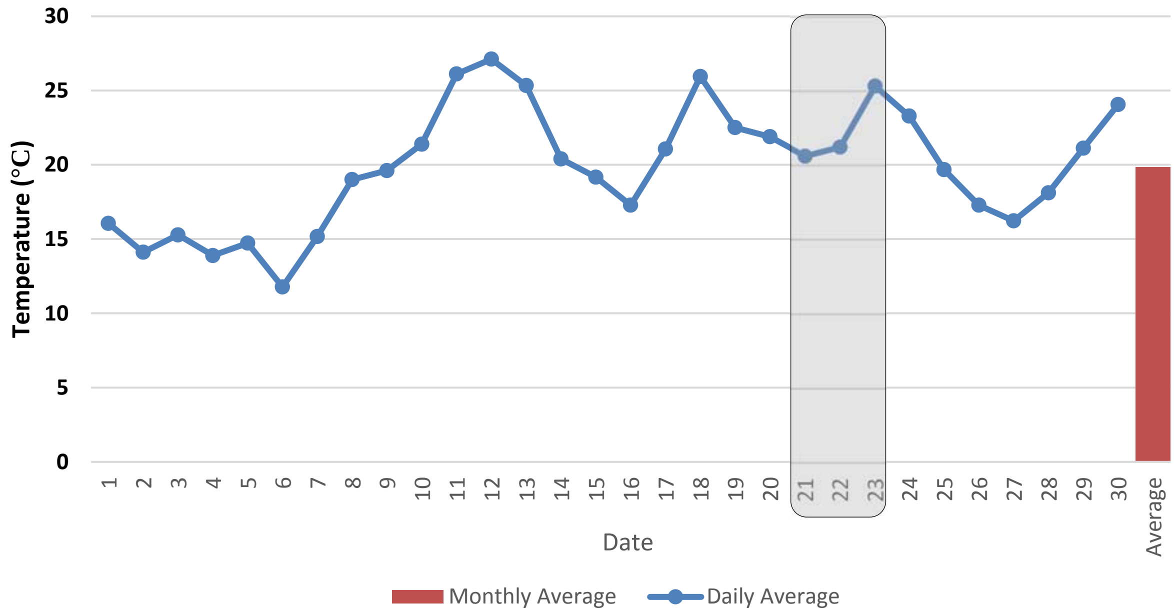


Figure 6. Temperature recorded during June 2017 at the Albany Airport weather station. The sampling period is highlighted by the gray box.

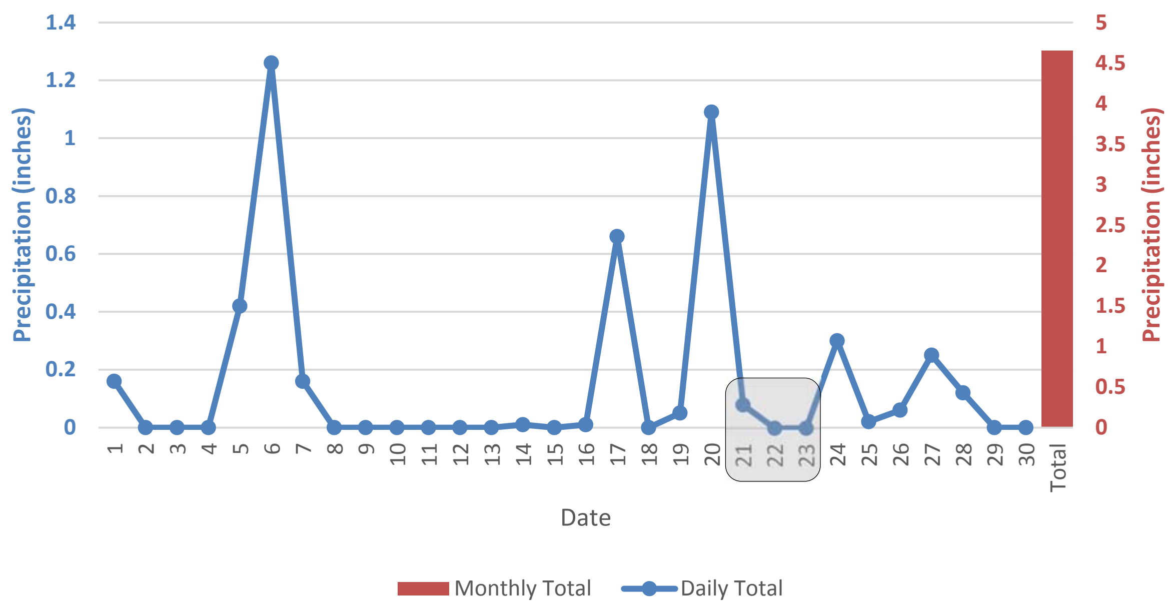


Figure 7. Rainfall recorded during June 2017 at the Albany Airport weather station. The sampling period is highlighted by the gray box.

In 2019, sampling occurred between June 18-20. Average daily air temperatures ranged between 13.1°C (55.5°F) and 25.3°C (77.6°F), with a monthly average of 20.3°C (68.5°F) (Fig. 8). During the sampling period, the average daily temperature was 20.9°C (69.6°F) (Fig. 8). During June 2019, a total of 5.0 inches of rainfall was recorded (Fig. 9). Prior to sampling (June

1-18), a total of 3.53 inches of rainfall was recorded at the weather station; totaling 71% of the sum rainfall recorded in June 2019. During the sampling period, 0.07 inches of rainfall was recorded; however, all sampling was performed during dry-weather conditions.

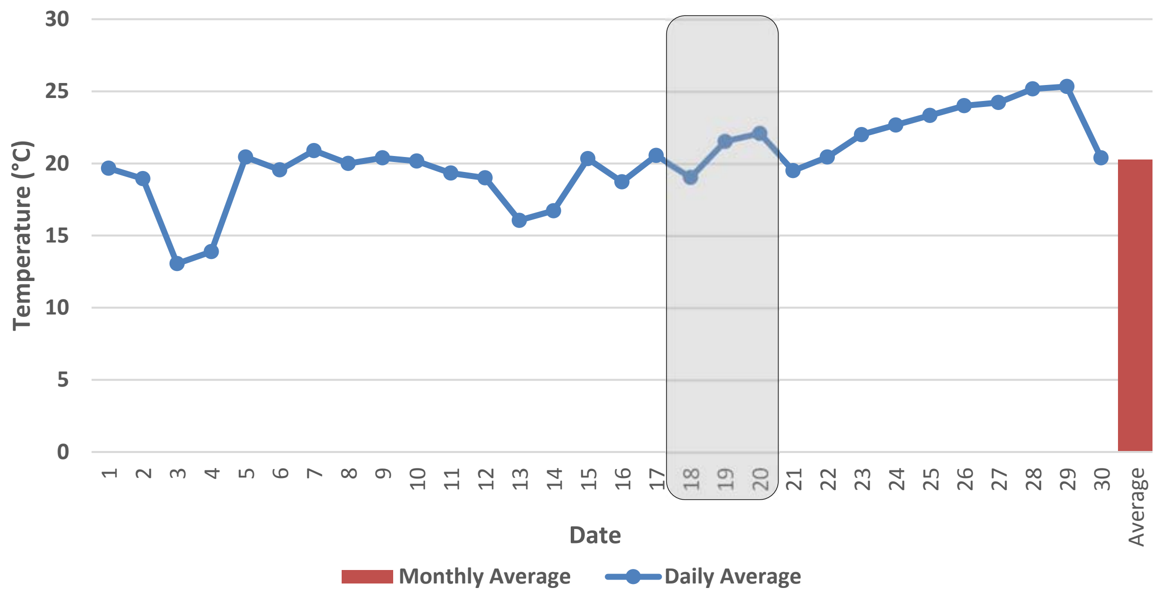


Figure 8. Temperatures recorded during June 2019 at the Albany Airport weather station. The sampling period is highlighted by the gray box.

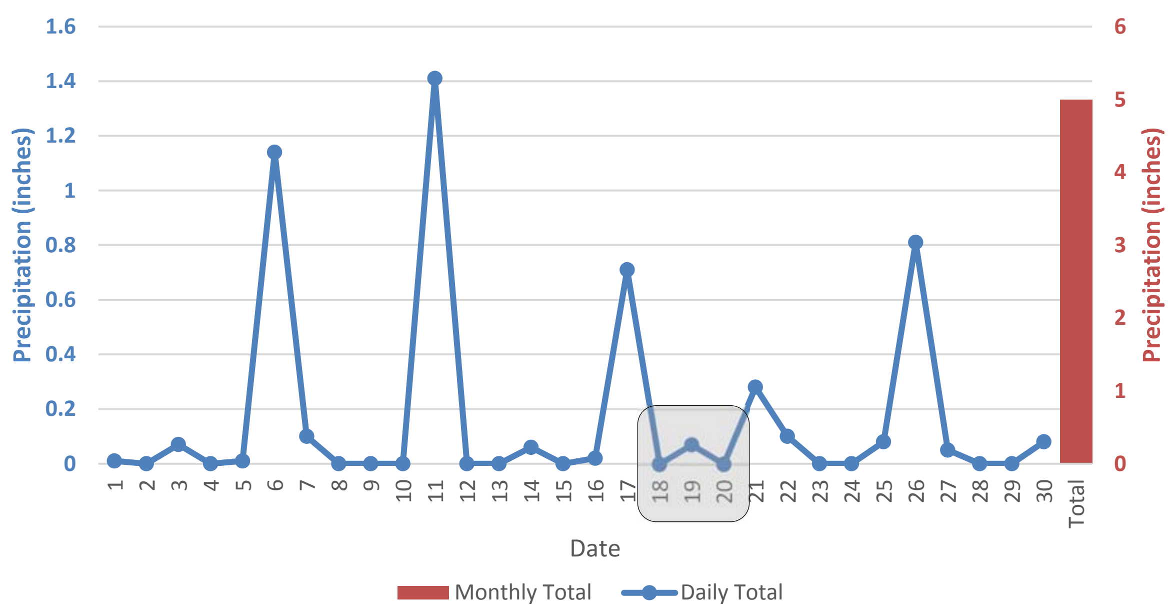


Figure 9. Rainfall recorded during June 2019 at the Albany Airport weather station. The sampling period is highlighted by the gray box.

Overall, both temperature and rainfall were comparable in the Poesten Kill region between the 2017 and 2019 surveys (Table 2). The minimum daily average temperature was greater in 2019; however, the maximum daily average temperature was lower than in 2017 (Table 2). Overall, the average temperature for the month of June was 0.5°C warmer in 2019 than 2017; representing a 3% difference in June air temperatures. During the respective sampling periods, however, the average temperature was 1.5°C cooler in 2019 than 2017. Total precipitation was 8% greater in June 2019 than in June 2017. Not only was precipitation greater in June 2019, but the maximum total daily rainfall was greater than in 2017. This suggests that individual rain events during June 2019 tended to be greater in intensity (Fig. 7 & Fig. 9). At the time of sampling, total rainfall was nearly identical between sampling years (Table 2).

Table 2. Ambient weather conditions for the month of June during Poesten Kill surveys and the percent-change in values from 2017-2019.

Year	Sample Dates	Temperature (°C)			Rainfall (inches)		
		Daily Avg Min-Max	Monthly Avg	Sample Period Avg	Daily Total Min-Max	Monthly Total	Sample Period Total
2017	21-23	11.8-27.1	19.8	22.4	0-1.09	4.65	0.08
2019	18-20	13.1-25.3	20.3	20.9	0-1.41	5.00	0.07
% Change		11% [-] -7%	3%	-7%	0%-29%	8%	-13%

c. Fish Sampling

Fish were collected using a Smith-Root Model LR-24 Electrofisher in 2017 and a Halltech Model HT 2000B Electrofisher in 2019. Prior to unit operation, all technicians were trained in proper electrofishing methods. This includes how to operate the unit, appropriate power levels, how to change the battery, proper maintenance, and how to use the unit in the field to maximize the safety and effectiveness of sampling (i.e., how to move the anode, and being aware of surrounding people and their location to the equipment).

Prior to sampling, the stream reach was delineated according to the representative habitat requirements (i.e., presence of reach, run, and riffle). Where natural barriers (e.g., waterfalls, log jams) were absent, a block seine was placed at the most upstream portion of the reach. Electrofishing began at a shallow riffle, or other physical barrier, and continued upstream to the block seine or natural barrier. The field crew consisted of three people, with one person operating the electrofisher unit and two members capturing fish with a scap net. The crew worked upstream, using a side-to-side sweeping motion between stream banks. All captured fish were placed in buckets for subsequent identification. Crew members wore polarized sunglasses to maximize capture efficiency. Shocking was done over an approximated stream length of 40-150 meters at each site, depending on stream width (narrower stream sections were sampled over longer distances).

Stunned fish were netted and placed into buckets for post sampling identification and measurement. Lengths of fish were measured with a metric measuring board and recorded on field sampling data sheets (Appendix A). Once 30 individuals of a given species were measured, counts of the remaining individuals of that species were tallied. Anomalies (e.g., evidence of parasites, deformities, etc.) on individual fish were noted. If necessary, voucher specimens were retained to confirm proper identification. Once processed, fish not kept for collection purposes were released unharmed at the point of capture.

d. Macroinvertebrate Sampling

Macroinvertebrate samples were collected following the NYSDEC Standard Operating Procedures for kick netting in wadable streams (Duffy et al. 2018). The procedure began by disturbing the stream bottom through a series of kicks. Dislodged organisms were collected downstream in an aquatic rectangular-frame net (12" frame, 1,200 µm mesh opening). The net was placed approximately 0.5 m downstream of where the stream bottom was disturbed. Sampling was conducted for 5 minutes over a distance of 5 meters, moving in a diagonal transect to stream flow when possible (Fig. 10).

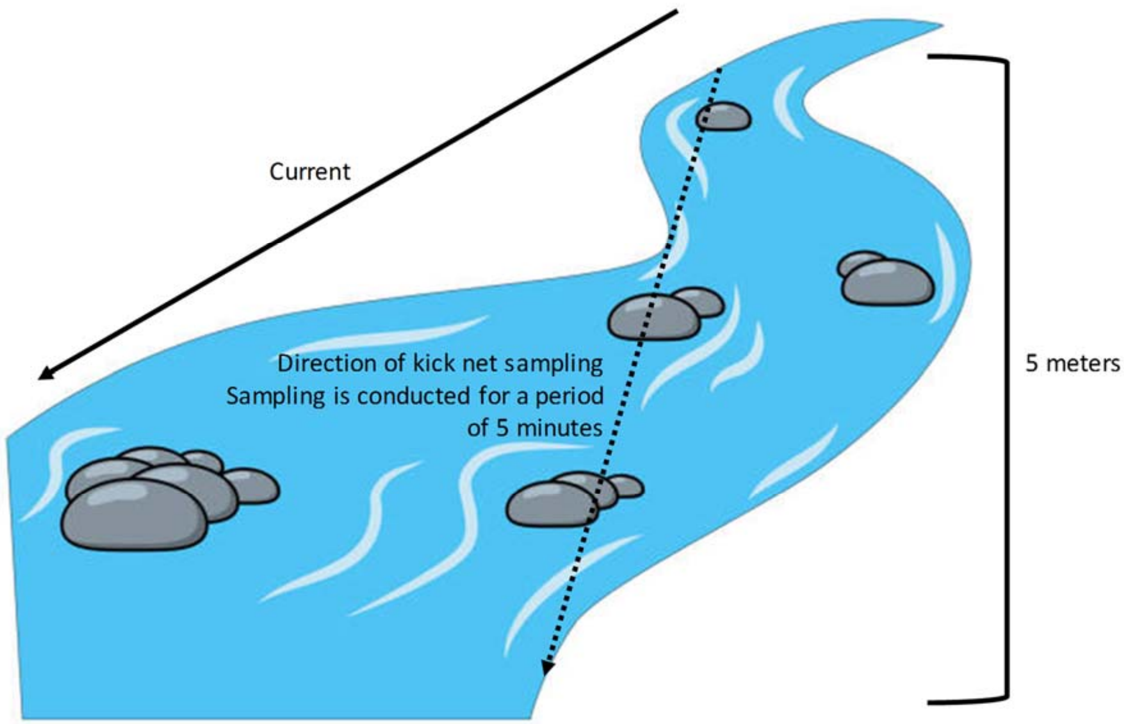


Figure 10. Traveling kick-net sampling procedure.

Once sampling was complete, the content of the net was emptied into a pan. Large debris (e.g., leaves, sticks, rocks) was removed from the sample after all organisms that may have been attached to the debris were removed and returned to the net. The remaining contents of the sample were sieved through a U.S. Standard No. 35 mesh sieve (0.50 mm) and transferred to either a Whirl-pak® bag or plastic container, where it was preserved in 70% ethanol. Labels with the date, location information (waterbody, county and township) and the collector(s) were placed both on the outside and inside of the sample container to prevent the misplacement and switching of samples.

e. Macroinvertebrate Sorting & Identification

A 100-organism subsample was conducted for each macroinvertebrate sample. Samples were rinsed through a U.S. No. 60 sieve with tap water to remove the alcohol, and a portion of the sample was randomly removed with a spatula and placed in a Petri dish. With the aid of a dissecting microscope, organisms were sorted from debris and placed into clean 20 mL scintillation vials containing 70-75% ethanol. This was repeated until 100 organisms were counted. For samples with low macroinvertebrate numbers, additional subsampling may have been necessary, and was conducted as needed until the desired number of organisms were counted. Post-sampling identification of invertebrate samples was done using an Olympus Model SZ-ST dissecting microscope with an AmScope Model LED-6WD spotlight. Macroinvertebrates were identified using several taxonomic keys to the lowest taxonomic level achievable (e.g., genus or species). Taxonomic keys used to facilitate identification were:

- *Merritt, R.W., K.W. Cummins and M.B. Berg. 2009. An Introduction to the Aquatic Insects of North America. Kendall/Hunt Publishing Company, 4th Edition, 1214 pp.*
- *Peckarsky, B.L, P.R. Fraissenet, M.A. Penton, and D.J. Conklin, Jr. 1990. Freshwater Macroinvertebrates of Northeastern North America. Cornell University, New York, 442 pp.*
- *Simpson, K.W. and R.W. Bode. 1980. Common Larvae of Chironomidae (Diptera) from New York State Streams and Rivers, with Particular Reference to the Fauna of Artificial Substrates. New York State Museum, Bulletin No. 439: 1-102.*
- *Stewart, K.W. and B.P. Stark. 2002. Nymphs of North American Stonefly Genera (Plecoptera). Entomological Society of America, 2nd Edition, 510 pp.*
- *Wiggins, G.B. 2009. Larvae of the North American Caddisfly Genera (Trichoptera) 2nd Ed. University of Toronto Press, 457 pp.*

f. Water Quality Analysis

General water chemistry and quality data were collected *in-situ* at each site using a YSI 650 MDS handheld device equipped with a 6820V-2 multi-parameter water quality monitoring probe. The parameters measured were Temperature, Dissolved Oxygen, pH, Conductivity, and Turbidity (Table 3). One measurement of these parameters was taken at each site during both surveys. Measurements were taken after fish and macroinvertebrate sampling was completed and the stream stabilized from the disturbance caused by the field staff.

Table 3. Water quality parameters measured in the Poesten Kill.

Parameter[1]	Unit of Measurement	Definition & Importance
Temperature	Degrees Celsius (°C)	***Quantity of the physical perception of hot and cold.*** Water temperature is most commonly measured with a thermometer or a water quality meter equipped with a temperature sensor. Stream temperature is a very easy water quality parameter to measure and can be incredibly informative to understanding the health of a stream system.
Dissolved oxygen	Milligrams per Liter (mg/L) (= Parts Per Million [ppm])	***The amount of oxygen in a volume of water.*** Dissolved oxygen is one of the most important water quality indicators because nearly all aquatic life, ranging from bacteria to fish, require oxygen. Dissolved oxygen is inversely related to temperature.
pH		***A unit-less measure of hydrogen ions in the water.*** Levels of pH are largely driven by the geological composition of the watershed and often change very little in stream systems. Inputs from industrial and municipal discharges, as well as urban runoff, can negatively impact the pH of freshwater systems; which can stress aquatic life and alter biodiversity.
Conductivity	Microsiemens Per Centimeter (µS/cm)	***Measure of electrical conductance in water.*** Natural waters contain dissolved solids, primarily inorganic salts, which are the predominant electrical conductors in water. Therefore, conductivity is an indirect measurement of salinity; or the concentration of salts in water. In freshwater systems, high conductivity concentrations can stress aquatic life and cause mortality.
Turbidity	Nephelometric Turbidity Units (NTUs)	***Measurement of particles suspended in the water.*** It serves as a quantifiable measure of water clarity. Fluctuations in turbidity can be caused by both natural and anthropogenic events. Elevated turbidity levels can impair the biological quality of a stream system, as well as degrade the recreational and aesthetic quality.

[1]Refer to the Factsheet 01, "*Water Quality*" for further discussion of these parameters.

In 2017, in addition to *in-situ* water quality, water samples were also collected for laboratory analysis of fecal coliforms and *Bacteroides*. Sources of fecal contamination to surface waters include untreated sewage, on-site septic systems, domestic and wild animal manure, and storm runoff from agricultural and urban lands. Therefore, fecal coliform analysis was used as an indicator of possible bacterial contamination from human and/or animal sources that could degrade water quality, affect biological integrity, and harm water usage by humans. Fecal coliforms analysis is also the indicator test used to establish water quality standards in New York State (NYCRR Part 703.4). To test for fecal coliform analysis, grab samples were collected from the centerline of the stream using a 150 mL plastic container just below the water surface. The sample was transferred to a 125 mL, pre-preserved plastic bottle and labeled with the date and time of collection, stream name, and site number. The sample was then stored in a cooler containing ice until delivery to the lab. Samples were delivered to the lab within six hours of collection. Samples were analyzed by St. Peter's Hospital Environmental Laboratory (Albany, NY), and sample collection, storage, and delivery adhered to laboratory Chain of Custody procedures (Appendix B).

Distinguishing the host-source (e.g., human, cow, dog, goose, etc.) of the fecal coliforms is an invaluable component when attempting to identify the physical source (e.g., farm, sewer pipe, septic system, etc.) of bacterial contamination and developing effective remedial strategies. Species-specific bacteria identification was used as a method for determining the organismal source of the fecal coliforms, using viral markers. Specifically, *Bacteroides*, a genus of bacteria, was used to differentiate between human and animal sources of bacteria. This information was gathered to help identify whether the predominant sources of bacteria in the Poesten Kill were from anthropogenic (e.g., sewer or agriculture) or natural sources (e.g., wildlife). Specifically, assays for human, canine (e.g., dog, coyote), and ruminant (e.g., cow, deer) markers were utilized. Samples were collected by taking a direct grab of water from the centerline of the stream using a 1-L plastic Nalgene bottle. The bottle was labeled with the date, time, stream name, and site number, and stored in a cooler containing ice until delivery to the lab. Samples were analyzed by the laboratory of Dr. Hyatt Green at SUNY College of Environmental Science and Forestry (SUNY-ESF) utilizing published methodologies (Mieszkin et al. 2010, Green et al. 2012, Green et al. 2014). Each sample was analyzed for the presence of human, canine, and bovine markers; with three replicates performed for each test per site. Due to the longer holding time permitted by this sample analysis, samples were retained on-ice for the duration of the survey and delivered to SUNY-ESF once all sampling was complete. Sample collection and delivery adhered to OEI's Chain of Custody procedures (Appendix B).

g. Physical Habitat

In-stream and surrounding habitat was evaluated using the Visual-based Habitat Assessment (VHA) method developed by the US Environmental Protection Agency (EPA) as part of their rapid bioassessment protocols used for wadeable streams (Barbour et al., 1999). Physical habitat was assessed and recorded on a standardized datasheet (Appendix A.2). The VHA is a semi-quantitative method that allows for a comparison of habitat quality among sites. Two different data sheets were utilized for this study, depending on stream gradient (high gradient and low gradient) (Appendix A.3]). For example, low gradient streams contain more pools, whereas high gradient streams contain more riffles. These data sheets take into consideration these differences and alter the in-stream parameters accordingly. In the Poesten Kill, four sites (Sites 31, 27, 18, and 37) were considered high gradient sites, and all remaining sites (N=10) were considered low gradient stream reaches. Barbour et al. (1999) recommends that at least one other biologist helps conduct the VHA at each site to reduce any bias that would be associated with only one person conducting the survey. Therefore, field technicians assisted the field team leader in conducting the VHA.

There are collectively ten parameters evaluated as part of the VHA. Individual parameters range in scores from a low of 0 (“Poor”) to a high of 10 or 20 (“Optimal”), depending on the parameter. The highest VHA score achievable for a site is 200. VHA scores were categorized to provide an overall assessment of habitat condition that could be visually displayed. Total VHA scores between 0-50 were considered “Poor”, between 51-100 “Marginal”, between 101-150 “Suboptimal”, and between 151-200 “Optimal”.

h. Data Analysis

As part of previous ecological surveys, OEI developed interpretative scales for various water quality parameters in order to categorize and visually represent numerical data in an easily comparable format (Table 4, Fig. 11). These scales were applied to all tables and figures for comparative purposes; they were implemented to provide relative perspective of the parameter-specific levels or concentrations in the watershed, spatially (i.e., upstream-downstream gradients).

Table 4. Data interpretative scales.

Parameter	Scale		Parameter	Scale	
Dissolved oxygen (mg/L)	Extremely high	14-17	pH	Highly alkaline	> 9
	Very high	12-14		Alkaline	8-9
	High	8-12		Slightly alkaline	8
	Moderate	5-8		Neutral	7
	Low	3-5		Slightly acidic	6
Temperature (°C)	Hot	> 25		Highly acidic	< 5
	Warm	20-25	Salinity (PPT)	Highly saline	10-35
	Mild	15-20		Moderately saline	3-10
	Cool	10-15		Slightly saline	1-3
	Cold	5-10		Freshwater	0-1
	Frigid	0-5	Specific conductivity (µmHos/cm)	Saline	3000-15,000
Turbidity (NTU)	Very high	> 1000		Moderately saline	1600-3000
	High	150-1000		Slightly saline	800-1600
	Medium	50-150		Freshwater	400-800
	Low	10-50		Pristine	0-400
	Very low	5-10	Fecal coliform (cfu/100 mL)	Severe	≥ 50,000
	Pristine	0-5		Very high	10,000-50,000
				High	1000-10000
				Moderate	100-1000
				Low	10-100
				Very Low	≤ 10

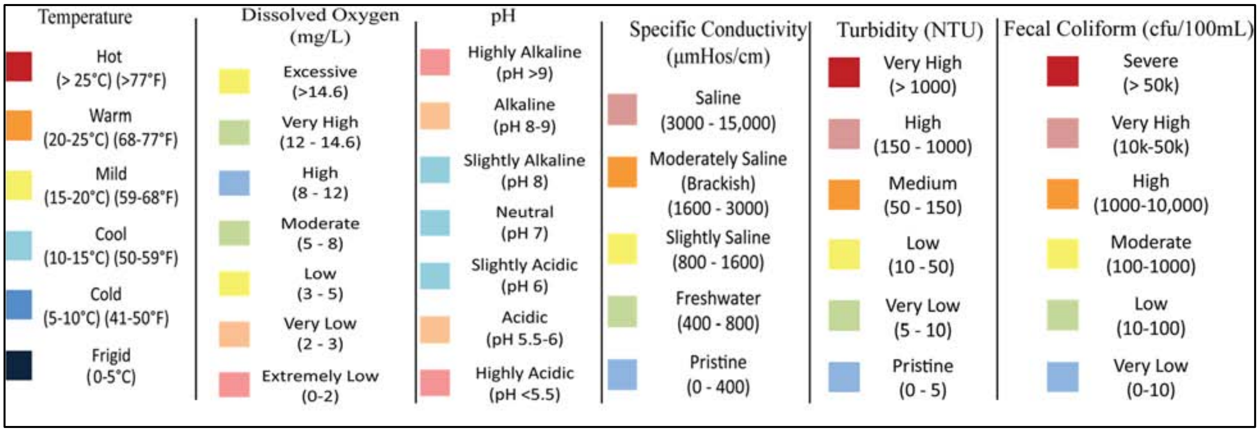


Figure 11. Data interpretative scales color-codes use for graphical summaries.

Descriptive statistics were calculated for each measured parameter. Site-specific measurements of each parameter were plotted on parameter-specific line-graphs for 2017 and 2019. Percentages of sites within specified ranges for each parameter and percent changes from 2017 to 2019 were analyzed and reported accordingly.

i. Fish Analytical Methods

Analyses included species lists, computation of metrics of fish community integrity, and descriptive statistics of all environmental variables for which data were collected. Calculated fish community metrics include:

- ***Fish abundance*****:** total number of individuals collected/location
- ***Shannon diversity (H´)*****:** takes into account both species richness (number of species) and evenness (number of individuals in each species) and is calculated using the formula (Shannon and Weaver 1949):

  $$H' = -[\sum_{i=1}^{k}(p_i)\,(\ln p_i)] \qquad \textbf{[eq.1]}$$

  Where: p_i = percentage of species *i* in the sample
  k = species

- ***Species richness*****:** total number of species per location
- ***Index of Biotic Integrity (IBI)*****:** Twelve metrics, from three major categories comprise the IBI (Table 5). The final IBI scores scaled from 12-60, and the scores were classified based on pre-determined value ranges. The classifications and ranges were: "Very Poor" (12-24), "Poor" (25-36), "Fair" (37-45), "Good" (46-54), and "Excellent" (55-60). The IBI developed for the northern Mid-Atlantic drainage slopes (Daniels et al. 2002) was used. The results of the IBI scores for each site were plotted on a line-graph including both years. The percentages of sites within each IBI category (i.e., poor, fair, etc.) and changes in IBI scores at each site from 2017 to 2019 were analyzed.

Table 5. Metrics used to calculate the fish Index of Biotic Integrity (IBI).

Category	Metric	Score		
		5	3	1
Resident fish richness and composition	Species richness	Maximum Species Richness Line[1]		
	Number of benthic-insectivorous species	Maximum Species Richness Line		
	Number of water column species	Maximum Species Richness Line		
	Number of terete minnow species	Maximum Species Richness Line		
	Percentage of dominant species	<40%	40-55%	>55%
	Percentage of white suckers (*Catostomus commersoni*)	<3%	3-15%	>15%
Trophic composition	Percentage of generalists	<20%	20-45%	>45%
	Percentage of insectivores	>50%	25-50%	<25%
	Percentage of top carnivores	>5%	1-5%	<1%
Fish abundance and condition	Fish density (fish/100 m^2)	Maximum Density Line		
	Percentage of species represented by 2 size classes	>40%	15-40%	<15%
	Percentage of individuals with diseases, tumors, fin damage, or other anomalies	0%	0-1%	>1%

[1] Adapted for the northern mid-Atlantic drainage basin (Daniels et al. 2002). The maximum species richness line (MSRL) is based on empirical data that suggest species richness increases with increasing stream size (Daniels et al. 2002). This method compensates for variation in species richness related to stream size. Species richness is compared with watershed area (km^2). Score criteria regions (i.e., 1, 3, and 5) are established for MSRL graphs and scores are computed based on where species richness falls on the graph, in relation to stream size. For example, low species richness (< 3) for a site with a watershed area > 100 km^2 receives a score of 1. This same method is applied for the Maximum Density Line.

ii. Macroinvertebrate Analytical Methods

The results of the 100-organism subsample were used to perform the following calculations:

- ***Taxon richness*****:** total number of taxa collected in a sample (e.g., genus)
- ***Shannon diversity (H´)*****:** refer to Equation 1
- ***Ephemeroptera-Plecoptera-Trichoptera (EPT) richness*****:** total number of taxa (e.g., species) of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera) found in a 100-organism subsample.
- ***Hilsenhoff Biotic Index (HBI)*****:** measures organic (sewage) pollution effects on benthic invertebrate communities (Hilsenhoff 1987). Each species is assigned a tolerance value on a scale of 0 (intolerant) to 10 (tolerant). HBI values will be obtained from Smith et al. (2009) and scores can be calculated with the equation:

  $$\text{HBI} = [\textstyle\sum_{i=1}^{k} S_i \text{ (tolerance value)}/\text{N} \quad \textbf{[eq. 2]}$$

  Where: S = number of individuals for each species *i*
  n = total number of individuals collected for each sample
  k = total number of species
- ***Dominance-3 (DOM3)*****:** percent contribution of the three most dominant species (Bode et al. 2002)

- ***"Non-Chironomidae and Oligochaeta" (NCO) richness***: total number of taxa found in all groups, except those in the groups Chironomidae and Oligochaeta.

- ***Percent Model Affinity (PMA)*****:** measures the similarity of the sample collected to a model non-impacted community in New York State (Novak and Bode 1992). The percent similarity is calculated for each sample to a model kick sample community of 40% Ephemeroptera, 20% Chironomidae, 10% Trichoptera, 10% Coleoptera, 10% Other, 5% Plecoptera, and 5% Oligochaeta. The sample community percent contribution is compared to the model community and the lesser of the two values is used. The total sum of the lesser values for each taxonomic category is the PMA value.

- ***Nutrient Biotic Index for Phosphorus (NBI-P):*** uses macroinvertebrate nutrient optima to assess nutrient enrichment (Smith et al. 2007). Similar to the HBI, which measures organic pollution, the NBI-P measures the effects of total phosphorus (P) on benthic macroinvertebrate composition. Scores range from 0 to 10, on an oligotrophic-eutrophic scale. Scores between 0-5 are considered oligotrophic, scores 5-6 are mesotrophic, and scores 6-10 are considered eutrophic.

- ***Biological Assessment Profile (BAP) for Riffle Habitats:*** a multi-metric index that integrates, and transforms select macroinvertebrate indices to a common scale for the assessment of water quality (Duffy et al. 2018). Values are standardized using formulas specific to each metric (Smith et al. 2009). Those values are summed and then divided by the number of metrics used. Values range between 0 (severely impacted) and 10 (non-impacted) and collectively represent the BAP. The classifications and bins are: "Severely Impacted" (0-2.5), "Moderately Impacted" (2.5-5), "Slightly Impacted" (5-7.5), and "Non-Impacted" (7.5-10). The resulting BAP scores for each site were plotted on a line-graph for both years. Percentages of sites per BAP category (i.e., non-impacted, etc.) and the percent change in BAP scores between 2017 and 2019 were analyzed for each site. BAP scores calculated as part of this survey were also compared to BAP scores obtained during previous NYSDEC surveys to better understand long-term trends in water quality in the Poesten Kill.

III. Results

a. Water Quality

i. Temperature

Stream temperatures in the Poesten Kill were comparatively lower in 2019 than in 2017 (Fig. 12). For both years, temperatures showed a consistent trend for the uppermost locations, with temperatures noticeably decreasing between the uppermost site, Site 31, and Site 30 (Fig. 12). While temperatures fluctuate downstream during both years, Site 31 consistently had the highest stream temperatures among sampling locations. This is likely due to the presence of the Dyken Pond dam just upstream of the sampling location, which regulates flow and controls Dyken Pond; causing open, relatively stagnant water to warm more quickly in the exposed sunlight.

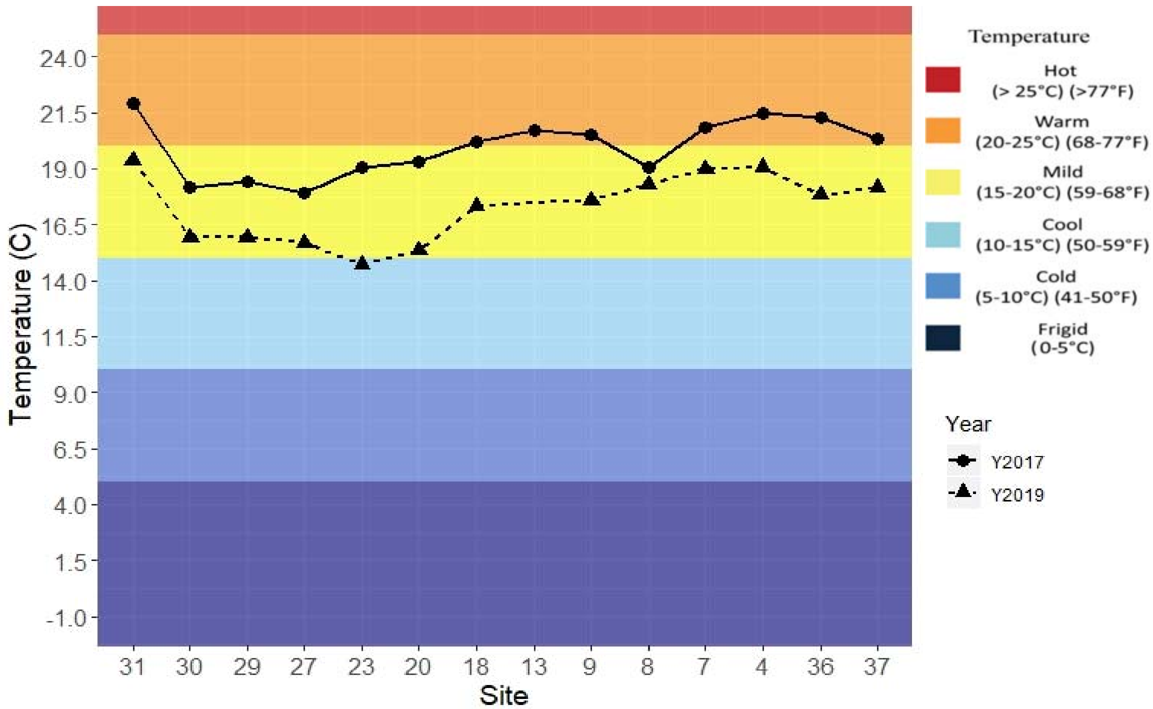
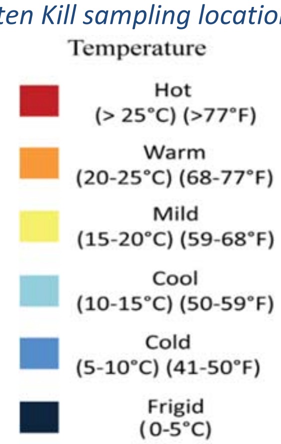


Figure 12. Poesten Kill stream temperatures in 2017 & 2019. Sites are arranged in downstream order.

Stream temperatures ranged between cool and warm levels between both years (Table 6). Average temperatures were considered mild for both years, with 2017 being 2.7°C warmer. Despite the differences in temperatures between years, stream temperatures for all sites were within ranges not considered detrimental to biological health, were consistent with ambient conditions, and were characteristic of stream temperatures for the Northeast United States (NOAA 2019).

Table 6. Descriptive statistics of temperature (°C) for 2017 and 2019 for Poesten Kill sampling locations.

Parameter	Statistic	Year	
		2017	2019
Temperature (°C)	Minimum	17.94	14.72
	Median	20.27	17.58
	Maximum	21.93	19.35
	Average	19.94	17.24
	Standard Deviation	1.29	1.56
	Standard Error	0.343	0.432
	Coefficient of Variation (%)	6.4%	9%
	N	14	13



In 2017, temperatures ranged between mild and warm, with 8 out of 14 sites (57.14%) in the "warm" range (20-25 °C) and 6 out of 14 sites (42.86%) in the "mild" range (15-20 °C)

(Table 7). In 2019, 12 out of 13 sites (92.31%) were in the "mild" range and one out of 13 sites (7.69%) was in the "cool" range (10-15 °C) (Table 7).

Table 7. Proportion of Poesten Kill sites within each interpretative range for temperature.

Temperature Range	2017		2019	
	# of Sites	% of Reach	# of Sites	% of Reach
Hot	0	0	0	0
Warm	8	57.14%	0	0
Mild	6	42.86%	12	92.31%
Cool	0	0	1	7.69%
Cold	0	0	0	0
Frigid	0	0	0	0
TOTAL	**14**	**100%**	**13**	**100%**

All sites were observed to have decreases in stream temperatures from 2017 to 2019 (Fig. 8). Of the 13 comparable sites (*recall site #13 was not sampleable in 2019 and, therefore, comparisons between years could not be made*), one site (7.69%) exhibited a temperature reduction in the range of 0-1 °C, one site (7.69%) exhibited a temperature reduction in the range of 1-2 °C, eight sites (61.54%) exhibited a 2-3 °C reduction in temperature, two sites (15.38%) exhibited a 3-4 °C reduction in temperature, and one site (7.69%) exhibited a 4-5 °C reduction in temperature (Table 8).

Table 8. Temperature reduction ranges for 2017 and 2019.

Temperature Change 2017 to 2019 (°C)	# of Sites	% of Reach
0-1	1	7.69%
1-2	1	7.69%
2-3	8	61.54%
3-4	2	15.38%
4-5	1	7.69%

Site 23 exhibited the most substantial change in stream temperature from 2017 to 2019 with a 22.65% reduction between years. Site 8 exhibited the least significant change from 2017 to 2019 with a 4.04% reduction in stream temperature. The median change in stream temperature across all sites was a 12.71% reduction, while the average change in temperature was a 13.34% reduction (Table 9).

Table 9. Poesten Kill site-specific changes in stream temperature from 2017 to 2019.

Site[1]	31	30	29	27	23	20	18	13	9	8	7	4	36	37
% Change	-12%	-12%	-14%	-13%	-23%	-21%	-14%	NA	-14%	-4%	-9%	-11%	-16%	-11%
Median	-12.71%													
Average	-13.34%													

[1]Sites are arranged in downstream order.

ii. Dissolved Oxygen

Like temperature, dissolved oxygen levels were higher in 2019 than in 2017 for all sampling locations (Fig. 13). The most distinctive increase in dissolved oxygen concentrations consistently occurred between Sites 29 and 27 during both sampling years. The Poesten Kill at Site 29 is located within a wetland where the water is moving relatively slow (Factsheet 06). By Site 27, stream flow is more turbulent (Factsheet 06), contributing, in part, to higher dissolved oxygen concentrations. Downstream of Site 27, dissolved oxygen concentrations remained fairly consistent (Fig. 13).

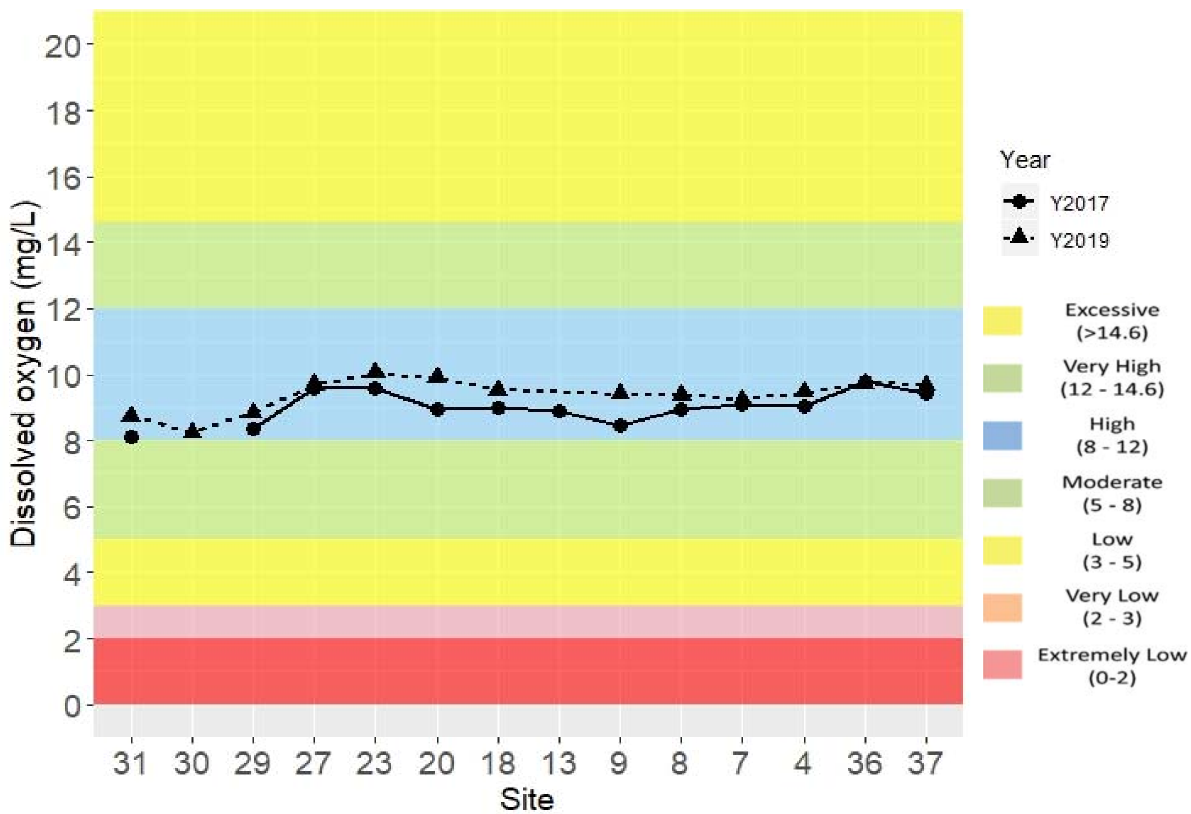


Figure 13. Poesten Kill dissolved oxygen levels in 2017 & 2019. Sites are arranged in downstream order.

All sites in both years (N=13; 100%) had relatively unchanged dissolved oxygen concentrations, with all values in the “high” range (8-12 mg/L) (Table 10). The high, relatively unchanged dissolved oxygen concentrations between sampling years indicates stable conditions, capable of supporting a diverse, healthy biotic community.

Table 10. Proportion of Poesten Kill sites within each interpretative range for dissolved oxygen.

Dissolved Oxygen Range	2017		2019	
	# of Sites	% of Reach	# of Sites	% of Reach
Excessive	0	0	0	0
Very High	0	0	0	0
High	13	100%	13	100%
Moderate	0	0	0	0
Low	0	0	0	0
Very Low	0	0	0	0
Extremely Low	0	0	0	0
TOTAL	**13**	**100%**	**13**	**100%**

Dissolved oxygen values ranged between a low of 8.13 mg/L (Site 31 in 2017) and a high of 10.04 mg/L (Site 23 in 2019) (Table 11). Average concentrations were nearly similar between sampling years, with an average increase of 0.35 mg/L (Table 11).

Table 11. Descriptive statistics of dissolved oxygen in 2017 and 2019 at Poesten Kill sampling locations.

Parameter	Statistic	Year	
		2017	2019
Dissolved Oxygen (mg/L)	Minimum	8.13	8.24
	Median	8.97	9.46
	Maximum	9.79	10.04
	Average	9.02	9.37
	Standard Deviation	0.50	0.50
	Standard Error	0.139	0.140
	Coefficient of Variation (%)	5.5%	5.4%
	N	13	13

Dissolved Oxygen (mg/L)

- Excessive (>14.6)
- Very High (12 - 14.6)
- High (8 - 12)
- Moderate (5 - 8)
- Low (3 - 5)
- Very Low (2 - 3)
- Extremely Low (0-2)

While variations in dissolved oxygen levels were comparatively low among and within locations by year, Site 9 exhibited the most significant change in dissolved oxygen from 2017 to 2019, with a 11.11% increase. Site 36 exhibited the least significant change with a 0.82% decrease. The median change in dissolved oxygen levels across all sites was a 4.73% increase, while the average change was a 4.97% increase (Table 12).

Table 12. Poesten Kill site-specific changes in dissolved oxygen from 2017 to 2019.

Site[1]	31	30[1]	29	27	23	20	18	13[2]	9	8	7	4	36	37
% Change	7.5%	NA	5.9%	1.0%	4.6%	10.5%	6.4%	NA	11.1%	4.8%	1.5%	4.7%	-0.8%	2.6%
Median	4.73%													
Average	4.97%													

[1]Sites are arranged in downstream order. [2]Due to probe malfunction, dissolved oxygen was not recorded at Site 30 in 2017. Water quality was not collected at Site 13 in 2019.

iii. pH

With the exception of Site 36, pH levels were higher in 2019 than in 2017 for sampling locations in Poesten Kill (Fig 14). Levels of pH ranged between alkaline (pH = 8.49, Site 31 in 2017) and slightly acidic pH (pH = 6.01, Site 27 in 2017) (Table 13). An overall downstream decrease in pH was observed between Sites 31 and 23 during both sampling years. The observable, consistent decline in pH is likely are result of the physical and geological conditions of the upper watershed, which is located in the Rensselaer Plateau and has characteristically low pH soils (RPA 2019).

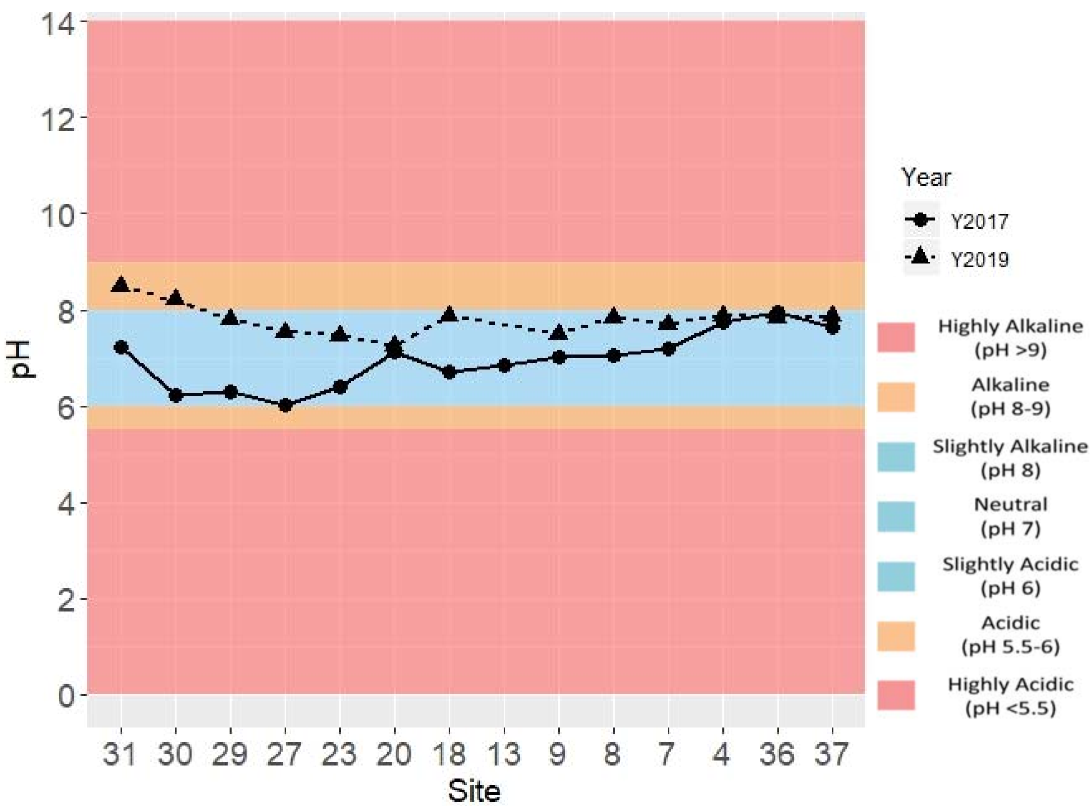
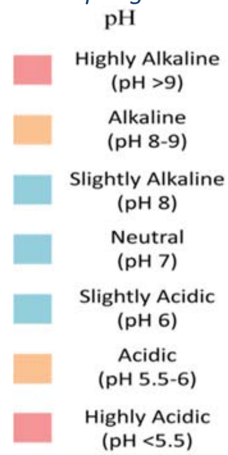


Figure 14. Poesten Kill pH levels in 2017 & 2019. Sites are arranged in downstream order.

Average pH levels in Poesten Kill were considered approximately neutral during both years, with average pH higher in 2019 (Table 13). Overall, pH levels were within ranges characteristic of the physical conditions of the watershed at the time of sampling and did not indicate an impairment to water quality.

Table 13. Descriptive statistics of pH in 2017 and 2019 at Poesten Kill sampling locations.

Parameter	Statistic	Year	
		2017	2019
pH	Minimum	6.01	7.25
	Median	7.035	7.83
	Maximum	7.94	8.49
	Average	6.96	7.79
	Standard Deviation	0.58	0.32
	Standard Error	0.156	0.089
	Coefficient of Variation (%)	8.4%	4.1%
	N	14	13



Of the 14 sites sampled in 2017, 8 (57.14%) had pH values in the "slightly alkaline" range and 6 (42.86%) had values in the "slightly acidic" range. Of the 13 sampled sites in 2019, two (15.38%) had pH values in the "alkaline" range and 11 (84.62%) had values in the "slightly alkaline" range (Table 14).

Table 14. Proportion of Poesten Kill sites within each interpretative range for pH.

pH Range	2017		2019	
	# of Sites	% of Reach	# of Sites	% of Reach
Highly Alkaline	0	0	0	0
Alkaline	0	0	2	15.38%
Slightly Alkaline	8	57.14%	11	84.62%
Neutral	0	0	0	0
Slightly Acidic	6	42.86%	0	0
Acidic	0	0	0	0
Highly Acidic	0	0	0	0
TOTAL	**14**	**100%**	**13**	**100%**

Site 30 exhibited the most significant change in pH from 2017 to 2019, having a 31.62% increase in pH levels (Table 15). Site 36 exhibited the least significant change from 2017 to 2019 with a 1.26% reduction in pH. The median change in pH among all sampling locations was a 11.06% increase; while the average change in pH levels between sampling years was a 12.48% increase (Table 15).

Table 15. Poesten Kill site-specific changes in pH levels from 2017 to 2019.

Site[1]	31	30	29	27	23	20	18	13	9	8	7	4	36	37
% Change	18%	32%	24%	25%	17%	2%	17%	NA	7%	11%	7%	2%	-1%	3%
Median	11.06%													
Average	12.48%													

[1]Sites are arranged in downstream order.

iv. Conductivity

Trends in stream conductivity followed similar spatial patterns during both sampling years (Fig. 15). Furthermore, conductivity levels at nearly all sampling locations changed relatively little between years (Fig. 15). A noticeable downstream increase in conductivity concentrations was observed, with the most upstream location, Site 31, having the lowest conductivity levels and the most downstream location, Site 37, having the highest conductivity levels during both sampling years (Fig. 15). Despite the increase, conductivity at all 14 sites in 2017 and all 13 sites in 2019 remained within the "pristine" range (0-400 uS/cm) (Table 16); ranging from a low of 24 µS/cm (Site 31 in 2019) to a high of 171 µS/cm (Site 37 in 2017) (Table 17).

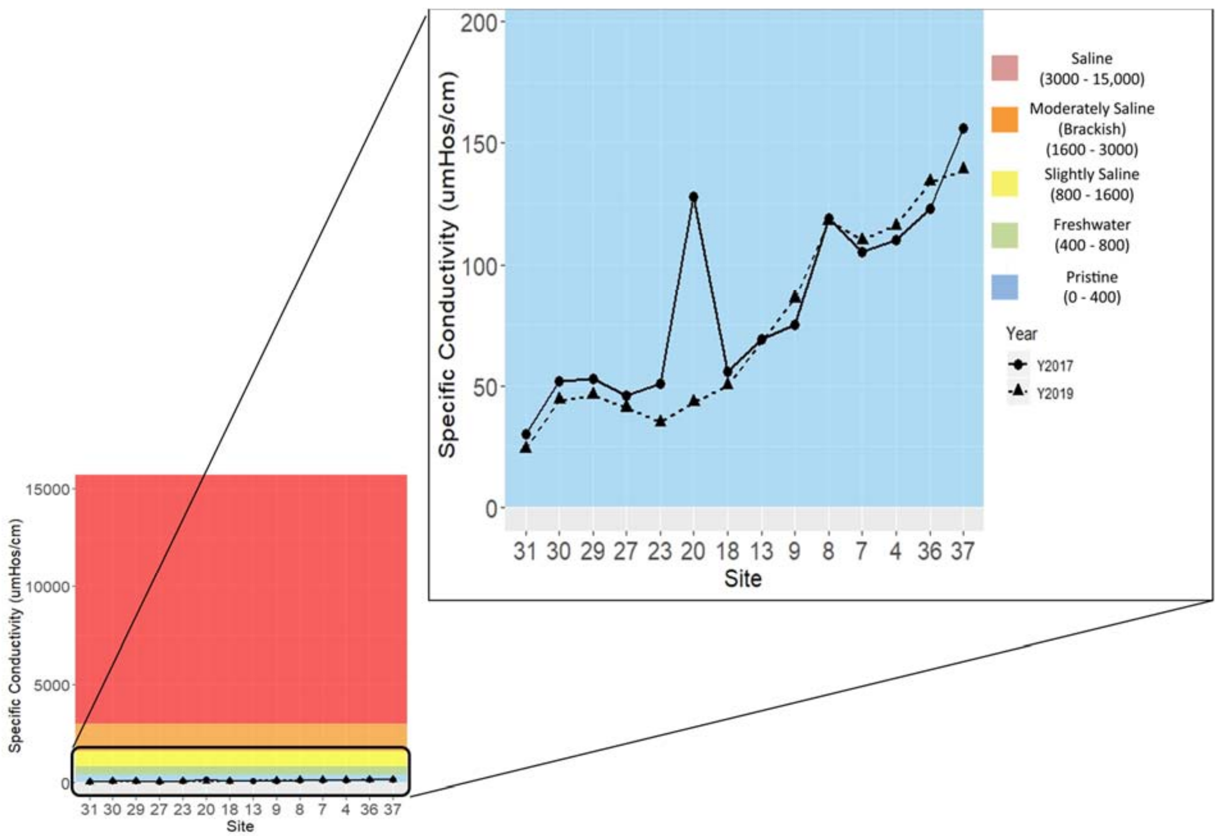


Figure 15. Poesten Kill conductivity levels in 2017 & 2019. Sites are arranged in downstream order. The inset is meant to highlight the narrow range of turbidity levels measured in the Poesten Kill relative to the total color-interpretative scale used.

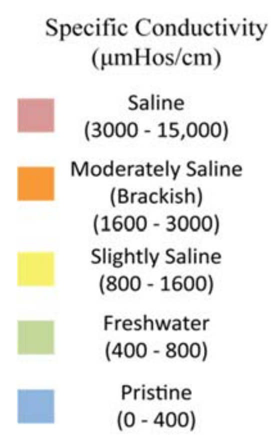
Table 16. Proportion of Poesten Kill sites within each interpretative range for pH.

Conductivity Range	2017		2019	
	# of Sites	% of Reach	# of Sites	% of Reach
Saline	0	0	0	0
Moderately Saline	0	0	0	0
Slight Saline	0	0	0	0
Freshwater	0	0	0	0
Pristine	14	100%	13	100%
TOTAL	**14**	**100%**	**13**	**100%**

Between sampling years, conductivity was collectively lower in 2019 than in 2017, with an average of 75.85 µS/cm in 2019 and an average of 92.57 µS/cm in 2017 (Table 17). During both years, however, concentrations remained within levels characteristic of unimpacted freshwater systems and do not appear to be impacting water quality in the Poesten Kill.

Table 17. Descriptive statistics of conductivity in 2017 and 2019 at Poesten Kill sampling locations.

Parameter	Statistic	Year	
		2017	2019
Conductivity (µS/cm)	Minimum	32	24
	Median	79	50
	Maximum	171	139
	Average	92.57	75.85
	Standard Deviation	42.21	42.08
	Standard Error	11.282	11.672
	Coefficient of Variation (%)	45.6%	55.5%
	N	14	13



Site-specific changes between years demonstrated several notable differences. Site 20 exhibited the most significant change in conductivity concentrations from 2017 to 2019 with a 66.41% reduction (Table 18). Site 8 had the least significant change from 2017 to 2019 with a 0.84% reduction. The median change in conductivity levels across all sites was a 10.87% reduction, while the average change was a 11.22% reduction between sample years (Table 18).

Table 18. Poesten Kill site-specific changes in conductivity levels from 2017 to 2019.

Site[1]	31	30	29	27	23	20	18	13	9	8	7	4	36	37
% Change	-20%	-15%	-13%	-11%	-31%	-66%	-11%	NA	15%	-1%	5%	5%	9%	-11%
Median	-10.87%													
Average	-11.22%													

[1]Sites are arranged in downstream order.

v. Turbidity

Of the measured water quality parameters, turbidity was the most noticeably variable parameter, with observable spatial and temporal fluctuations (Fig. 16). Between years, turbidity values in 2017 varied more than those in 2019 (Fig. 16).

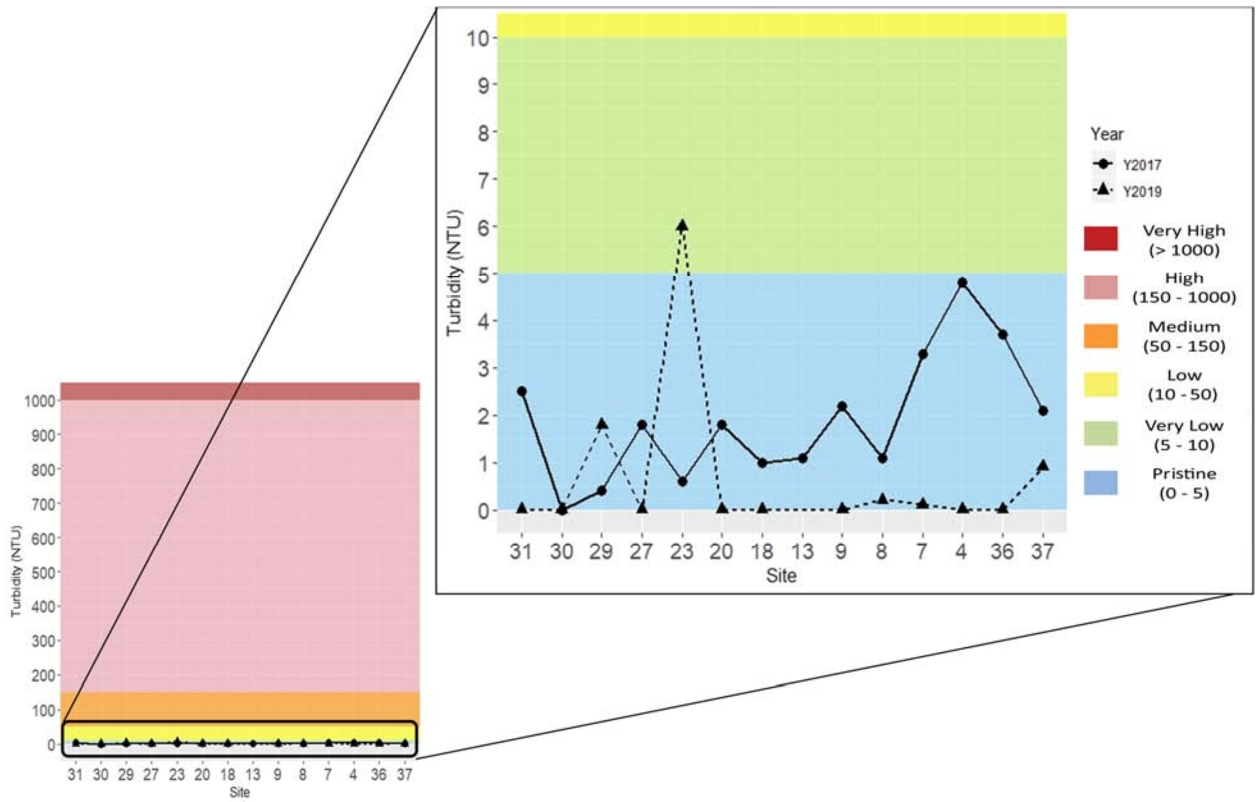


Figure 16. Poesten Kill turbidity levels in 2017 & 2019. Sites are arranged in downstream order. The inset is meant to highlight the narrow range of turbidity levels measured in the Poesten Kill relative to the total color-interpretative scale used.

In 2017, all 14 sites (100%) had turbidity values in the "pristine" range. Of the 13 sampled sites in 2019, one site (7.69%) had a turbidity value in the "very low" range and 12 (92.31%) had values in the "pristine" range (Table 19). Despite spatial and temporal fluctuations in turbidity levels, the range in turbidity levels during both sampling years was relatively low; falling within ranges indicative of pristine, non-impacted stream conditions with high water clarity at all sampling locations (Table 20). In 2017, turbidity levels ranged between 0 NTU and 4.8 NTU. In 2019, turbidity levels ranged between 0 NTU and 6 NTU (Table 20). While the range in turbidity levels was greater in 2019, average turbidity was noticeably lower than in 2017 (Table 20).

Table 19. Proportion of Poesten Kill sites within each interpretative range for turbidity.

Turbidity Range	2017		2019	
	# of Sites	% of Reach	# of Sites	% of Reach
Very High	0	0	0	0
High	0	0	0	0
Medium	0	0	0	0
Low	0	0	0	0
Very Low	0	0	1	7.69%
Pristine	14	100.00%	12	92.31%
TOTAL	**14**	**100%**	**13**	**100%**

Table 20. Descriptive statistics of turbidity in 2017 and 2019 at Poesten Kill sampling locations.

Parameter	Statistic	Year	
		2017	2019
Turbidity (NTU)	Minimum	0	0
	Median	1.8	0.0
	Maximum	4.8	6.0
	Average	1.89	0.69
	Standard Deviation	1.35	1.68
	Standard Error	0.361	0.466
	Coefficient of Variation (%)	71.7%	242.7%
	N	14	13

Site-specific changes in turbidity levels between sampling years highlights the localized variation in turbidity in the Poesten Kill. Site 23 exhibited the most significant change in turbidity levels from 2017 to 2019 with a 900% increase. Site 30 exhibited the least significant change from 2017 to 2019 with a 0% change (Table 21). The median change across all sites was a 100% decrease, while the average change in turbidity was a 24.16% increase (Table 21).

Table 21. Poesten Kill site-specific changes in conductivity levels from 2017 to 2019.

Site[1]	31	30	29	27	23	20	18	13	9	8	7	4	36	37
% Change	-100%	0%	350%	-100%	900%	-100%	-100%	NA	-100%	-82%	-97%	-100%	-100%	-57%
Median	-100.00%													
Average	24.16%													

[1]Sites are arranged in downstream order.

vi. Pathogens

Water quality samples were collected in 2017 to (1) quantify the amount of bacterial contamination via fecal coliform analysis and to (2) identify the host-source (e.g., human vs. animal) of the bacterial contamination via *Bacteriodes* analysis. Overall, the results of the bacterial analysis identified the Poesten Kill as being minimally impacted by bacteria contamination at the time of the 2017 survey. Fecal coliform levels showed a distinct longitudinal increase from the headwaters to the most downstream location (Fig. 17). A spike in fecal coliform concentrations was observed at Site 20 (Fig. 17). This site is located on Columbia Hill Rd, immediately south of Plank Rd (Factsheet 06) and was not fully accessible in 2017 for biological sampling. At the time of sampling, an upstream property owner was installing fencing along the streambank to prevent livestock, namely goats, from entering the stream. It is hypothesized that the spike in fecal coliform came from upstream agricultural practices. Despite the increase in fecal coliform levels at Site 20, the concentration was still below harmful levels.

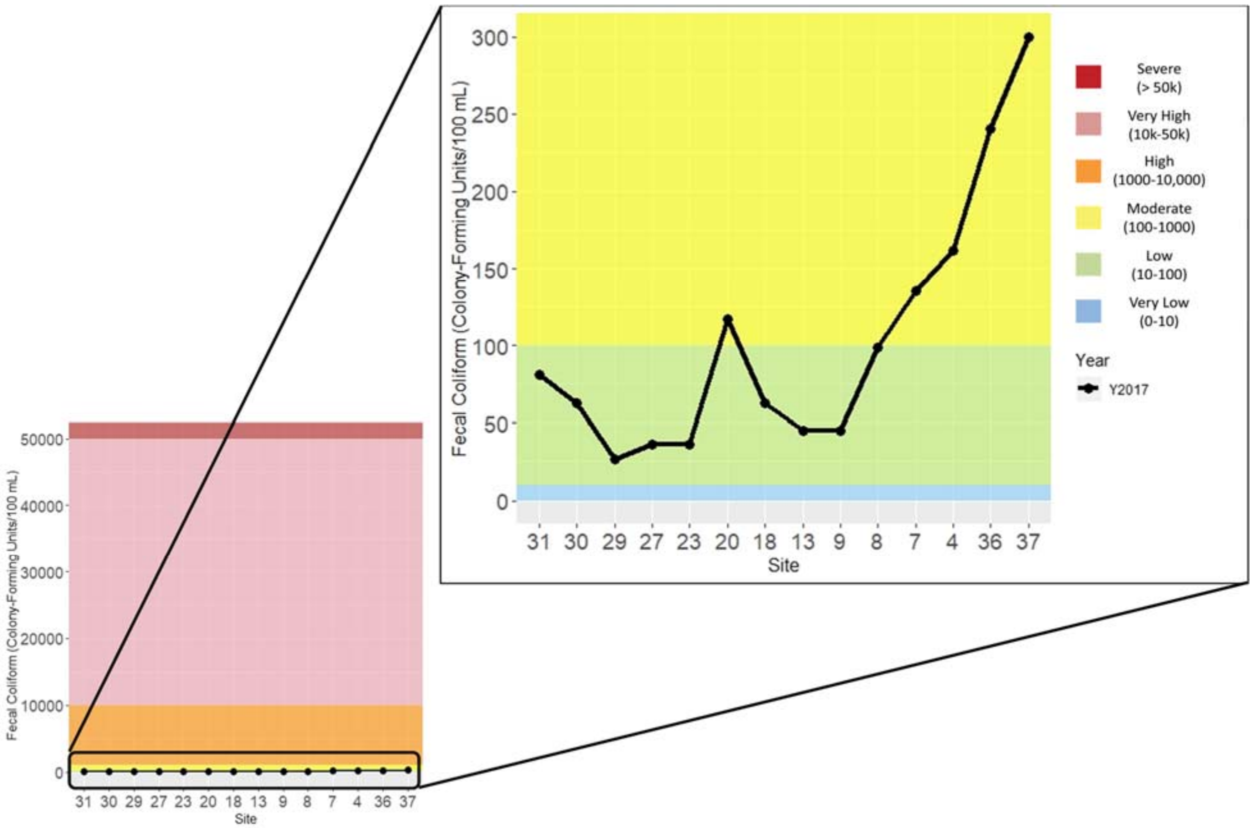


Figure 17. Fecal coliform concentrations in Poesten Kill (2017). Sites are arranged in downstream order. The inset is meant to highlight the narrow range of fecal coliform concentrations measured in the Poesten Kill relative to the total color-interpretative scale used.

Fecal coliform concentrations ranged between low and moderate levels, with a low concentration of 27 colony forming units (cfu)/100 mL at Site 29 and a high concentration of 300 cfu/100 mL at Site 37 (Table 22). The median fecal coliform concentration across all sites was 72 cfu/100 mL (low) and the average was 103.5 cfu/100 mL (moderate) (Table 22).

Table 22. Descriptive statistics of fecal coliform at Poesten Kill sampling locations (2017).

Parameter	Statistic	2017
Fecal Coliform (cfu/100 mL)	Minimum	27
	Median	72
	Maximum	300
	Average	103.5
	Standard Deviation	82.02
	Standard Error	21.92
	Coefficient of Variation (%)	79.25%
	N	14

Most sites in Poesten Kill had low fecal coliform concentrations (Table 23). Of the 14 sampled sites, nine (64.29%) were in the "Low" range and five (35.71%) were in the "Moderate" range (Table 23).

Table 23. Proportion of Poesten Kill sites within each interpretative range for fecal coliform.

Temperature Range	# of Sites	% of Reach
Severe	0	0
Very High	0	0
High	0	0
Moderate	5	35.71%
Low	9	64.29%
Very Low	0	0
TOTAL	14	100%

Bacteria in stream systems is greatly influenced by ambient weather conditions (i.e., dry vs. wet weather), seasonal changes (i.e., warm vs. cold), land uses (e.g., urban vs. agriculture), infrastructure, and human population density (Baxter-Potter and Gilliland 1988, Rubin and Leff 2007, Hathaway et al. 2010). As a result, bacteria concentrations in streams are highly dynamic; changing not only from one day to the next, but even from hour to hour (OEI 2015). Because only one water sample was collected at each site in 2017, making comparisons to NYS Water Quality Standards cannot be made. Likewise, long-term changes in fecal coliform levels could not be evaluated based on one discrete sampling event (June 21-23, 2017); making inferences about seasonal impacts to bacteria loading in the Poesten Kill unachievable. However, based on ambient conditions prior to, and during sampling, inferences about weather-driven impacts to bacteria loading in Poesten Kill can be made.

At the time of sampling, all water samples were collected during dry-weather conditions, with only 0.08" of rainfall recorded during the sampling period. Prior to the initiation of sampling on June 21, 2017, a significant rain event was recorded on June 20, 2017, with 1.09" of rainfall recorded (Fig. 18).

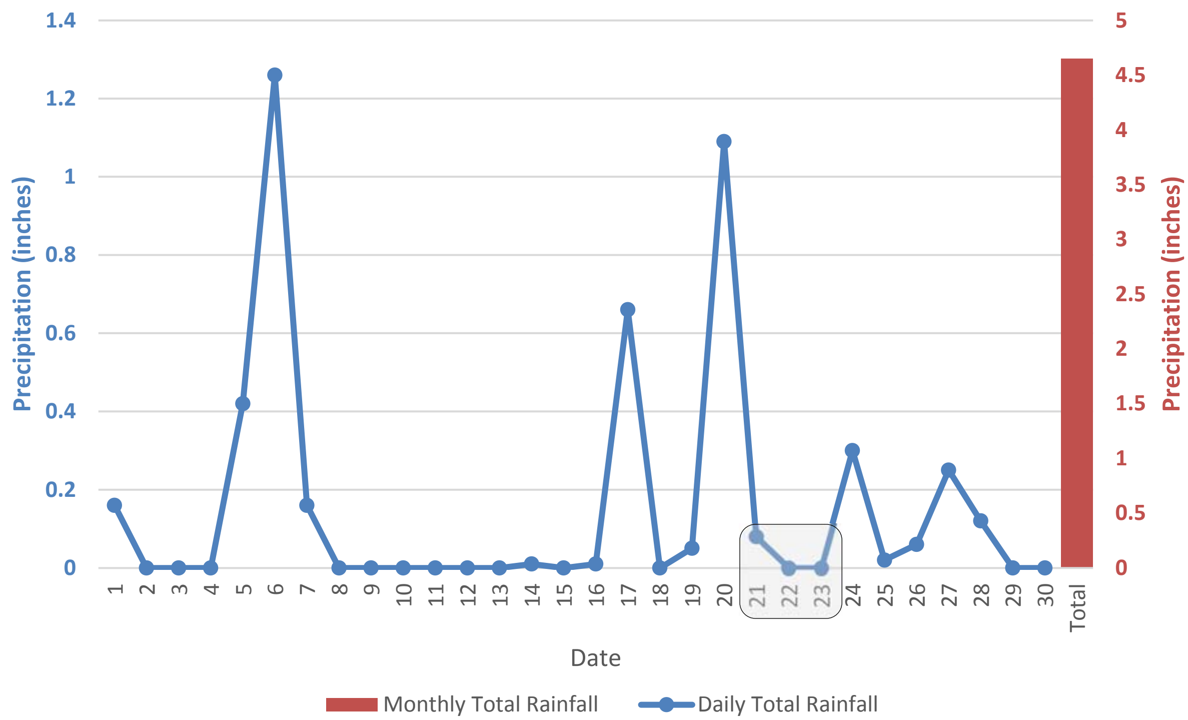


Figure 18. Daily and monthly precipitation totals for June 2017. The period in which samples were collected for bacteria analysis is denoted by the gray box. Rainfall totals were obtained from the Albany International Airport weather station (wunderground.com).

While high-flow rain events increase runoff, and therefore, commonly increase bacteria levels in streams over the short and long-term (Koirala et al. 2008, OEI 2013), results of this survey suggest that the rain event on June 20 either (1) minimally impacted bacteria concentrations in the Poesten Kill, or (2) any significant impacts to bacteria loading were short-term (i.e., ≤ 24 hours) and not detected at the time of sampling.

Spatial inferences about bacteria loading to Poesten Kill can also be made based on the 2017 survey. Fecal coliform results suggest an effect of land use, with the most downstream, and more urbanized locations having the highest fecal coliform concentrations among sampling sites (Fig. 19). One notable exception to this downstream trend is Site 20, which was the only site in the middle and upper segments of Poesten Kill to have a fecal coliform concentration in the "Moderate" range (Fig. 19).

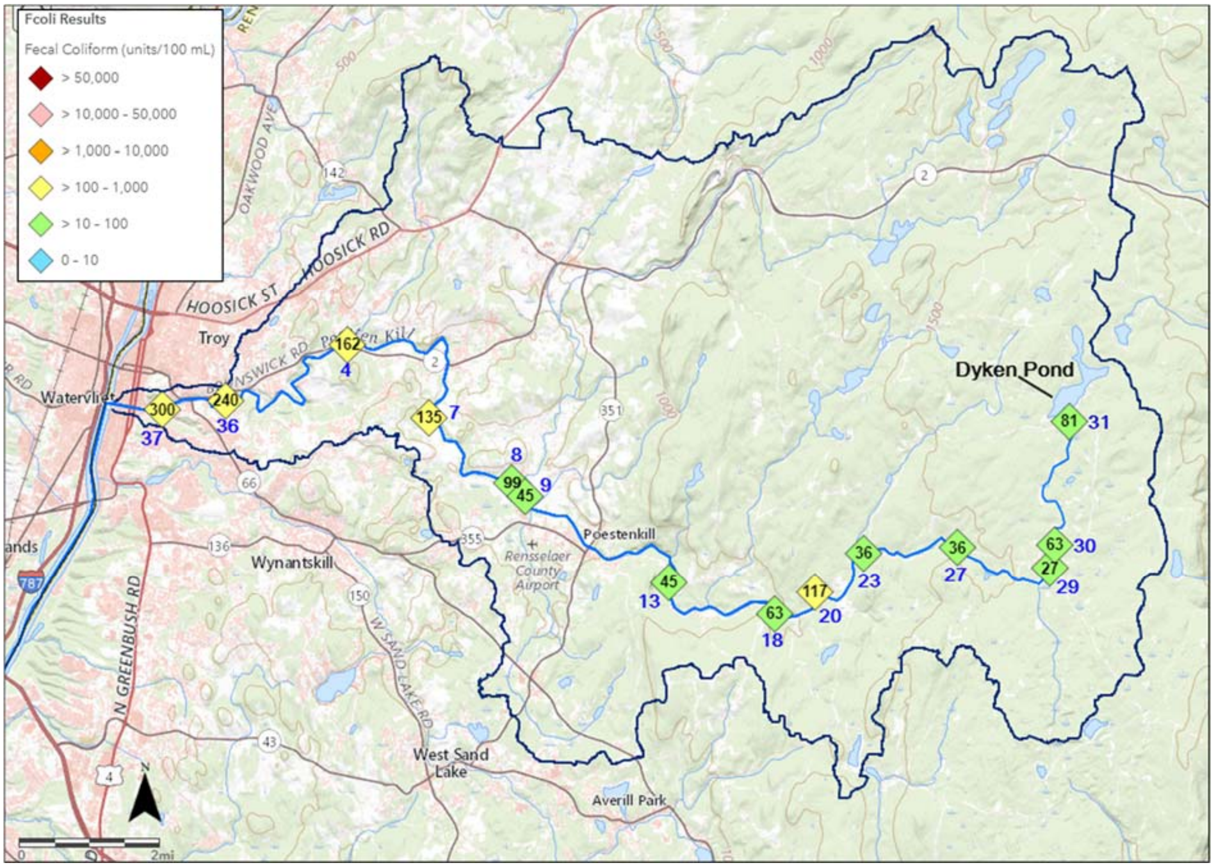


Figure 19. Fecal coliform concentrations (cfu/100 mL) in Poesten Kill, 2017. Concentrations are denoted in the symbols. Site numbers are indicated by the numerals adjacent to the symbols, in blue font.

Due to the low concentration of fecal coliforms at all sampling locations, *Bacteroides* analysis did not yield any significant findings, with nearly all samples undetectable for *Bacteroides*. The only exception to this, is Site #36 (behind Elmwood Hill Cemetery), which had a trace detection of *Bacteroides* from human sources in all three replicates analyzed (Table 24). Tests of canine and bovine were below detection limits for all sampling locations. At the time of the 2017 survey, results suggest that bacteria contamination from animal sources in the Poesten Kill is not concerning. While fecal coliform concentrations are generally low in the Poesten Kill, *Bacteroides* analysis suggests that the downstream sites with moderate fecal coliform concentrations are likely impacted by human sources.

Table 24. Bacteroides analysis of Poesten Kill water samples (2017).

Site[1]	Human[2]	Canine	Bovine
31	ND	ND	ND
30	ND	ND	ND
29	ND	ND	ND
27	ND	ND	ND
23	ND	ND	ND
20	ND	ND	ND
7	ND	ND	ND
18	ND	ND	ND
13	ND	ND	ND
9	ND	ND	ND
8	ND	ND	ND
4	ND	ND	ND
36	TR	ND	ND
37	ND	ND	ND

[1]Sites are arranged in downstream order
[2]ND = Non-detection; TR = Trace. Results are based from three replicates per sample per site.

b. Physical Habitat

Collectively, physical habitat throughout the Poesten Kill mainstem was found to be in good quality during both stream surveys. VHA scores were predominantly concentrated in the "Sub-Optimal" and "Optimal" ranges (VHA = 100-200 pts) during both surveys (Fig. 20). Distinct longitudinal trends in habitat condition was not observed during either survey, suggesting changes to habitat condition were relatively localized.

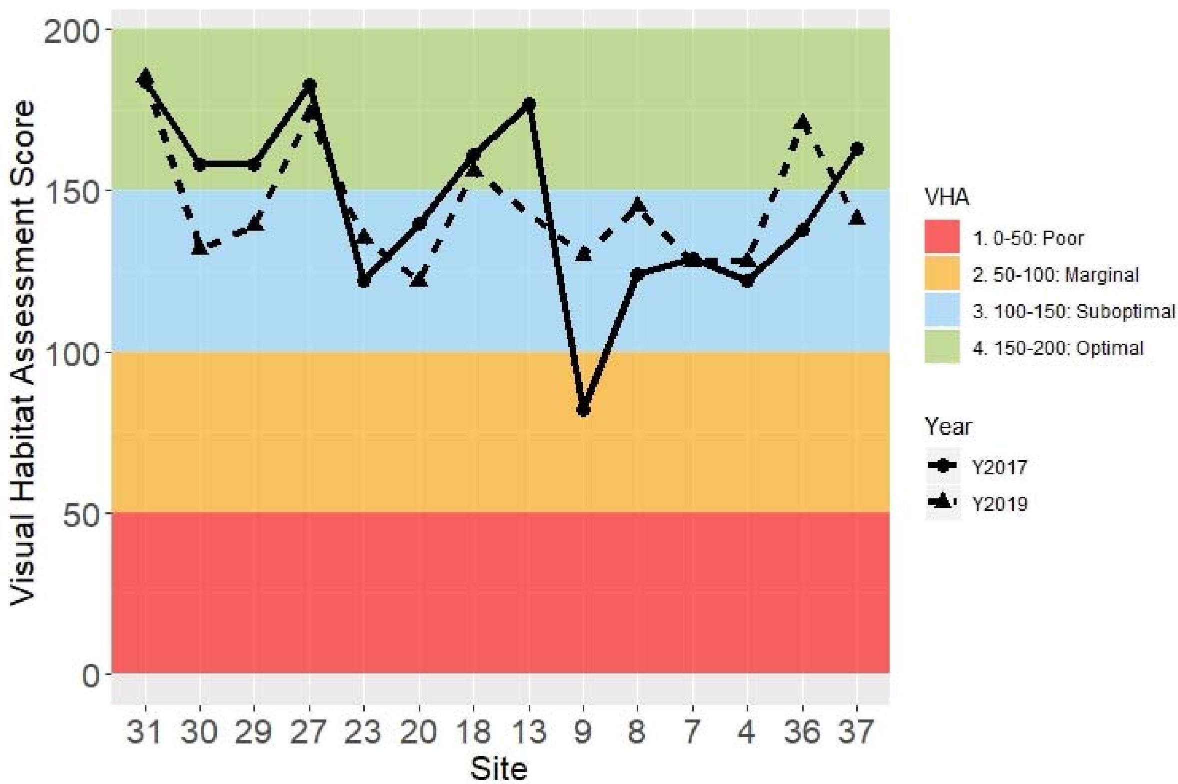


Figure 20. Visual Habitat Assessment scores in Poesten Kill (2017 & 2019). Sites are arranged in downstream order.

VHA scores were more variable in 2017 than in 2019, ranging from a low of 82 (Site 9) to a high of 184 (Site 31) (Table 25). The average VHA score in 2017 was 145.8 ("Suboptimal"). Of the 14 sampled sites in 2017, one (7.14%) was in the "Marginal" range, six (42.86%) were in the "Suboptimal" range, and seven (50%) were in the "Optimal" range (Table. 26). In 2019, VHA scores ranged from a low of 122 (Site 20) to a high of 185 (Site 31), with an overall average VHA score of 145.1 (Table 25). Average scores were nearly identical between surveys, despite a greater variability in VHA scores in 2017 (Table 25). Of the 13 sampled sites in 2019, nine (69.23%) were in the "suboptimal" range and four (30.77%) were in the "optimal" range (Table 26).

Table 25. VHA scores for Poesten Kill sampling locations (2017 & 2019). Changes in VHA between sampling years is shown.

Site[1]	VHA Score		Difference	
	2017	2019	Pts	%
31	184	185	1	0.54%
30	158	132	-26	-16.46%
29	158	139	-19	-12.03%
27	183	174	-9	-4.92%
23	122	135	13	10.66%
20	140	122	-18	-12.86%
18	161	156	-5	-3.11%
13	177	-	-	-
9	82	130	48	58.54%
8	124	145	21	16.94%
7	129	128	-1	-0.78%
4	122	128	6	4.92%
36	138	171	33	23.91%
37	163	141	-22	-13.50%
Minimum	**82**	**122**	**-26**	**-16%**
Median	**149**	**139**	**-1**	**-1%**
Maximum	**184**	**185**	**48**	**59%**
Average	**145.79**	**145.08**	**1.69**	**4%**

[1]Sites are arranged in downstream order.

Table 26. Proportion of sites within each interpretative range for VHA scores for Poesten Kill sampling locations (2017 & 2019).

Condition	2017		2019	
	# of Sites	% of Reach	# of Sites	% of Reach
Poor	0	0.00%	0	0.00%
Marginal	1	7.14%	0	0.00%
Suboptimal	6	42.86%	9	69.23%
Optimal	7	50.00%	4	30.77%

When evaluating site-specific changes between sample year, Site 9 exhibited the most significant change from 2017 to 2019, with a 58% increase in VHA score (Table 25). The improvement to habitat condition at Site 9 is attributed to improvements in the frequency and quality of instream pool habitat. In 2017, flow and depth were comparatively lower, resulting in the complete absence of pool habitat at Site 9; resulting in scores of zero for two of the VHA parameters. Compared to 2017, stream flow, and therefore, depth was greater in 2019. This contributed to a diverse suite of instream habitat types that was absent in 2017. Conversely, Sites 7 and 31 had the least significant changes in habitat condition between surveys, exhibiting a -0.78% decrease and 0.54% increase in VHA scores, respectively (Table 25).

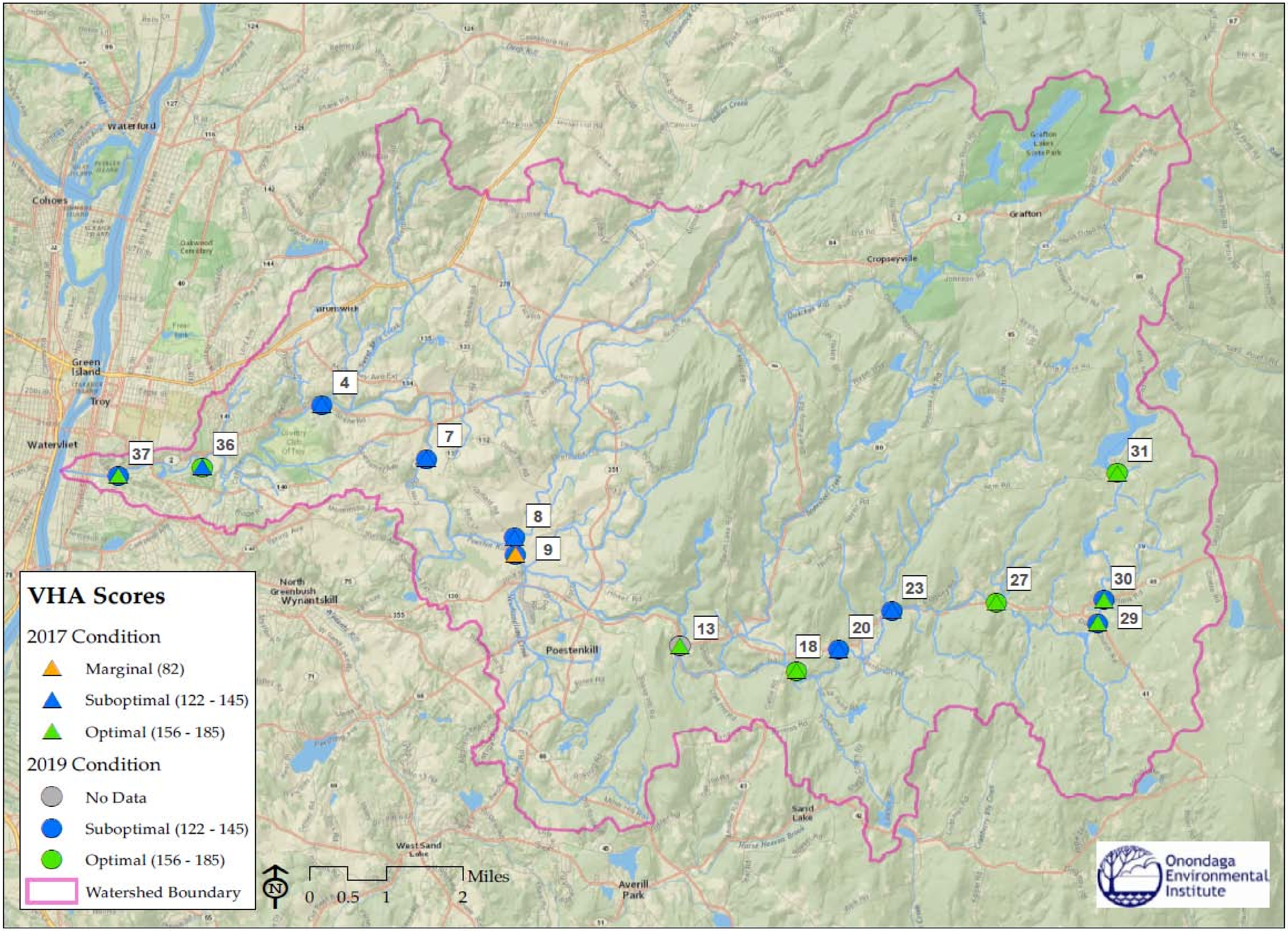


Figure 21. VHA scores at Poesten Kill sampling locations, by year (2017 & 2019).

c. Biological Survey

i. Aquatic Macroinvertebrates

Concurrent with water quality analysis, results from macroinvertebrate sampling indicated that stream health in the Poesten Kill was minimally impacted at certain sites, with many locations considered non-impacted. The macroinvertebrate community at many locations was dominated by pollution-sensitive taxa, such as mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera) during both stream surveys.

1. Trends by Year

In 2017, total macroinvertebrate richness ranged between a low of eight taxa (Site 27) to a high of 22 taxa (Site 23) (Table 27). The presence of pollution-tolerant aquatic macroinvertebrates (e.g., worms and midges) was very low in both taxonomic richness and spatial distribution; as evidenced by the proportion of aquatic macroinvertebrate richness belonging to the EPT and NCO groups. EPT richness ranged between a low of 3 (Sites 31 and 29) and a high of 14 (Site 37); representing a range of 25% to 82% of total macroinvertebrate richness among sampling locations (Table 27). At all locations in Poesten Kill, most macroinvertebrate taxa identified belonged to non-Chironomidae & Oligochaeta (NCO) groups, comprising an average of 93% of total macroinvertebrate richness (Table 27). Spatial trends in richness metrics were not evident in 2017, suggesting local effects (as opposed to large-scale, gradient effects) drive macroinvertebrate richness (Fig. 22).

The dominance of pollution-sensitive taxa is also supported by the HBI index, which is used to indicate the severity of organic pollution; greater levels of organic pollution contribute to a predominance of pollution-tolerance taxa. HBI scores in 2017 ranged between a low of 2.33 (Site 23) to a high of 6.23 (Site 31), with an average score of 3.91 (Table 27). The relatively low scores (compared to a maximum score of 10) indicates that Poesten Kill is minimally impacted by organic pollution. The most upstream location, Site 31, had the highest HBI score. Sampling at this site occurred directly adjacent to a small farm where cows had visible access to the stream. The high HBI score indicates that farming activities and agricultural runoff are impacting macroinvertebrate community structure. This is further supported by the Nutrient Biotic Index for Phosphorus (NBI-P), which is used to indicate impacts from nutrient pollution; a major component of agricultural runoff. Higher scores are an indication of nutrient pollution and Site 31 had one of the highest NBI-P values among sampling sites, with a score of 6.31 (Table 27).

Results of diversity and dominance metrics indicate that community evenness (i.e., the number of individuals per taxonomic group) was low during the 2017 survey. Macroinvertebrate diversity (H′) ranged between 1.0 (Site 29) and 2.65 (Site 23), with an average H′ of 1.97 (Table 27). Dominance of the three most abundant taxa (DOM-3) ranged between a low of 45% (Site 23) and a high of 89% (Sites 29 and 27), with an average DOM-3 of 65.8% (Table 27). While pollution-sensitive taxa were prevalent at sampling locations, the comparatively low diversity and high dominance contributed to moderate Percent Model Affinity (PMA) scores; ranging from a low of 28% (Site 7) to a high of 72% (Site 18). An overall average PMA score of 47.4% suggests that the macroinvertebrate community in Poesten Kill is largely dissimilar to a model, non-impacted community.

Table 27. Macroinvertebrate metric scores for Poesten Kill sampling locations (2017).

Site[1]	Total Richness	EPT Richness		NCO Richness		H′	DOM-3 (%)	HBI	PMA (%)	NBI-P
		Count	% of Total	Count	% of Total					
31	9	3	33	8	89	1.57	80	6.23	39	6.31
30	17	6	35	16	94	2.14	62	4.62	53	6.92
29	12	3	25	11	92	1.00	89	5.52	43	6.40
27	8	6	75	7	88	1.11	89	2.82	32	2.29
23	22	13	59	21	95	2.65	45	2.33	54	3.31
20	N/A									
18	18	13	72	17	94	2.33	58	3.36	72	3.07
13	19	13	68	18	95	2.39	56	3.75	65	3.13
9	11	8	73	10	91	1.93	60	3.22	36	4.00
8	15	9	60	14	93	2.08	64	3.94	70	4.37
7	10	7	70	10	100	1.88	70	3.29	28	3.98
4	14	8	57	13	93	1.90	67	3.91	39	6.32
36	17	12	71	16	94	2.24	60	3.99	45	4.87
37	17	14	82	16	94	2.34	55	3.90	40	4.20
Minimum	8.0	3.0	25	7.0	88	1.00	45.0	2.33	28.0	2.29
Median	15.0	8.0	68	14.0	94	2.08	62.0	3.90	43.0	4.20
Maximum	22.0	14.0	82	21.0	100	2.65	89.0	6.23	72.0	6.92
Average	14.5	8.8	60	13.6	93	1.97	65.8	3.91	47.4	4.55

[1]Sites are arranged in downstream order. Metric abbreviations are defined in the methods.
N/A = not available; Site #20 was not accessible in 2017.

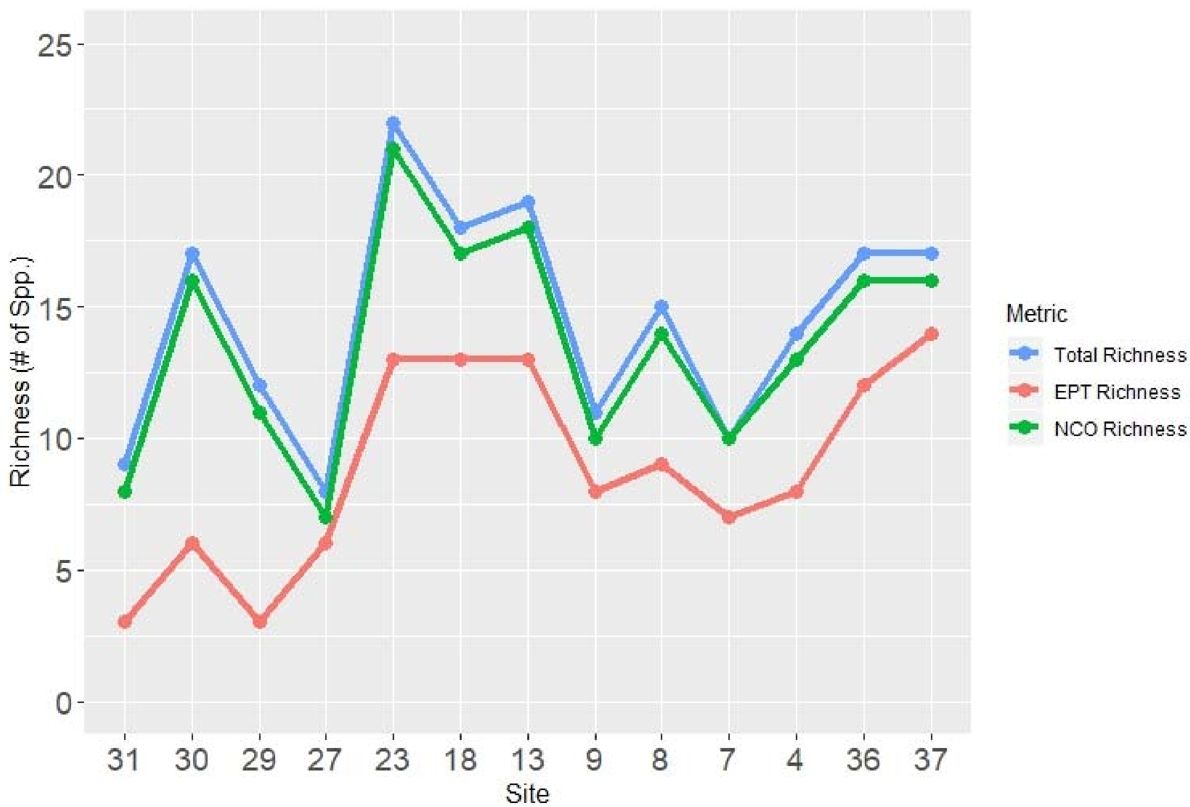


Figure 22. Macroinvertebrate richness metrics for Poesten Kill sampling sites (2017). Sites are arranged in downstream order.

In 2019, total macroinvertebrate richness ranged between a low of six (Site 31) and a high of 18 (Site 7), with an average total richness of 13.3 (Table 28). Similar to 2017, taxa were dominated by pollution-sensitive macroinvertebrates. On average, EPT richness and NCO richness comprised 67% and 92% of total richness at sampling locations in 2019, respectively (Table 28). EPT richness was lowest at the most upstream location, Site 31 (EPT = 3) and highest at Site 8 (EPT = 12). NCO richness was also lowest at Site 3 (NCO = 5) and highest at Site 7 (NCO = 17) (Table 28). Richness values noticeably increased downstream of Site 31, the most upstream location (Fig. 23). Despite the increase, richness values fluctuated among sites and did not yield a significant downstream trend.

Like 2017, HBI scores corresponded to EPT and NCO richness, with HBI scores indicative of good water quality and minor organic pollution impacts. HBI scores ranged between a low of 2.7 (Site 23) and a high of 5.8 (Site 31), with an average of 4.5 (Table 28). Higher HBI scores (HBI ≥ ~5.0) were identified in the upper watershed (Sites 31, 30, 29) and the lower watershed (Sites 7, 4, 36, 37). This indicates two potential sources of organic pollution (albeit relatively minor); one in the upper watershed and one in the lower (Table 28). This corresponded with NBI-P metric scores, which also showed elevated scores in the upper (Sites 31, 30, 20, 27) and lower watershed (Sites 4, 36, 37) compared to the middle Poesten Kill (Table 28). The comparison of macroinvertebrate community composition in Poesten Kill to that of a model, non-impacted community (PMA) did not yield any noticeable spatial trends in 2019. PMA scores ranged from a low of 31% (Site 31) to a high of 87% (Site 7) (Table 28). The average PMA score was 54%, slightly higher than in 2017 (Table 28). The most upstream site in Poesten Kill, Site 31, consistently had metric scores that indicated a macroinvertebrate community comparatively more impacted than all other sampling sites.

Table 28. Macroinvertebrate metric scores for Poesten Kill sampling locations (2019).

Site[1]	Total Richness	EPT Richness		NCO Richness		H'	DOM-3 (%)	HBI	PMA (%)	NBI-P
		Count	% of Total	Count	% of Total					
31	6	3	50	5	83	0.474	97	5.810	31	5.600
30	12	8	67	11	92	1.875	75	4.890	59	6.379
29	14	10	71	13	93	1.649	82	5.130	54	6.326
27	13	9	69	12	92	1.845	72	4.730	75	5.345
23	15	11	73	14	93	1.772	70	2.700	45	1.973
20	15	8	53	14	93	2.155	63	3.940	79	4.246
18	14	11	79	13	93	1.349	81	2.860	40	1.718
9	11	7	64	10	91	1.704	75	4.070	51	2.622
8	17	12	71	16	94	2.083	63	4.110	63	4.538
7	18	11	61	17	94	2.332	57	5.090	87	4.906
4	14	11	79	13	93	2.067	61	5.270	75	5.620
36	13	7	54	12	92	1.722	79	5.190	51	6.479
37	11	9	82	10	91	1.457	85	5.330	51	5.885
Minimum	6.0	3.0	50	5.0	83	0.5	57.0	2.7	31.0	1.7
Median	14.0	9.0	69	13.0	93	1.8	75.0	4.9	54.0	5.3
Maximum	18.0	12.0	82	17.0	94	2.3	97.0	5.8	87.0	6.5
Average	13.3	9.0	67	12.3	92	1.7	73.8	4.5	58.5	4.7

[1]Sites are arranged in downstream order. Metric abbreviations are defined in the methods.
N/A = not available; Site #13 was not accessible in 2019.

Figure 23. Macroinvertebrate richness metrics for Poesten Kill sampling sites (2017). Sites are arranged in downstream order.

2. Spatiotemporal Trends

An examination of metric scores between sampling years along the stream gradient yielded several notable observations. Changes in the Poesten Kill macroinvertebrate community, based on measures of diversity (H′), dominance (DOM-3), and pollution and disturbance (HBI, NBI-P, and PMA), generally did not follow a distinct spatiotemporal (i.e., spatial/ longitudinal changes over time) trend. In other words, broadscale improvements or declines in macroinvertebrate community structure along a spatial gradient were not evident during each survey, nor between sampling years. Rather, most changes in metric scores were predominantly site-specific each year and suggest that localized conditions (i.e., stream-reach; rather than watershed-scale) more greatly affected macroinvertebrate community structure.

One trend consistent during both years, however, was an improvement in macroinvertebrate community composition from the most upper site, Site 31, to the most downstream location, Site 36. However, significant fluctuations in metrics scores between Sites 31 and 36 obscured any longitudinal trends. Site 31, immediately downstream of Dyken Pond, had metric scores indicative of a moderately impacted macroinvertebrate community; such as, low diversity and PMA scores and high dominance, HBI, and NBI-P scores (Fig. 24). Results also suggest that inputs of organic pollution are occurring in the upper and lower watershed. During both surveys, the three most upstream sites (Sites 31, 30, 29) and four most downstream sites (Site 7, 4, 36, 37) had HBI and NBI-P values comparably higher than locations in between the upper and lower reach (Fig. 24c and d). Potential sources for such inputs are unknown, but based on surrounding land use for both areas, it is hypothesized that the upstream sites are impacted by the conditions created by the Dyken Pond dam (e.g., warmer temperature, increased productivity) and adjacent agricultural practices and that downstream sites are impacted by urban runoff (e.g., City of Troy).

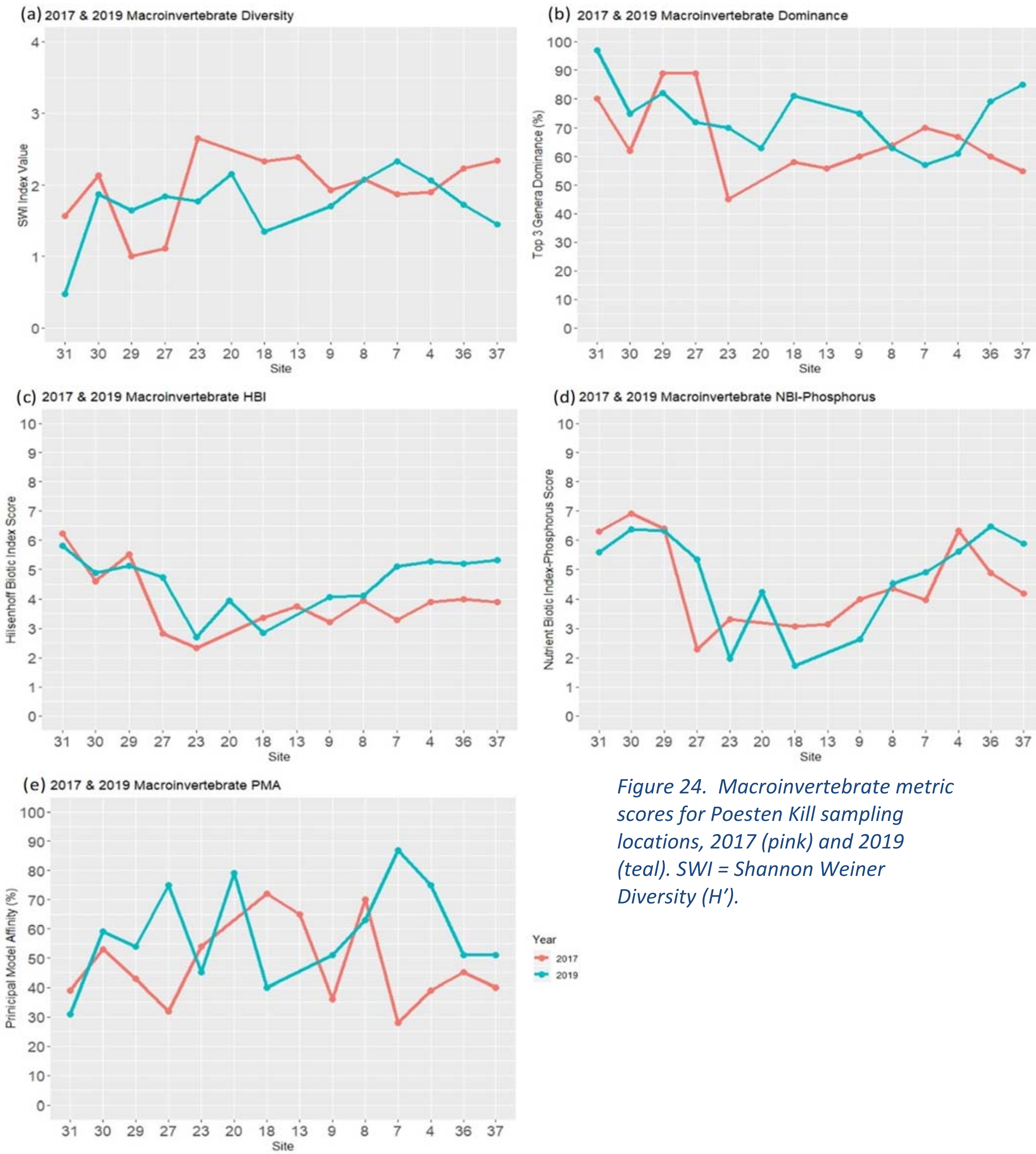


Figure 24. Macroinvertebrate metric scores for Poesten Kill sampling locations, 2017 (pink) and 2019 (teal). SWI = Shannon Weiner Diversity (H').

3. Biological Assessment Profile (BAP)

The BAP index indicated water quality in the Poesten Kill was minimally impacted; concurrent with water quality assessments. All BAP scores in 2017 and 2019 were in the "Slightly Impacted" to "Non-Impacted" range (Fig. 25). In 2017, BAP scores ranged from a low of 5.65 (Site 27) to a high of 8.65 (Site 18), with an overall average of 7.57 ("Non-Impacted") (Table 29). BAP results indicated that overall water quality in Poesten Kill was slightly better in 2019 than in 2017. In 2019, BAP scores ranged from a low of 6.39 (Site 9) to a high of 9.35 (Site 4), with an overall average of 7.97 ("Non-Impacted") (Table 29).

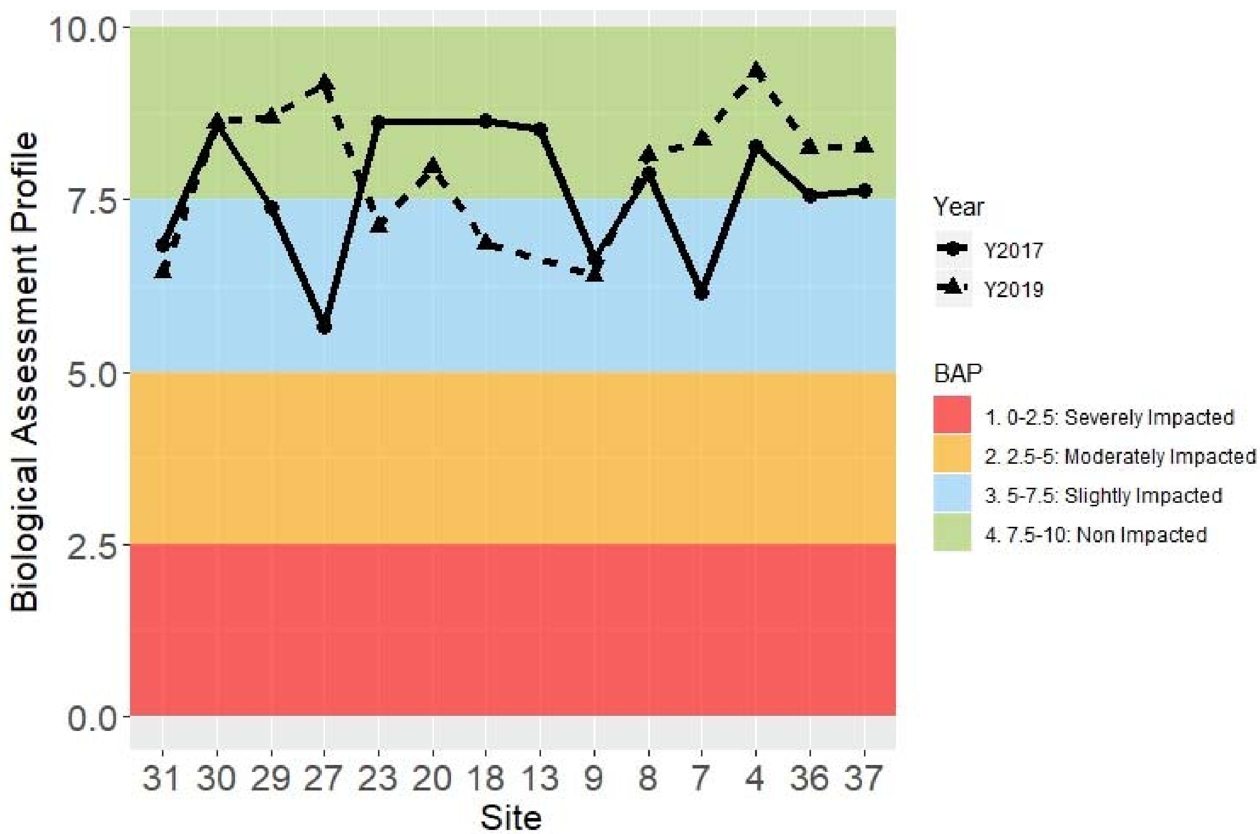


Figure 25. Biological Assessment Profile Scores (BAP) for Poesten Kill sampling locations (2017 & 2019).

Table 29. Biological Assessment Profile (BAP) scores for Poesten Kill sampling locations (2017 & 2019) and site-specific changes in scores between sampling years.

Site	2017 BAP	2019 BAP	Pts Difference	Improvement (I) / Degraded (D)	Notes
31	6.84	6.43	-0.41	D	Degraded, but stayed "Slight"
30	8.60	8.62	0.01	I	Improved, but stayed "Non"
29	7.38	8.69	1.32	I	Improved from "Slight" to "Non"
27	5.65	9.19	3.55	I	Improved from "Slight" to "Non"
23	8.63	7.11	-1.52	D	Degraded from "Non" to "Slight"
20	-	7.97	-	-	-
18	8.65	6.86	-1.80	D	Degraded from "Non" to "Slight"
13	8.53	-	-	-	-
9	6.65	6.39	-0.26	D	Degraded, but stayed "Slight"
8	7.89	8.14	0.26	I	Improved, but stayed "Non"
7	6.16	8.37	2.20	I	Improved from "Slight" to "Non"
4	8.29	9.35	1.07	I	Improved, but stayed "Non"
36	7.57	8.25	0.68	I	Improved, but stayed "Non"
37	7.63	8.28	0.65	I	Improved, but stayed "Non"
Minimum	**5.65**	**6.39**		**66.67%**	**% Improved**
Median	**7.63**	**8.25**		**33.33%**	**% Degraded**
Maximum	**8.65**	**9.35**			
Average	**7.57**	**7.97**			

[1]Sites are arranged in downstream order.

Proportionally, more sites were considered non-impacted during both sampling years, with a slight improvement in 2019 (Table 30). Of the 13 sampled sites in 2017, five (38.46%) had a BAP classification of "Slightly Impacted" and the remaining eight (61.54%) had a BAP classification of "Non-Impacted". Of the 13 sites sampled in 2019, four (30.77%) had a classification of "Slightly Impacted" and the remaining nine (69.23%) had a BAP classification of "Non-Impacted" (Table 30).

Table 30. Proportion of Poesten Kill sites within each interpretative range for the BAP.

BAP Rating	2017		2019	
	N	%	N	%
Severe	0	0.00%	0	0.00%
Moderate	0	0.00%	0	0.00%
Slight	5	38.46%	4	30.77%
Non	8	61.54%	9	69.23%

According to the BAP, eight out of 12 (67%) sites showed improvements from 2017 to 2019 (Table 29). Of these eight, five improved but stayed within, (the highest) "Non-Impacted" range and three improved from "Slightly Impacted" to "Non-Impacted" (Table 29). Four out of 12 (33%) sites exhibited a decline in BAP scores from 2017 to 2019. Of these four, two exhibited reductions in BAP scores, but stayed within the "Slightly Impacted" range. The remaining two sites to show declines in BAP scores had downgraded ratings, going from "Non-

Impacted” to “Slightly Impacted” status (Table 29). The most significant improvement was seen at site 27 with a BAP score increase of 3.55 points; changing classification from “Slightly Impacted” to “Non-Impacted” (Table 29). This significant improvement led to Site 27 having the second highest BAP score of 2019 (BAP = 9.19). The most significant decline in BAP scores was seen at Site 18, with a decrease in 1.80 BAP points. This decrease also downgraded the site’s classification from “Non-Impacted” to “Slightly Impacted”. Site 18 had the third lowest BAP score of 2019 (BAP = 6.86). Of the three lowest scores, Site 18 was the only site to have degraded from “Non-Impacted” to “Slightly Impacted” (Table 29).

Consecutive sites that showed increases or decreases in BAP scores between years could be indicative of larger-scale changes (e.g., stream reach, rather than site-specific) to water quality. This was evident in several reaches of Poesten Kill. Namely, improvements in BAP scores between Sites 30 and 27 indicate an improvement in water quality in the upper reaches of Poesten Kill. (Fig. 26, Table 29). Sites 23, 18, and 9 showed declines in BAP scores (Fig. 26, Table 29). However, because Sites 20 and 13 only had data from one year, it is unknown whether the observed declines in BAP scores at Sites 23, 18, and 9 are indicative of a large-scale decline in water quality in the Poesten Kill from 2017 to 2019. Despite such declines, however, scores remained within ranges characteristic of high water quality streams. Sites downstream of Site 9 all exhibited increases in BAP scores, which may be indicative of large-scale improvements to water quality in lower Poesten Kill (Fig. 26).

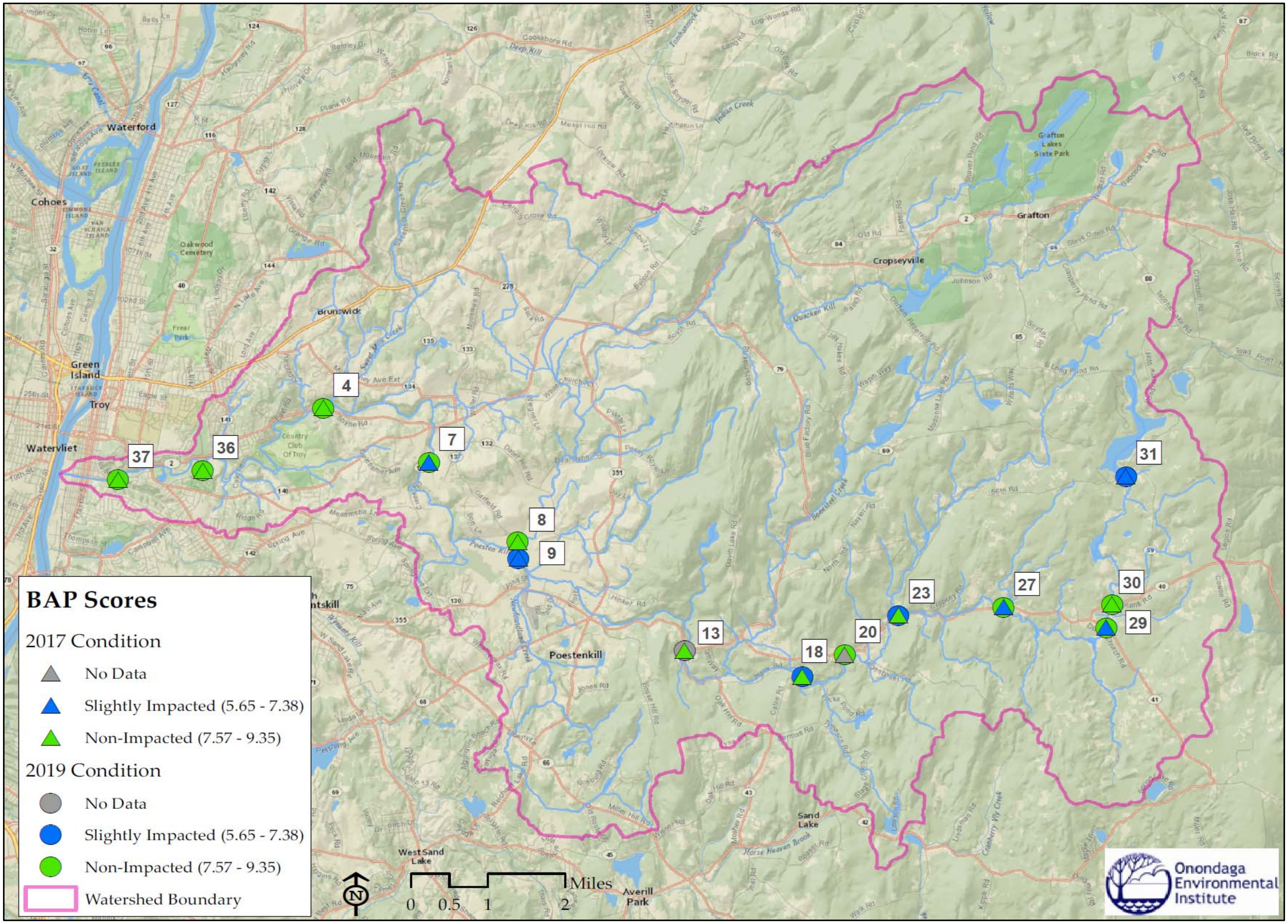


Figure 26. Macroinvertebrate Biological Assessment Profile (BAP) scores in Poesten Kill (2017 & 2019)

ii. Fish

1. Composition & Diversity: Spatiotemporal Trends

Poesten Kill comprised a total of 17 species between both surveys (Table 31). Fish community structure in Poesten Kill included a diversity of species representative of different habitat types (e.g., riffle vs. pool, sandy vs. substrate, etc.), feeding habits (e.g., omnivore, carnivore), morphologies (i.e., body shape), and life history (e.g., migratory vs. stationary). Descriptions for each fish species, including distribution in the Poesten Kill, life history, habitat preferences, feeding behaviors, and morphological traits are provided in Factsheet 05.

Table 31. Fish species present in Poesten Kill surveys, by year (2017 & 2019).

Species	Scientific Name	2017	2019
American eel	*Anguilla rostrata*	29	14
Blacknose Dace	*Rhinichthys atratulus*	151	152
Bluegill	*Lepomis macrochirus*	8	6
Brown Bullhead	*Ameiurus nebulosus*	1	1
Brown Trout	*Salmo trutta*	1	16
Chain Pickerel	*Esox niger*	0	1
Common shiner	*Luxilus cornutus*	3	43
Creek Chub	*Semotilus atromaculatus*	103	171
Golden Shiner	*Notemigonus crysoleucas*	0	10
Largemouth Bass	*Micropterus salmoides*	1	0
Longnose Dace	*Rhinichthys cataractae*	71	67
Pumpkinseed	*Lepomis gibbosus*	27	23
Rock Bass	*Ambloplites rupestris*	3	10
Spotfin Shiner	*Cyprinella spiloptera*	3	0
Spottail shiner	*Notropis hudsonius*	0	15
Tessellated Darter	*Etheostoma olmstedi*	49	22
White Sucker	*Catostomus commersoni*	10	5
Yellow Perch	*Perca flavescens*	2	0
Darter Spp.	*Etheostoma spp.*	2	0
Shiner Spp.		3	0
	TOTAL RICHNESS (COUNT)[1]	15	15
	TOTAL ABUNDANCE	464	556

[1]Fish that could not be identified to species are not included in the species richness count.

Total fish species richness was the same between years, with 15 species identified during both surveys; the species themselves, however, varied between years (Table 31). Species collected in 2017, but not in 2019, included largemouth bass, spotfin shiner, and yellow perch.

Species collected in 2019, but not in 2017, included chain pickerel and spottail shiner (Table 31). Overall, total fish abundance was greater in 2019 than in 2017 (Table 31). The most abundant species collected in 2017 was blacknose dace, whereas the most abundant species collected in 2019 was creek chub (Table 31). Both species were highly prevalent during both years, comprising more than 50% of the total fish community in 2017 and 2019 (Fig. 27). These species were also widely distributed throughout the watershed, being found at nearly all sampling locations during both years (Fig. 28). Longnose dace was found to be the third most abundant fish species during both sampling years. Collectively, blacknose dace, creek chub, and longnose dace comprised 71% and 70% of the total fish community in Poesten Kill in 2017 and 2019, respectively (Fig. 27).

A noticeable decline in fish abundance was observed between Sites 27-13 (N = 5) during both years (Fig. 28). All these locations were characteristically shallow and rocky stream reaches with predominantly riffle and run habitat. It is hypothesized that the low diversity of habitat and stream depth contributed to the low fish abundance at these sampling locations. While abundance was low at these locations, species richness was considerably diverse; suggesting that these stream reaches are capable of supporting a diverse fish community, but in low abundances (Fig. 28).

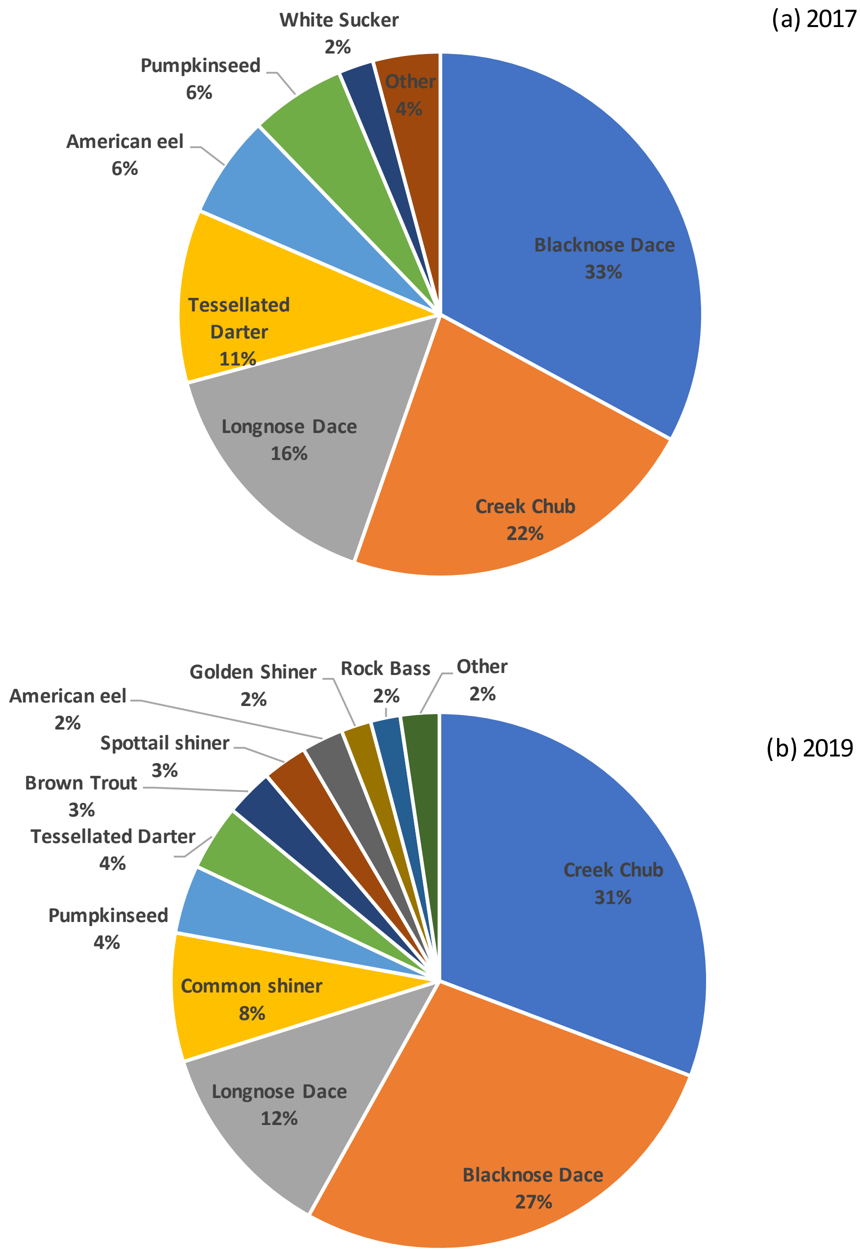


Figure 27. Total fish community structure for surveys performed in Poesten Kill in 2017 (a) and 2019 (b).

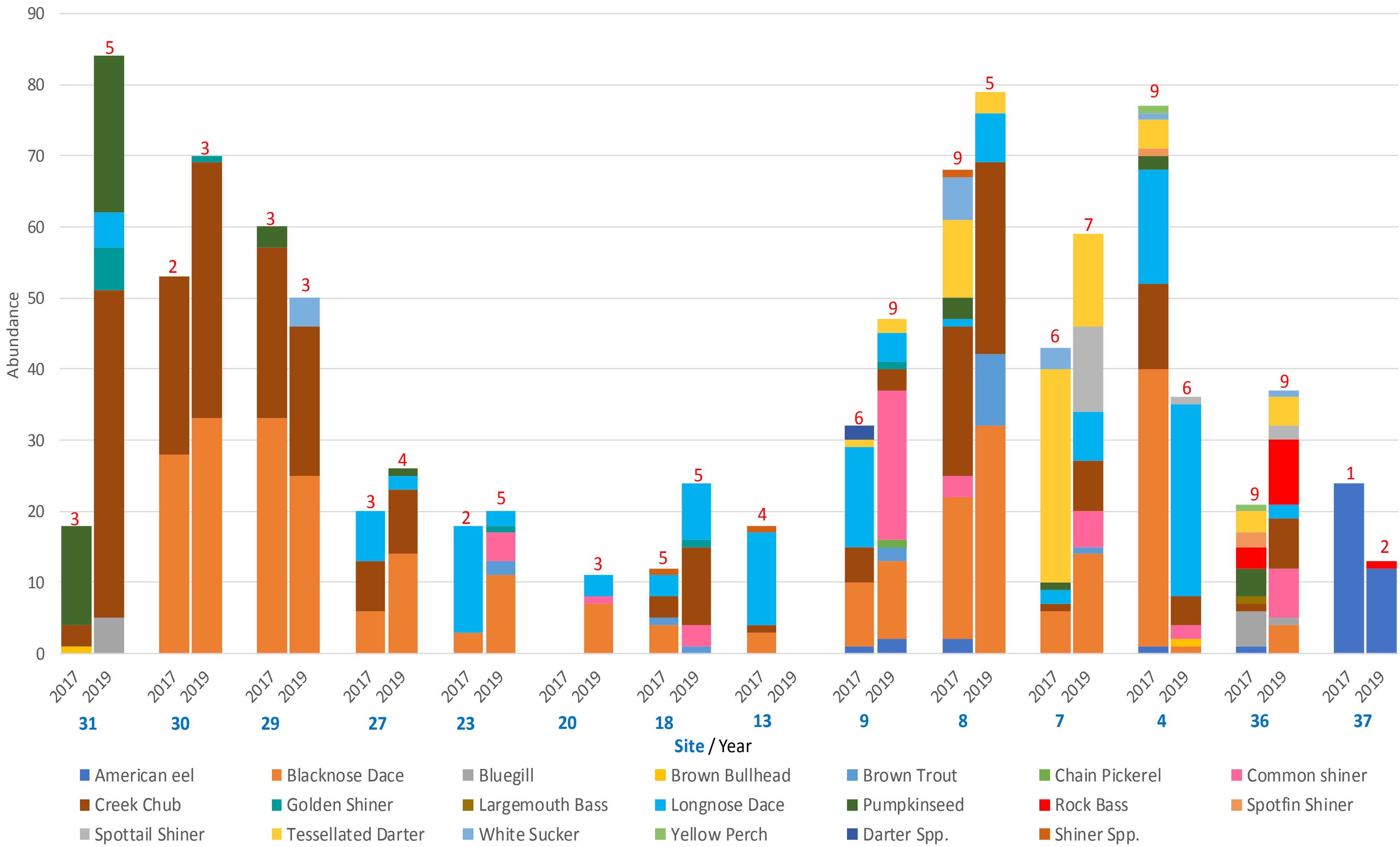


Figure 28. Species composition, by site and year for Poesten Kill locations. Total richness is included above each bar in red font. Sites are arranged in downstream order.

Fish species richness and diversity exhibited several notable spatial and temporal trends in Poesten Kill during surveys. In 2017, fish richness was lowest at Site 37 (N = 1) and greatest at Sites 8, 4, and 36 (N = 9) (Table 32). In 2019, fish richness ranged between a low of two at Site 37 and a high of nine at Sites 9 and 36. For both years, fish richness was consistently lowest at Site 37 and highest at Site 36 (among others) (Fig. 29). Average species richness in Poesten Kill was nearly the same in 2017 and 2019, with an average of 4.77 and 5.08, respectively (Table 32). Except for the most downstream location, Site 37, species richness generally increased downstream from the uppermost location (Site 31) during both years (Fig. 29). The low richness at Site 37 is attributed to a lack of habitat diversity in this reach of Poesten Kill. Habitat at Site 37 is predominantly riffle habitat, comprising approximately 80% of the stream reach. This site is also immediately downstream of the Poesten Kill gorge falls, contributing to high water velocity at this site even during baseflow conditions; which may preclude many small-bodied, water-column fishes (e.g., shiners, suckers, sunfish etc.) from successfully colonizing this area of Poesten Kill.

Table 32. Calculated fish metrics for Poesten Kill sampling locations, by year (2017 & 2019). Sites are arranged in downstream order.

Site	2017			2019		
	Total Abundance	Total Richness	Diversity	Total Abundance	Total Richness	Diversity
31	18	3	0.65	84	5	1.21
30	53	2	0.69	70	3	0.76
29	60	3	0.85	50	3	0.91
27	20	3	1.10	26	4	1.02
23	18	2	0.45	20	5	1.26
20	-	-	-	11	3	0.86
18	12	5	1.47	24	5	1.25
13	18	4	0.85	-	-	-
9	32	6	1.40	47	9	1.65
8	68	9	1.73	79	5	1.33
7	43	6	1.03	59	7	1.78
4	77	9	1.43	36	6	0.92
36	21	9	2.02	37	9	1.97
37	24	1	0	13	2	0.27
Minimum	**12**	**1**	**0**	**11**	**2**	**0.27**
Median	**24**	**4**	**1.03**	**37**	**5**	**1.21**
Maximum	**77**	**9**	**2.02**	**84**	**9**	**1.97**
Average	**35.69**	**4.77**	**1.05**	**42.8**	**5.08**	**1.17**

Figure 29. Fish species richness at Poesten Kill sampling locations (2017 & 2019). Sites are arranged in downstream order.

Fish diversity followed similar trends to fish richness during both sampling years, with an overall increase in diversity from the most upstream location (Site 31) to Site 36, the second most downstream location (Fig. 30). Average diversity was slightly higher in 2019 than in 2017, with an average of 1.17 compared to 1.05, respectively (Table 32). Overall, diversity was relatively low in Poesten Kill during both years, with values ranging from a low of 0.00 to a high of 2.02 (Fig. 30). In 2017, fish diversity was slightly more variable than in 2017; ranging from a low of 0 (Site 37) to a high of 2.02 (Site 36) (Table 32). Comparably, diversity ranged from a low of 0.27 (Site 37) to a high of 1.97 (Site 36). Consistently between years, diversity was highest at Site 36 and lowest at Site 37 (Fig. 30).

Figure 30. Fish diversity at Poesten Kill sampling locations (2017 & 2019). Sites are arranged in downstream order.

2. Index of Biotic Integrity (IBI)

The integrative fish IBI helped to make informative assessments of water quality in the Poesten Kill. Contrary to the macroinvertebrate BAP, which indicated that the Poesten Kill was largely non-impacted and indicative of good water quality, the fish IBI suggests that fish community structure, and thus stream habitat, is substantially impaired. According to the fish IBI, sites in 2017 and 2019 had IBI classifications that ranged between "Very Poor" and "Fair" designations (Fig. 31). Of the 13 sampled sites in 2017, one (7.69%) had an IBI classification of "Very Poor", 11 (84.62%) "Poor", and one (7.69%) "Fair". Of the 13 sampled sites in 2019, one (7.69%) had an IBI classification of "Very Poor", 10 (76.92%) "Poor", and two (15.38%) "Fair" (Table 33).

Table 33. Proportion of Poesten Kill sites within each interpretative range for the BAP.

IBI Rating	2017	2019
Condition	% of Reach	% of Reach
Very Poor	7.69%	7.69%
Poor	84.62%	76.92%
Fair	7.69%	15.38%
Good	0	0
Excellent	0	0

IBI scores suggest fish community structure, and thus stream quality, were in slightly better condition in 2019 than in 2017. However, these differences were minimal, with minimum (= 24; "Very Poor"), median (= 32; "Poor"), and average ($\tilde{x}$ = 31.23; "Poor") IBI scores identical in 2017 and 2019 (Table 34).

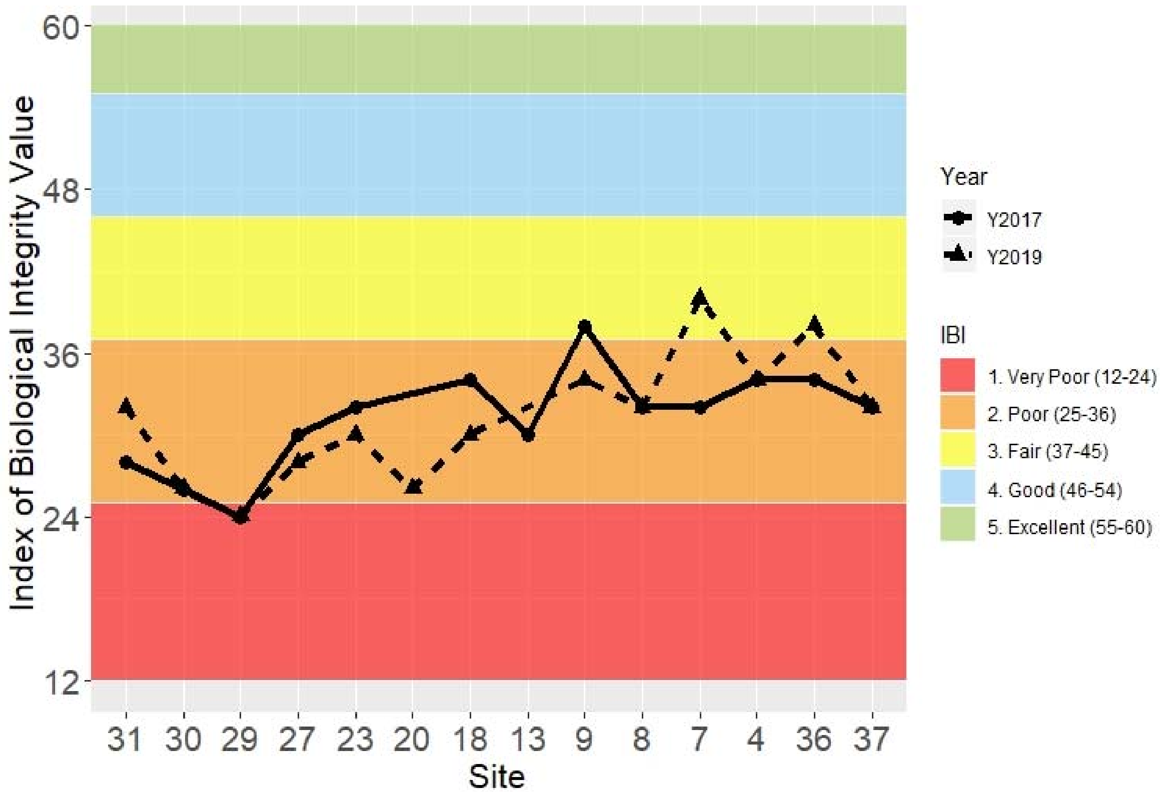


Figure 31. Index of Biotic Integrity (IBI) scores at Poesten Kill sampling locations, by year (2017 & 2019). Sites are arranged in downstream order.

Site-specific changes to IBI scores occurred at several sampling locations between 2017 and 2019. Three out of 12[1] (25%) sites showed improvements in IBI scores from 2017 to 2019. Of those three, one of them improved but stayed "Poor" and the remaining two improved from "Poor" to "Fair" (Table 34). According to the IBI, four out of 12 (33.33%) sites exhibited degradations in stream condition from 2017 to 2019. Of those four, three declined in IBI scores, but stayed "Poor". The remaining other site degraded from "Fair" to "Poor" (Table 34). Five out of 12 (41.67%) sites exhibited no change in IBI scores from 2017 to 2019. Of those five locations, one site was considered "Very Poor" and the other four sites were considered "Poor" (Table 34). The most significant improvement in stream condition, based on IBI scores, was seen at site 7 with a 25% increase; improving classification from "Poor" to "Fair" (Table 34). The most significant declines in IBI scores were seen at sites 9 and 18 with a decrease by four IBI points (10% and 11% declines, respectively). While IBI scores declined at Site 18, scores remained within the "Poor" designations. Site 9 exhibited a decline in IBI that resulted in a downgrade from "Fair" to "Poor" condition (Table 34).

[1] Two locations were not sampled during one of the years; Site 20 (2017) and Site 13 (2019). Therefore, 12 out of 14 sites could be used for this temporal analysis.

Table 34. Index of Biotic Integrity (IBI) scores for Poesten Kill sampling locations (2017 & 2019) and site-specific changes in scores between sampling years.

Site[1]	2017 IBI	2019 IBI	Pts Difference	Improvement (I) / Decline (D) / No Change (NC)	Notes
31	28	32	4	I	Improved, but stayed "poor"
30	26	26	0	NC	No change
29	24	24	0	NC	No change
27	30	28	-2	D	Degraded, but stayed "poor"
23	32	30	-2	D	Degraded, but stayed "poor"
20	-	26	-	-	-
18	34	30	-4	D	Degraded, but stayed "poor"
13	30	-	-	-	-
9	38	34	-4	D	Degraded from "fair" to "poor"
8	32	32	0	NC	No change
7	32	40	8	I	Improved from "poor" to "fair"
4	34	34	0	NC	No change
36	34	38	4	I	Improved from "poor" to "fair"
37	32	32	0	NC	No change
Minimum	**24**	**24**		**25%**	**% Improved**
Median	**32**	**32**		**33.33%**	**% Degraded**
Maximum	**38**	**40**		**41.67%**	**% No Change**
Average	**31.23**	**31.23**			

[1]Sites are arranged in downstream order.

The only site to have been considered “Very Poor” according to the IBI, was site 29; which was a consistent designation for both sampling years (Fig. 31). While fish abundance was comparably high at this site, richness was low, with only three species collected both years (Fig. 29). Fish community structure were dominated by blacknose dace and creek chub both years. Site 29 was the only sampling location situated in a wetland, where the water was deep, slow-moving, and stream substrate was predominantly sand. The unique features of this stream reach, among all sampling locations, contributed to the low IBI score and suggests stream quality is most impacted at this location. The occurrence of IBI scores designated as “Fair”, the highest rating attained in Poesten Kill, was most evident in the more downstream locations (Site 9-36) (Fig. 31). Several metrics of the IBI score are predicated on fish density, stream size, and watershed area; meaning sites with greater stream widths and watershed areas typically lead to higher IBI scores. This is because larger streams are physically capable of supporting a greater abundance and diversity of fish. This was true at Sites 9-36, which had stream widths ranging between 13 and 22 meters; more than double most sampling sites upstream of Site 9. Likewise, stream diversity at these locations was noticeably higher (Fig. 30); collectively contributing to the higher IBI scores.

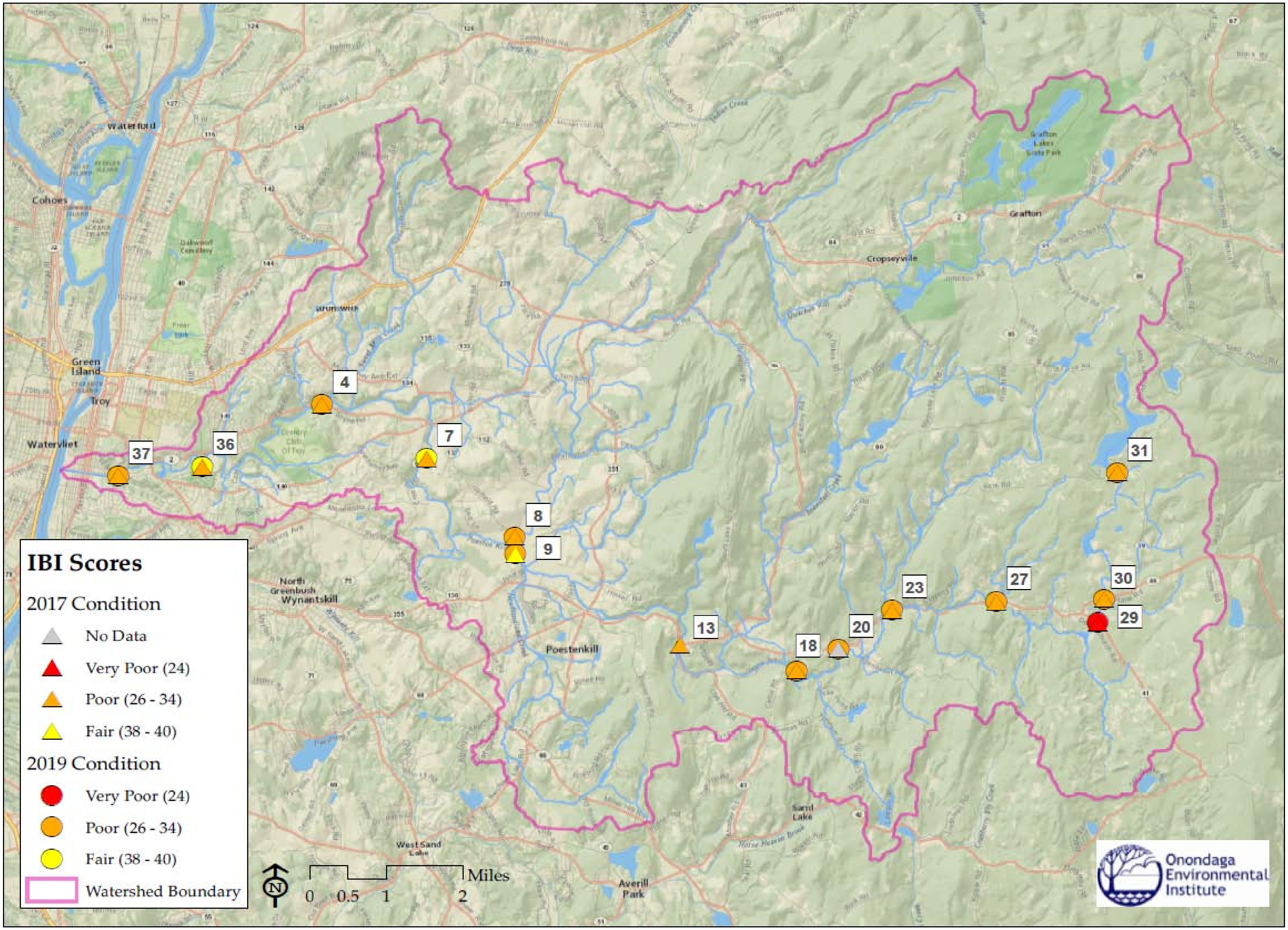


Figure 32. Fish Index of Biotic Integrity (IBI) scores in Poesten Kill (2017 & 2019).

iii. Relationships Between Macroinvertebrates & Fish

Assessments of water quality according to macroinvertebrate and fish metrics suggest that stream condition in Poesten Kill is largely both non-impacted (macroinvertebrate metrics) and highly impacted (fish metrics). The Index of Biotic Integrity (IBI) and the Biological Assessment Profile (BAP) integrate several different fish and macroinvertebrate metrics, respectively, to provide an assessment of biological integrity and stream condition. Correlation analysis showed that the IBI and BAP were not significantly correlated (Fig. 33); meaning the response of macroinvertebrates to stream condition was not correlated with the response of fish to stream condition. Or, in other words, as BAP scores increased, IBI scores did not. Despite the overall difference in assessments of stream condition, the inclusion of stream water quality and physical habitat assessments suggests that the results of macroinvertebrate metric calculations better accurately depict overall stream health in Poesten Kill; with stream condition considered of high quality.

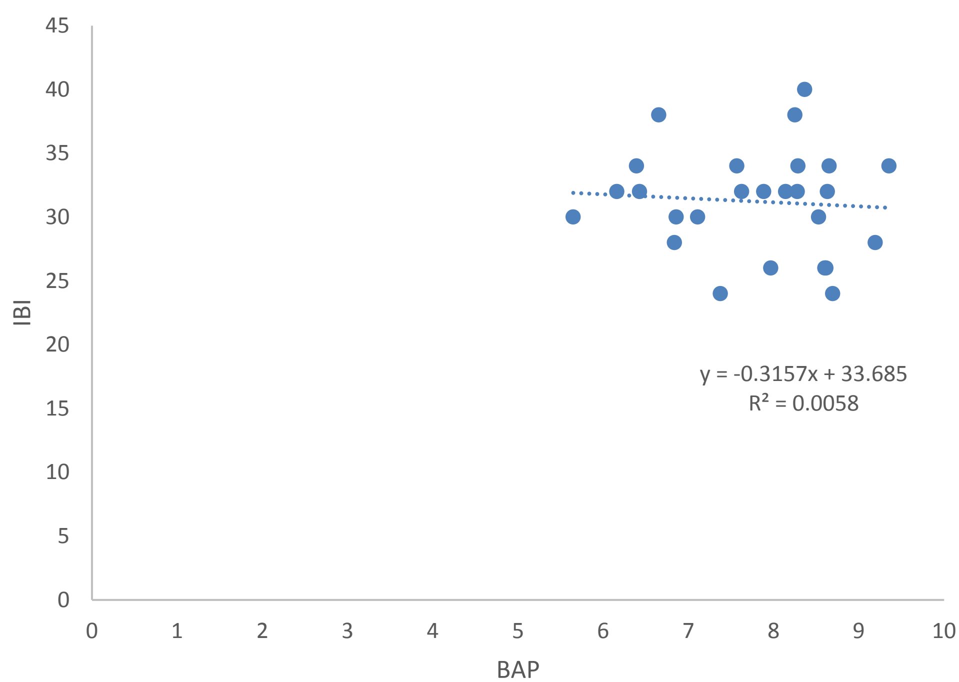
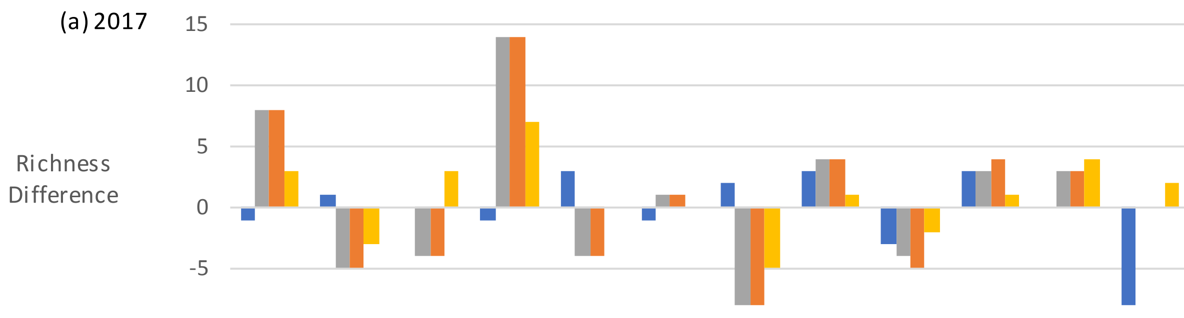


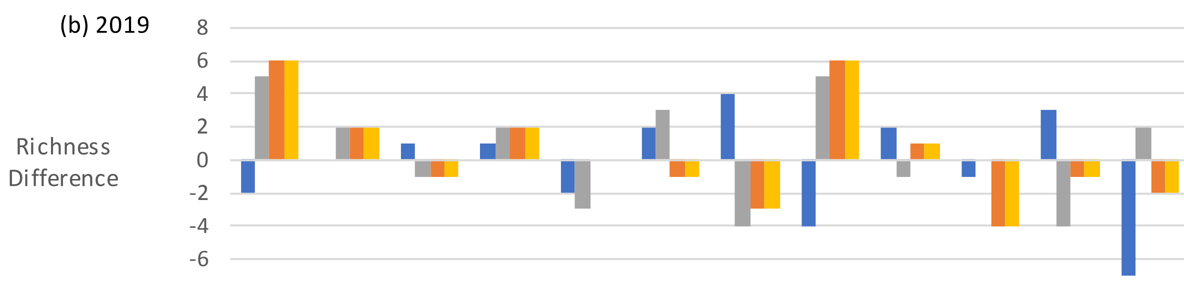
Figure 33. Correlation analysis of the macroinvertebrate BAP scores to the fish IBI scores for Poesten Kill. Both 2017 & 2019 data have been integrated into this analysis.

While comparable measures of stream condition for fish and macroinvertebrates yielded assessments of stream health, the relationships between fish and macroinvertebrate assemblages was evident in the Poesten Kill. As vital components of an aquatic ecosystem, fish and macroinvertebrates are inherently linked; affecting the community structure of one another. In

Poesten Kill, there were observable changes in fish richness and diversity along the stream gradient that are hypothesized to be attributed, in part, to changes in macroinvertebrate richness and diversity (and vice versa). When comparing changes in fish and macroinvertebrate richness between sites, there were often distinctive changes in downstream richness in response to upstream richness. For example, in 2017 and 2019, when upstream fish richness was high, macroinvertebrate richness at the subsequent downstream location often declined. Conversely, when fish richness was low, macroinvertebrate richness increased (Fig. 34). Similarly, these trends were observed for fish and macroinvertebrate diversity. Reduced upstream fish diversity often contributed to an increase in downstream macroinvertebrate diversity (Fig. 35). Overall, results suggest that macroinvertebrate richness and diversity tend to decline when fish richness and diversity are high; highlighting the trophic (i.e., food web) relationships between fish and macroinvertebrates.



	31 to 30	30 to 29	29 to 27	27 to 23	23 to 18	18 to 13	13 to 9	9 to 8	8 to 7	7 to 4	4 to 36	36 to 37
Total Fish Richness	-1	1	0	-1	3	-1	2	3	-3	3	0	-8
EPT Richness	8	-5	-4	14	-4	1	-8	4	-4	3	3	0
Total MI Richness	8	-5	-4	14	-4	1	-8	4	-5	4	3	0
NCO Richness	3	-3	3	7	0	0	-5	1	-2	1	4	2



	31 to 30	30 to 29	29 to 27	27 to 23	23 to 20	20 to 18	18 to 9	9 to 8	8 to 7	7 to 4	4 to 36	36 to 37
Total Fish Richness	-2	0	1	1	-2	2	4	-4	2	-1	3	-7
EPT Richness	5	2	-1	2	-3	3	-4	5	-1	0	-4	2
Total MI Richness	6	2	-1	2	0	-1	-3	6	1	-4	-1	-2
NCO Richness	6	2	-1	2	0	-1	-3	6	1	-4	-1	-2

Figure 34. Spatial differences in fish and macroinvertebrate richness in Poesten Kill in (a) 2017 and (b) 2019.

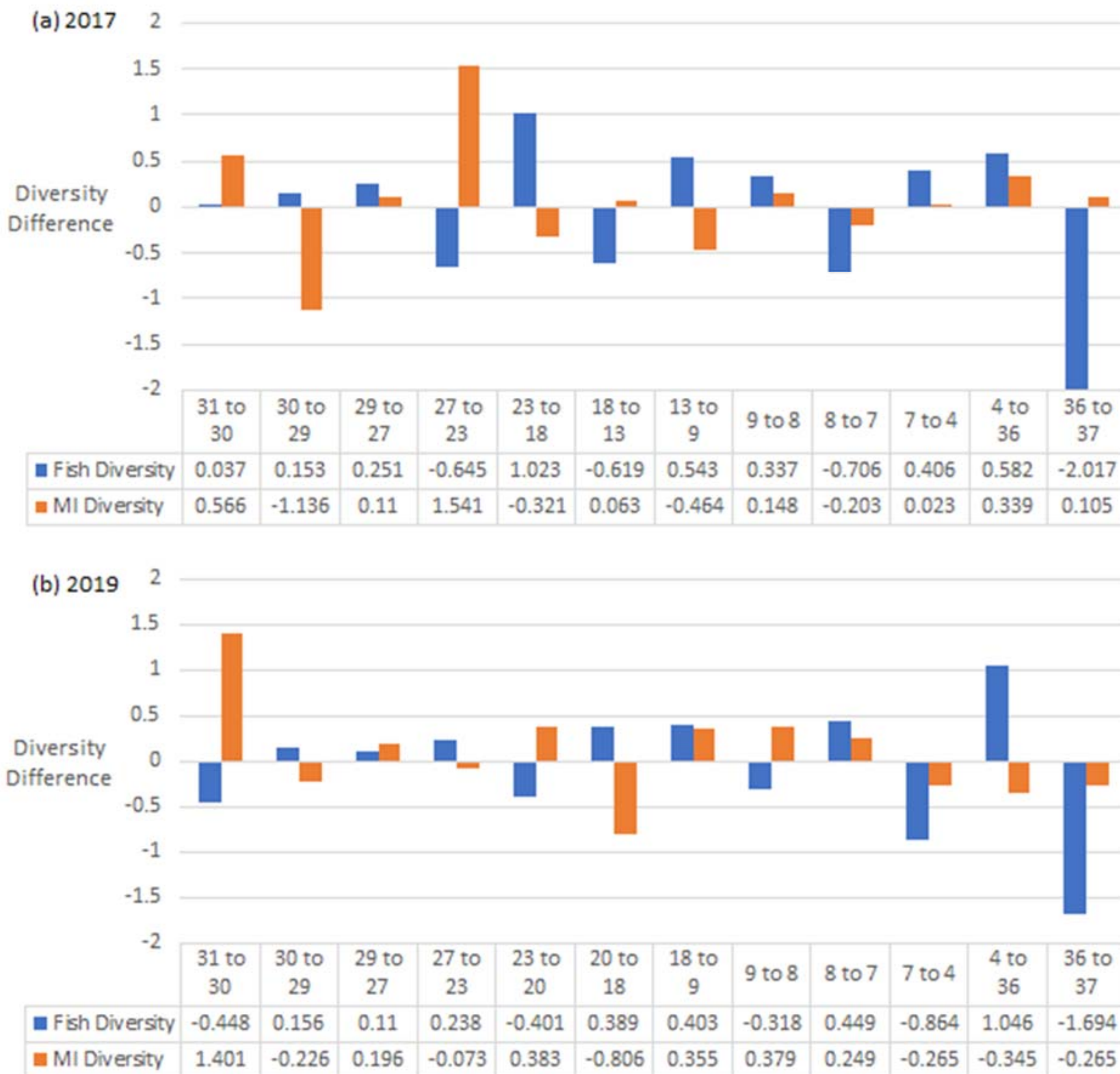


Figure 35. Spatial differences in fish and macroinvertebrate diversity in Poesten Kill in (a) 2017 and (b) 2019.

IV. Discussion

a. Assessments of Water Quality

The Poesten Kill watershed is a unique and diverse area that has inevitably shaped the aquatic ecosystem within it. Overall, the collective assessment of water chemistry, bacteria analysis, physical habitat, and fish and macroinvertebrate community structure showed stream condition in Poesten Kill to be of high quality with minimal impacts.

All water quality parameters were within ranges considered suitable to optimal for aquatic organisms throughout the Poesten Kill during both survey years. Several water quality parameters, however, did exhibit distinct longitudinal changes along the stream gradient that were indicative of anthropogenic impacts. Temperature, dissolved oxygen, and pH were within levels characteristic of ambient conditions, for both the time of year, geographic location, and geology of the area. The positive feedback effects of various water quality parameters on one another was highly evident in the Poesten Kill. For example, low temperatures throughout the watershed contributed to high dissolved oxygen levels; with nearly all sites having high dissolved oxygen levels during both years. Similarly, turbidity levels were in the pristine range except for one site in 2019. Very turbid waters can harm aquatic habitat by silting over macroinvertebrates and fish eggs. Also, the substrate can serve as an attachment point for harmful bacteria and metal containing pollutant compounds. Even more so, substrate laden water has a higher heat absorptive capacity. Therefore, higher turbidity concentrations increase stream temperatures (Waters 1995).

Increases in specific conductivity and fecal coliform concentrations were observed along the stream gradient, with significant increases in the most downstream, urban areas. While conductivity was within pristine levels during both years and for all locations, the downstream increase is a trend characteristic of streams impacted by urban development. A primary contributor to elevated conductivity levels in urban areas is the increased application (both in spatial extent and frequency) of road salt. Specific conductivity has been identified as a primary parameter for assessing the impacts of urbanization on stream quality, with urbanized/impacted streams typically having higher specific conductivity levels (Wenner et al. 2003). There is also a clear indication that fecal coliform concentrations along the Poesten Kill increase the closer you get to human-populated areas. The peak concentration was noted just upstream of where the Poesten Kill discharges into the Hudson River at Troy. Furthermore, the only location to have trace levels of *Bacteroides* was at Site 36, the second-most downstream location, and the only marker identified was human; suggesting that the predominant source of fecal bacteria came from human sources (e.g., storm sewer discharges, failing infrastructure and septic systems). Unfortunately, the survey results are limited to one year of sampling, so determining the relative health of these sites in relation to established state and federal regulations was not possible.

Collectively, stream conductivity levels and fecal coliform concentrations are indicative of the “Urban Stream Syndrome” (Walsh et al. 2005). Streams affected by urbanization characteristically have similar “symptoms” that have resulted from riparian and channel alteration, increased wastewater inputs, and increased stormwater runoff. Symptoms indicative of urbanization impairment include: (1) increased nutrients, contaminants, sedimentation, and temperature; (2) alterations in hydrology, such as increased stormflow magnitude and erosive flow frequency; (3) degradation of the physical habitat; and (4) changes in energy sources, including decreases in organic matter retention and changes in organic matter inputs and algal biomass (Walsh et al. 2005). The effects on aquatic biota are often significant and deleterious. Approximately 42% of wadeable streams in the U.S. are considered to have “poor” biological condition (USEPA 2006), and urbanization is a primary cause (Klein 1979, Jones and Clark 1987, Paul and Meyer 2001, Wang et al. 2001). Despite the evident impact of urbanization to water quality in the Poesten Kill, these impacts at the time of the surveys were relatively minor and did not significantly impair ecological condition. Results do, however, highlight that urbanization is pervasive issue that has the potential to negatively impact Poesten Kill stream health in the future if urban expansion continues without consideration for local waterways (e.g., reducing riparian zones, increasing impervious surfaces, and neglecting infrastructure).

Both the VHA and water quality measurements indicated that holistic stream condition in Poesten Kill was minimally impacted. There were, however, spatial trends in water quality and physical habitat that indicate locations of impairment; specifically, in relationship to land use. Physical habitat results showed varying conditions along the stream gradient, but there was an overall decline in VHA scores from the headwaters to the most downstream location in Troy (Site 37). The major factors that contributed to lower VHA scores were in-stream habitat diversity, namely the absence of pool habitat, and streambank protection (canopy cover and riparian zone width). Sites that had impaired riparian zones were often in areas where there was greater development (residential and urban) or modifications to the landscape (e.g., agricultural fields), which largely occurred in the middle and lower reaches of Poesten Kill.

Macroinvertebrate and fish metrics did identify several distinct trends in water quality and habitat condition that were generally conflicting in their interpretation. Namely, macroinvertebrate assessments of water quality indicated largely non-impacted stream condition in Poesten Kill; whereas fish metrics suggest stream condition to be highly impacted. While these assessments differed, the collective analysis of all the data were more aligned with the results of the macroinvertebrate community metrics; which identified minimal impacts throughout the watershed. The difference in assessments of water quality, according to the fish Index of Biotic Integrity (IBI) and the macroinvertebrate Biological Assessment Profile (BAP), can be attributed, in part, to the inherent differences of the assemblage-specific metrics and the components that get integrated into each metric. Furthermore, differences in the life histories, habits, and habitat preferences of fish and macroinvertebrate assemblages can cause differences in their response to various stressors (Lemly 1982, Erman and Erman 1984, Roth et al. 1996 Wang et al. 1997, Lammert and Allan 1999, Paller 2001, Griffith et al. 2005, Hering et al. 2006, Freund and Petty 2007, Flinders et al. 2008, Merritt et al. 2019).

In the case of the fish IBI, there are also important considerations to be noted when interpreting the results of this index. The original IBI was developed by Karr et al. (1986) for use in midwestern U.S. streams. The metrics that comprised the original IBI were, therefore, adapted for streams with considerably different fish communities than in the northeast U.S. As a result, the IBI has been modified for different geographic regions across the U.S., including the IBI developed by Daniels et al. (2002); specially adapted for the northern Mid-Atlantic drainage. While the Mid-Atlantic drainage includes the Hudson River watershed (including the Poesten

Kill), results suggest the metrics that comprise the Mid-Atlantic IBI may not be all directly applicable to the fish community in Poesten Kill; and, therefore, skewing results. Such an interpretation is not unique to Poesten Kill, with similar findings in other watersheds. As a result, the original IBI has been modified to fish community structure on a more localized scale, such as by state (e.g., New Jersey, state.nj.us [NJ 2019]; New Hampshire, Neils 2011) or by waterbody (e.g., South Dakota lakes, Nelson 2017; Great Lakes coastal wetlands, Cooper et al. 2018). An IBI has not been developed specifically for New York State, but the NYSDEC has recognized that the Mid-Atlantic IBI may not be the most accurate measure of stream condition for many watersheds throughout the state. For stream surveys where the NYSDEC SBU performs fish sampling, data analyses do not include the IBI, but rather a Percent Model Affinity that includes parameters such as percent herbivores, percent blacknose dace; metrics not included in the IBI (Duffy et al. 2018). Future studies in the Poesten Kill should consider using the Percent Model Affinity index, as well as the other data analyses performed by NYSDEC, for comparative purposes; both for the comparison to other waterbodies in NYS, as well as for a comparison to the IBI.

b. Temporal Changes

Stream temperatures were within normal ranges for all locations during both years and did not indicate any impacts to water quality. Between years, stream temperatures were lower in 2019 than in 2017. Average air temperatures were nearly identical between years for the month of June (19.8°C in 2017 vs. 20.9°C in 2019); which suggests that the lower stream temperatures in 2019 are a result of increased precipitation and stream flows. Flow and stream depth were observably higher at all sampling locations during the 2019 survey. A trend of decreasing temperature serves as a good sign for the aquatic fauna community. Species like trout tend to prefer cooler waters for all life stages. The cooler the water, the less stress these animals will have in relation to their metabolic needs. Also, lower temperatures hold more dissolved oxygen; further supporting a robust and diverse aquatic community. Additionally, lower temperatures decrease the solubility of harmful pollutants; thus, reducing their toxicity in the environment and deleterious effects on aquatic organisms (Wood and McDonald 1997).

Levels of pH were generally higher in 2019 than in 2017, suggesting a stream-wide increase in pH levels. While the actual pH readings were still within the US Environmental Protection Agency's (USEPA) threshold for freshwater (6.5-9) and the optimum range for the productivity of freshwater organisms (6.5-8.5) (Cushing and Allan 2001), a consistent increase in pH may be concerning if identified in any future monitoring efforts. An increase beyond EPA's pH threshold upper limits would result in adverse effects to aquatic life. An increase in pH levels in Poesten Kill between years could be attributed to several things. One, differences in sampling equipment could have affected readings. Between 2017 and 2019 a pH probe was installed in the YSI sonde used in the Poesten Kill. pH sensors must be routinely replaced due to gradual deviations from standard values that cannot be corrected by standard calibration procedures. It is possible that there was a deviation from calibrated values prior to replacement of the pH sensor that would have resulted in the slightly lower pH levels observed in 2017. Though all pH values remained within an acceptable range, the increases from 2017 to 2019 are also coupled with an overall decrease in temperature. Higher temperature is a factor that can increase the pH of water (SOURCE). However, temperature at each respective site decreased in 2019, while pH increased. This could speak to larger-scale impacts to the stream (e.g., runoff/erosion of alkaline substrates). Alternatively, the time of day at which pH was measured could affect pH levels. For example, photosynthetic activity is higher during daytime hours, and particularly in the presence of ample sunlight. During these periods of photosynthesis, more carbon dioxide is removed from the water, which can ultimately increase pH during daytime hours and during the growing season (RBI 2004, Waterontheweb.org 2004). Also, sampling did show increased oxygen levels from 2017 to 2019, which could also be an indication of increased photosynthetic activity (in addition to lower stream temperatures). Historical surveys performed by NYSDEC SBU identified low pH at several locations in the Poesten Kill as potential sources of impairment to the macroinvertebrate community (Bode et al. 2004). Additional water quality monitoring would need to occur in the Poesten Kill to fully understand the seasonal and long-term changes to pH and the potential sources (e.g., landscape changes, increased plant production, and/or equipment discrepancies) for such observations.

Physical habitat, as measured by the Visual Habitat Assessment (VHA) showed highly changing conditions between sites and years. Between years, six sites showed improvements in VHA scores, while seven were found to have declined. The biggest contributing factor affecting VHA scores between years was the absence or presence of pool habitat in 2019, resulting in either declines or increases in VHA scores, respectively. Water flow, and therefore, stream depth was greater in 2019 than in 2017. This helped to diversify stream habitat with the inclusion of diverse pool habitat (e.g., low-velocity, deep pools; high-velocity deep pools; low-velocity shallow pools; high-velocity deep pools) at several locations in Poesten Kill. Conversely, several stream reaches showed substantial declines in pool habitat that could be attributed to the homogenization of stream habitat caused by the higher flows. This was particularly evident in the upper watershed (Site 30 and Site 29), where upper reaches were predominantly run habitat, the stream was smaller in width, and flows were comparably lower than the larger, downstream sites. Increased water flows likely contributed to increased transport of sediment to pools where stream flow was comparably lower (i.e., depositional stream zones), filling in pool habitat and creating a relatively uniform depth throughout the reach. Two of the field staff performing the VHA assessment participated in both the 2017 and 2019 stream surveys. Therefore, changes in VHA scores are attributed to changes in physical habitat more so than differences in interpretation that may have been caused by the field staff.

Concurrent with water quality, macroinvertebrate assessments of water quality suggest a general improvement in Poesten Kill stream health from 2017 to 2019. While macroinvertebrate assessments of water quality were indicative of good stream health during both years, a significant portion of sites (67%) showed improvements from 2017 with three of those sites changing from “slightly impacted” to “non-impacted”. Due to the life histories of most aquatic macroinvertebrates (e.g., shorter lifespan in relation to fish), these changes may be an indication of positive short-term changes in water quality. Even more so, these findings may serve as a better indicator of local water quality than the fish IBI due to the limited migration patterns that macroinvertebrates exhibit. In relation to the results of the fish IBI, an improving macroinvertebrate community throughout the reach may be a good sign for an improving fish assemblage in the long-term, as a healthy macroinvertebrate community is beneficial for the dietary requirements of the fish community (Barbour et al. 1999).

As previously discussed, fish measures of water quality indicated that Poesten Kill stream health was impaired throughout the watershed. According to the fish IBI, 2019 had more sites in the “fair” range, but a significant portion of the sites in both years (77-85%) still had IBI scores within the “poor” range. Relying on scores alone, the Poesten Kill would appear to have a poor fish community. However, it is important to note that analyzing changes in the fish community is more meaningful when carried out over a longer time period (Barbour et al. 1999). Therefore, a 2-year survey window may not be truly indicative of any significant changes in the community. This can be further substantiated in the small differences in scores observed from 2017 to 2019 across all sites. Likewise, all other measures of water quality indicated non-impacted conditions in Poesten Kill. While the individual metrics of the IBI can provide very useful assessments of changes to fish community structure along a stream gradient, the sole reliance on the IBI as an indicator of water quality does not appear to provide an accurate depiction of stream health.

V. Conclusions & Recommendations

The Poesten Kill watershed is a highly dynamic and unique system, located in the upper reaches of the Hudson River Estuary watershed. Results from the 2017 and 2019 surveys identified changes to stream health along spatial and temporal gradients, but viewed holistically, the watershed was minimally impacted and was of high ecological integrity. Minor impacts were evident, such as increased fecal coliform concentrations and conductivity levels that were correlated with urban development and indicative of the “Urban Stream Syndrome”. While impacts were comparatively minor, these observations indicate the ever-growing and prevalent issues surrounding urban development and the impacts to freshwater ecosystems. In order to ensure the long-term health of the Poesten Kill, as well as contribute to the revitalization of the Hudson River Estuary, the following recommendations have been made:

- *Continued monitoring of the Poesten Kill watershed*
    - Water quality results indicated a noticeable effect of urbanization on downstream water quality. Continued monitoring should be performed to understand long-term changes (if any) to stream conditions as a result of urban land use.
    - The survey was purposely performed during the same time of year in an

effort to eliminate the effects of seasonality on water quality assessments. However, the inclusion of monitoring events during other times of year (e.g., late summer and fall) could help identify seasonal changes to stream condition that could affect stream health. For example, more frequent monitoring of bacteria during different times of year and weather conditions could better identify problematic sources of bacterial inputs that were only weakly detected during this study.
    - Of the water quality parameters measured, pH was the only parameter to have levels approaching thresholds that could be detrimental to aquatic organisms. Given that low pH, from the runoff of acidic soils, was identified as a potential stream impairment during surveys performed by NYSDEC in 2013 (Bode et al. 2001), the focused monitoring of pH levels in Poesten Kill is needed to understand long-term changes, as well as determine if pH levels fluctuate on a diurnal (i.e., day vs. night) schedule in response to photosynthetic activity.
- *Perform additional analyses of water quality using biological data*
    - It is recommended that future analyses of water quality should include metrics performed by NYSDEC SBU (Duffy et al. 2018), such as the Percent Model Affinity for fish. The addition of such analyses could provide a more robust assessment of stream health in Poesten Kill.
- *Develop a comprehensive, public database for the Poesten Kill*
    - As more data becomes available, scientists and stakeholders studying the Poesten Kill can help build a monitoring database for long-term assessments of stream health.
    - The results of the database can be used to perform robust statistical analyses of spatial and long-term changes to stream condition in Poesten Kill.
- *Engage with the community and Hudson Riverkeeper to establish a citizen-science monitoring program in Poesten Kill.*
    - Riverkeeper is currently looking for volunteers to assist with water monitoring in tributaries to the Hudson River (https://www.riverkeeper.org/get-involved/volunteer/).
    - A routine monitoring program that includes bacteria analysis could then be used to statistically evaluate bacteria levels in the Poesten Kill in relation to NYS Water Quality Standards.

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FISH SAMPLING FIELD DATA SHEET (FRONT)

page _____ of _____

STREAM NAME	LOCATION	
STATION #_________ RIVERMILE_________	STREAM CLASS	
LAT _______________ LONG _______________	RIVER BASIN	
STORET #	AGENCY	
GEAR	INVESTIGATORS	
FORM COMPLETED BY	DATE _______ TIME _______ AM PM	REASON FOR SURVEY

SAMPLE COLLECTION	**How were the fish captured?** ❑ back pack ❑ tote barge ❑ other ___________________ **Block nets used?** ❑ YES ❑ NO **Sampling Duration** Start time __________ End time __________ Duration __________ **Stream width (in meters)** Max__________ Mean__________
HABITAT TYPES	**Indicate the percentage of each habitat type present** ❑ Riffles_____% ❑ Pools_____% ❑ Runs_____% ❑ Snags_____% ❑ Submerged Macrophytes_____% ❑ Other ( )_____%
GENERAL COMMENTS	

SPECIES	**TOTAL (COUNT)**	**OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMEN MAX SUBSAMPLE)**					**ANOMALIES***							
							D	**E**	**F**	**L**	**M**	**S**	**T**	**Z**

FISH SAMPLING FIELD DATA SHEET (BACK)

SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMEN MAX SUBSAMPLE)					ANOMALIES*							
							D	E	F	L	M	S	T	Z

* **ANOMALY CODES:** D = deformities; E = eroded fins; F = fungus; L = lesions; M = multiple DELT anomalies; S = emaciated; Z = other

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME	LOCATION	
STATION #_________ RIVERMILE_________	STREAM CLASS	
LAT ______________ LONG ______________	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE ________ TIME _________ AM PM	REASON FOR SURVEY

WEATHER CONDITIONS	**Now** / **Past 24 hours** ❑ storm (heavy rain) ❑ ❑ rain (steady rain) ❑ ❑ showers (intermittent) ❑ ____%❑ %cloud cover ❑____% ❑ clear/sunny ❑ **Has there been a heavy rain in the last 7 days?** ❑ Yes ❑ No **Air Temperature**_____ ^{0} C **Other**______________________________________
SITE LOCATION/MAP	**Draw a map of the site and indicate the areas sampled (or attach a photograph)**
STREAM CHARACTERIZATION	**Stream Subsystem** ❑ Perennial ❑ Intermittent ❑ Tidal **Stream Type** ❑ Coldwater ❑ Warmwater **Stream Origin** ❑ Glacial ❑ Spring-fed ❑ Non-glacial montane ❑ Mixture of origins ❑ Swamp and bog ❑ Other__________ **Catchment Area**__________km^2

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES	**Predominant Surrounding Landuse** ❑ Forest ❑ Commercial ❑ Field/Pasture ❑ Industrial ❑ Agricultural ❑ Other _______________ ❑ Residential **Local Watershed NPS Pollution** ❑ No evidence ❑ Some potential sources ❑ Obvious sources **Local Watershed Erosion** ❑ None ❑ Moderate ❑ Heavy
RIPARIAN VEGETATION (18 meter buffer)	**Indicate the dominant type and record the dominant species present** ❑ Trees ❑ Shrubs ❑ Grasses ❑ Herbaceous **dominant species present** ____________________________________
INSTREAM FEATURES	**Estimated Reach Length** _______m **Estimated Stream Width** _______m **Sampling Reach Area** _______m² **Area in km² (m²x1000)** _______km² **Estimated Stream Depth** _______m **Surface Velocity (at thalweg)** _______m/sec **Canopy Cover** ❑ Partly open ❑ Partly shaded ❑ Shaded **High Water Mark** _______m **Proportion of Reach Represented by Stream Morphology Types** ❑ Riffle_______% ❑ Run_______% ❑ Pool_______% **Channelized** ❑ Yes ❑ No **Dam Present** ❑ Yes ❑ No
LARGE WOODY DEBRIS	**LWD** _______m² **Density of LWD** _______m²/km² **(LWD/ reach area)**
AQUATIC VEGETATION	**Indicate the dominant type and record the dominant species present** ❑ Rooted emergent ❑ Rooted submergent ❑ Rooted floating ❑ Free floating ❑ Floating Algae ❑ Attached Algae **dominant species present** ____________________________________ **Portion of the reach with aquatic vegetation** _____%
WATER QUALITY	**Temperature**________ ⁰ C **Specific Conductance**________ **Dissolved Oxygen** ________ **pH** ________ **Turbidity** ________ **WQ Instrument Used** _______________ **Water Odors** ❑ Normal/None ❑ Sewage ❑ Petroleum ❑ Chemical ❑ Fishy ❑ Other________________ **Water Surface Oils** ❑ Slick ❑ Sheen ❑ Globs ❑ Flecks ❑ None ❑ Other____________________ **Turbidity (if not measured)** ❑ Clear ❑ Slightly turbid ❑ Turbid ❑ Opaque ❑ Stained ❑ Other________
SEDIMENT/ SUBSTRATE	**Odors** ❑ Normal ❑ Sewage ❑ Petroleum ❑ Chemical ❑ Anaerobic ❑ None ❑ Other_________________________________ **Oils** ❑ Absent ❑ Slight ❑ Moderate ❑ Profuse **Deposits** ❑ Sludge ❑ Sawdust ❑ Paper fiber ❑ Sand ❑ Relict shells ❑ Other________________ **Looking at stones which are not deeply embedded, are the undersides black in color?** ❑ Yes ❑ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			**ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)**		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	
Boulder	> 256 mm (10")				
Cobble	64-256 mm (2.5"-10")		Muck-Mud	black, very fine organic (FPOM)	
Gravel	2-64 mm (0.1"-2.5")				
Sand	0.06-2mm (gritty)		Marl	grey, shell fragments	
Silt	0.004-0.06 mm				
Clay	< 0.004 mm (slick)				

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION	
STATION #__________ RIVERMILE__________	STREAM CLASS	
LAT _______________ LONG _______________	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE ________ TIME ________ AM PM	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score __________

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION	
STATION #__________ RIVERMILE__________	STREAM CLASS	
LAT _______________ LONG _______________	RIVER BASIN	
STORE</br>#	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE _________ TIME _________ AM PM	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score __________

Chain of Custody Form

Page 1

Company:	Onondaga Environmental Institute
Company to be analyzed by:	
Total # of Samples this project:	
# of Samples Shipped this shipment:	

Onondaga Environmental Institute

Site Code	In Box #	#of Jars	Stream	Habitat	Device	Collection Date	Notes

Relinquished By/ Date:		Condition:	
Company:			
Received By/ Date:		Condition:	
Company:			
Relinquished By/ Date:		Condition:	
Company:			
Received By/ Date:		Condition:	
Company:			

POESTEN KILL FACT SHEET: WATER QUALITY

INTRODUCTION

Water quality monitoring is an incredibly vital component of stream assessments. Selecting what parameters to include in a stream survey can be challenging, given all the options. However, relatively simple and inexpensive tests, such as temperature, dissolved oxygen, pH, and water clarity, can provide a tremendous amount of information on overall stream health. By understanding what each parameter measures, its relative importance in an aquatic ecosystem, and how parameters may interact with each other in the natural environment, researchers and citizen scientists can better predict and understand the responses of aquatic organisms. And in doing so, one can make more informed assessments of stream health and prioritize monitoring, restoration, and/or conservation efforts. Thus, an invested interest in water quality is an invested interest in the health, diversity, and abundance of biota.

Water quality includes a number of parameters that environmental scientists use to measure the "health" and character of natural waters. Water quality has a direct relationship with the biota living within the water body. Technicians, scientists, and citizens can measure physical and chemical measurements directly in the field (in-situ) or via laboratory analysis. Common water quality parameters include, but are not limited to (1):

- **Temperature**
- **Dissolved oxygen**
- **Salinity (specific conductivity; total dissolved solids)**
- **Turbidity (suspended solids, water clarity)**
- **Alkalinity and pH**
- **Pathogens / Fecal indicator bacteria (e.g., fecal coliform, E. coli, Enterococcus, total coliform)**
- Hardness (calcium and magnesium)
- Major ions (e.g. chloride, sulfate)
- Nutrients (e.g., phosphorus and nitrogen
- Trace metals (e.g. copper, iron).
- Trace organic chemicals (e.g. pesticides, PCBs, herbicides)

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(1) Parameters that were measured as part of the Poesten Kill Ecological Survey are denoted in bold and discussed in further individual factsheets.

The concentration at which water quality parameters are measured and reported cover an extremely wide range, from part-per-trillion levels (e.g. dissolved mercury) to part-per-thousand levels (e.g. salinity); emphasizing that the effects of these parameters on water quality and wildlife is relative and do not exert the same effects. Moreover, multiple factors in a waterbody can compound effects and exacerbate impacts to stream health and biological quality. Measurements of water quality can be incredibly informative to understanding overall stream health. However, due to the dynamic nature of waterbodies, and in particular stream systems, identifying the potential sources of impairment to water quality can be particularly challenging. Measures of water quality at a given location are not necessarily indicative of water quality for the entire stream reach and can be relatively localized in spatial extent and effects on stream health. And likewise, most sources of water quality impairment and pollution originate at, or are a result of, sources from outside of the stream (Fig. 1).

Figure 1. Sources of stream pollution can originate from multiple sources. (Image obtained from: FilterWater.com)

POESTEN KILL WATER QUALITY: TEMPERATURE

Stream temperature is a very easy water quality parameter to measure and can be incredibly informative to understanding the health of a stream system. Water temperature is most commonly measured with a thermometer or a water quality meter equipped with a temperature sensor. Stream temperature is largely a function of climate, influenced by season and altitude (e.g., higher elevations tend to maintain colder stream temperatures). Water temperature can be locally influenced by groundwater inputs, shade canopy provided by overhanging vegetation, and human activities. In temperate climates, such as the Northeastern United States, aquatic life is adapted to colder stream temperatures. Therefore, warmer stream systems are more likely to preclude aquatic life than colder stream systems (Fig. 1). As a result, colder stream temperatures can be suggestive of a healthy stream system capable of supporting abundant and diverse aquatic life.

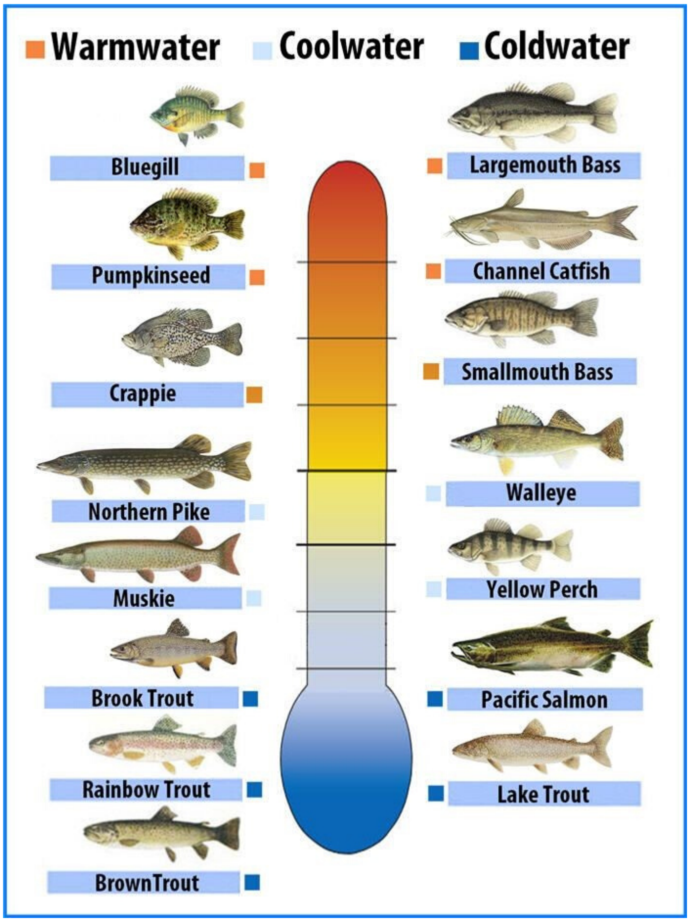

Figure 1. Examples of fish thermal tolerance designations. (Image obtained from: ShaddockFishing.com)

Sensitive species, such as trout require low temperatures year-round. Excessive heat in the summer can limit the available habitat and/or threaten the sustainability of fish populations. The loss or absence of sensitive species such as trout in streams once capable of supporting such species could be indicative of a change in temperature and suggestive of a decline in stream health.

IMPLICATIONS

- As water temperature approaches 70˚ F (21˚C), trout are less able to compete with other fish species for food. Lethal temperatures for trout range from 73˚F to 79˚F (23˚– 26˚C) (Cushing and Allen 2001).·
- Temperature is inversely related to dissolved oxygen (please see below). Therefore, measures of temperature can inform scientists about potential impacts to dissolved oxygen, and thus, aquatic life.

WATER TEMPERATURE IN POESTEN KILL

Stream temperatures in Poesten Kill ranged between cool (14.72˚C) and warm (21.93˚C) ranges (Fig. 2). During each survey, stream temperatures were warmest at the most upstream site (Site #31). This site was directly downstream of the Dyken Pond outlet. The large, open waterbody has a high exposure to sunlight with relatively stagnant conditions; likely contributing to the higher temperatures at this site. Overall, stream temperatures were within normal ranges for mid- to late-June and were not indicative of any impairment to water quality or biotic health.

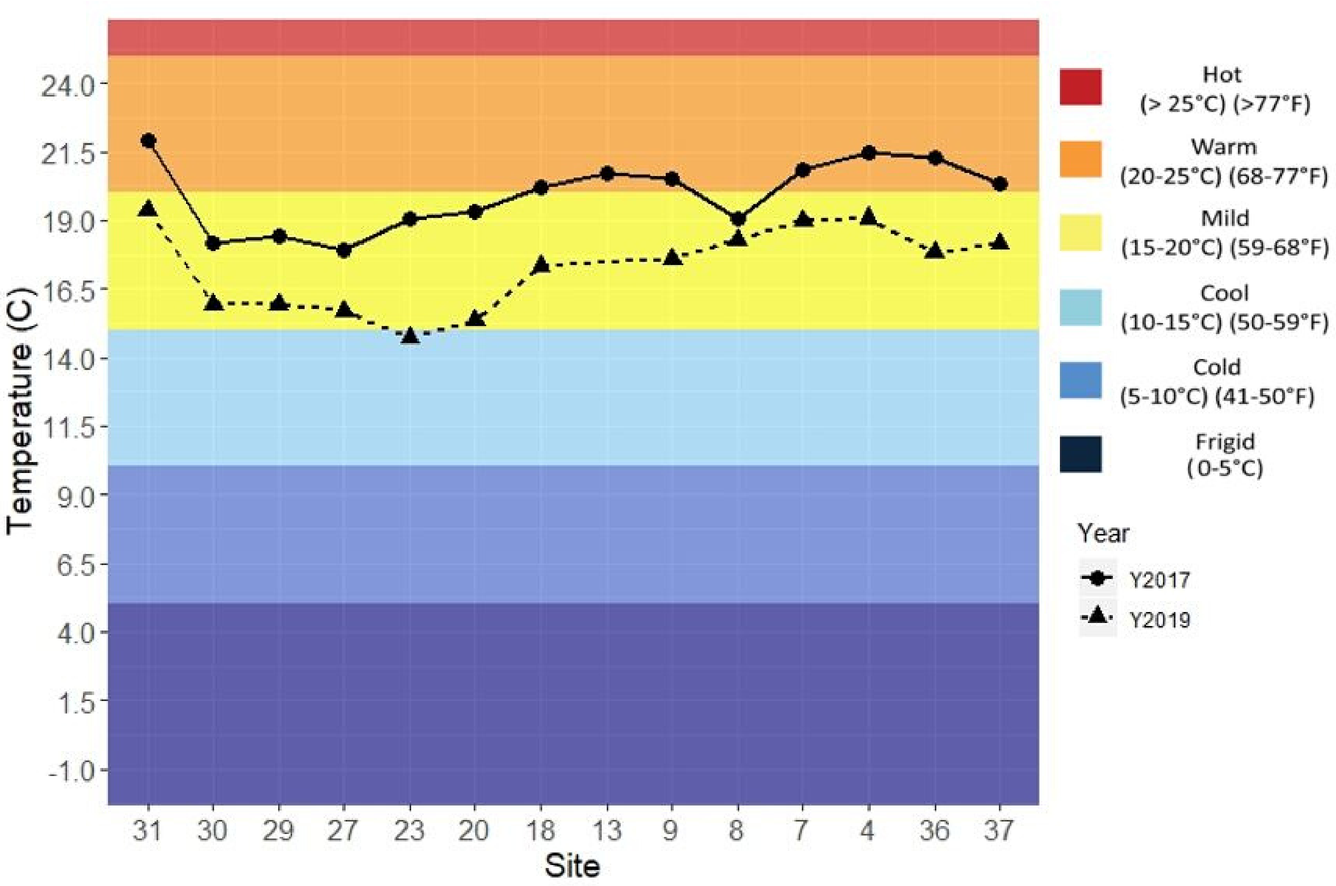

Figure 2. Stream temperatures in Poesten Kill (2017 & 2019). Sites are arranged in downstream order.

POESTEN KILL WATER QUALITY: DISSOLVED OXYGEN

Dissolved oxygen (D.O.) is one of the most important water quality indicators because nearly all aquatic life, ranging from bacteria to fish, require oxygen. Even plants, which produce oxygen via photosynthesis during the daylight hours, need oxygen to respire. Only certain forms of microorganisms do not require oxygen to survive. In addition to its critical biological role, oxygen also regulates chemical reactions in aquatic systems. Inversely related to temperature, as oxygen levels decline, species richness and diversity decline, and sensitive organisms decline or become absent altogether (Fig. 1).

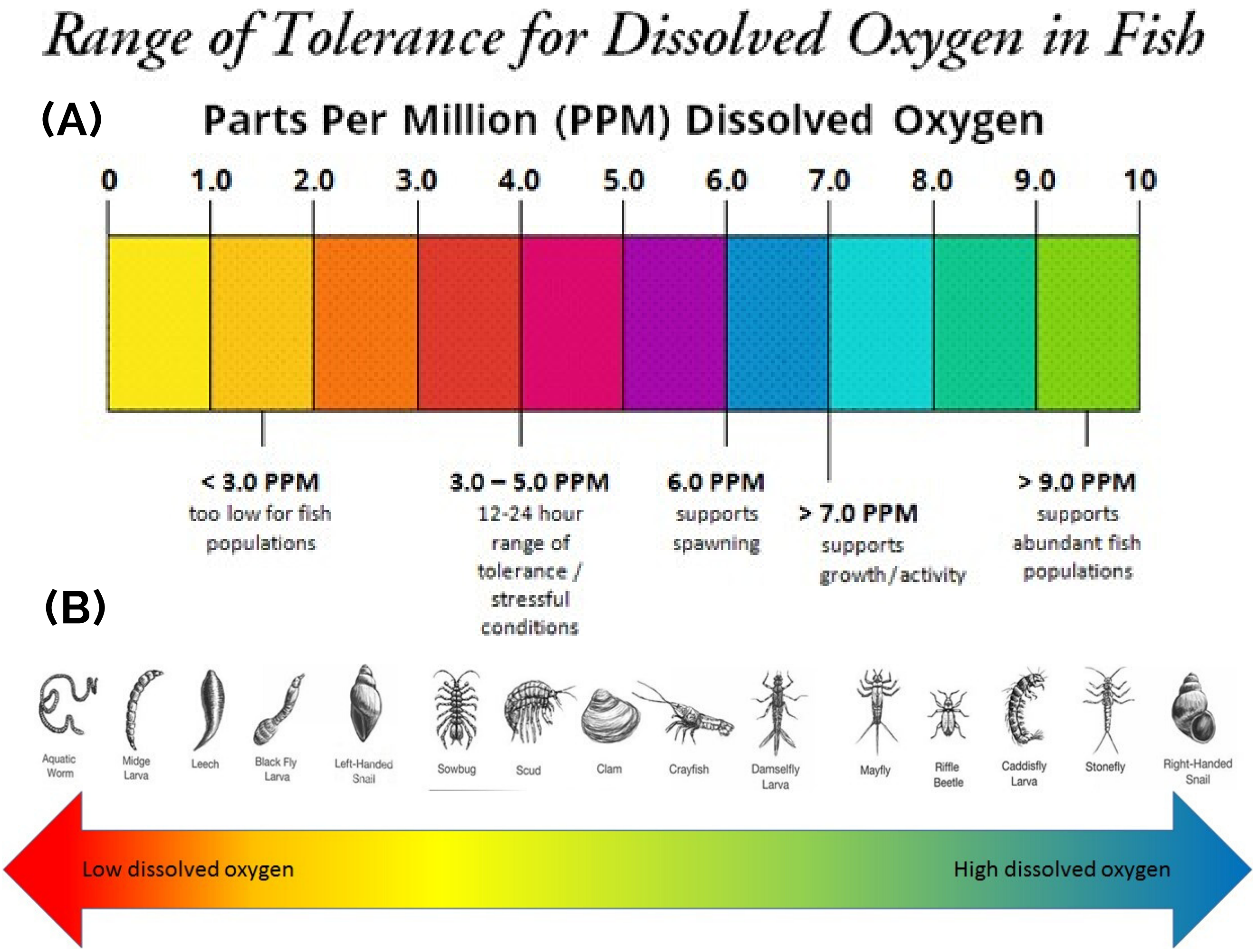

Figure 1. Dissolved oxygen tolerances for (a) Fish and (b) Macroinvertebrates. (Images obtained from: limnoloan.org and fineartamerica.com, respectively)

D.O. is highest (13-15 mg/L) in cold weather, and lowest in the summer (8-9 mg/L) because the solubility (the ability to dissolve in water) of oxygen decreases as temperature increases. Animal respiration also increases when temperatures increase. As a result, oxygen levels become further reduced (Fig. 2). High salinity concentrations also affect D.O. solubility, causing a reduction in total D.O. levels.

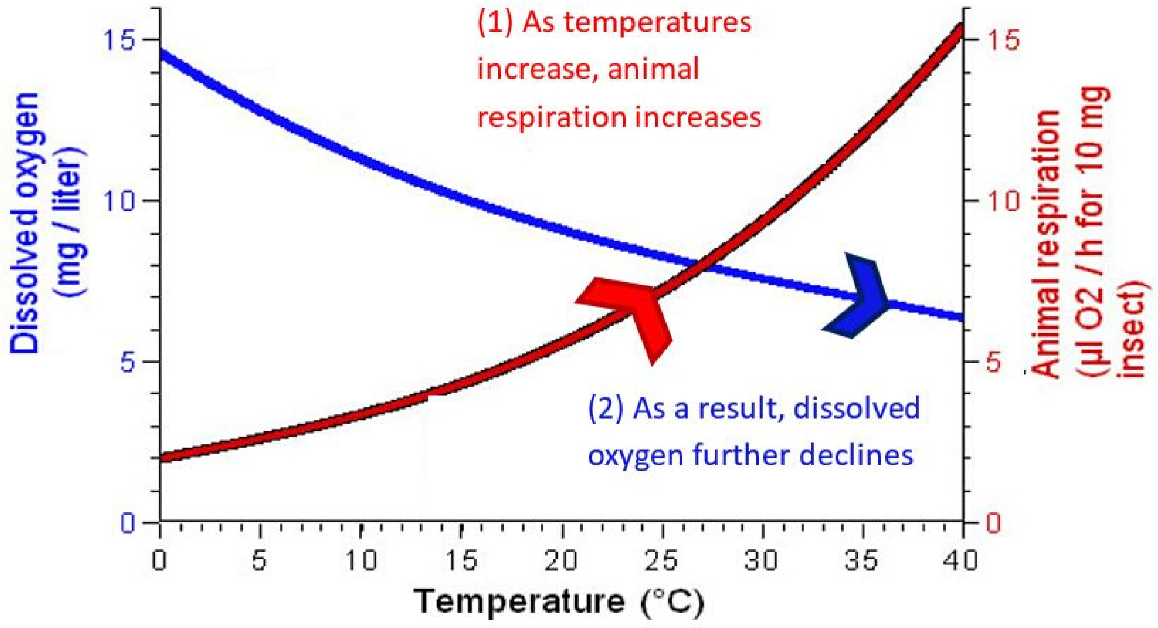

Figure 2. Relationship between dissolved oxygen and temperature.

WHERE DOES OXYGEN IN STREAMS COME FROM AND WHERE DOES IT GO?

Dissolved oxygen concentrations in streams are affected by many different physical, chemical, and biological processes (Text Box 1).

TEXT BOX 1: DISSOLVED OXYGEN IN STREAMS – SOURCES & SINKS

OXYGEN SOURCES:

- Aquatic plants, algae (photosynthesis)
- Aeration from the atmosphere
- Forces that increase aeration:
  - Wind energy
  - Kinetic energy & turbulence – movement of water through stream channel

OXYGEN SINKS (INPUTS WHICH REMOVE OXYGEN):

- Sewage inputs
- Carbonaceous (organic) matter decomposition
- Sediment oxygen demand
- Plant and microbial respiration

In streams affected by organic (i.e., sewage) pollution, a characteristic oxygen sag curve is often observed (Fig. 3)

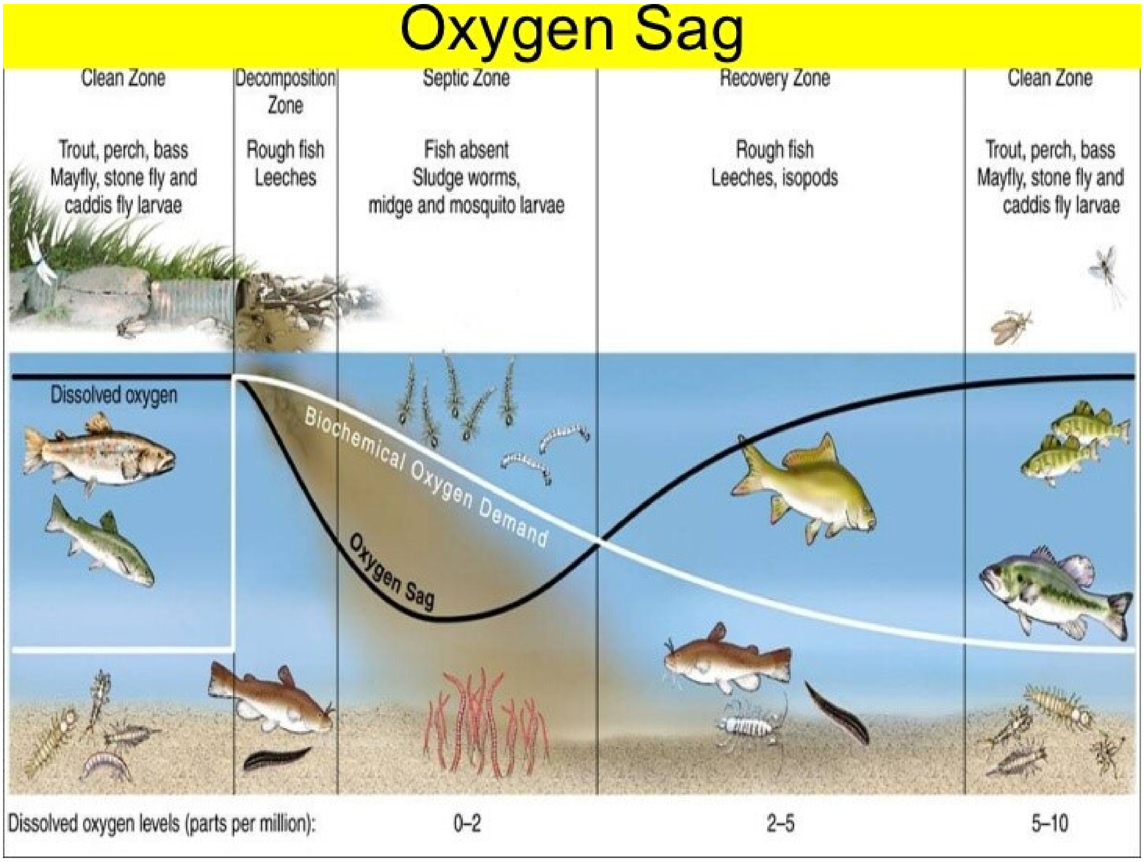

Figure 3. Dissolved oxygen sag curve typical of streams affected by organic pollution and the predicted effects on stream biota. (Image obtained from: slideshare.net)

IMPLICATIONS

- D.O. concentrations below 5 mg/L can begin to stress aquatic life, ultimately leading to mortality.
- Rapid changes in D.O. concentrations can cause "fish kills" that significantly reduce populations in a short period of time. Prolonged reductions in D.O. can cause long-term impacts to fish populations, significantly reducing reproductive success and juvenile survival.
- Declines in D.O. can also induce reductions in important prey items for fishes (e.g., aquatic macroinvertebrates), causing significant alterations to the food web.

DISSOLVED OXYGEN REQUIREMENTS IN NEW YORK STATE

New York State Department of Environmental Conservation (NYSDEC) sets a regulatory standard for allowable D.O. concentrations in streams, based on stream class. In Poesten Kill, waters are classified as Class C(T) in the lower watershed and Class C(TS) in the upper watershed. Such designations have classified Poesten Kill as a waterbody best suitable forfishing (Class C), capable of supporting trout populations (T) in the lower watershed and trout spawning (TS) in the upper watershed. Based on these classifications, minimum daily average D.O. concentrations in Poesten Kill shall not be less than 6.0 mg/L in the lower watershed and not less than 7.0 mg/L in the upper watershed. Additionally, at no time in Poesten Kill shall dissolved oxygen concentrations be less than 5.0 mg/L (NYSDEC 2019a)

DISSOLVED OXYGEN IN POESTEN KILL

D.O. concentrations in Poesten Kill were relatively consistent among sampling sites and between survey years (Fig. 4). D.O. was consistently within the 'high' range and indicative of good water quality. The relatively constant D.O. concentrations throughout the reach did not indicate evidence of organic pollution as modeled by the Oxygen Sag Curve (Fig. 3). D.O. concentrations were found well above the required concentrations set forth by NYSDEC, maintaining concentrations necessary for the survival, growth, and reproduction of trout.

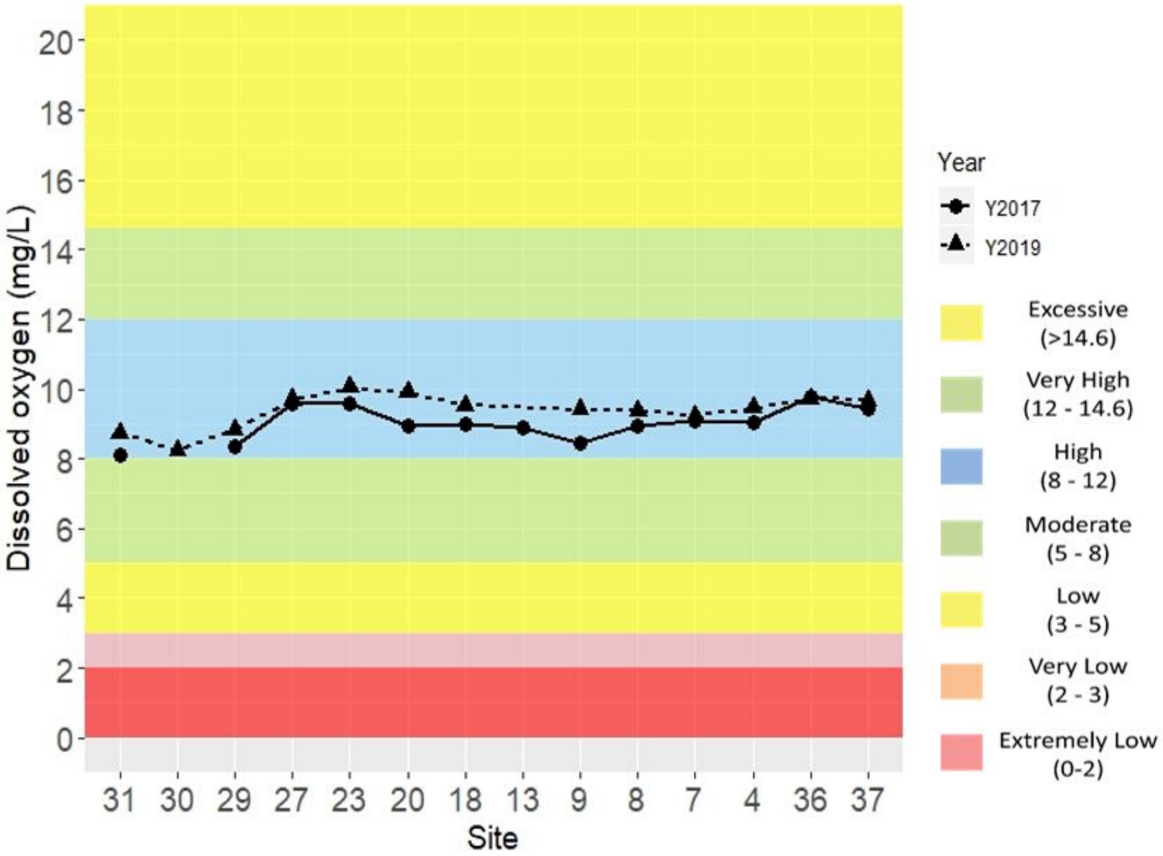

Figure 4. Dissolved oxygen levels in Poesten Kill (2017 & 2019). Sites are arranged in downstream order.

POESTEN KILL WATER QUALITY: SALINITY

Natural waters contain dissolved solids, primarily inorganic salts. Salinity is the concentration of salts in water. These salts consist of positive and negative ions, including:

MAJOR POSITIVE IONS

Calcium (Ca^{++})
Magnesium (Mg^{++})
Sodium (Na^{+})
Potassium (K^{+})

MAJOR NEGATIVE IONS

Bicarbonate (HCO_3^{-})
Chloride (Cl^{-})
Sulfate ($SO_4^{=}$

Other dissolved inorganic constituents, including nitrate (NO_3^{-}), silica (SiO_2), and iron oxides (e.g. Fe_2O_3), occur at relatively minor concentrations. Dissolved salts do not affect the appearance of water, while in solution. Often, salts become visible when forming solid precipitates. Dissolved salts above 500 mg/L can affect the usefulness of water as a source of drinking water and above 1000 mg/L for agricultural purposes. Salts can adversely affect some freshwater organisms. (Allan 1995)

Salinity (saltiness) can be measured as:

- Total dissolved solids (TDS) [units = mg/L]
- Specific conductivity (or conductance) [units = microSiemens per cm (μS/cm)]
- Sum of individual ions (e.g. chloride) [units = mg/L]

Table 1 provides the reader with a frame of reference for differing levels of salinity in the environment.

	uS/cm
DISTILLED WATER	0.5 - 3
MELTED SNOW	2 - 42
TAP WATER	50 - 800
POTABLE WATER IN THE US	30 - 1500
FRESHWATER STREAMS	100 - 2000
INDUSTRIAL WASTEWATER	10000
SEAWATER	55000

Table 1. Typical concentrations of conductivity (μS/cm) in various types of water. (Image obtained from: Fondriest Environmental, Inc.)

SALINITY SOURCES

Contributions of salts to freshwater systems can come from natural (e.g., salt springs, erosion of rocks) and anthropogenic (human) sources (Fig. 1). Increases in salinity can significantly impair biological communities in streams, as well as negatively affect the use of waterbodies by humans (e.g., drinking, swimming, recreation).

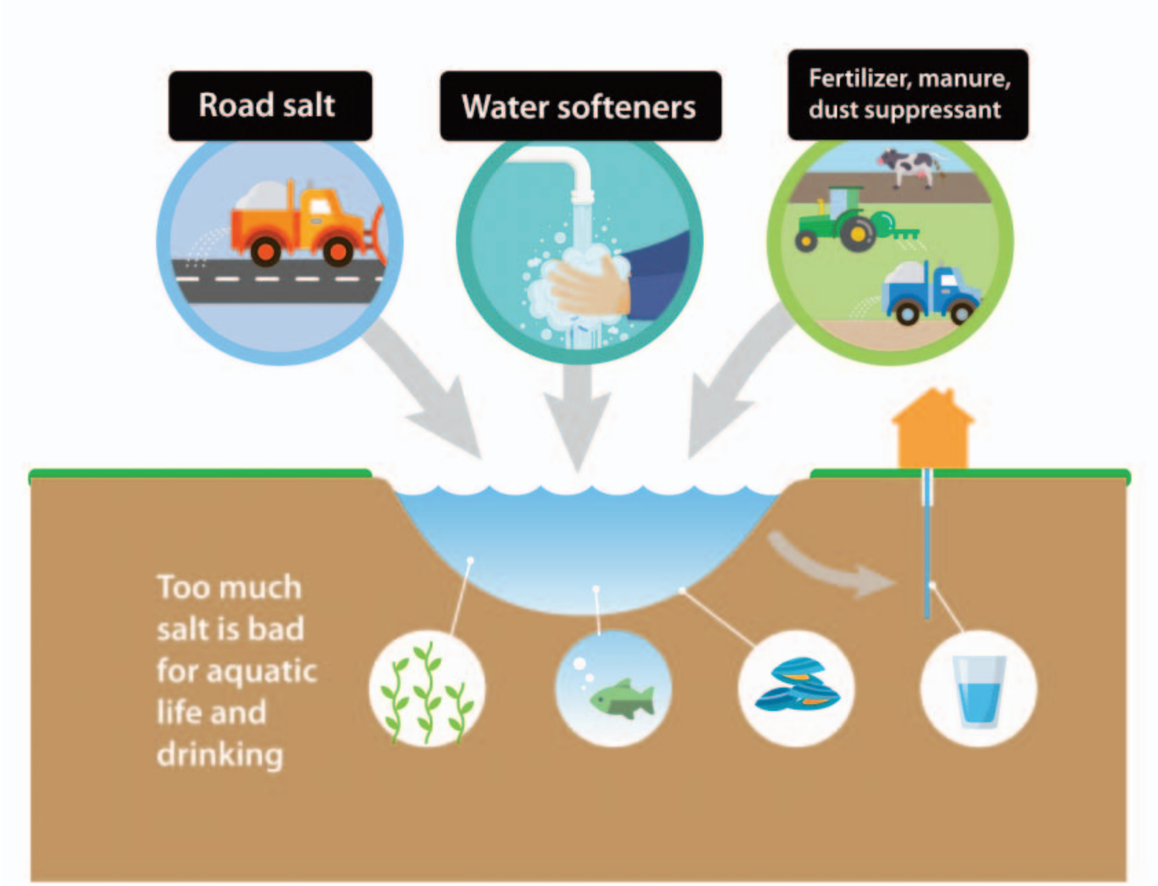

Figure 1. Sources of salt into waterbodies. (Image obtained from: pca.state.mn.us/water/chloride-101)

More recently, scientists have discovered an alarming trend in freshwater streams across the United States; freshwater salinity is on the rise (Fig. 2). One of the most pervasive sources of elevated salinity concentrations is from road salt applications by state and municipal highway departments and homeowners. Researchers studying the Mohawk River basin in New York State concluded that the two major components of road salt, sodium and chloride, had increased by 130 and 240%, respectively over the period 1952-1998 (Godwin et al. 2002).

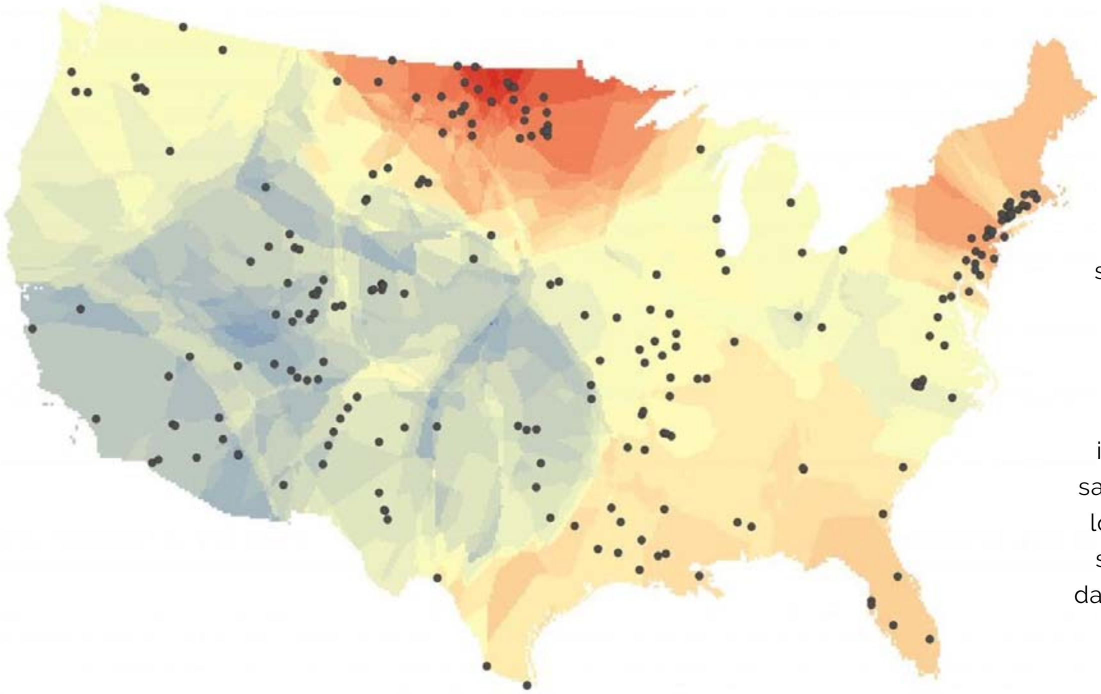

Figure 2. Changes in salinity in rivers and streams throughout the United States. Warmer colors indicated an increase in salinity, whereas cooler colors indicated a decrease in salinity. Dots indicated the location of USGS gaging stations from which the data to build the map were derived (Dennis 2018).

IMPLICATIONS

- Freshwater aquatic organisms are adapted to low conductivity waters. Increases in turbidity can alter their internal controls for regulating internal salt concentrations (i.e., osmoregulation); which can induce stress and cause mortality.
- Increases in salt inputs can suppress aquatic plant growth, altering physical habitat and food web dynamics.

SPECIFIC CONDUCTIVITY IN THE POESTEN KILL

Conductivity concentrations in Poesten Kill fell within the normal range for freshwater streams, with all sites considered 'pristine' during both surveys (Fig. 3). However, a noticeable downstream increase in conductivity was evident during both surveys. From the headwaters to the outlet, land use follows a distinct rural-urban gradient. The increase in urbanization, and thus road density and impervious surfaces, along the stream gradient is likely contributing to increased road salt runoff and ultimately stream conductivity levels. Of the water quality parameters measured during this survey, conductivity appears to pose the greatest impact to stream health. In the future, road salt application management may need to be considered by municipalities for the long-term protection of Poesten Kill.

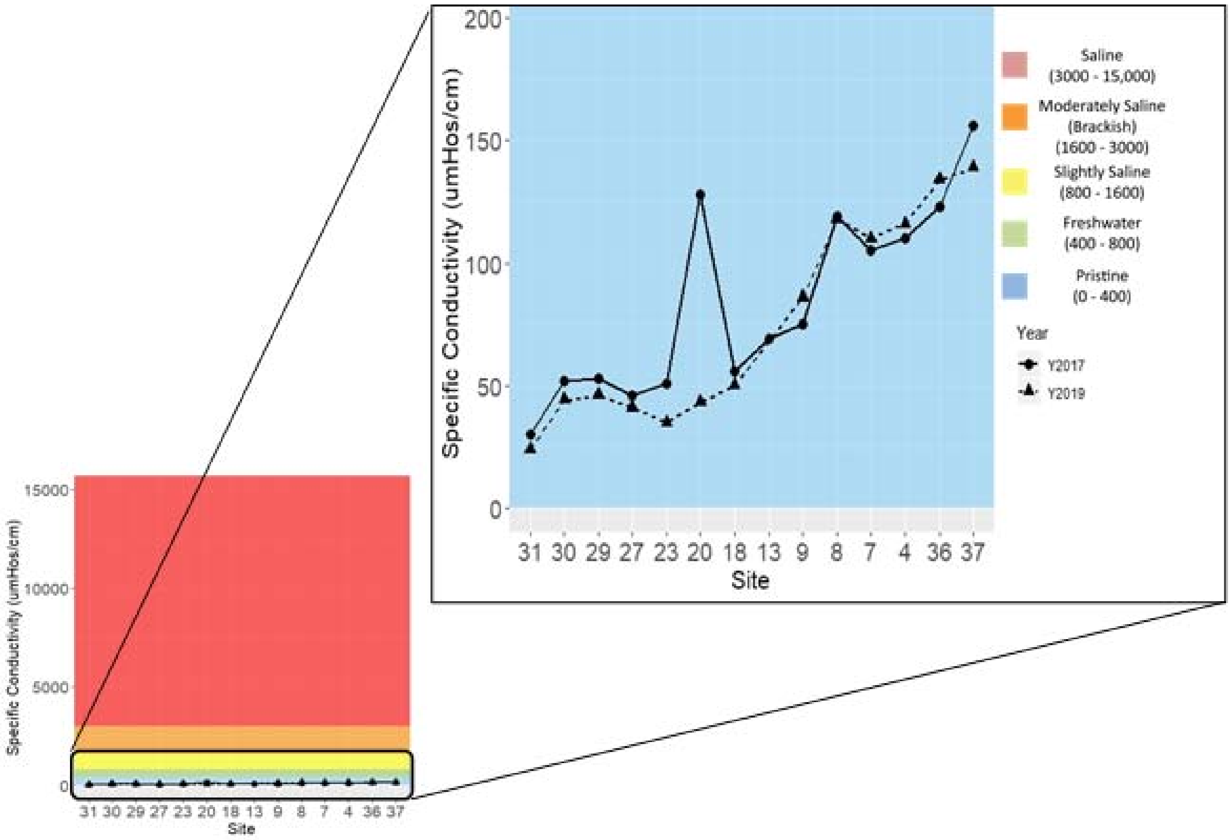

Figure 3. Conductivity levels for Poesten Kill (2017 & 2019). Sites are arranged in downstream order. The inset is meant to highlight the narrow range of conductivity levels measured in the Poesten Kill relative to the total color-interpretative scale used.

POESTEN KILL WATER QUALITY: ALKALINITY & PH

Alkalinity is a measurement of ions that control the pH of water. A pH of 7 is considered neutral. A pH value above 7 is considered alkaline and below 7 is considered acidic. Alkalinity is determined primarily by the amount of bicarbonate and carbonate ions in water. Levels of pH are largely driven by the geological composition of the watershed and often change very little in stream systems. Water draining from land characterized by limestone (calcium carbonate) rock can be strongly alkaline, whereas water draining from lands characterized by igneous rocks tend to be more acidic. Generally, alkaline waters are more biologically productive than acidic waters (Cushing and Allan, 2001). However, inputs from industrial and municipal discharges, as well as urban runoff can negatively impact the pH of freshwater systems. More recently, scientists have identified climate change, as a result of increased carbon emissions, as a primary cause of aquatic acidification, particularly in oceans (NOAA 2013). Highly acidic or highly alkaline waters can stress aquatic life and ultimately alter the biological community (Fig. 1).

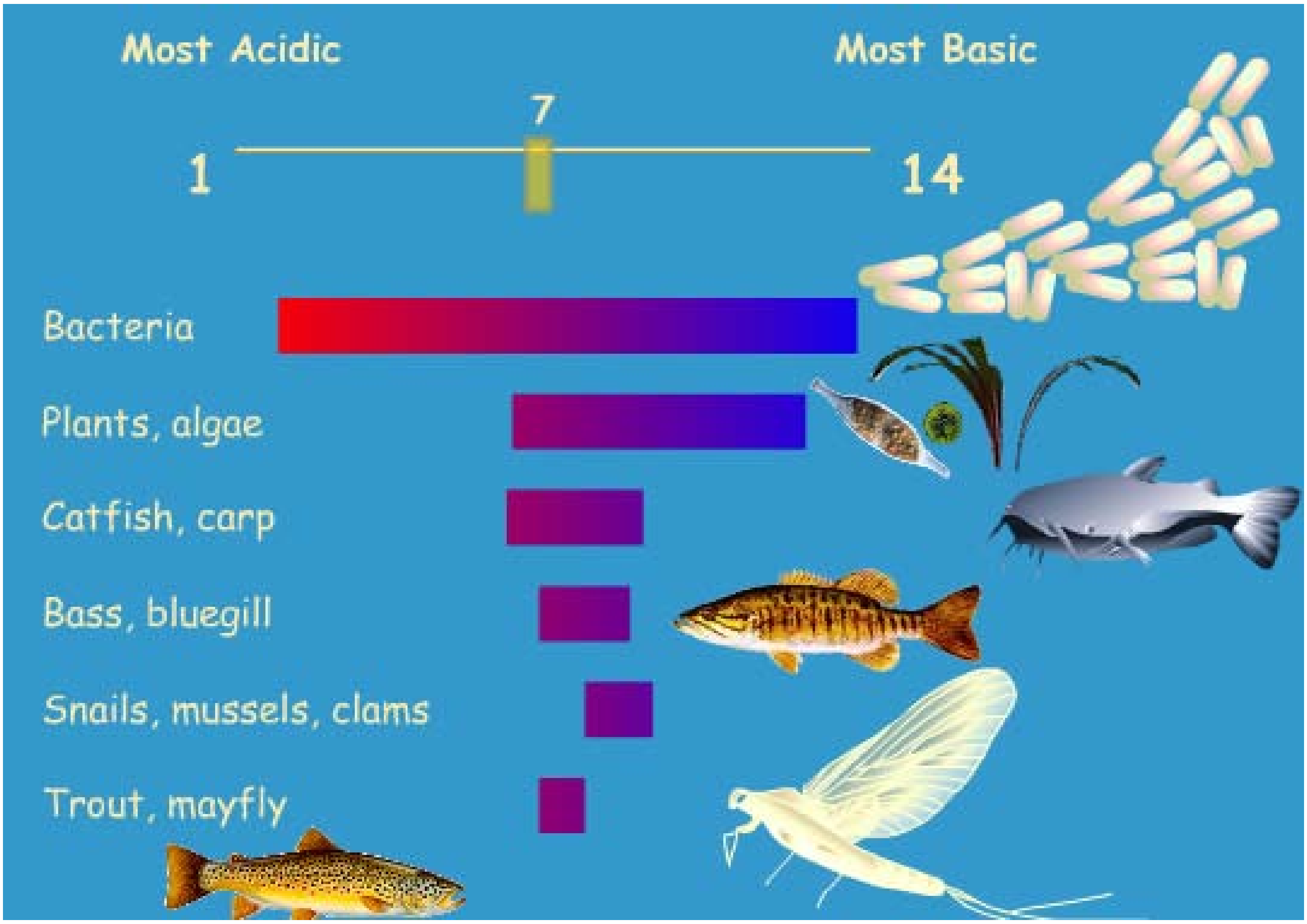

Figure 1. Examples of pH tolerances of freshwater organisms. Image obtained from: techalive.mtu.edu.

IMPLICATIONS

- Slight rapid and/or pervasive changes to pH can stress aquatic life, affect reproductive success, and lead to mortality
- For sensitive species such as trout and mayflies, deviations beyond a neutral pH (< 7 or > 8) can affect populations.
- For most fish species, a pH of < 6.5 and > 9 can cause stress or mortality.
- Changes to pH can significantly alter other water quality parameters and pollutants:
  - Lower pH levels can mobilize heavy metals, making them more toxic to aquatic life and humans (Fondriest Environmental, Inc. 2013)
  - Changes in pH can increase the solubility of nutrients, such as phosphorus, causing changes in plant and algal productivity; ultimately affecting parameters such as water clarity, dissolved oxygen, and temperature.

PH LEVELS IN POESTEN KILL

Levels of pH ranged between alkaline (pH = 8.49 at Site #31 in 2019) and slightly acidic (pH = 6.01 at Site #27 in 2017) conditions (Fig. 2). For most sites during both years, pH was considered neutral. Surveys did not identify anthropogenic factors that could be affecting pH; rather, pH appeared to be indicative of natural conditions. Levels of pH were within ranges not considered harmful to aquatic life.

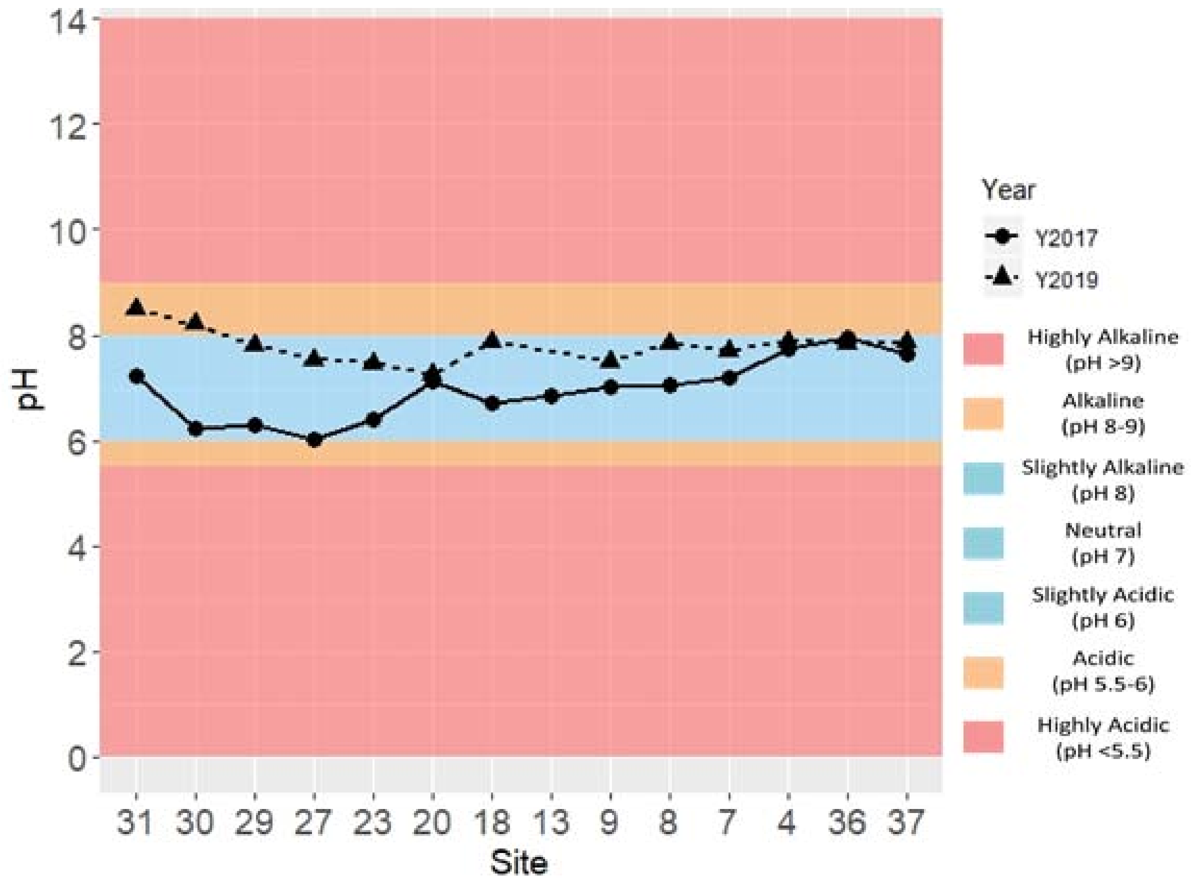

Figure 2. pH levels in Poesten Kill (2017 & 2019). Sites are arranged in downstream order.

POESTEN KILL WATER QUALITY: TURBIDITY

Particles in water are measured two different ways: turbidity and total suspended solids (TSS). Turbidity is a measure of water clarity, or light attenuation (extinction), caused by materials (e.g., clay, silt, and sand, algae, plankton, microbes, & other substances, including dissolved substances) suspended in the water. TSS is the dry weight of suspended (not dissolved) particles in the water. Turbidity and TSS are well-correlated (the presence of one predicts the other) and are very dynamic. In most stream systems, they are low when stream flow is constant and high during major runoff and storm events when scour and erosion occur. Fluctuations in turbidity can be caused by both natural (e.g., snow melt, rainstorms) and anthropogenic events (e.g., land/soil disturbance, point-source pollution).

IMPLICATIONS

The effects of elevated turbidity in aquatic systems includes (FISRWG 1998) (Fig. 1):

- Suffocation of aquatic insect and fish eggs/larvae
- Interference with fish reproduction
- Clog and abrade fish gills
- Aesthetically displeasing
- Sediments can serve as a transport mechanism for toxic substances (e.g. pesticides), pathogens, and nutrients such as nitrogen and phosphorus
- Settled sediments can interfere with stream flow, fish passage, and navigation by filling in channels
- High volumes of deposited sediments can reduce the storage capacity of the channel, thereby increasing flooding risks

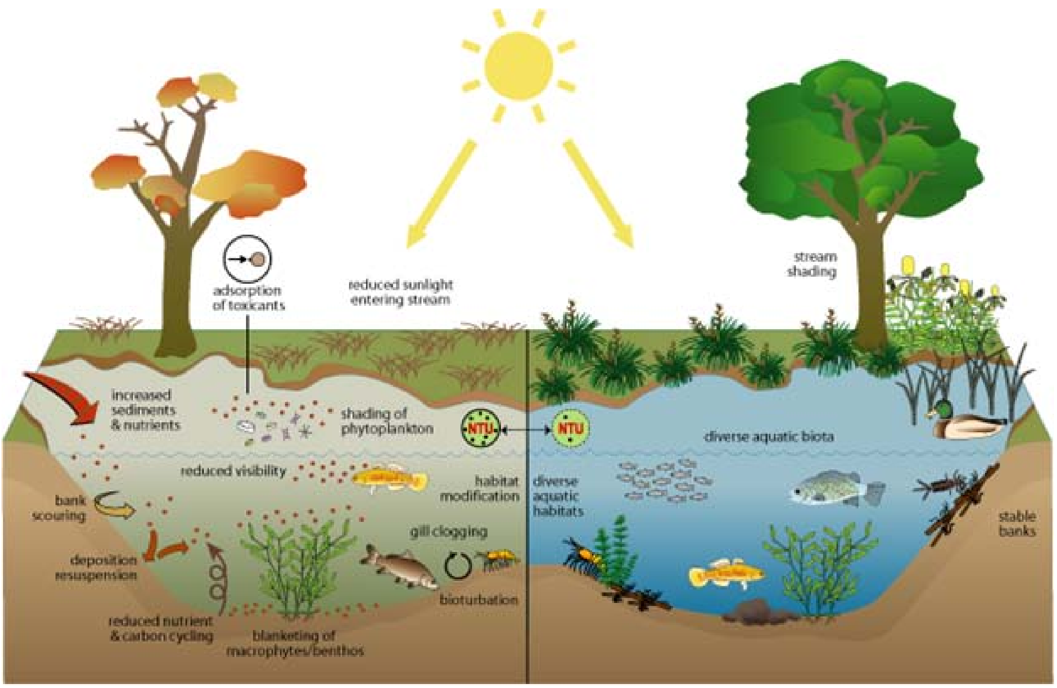

Figure 1. Effects of high (left) versus low (right) turbidity in aquatic systems. Image obtained from: wetlandinfo.des.qld.gov.au.

TURBIDITY LEVELS IN POESTEN KILL

The 2017 and 2019 ecological surveys in Poesten Kill found turbidity levels to range between 'pristine' and 'very low' levels (Fig. 2). The very low turbidity levels indicate pristine water clarity. During the 2019 survey, water levels were slightly elevated compared to 2017 due to a large rain event that had preceded sampling; possibly explaining why levels (albeit still very low) were a little more variable in 2019. Overall, the Poesten Kill is lined with large boulders and bedrock, with very little fine sediment. This appears, in part, to limit sediment transport, and thus, turbidity during high flow events.

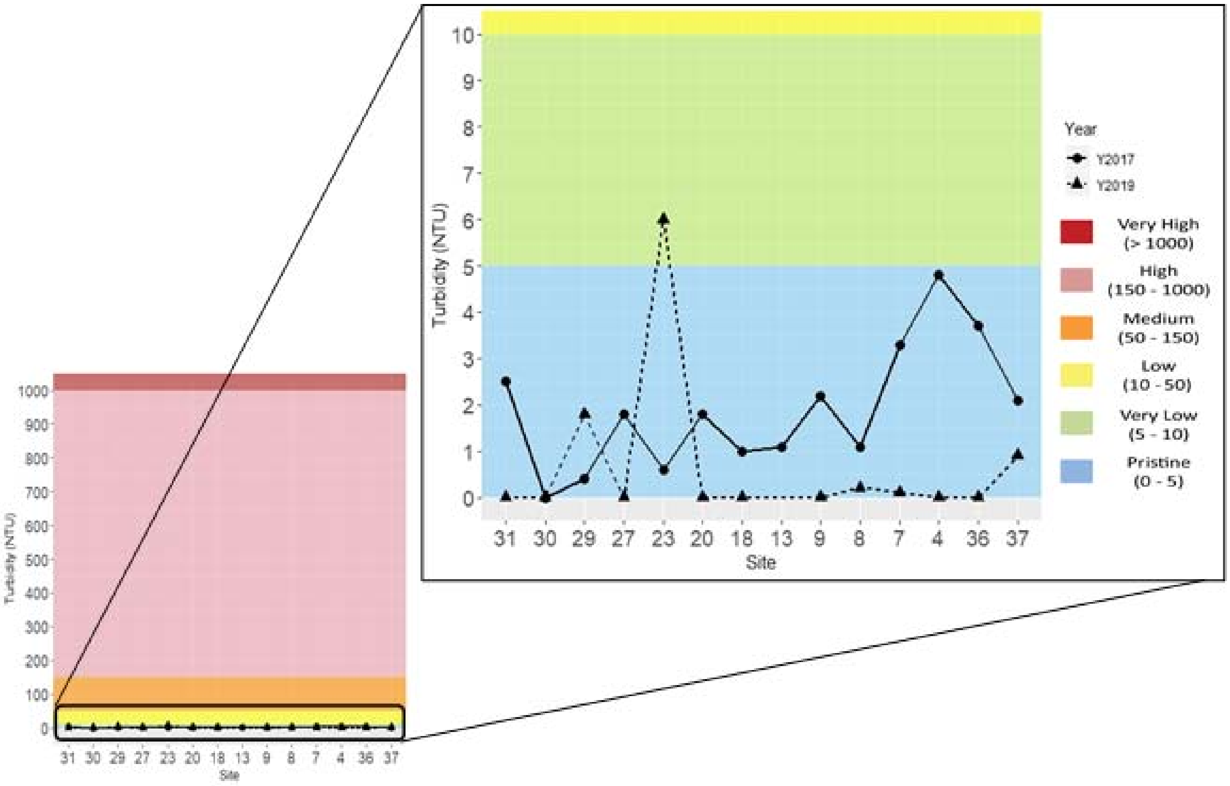

Figure 2. Turbidity levels in Poesten Kill (2017 & 2019). Sites are arranged in downstream order. The inset is meant to highlight the narrow range of turbidity levels measured in the Poesten Kill relative to the total color-interpretative scale used.

POESTEN KILL WATER QUALITY: PATHOGENS

Figure 1. Examples of sources of fecal contamination into waterbodies. Image obtained from: whatcomcounty.us/2169/Sources-of-Bacterial-Pollution.

Pathogens are microorganisms such as bacteria, viruses, and protozoans that can cause disease. Pathogens are commonly associated with decomposing carcasses and fecal material from animals of all kinds (human, other mammals, birds, etc.). Sources of fecal contamination to surface waters include untreated sewage, on-site septic systems, domestic and wild animal manure, and storm runoff from agricultural and urban lands (USEPA 1997) (Fig. 1).

Two bacteria groups, coliforms (2) and fecal streptococci, are used as indicators of possible sewage contamination because both groups are commonly found in human feces. Although generally not harmful, both groups indicate the potential presence of pathogens that also live in human and animal digestive systems. It is not practical to test for every pathogenic organism, so water is tested for indicator bacteria instead (USEPA 1997).

Because fecal bacteria can survive in waterbodies for varying periods of time, their introduction to aquatic systems can have lasting impacts that are affected by numerous, often compounding, factors and ambient conditions (Fig. 2).

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(2) Coliforms, as the name suggests, are bacteria having a form similar to E. Coli, which is a major bacterium present in the intestinal tract of humans and other warm-blooded animals.

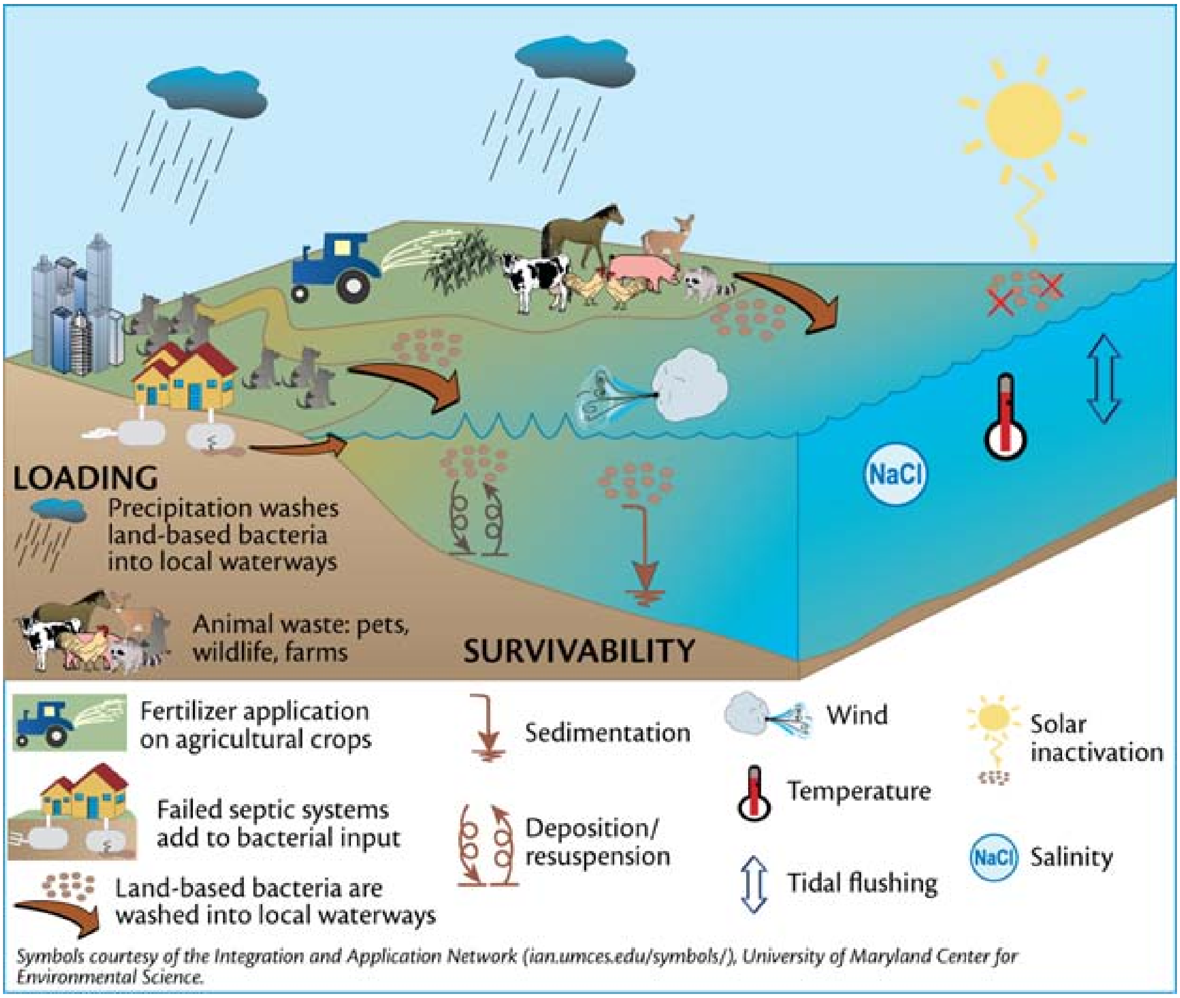

Figure 2. Conceptual model of factors affecting bacteria contamination and concentrations in an aquatic system. Image obtained from: aacounty.org.

IMPLICATIONS

- Fecal contamination can lead to algal blooms, causing significant alterations to the trophic structure of an aquatic ecosystem
- Fecal contamination can deplete oxygen levels, inducing stress on aquatic life
- High bacteria concentrations can impede recreation, such as swimming, boating, and fishing
- Fecal contamination can pollute drinking water sources, causing drinking water restrictions and shortages

WATER QUALITY STANDARDS

Fecal indicator bacteria are a primary measure used to evaluate compliance with water quality standards. In New York State, total coliforms and fecal coliforms are used to measure water quality compliance for bacteria in freshwater systems. In Class C waters (e.g., Poesten Kill), the monthly median value (from ≥ 5 samples) and >20% of total coliforms are not to exceed a concentration of 2400 colonies/100 mL and 5000 colonies/100 mL, respectively (NYSDEC 2019b). For fecal coliforms, the monthly geometric mean (from ≥ 5 samples) shall not exceed a concentration of 200 colonies/100 mL (NYSDEC 2019b).

PATHOGENS IN POESTEN KILL

Samples were collected for fecal coliform and Bacteroides analysis in 2017. Fecal coliform results indicated the concentration and extent of potential fecal contamination in Poesten Kill, providing a quantitative analysis of bacterial pollution. Bacteroides analysis is a genetic-based test that indicates the host-source (e.g., human, cow, deer, etc.) of bacterial contamination; which could then be used to isolate the physical source(s) of contamination (e.g., farm versus public sewer system).

In Poesten Kill, fecal coliform concentrations were relatively low, ranging between 'low' (27 colonies/100 mL at Site #29) and 'moderate' (300 colonies/100 mL at Site #37) (Fig. 3). The highest fecal coliform concentrations observed occurred at the three most downstream locations (Sites #4, #36, #37), suggesting that increased urbanization may be affecting bacteria concentrations. In Troy, residents are connected to municipal sewer lines. Aging infrastructure has been identified as a known source of fecal contamination, particularly in cities in the Northeast (OEI 2019). It is possible that a similar problem could be occurring in Troy. However, fecal coliform levels were still low compared to streams impacted by Combined Sewer Overflows (OEI 2019). Due to the comparably low fecal coliform levels, Bacteroides analysis did not yield any findings, with all sampling below detectable limits for host-source identification. Because only one sampling event was performed, comparisons to water quality standards could not be made.

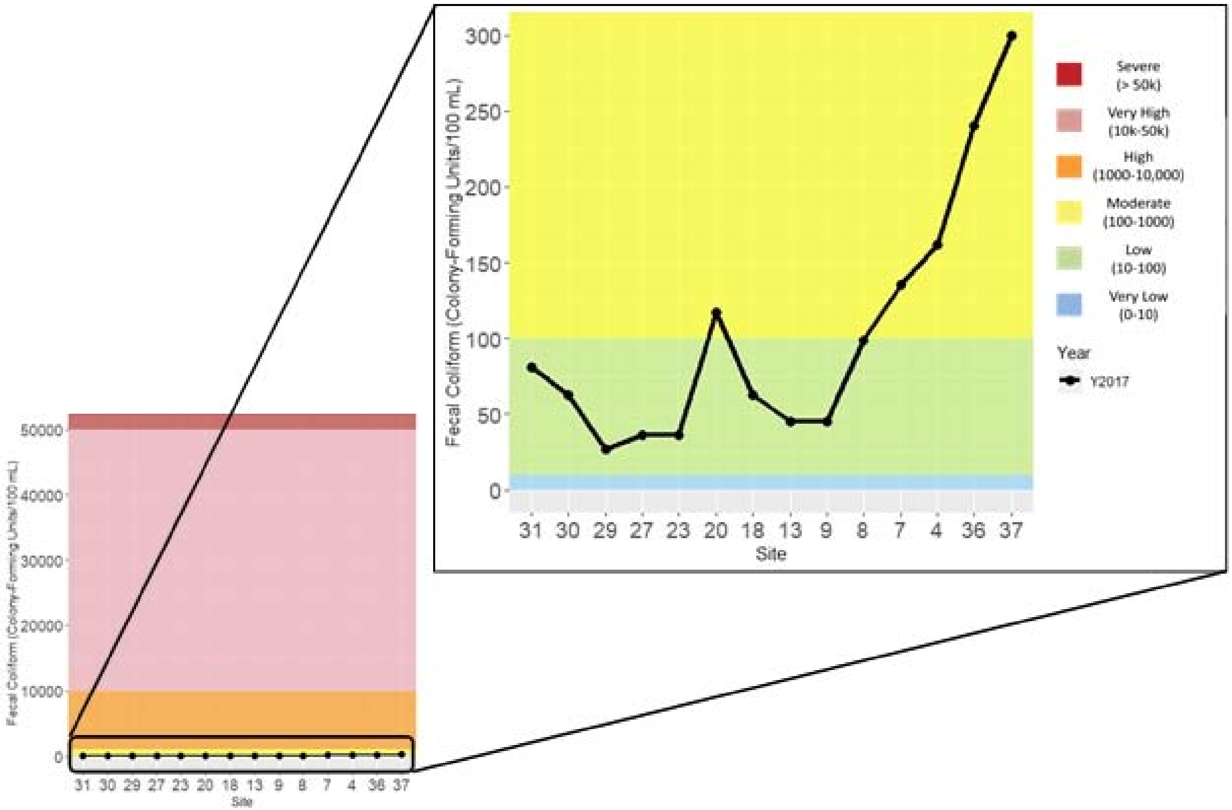

Figure 3. Fecal coliform concentrations in Poesten Kill (2017). Sites are arranged in downstream order. The inset is meant to highlight the narrow range of fecal coliform concentrations measured in the Poesten Kill relative to the total color-interpretative scale used.

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POESTEN KILL FACT SHEET: AQUATIC HABITAT

INTRODUCTION

The term 'habitat' is usually used with respect to a specific group of organisms, most frequently a species. This section introduces methods broadly applied in the Poesten Kill watershed for assessing habitat degradation in terms that can be relevant from community-level (e.g., fish community) and/or species-level (e.g., brown trout) planning, restoration, or management efforts. Species-specific assessments of habitat can be important should conservation or reintroduction of individual species (e.g., American eel, brook trout) be an eventual goal for Poesten Kill.

WHAT IS AN "ECOSYSTEM"?

An ecosystem is comprised of the site-specific interactions between all biota and their physical and chemical surroundings (e.g., substrate composition, temperature, dissolved oxygen concentrations, etc.). An ecosystem includes all the living and non-living structural components within a defined region and the internal connections and functions among components (Fig. 1). Depending on the spatial scope of the assessment or survey, an aquatic ecosystem can include both aquatic and terrestrial (i.e., land-based) components.

WHAT IS "HABITAT"?

The term "habitat" may be broadly defined as the subset of ecosystem components that directly relate to the biological requirements and preferences of a group of organisms (Fig. 1). Typically, habitat is thought of in relation to a species but can also apply to a larger group such as coldwater fish, or a subset of individuals within a species, such as early life stages. Habitat for a species may include other biotic (i.e., living) factors as part of the surroundings. For instance, some fish prefer the presence of rooted aquatic plants, which in turn have their own habitat requirements. A species' preferred habitat can differ among life stages and seasons. Examples of factors that can be used to assess and describe stream habitat are shown in Text Box 1. Relative importance among habitat factors on the organism(s) or community in question can depend on, but not be limited to:

- Organism
  - Resource requirements
  - Tolerance ranges to environmental perturbations or disturbances
- Population
  - The need for certain habitat conditions can be greatly affected by population size and the capacity of the ecosystem to support populations of varying sizes
- Species
  - The size of an organism can influence survivorship; parameters important to small organisms may be less significant to larger individuals of the same species, and vice versa
- Life stage
  - Similar to species size, which is often used to identify different life stage, preferred habitat for adults and early life stages may differ significantly
- Annual cycles
  - For example, some fish spawn under one set of conditions, but live the rest of the year under other conditions or in altogether different ecosystems; such as migratory species that live most of their lives in freshwater streams and reproduce in marine systems (i.e., catadromous fish) or vice versa (i.e., anadromous fish).

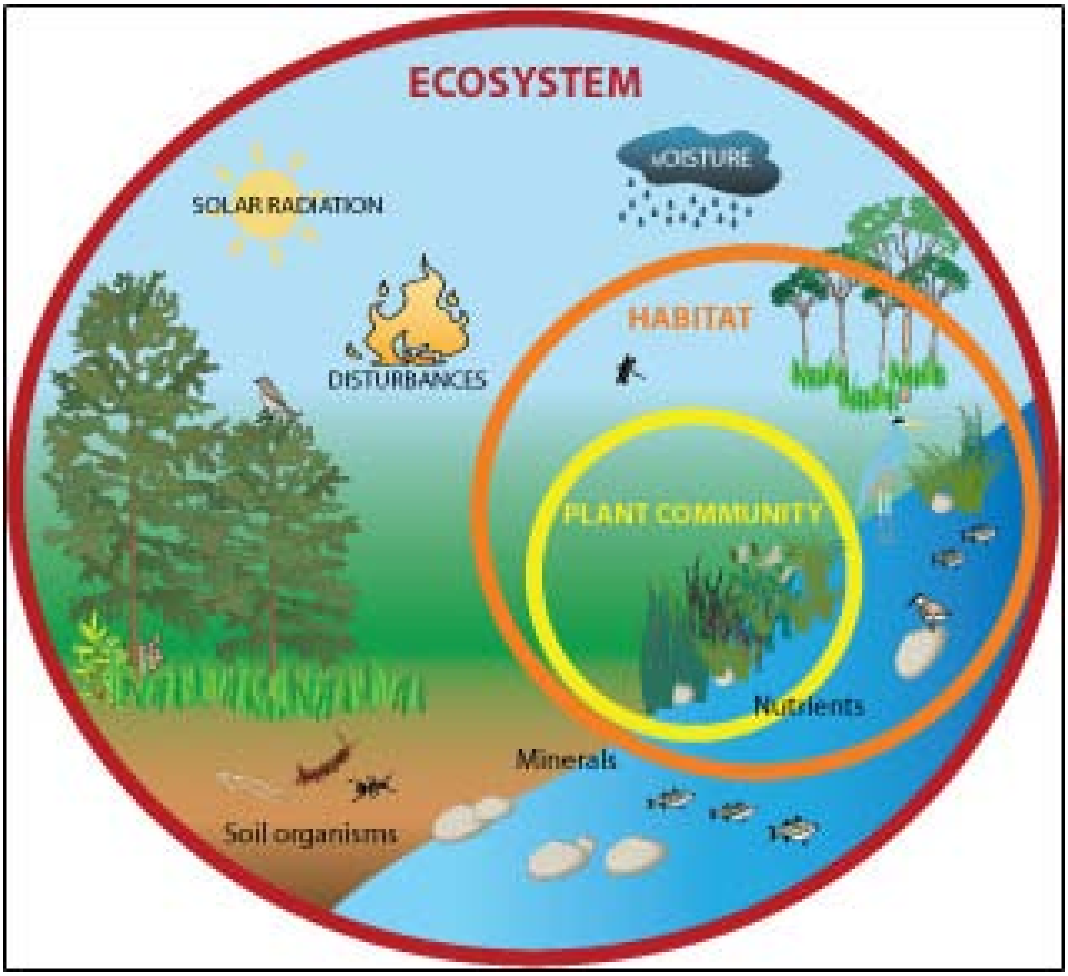

Figure 1. Example of an ecosystem with aquatic and terrestrial linkages. Habitat for a given species or community is a subset of an ecosystem. Image obtained from: Socratic.org.

RIPARIAN ZONE

The transitional zone between adjacent aquatic and terrestrial ecosystems is called the "riparian zone" (Mitsch and Gosselink 2000). It is the area where the soil becomes saturated due to the influence of surface water (Fig. 2). Riparian zones are closely associated with aquatic habitats and are vital in providing important habitat for birds, insects, fish, and animals. They provide sources of food that support the food web for early life stages of many fish. Riparian zone vegetation is important for shading, and thus, maintaining cool waters, providing cover during flood periods, and contributing vegetative detritus; forming the base of the food web in headwater areas. Sufficiently dense, and/or wide riparian vegetation serves as a buffer to intercept nutrients and sediments contained in surface water runoff from pastures, crop fields, suburban lawns, and urban open areas.

TEXT BOX 1: FACTORS USED TO DESCRIBE STREAM HABITAT

WATER QUALITY
- TEMPERATURE
- CONDUCTIVITY/SALINITY
- NUTRIENTS (PHOSPHORUS, NITROGEN)
- DISSOLVED OXYGEN
- PH
- TURBIDITY

BIOLOGICAL STRUCTURE
- AQUATIC PLANTS
- RIPARIAN TREES AND SHRUBS
- FLOODPLAIN PLANTS

PHYSICAL STRUCTURE
- SHADING (A.K.A. CANOPY COVER
- SUBSTRATE COMPOSITION
- COVER FROM PREDATION (E.G., WOODY DEBRIS, UNDERCUT BANKS
- STREAM RIFFLE/POOL ALTERATION
- STREAM BED SHAPE (PROFILE)
- SIZE AND SHAPE OF RIPARIAN WETLANDS AND FLOODPLAINS
- SINUOSITY (DEGREE OF STREAM MEANDERING)

HYDROLOGY
- WATER FLOW (VOLUME/TIME)
- WATER VELOCITY (SPEED/DISTANCE)
- WATER LEVEL RELATIVE TO BANK FULL
- CHANNEL SHAPE
- STEEPNESS OF GRADE

ECOLOGICAL STRUCTURE
- ABUNDANCE
- POPULATION
- COMMUNITY
- DIVERSITY

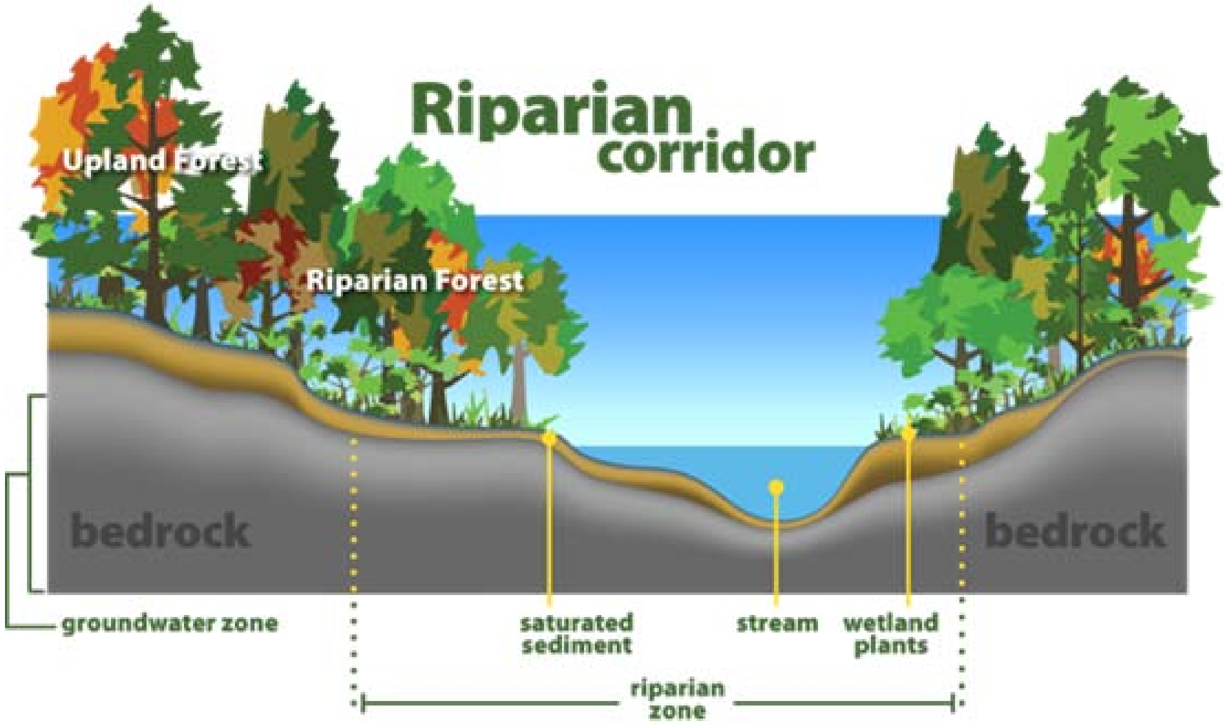

Figure 2. Riparian zone schematic. Image obtained from: Lakeconesteenaturepark.com

REFERENCE CONDITION

Numerical scores and species composition from habitat and biological surveys are usually interpreted in comparison to a reference system, or reference condition. A reference system is a background or baseline set of conditions for a given habitat, such as a stream reach, that would be expected in an otherwise undisturbed (non-impacted), natural setting. A background site references a state of conditions prior to anthropogenic influence. A baseline site typically references a past unimpacted condition, prior to disturbance or perturbation. By defining reference condition, assessments of stream condition can be effectively measured against a defined, non-impacted system and deviations from reference condition can be quantified. Results can be used to identify stream impairments and prioritize remedial efforts. Definitions of reference condition vary depending on the geographic location of the survey, agency/organization performing the survey, and local, state, or federal monitoring program requirements. In New York State, the Department of Environmental Conservation (NYSDEC) Stream Biomonitoring Unit (SBU), which assesses state-wide stream condition on a rotating basis, defines reference conditions as:

"For watersheds with minimal disturbance such as those within the Catskills and Adirondacks reference sites typically exceed 95% natural cover (forest, wetland, open water, etc.). In regions with more extensive anthropogenic disturbance, a minimum of 75% natural [cover] and less than 2% impervious surface may be used to represent best attainable reference condition. In cases where best attainable condition may not be non-impacted, the highest water quality designation should be used. Water chemistries if available should indicate background condition. A good surrogate for water chemical information is specific conductance and it should be less than 150 µS/cm which is the 25th percentile of all data collected in New York State's ambient water quality monitoring program but should not exceed 250 µS/cm." (Duffy et al. 2018)

IN-STREAM HABITAT

Habitat naturally changes dramatically from headwaters to the mouth of a stream. While each stream system is unique, scientists have identified relatively predictable transitions in stream and biotic condition along the longitudinal gradient of a stream in undisturbed systems.   The River Continuum Concept is a classical paradigm of changes in flowing (lotic) water systems from headwaters to mouth (Text Box 2, Fig. 3). Similar to the reference condition concept, the River Continuum Concept serves as a model for predicting stream condition, identifying potential impairments, and estimating deviations in stream health from model conditions.

TEXT BOX 2: RIVER CONTINUUM CONCEPT (RCC)

The river continuum concept (RCC) is a classic paradigm in stream and river ecology (Vannote et al. 1980). It proposes that an unimpacted stream will exhibit predictable physical and chemical changes from the headwaters to its outlet. Additionally, these changes are reflected in changes in the stream biota, or plant and animal life. Water in upper stream reaches are fast-moving due to relatively steep topography, shallow, cold due to groundwater springs and forest shading, well-oxygenated, clear, and relatively nutrient-poor. Headwater food webs are primarily based on energy sources from outside of the system (allochthonous sources), such as leaf fall, because relatively little photosynthesis occurs in swift-flowing, nutrient-poor, shaded waters. As a result, the aquatic macroinvertebrate community is typically dominated by leaf-eating shredders, grazers, and predators. Sensitive fish species such as trout are characteristic of headwater fish communities. Species richness (number of species) and biomass (total weight) are relatively low near the headwaters compared to downstream reaches. Topography flattens out near the outlet of an unimpacted stream and the waters are slower, deeper, wider, and more turbid, less oxygenated, less shaded, exposed to sunlight, and relatively nutrient-rich. A greater fraction of energy entering the food web is captured within the system (autochthonous sources) by photosynthetic algae and macrophytes. Both species richness and overall biomass are greater than at the headwaters. A continuum of habitat conditions occurs between these extremes. According to the RCC paradigm, both autochthony and species richness are greatest in middle stream reaches, where biota from both upstream and downstream converge, and waters are still clear enough to support high levels of photosynthesis.

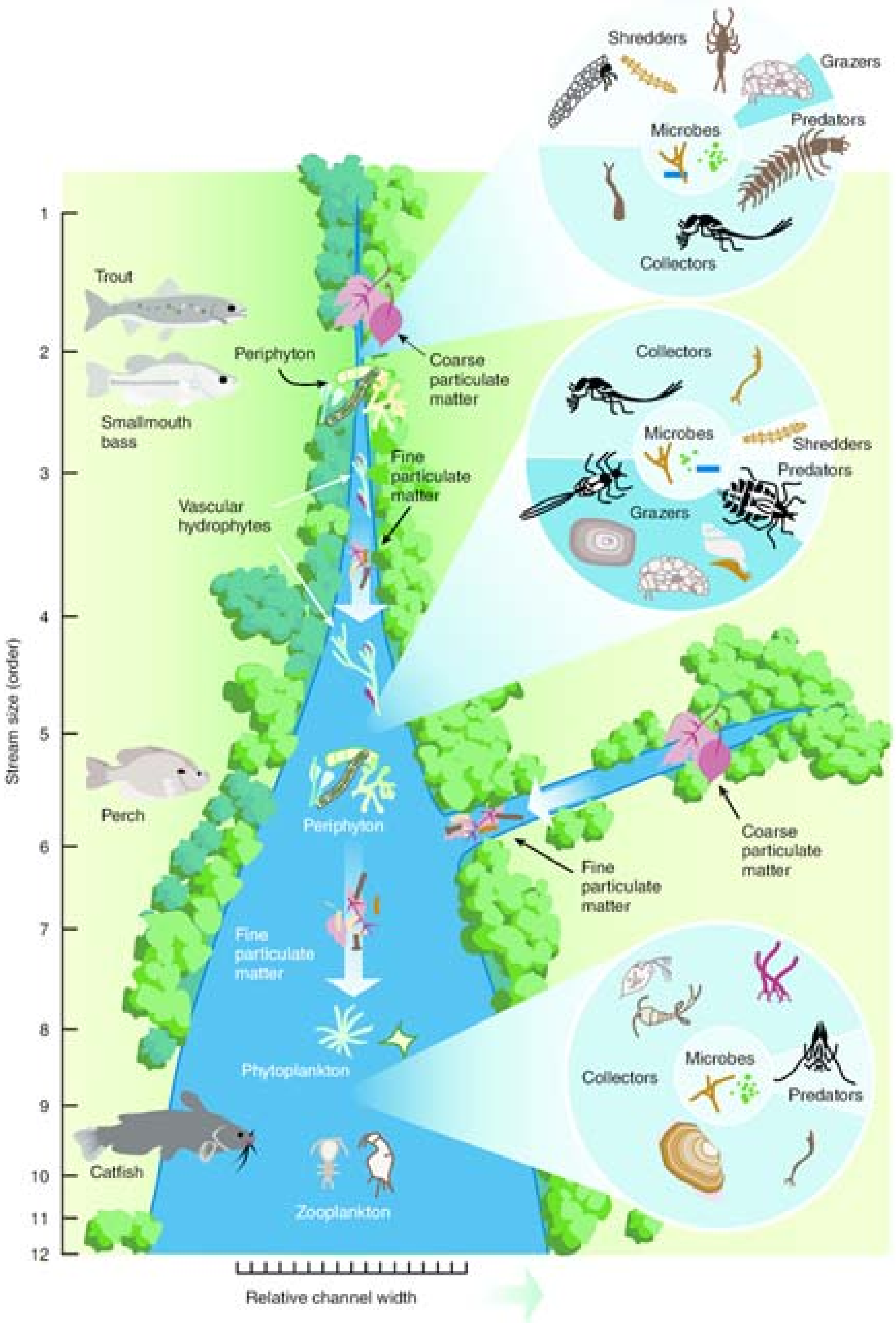

Figure 3. River Continuum Concept (Vannote et al. 1980). Image obtained from: Peters et al. 2011

THE STATE OF AQUATIC HABITAT IN THE UNITED STATES

The unimpacted continuum of conditions can be disrupted by changes to hydrology (due to damming, loss of riparian wetlands and floodplains, and channelization) and pollution (nutrients, suspended solids, and toxins). Unfortunately, most streams in the United States are impacted to some degree. Approximately 46 % of stream and river miles are in poor biological condition, largely due to nutrient pollution, leading to a phenomenon known as eutrophication caused by excess anthropogenic discharges of nitrogen and phosphorus (USEPA 2017). The greatest impacts to physical condition of stream and riverine systems in the United States are not due to in-stream impairments, but rather to poor riparian vegetative cover and riparian disturbance; further highlighting the vital role that riparian zones serve to aquatic systems.

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POESTEN KILL AQUATIC MACROINVERTEBRATES

WHAT IS AN AQUATIC BENTHIC MACROINVERTEBRATE?

An aquatic benthic macroinvertebrate is an organism that lacks a vertebra (i.e., spine) and inhabits the bottom substrate of a waterbody. In the case of aquatic benthic invertebrates, macroinvertebrates are organisms that can be seen by the naked eye, without the aid of a microscope. While they can be seen without the use of a microscope, a microscope is often needed to identify them to a certain taxonomic level (e.g., family, genus, and species).

DEFINITION BREAKDOWN

AQUATIC: pertaining to water

BENTHIC: pertaining to the bottom of a waterbody

MACRO: large-scale (from the Greek word makros, meaning 'long' or 'large')

INVERTEBRATE: organism lacking a spinal cord, or vertebra

Aquatic macroinvertebrates include insects, snails, mussels, worms, crustaceans (e.g., crayfish), and leeches.

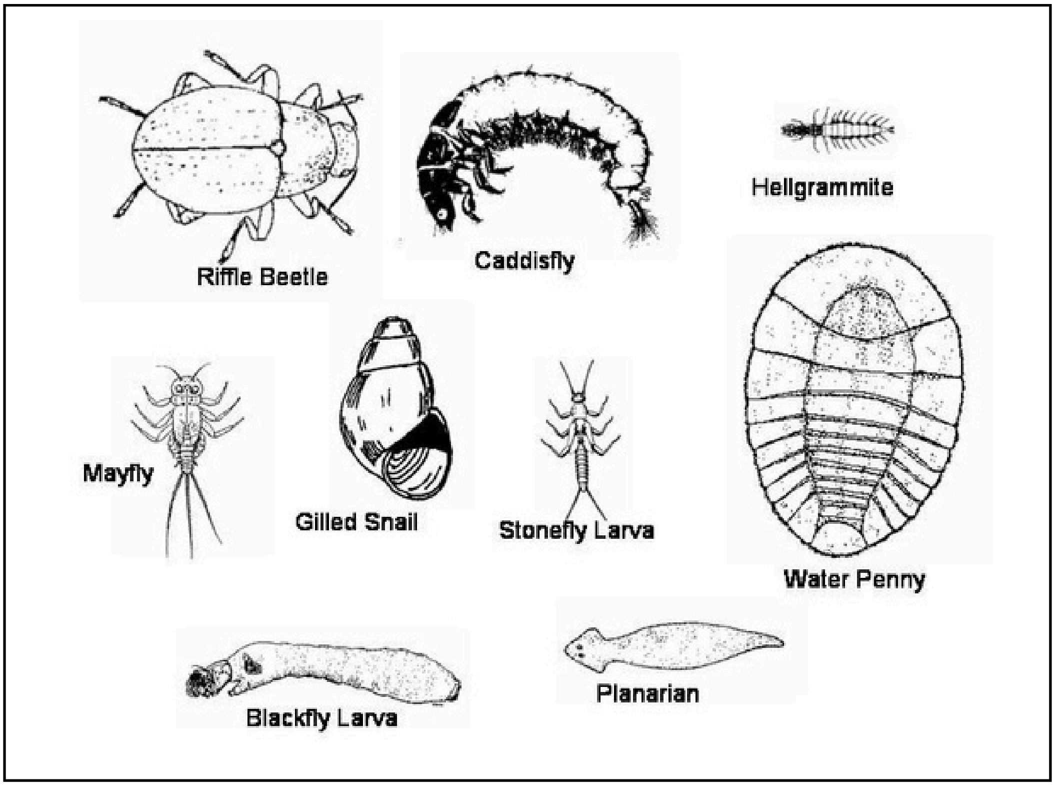


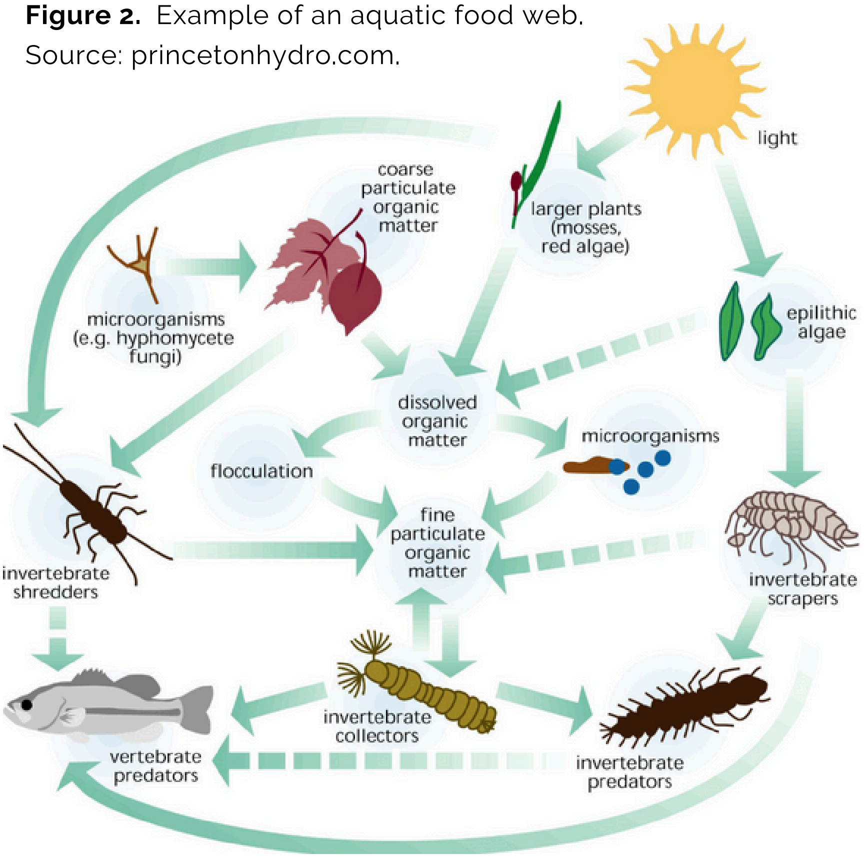
Figure 1. Examples of aquatic macroinvertebrates. Source: techalive.mtu.edu.

WHAT IS THE ECOLOGICAL ROLE OF AQUATIC MACROINVERTEBRATES?

Benthic macroinvertebrates play a significant ecological role in the structure and function of aquatic systems. As an intermediate level on the food chain, between other biological groups such as algae, zooplankton, and fish, aquatic benthic macroinvertebrates are key members of anaquatic community that can be used in understanding trophic, or food web, relationships. As a vital food resource for many species of fish, the study of macroinvertebrates is a critical component in developing a comprehensive understanding of aquatic systems (Voshell, 2002). By understanding changes in the macroinvertebrate community and/or their responses to stream impairments, scientists can make inferences about those effects on the larger aquatic community and how overall stream "health" is affected.

Up until the last several decades, aquatic organisms were considered vital components to only aquatic systems. It is now known that aquatic systems are inextricably linked to the surrounding terrestrial environment and, in fact, many interactions between the two environments are continuously taking place.

Figure 2. Example of an aquatic food web. Source: princetonhydro.com.



Just as the surrounding landscape can shape a stream and affect the organisms within them, the stream system can have an equally profound impact on the terrestrial environment. Aquatic macroinvertebrates have been shown to be a vital component of not only aquatic food webs, but terrestrial ones as well (McDowall et al. 1996, Nakano et al. 1999a, Nakano et al. 1999b, Kawaguchi and Nakano 2001, Nakano and Murakami 2001, Kawaguchi et al. 2003).

WHAT IS THE LIFE CYCLE OF AQUATIC INSECT?

Aquatic insects are a subset of macroinvertebrates that have been shown to serve an especially important ecological role to terrestrial ecosystems because of their unique life history. It is, therefore, worthwhile to discuss the lifecycle of aquatic insects.

Like frogs and butterflies, aquatic insects undergo metamorphosis, whereby they undergo distinctive changes in form and structure at discrete stages during their life cycle. Some species of aquatic insects undergo complete metamorphosis, like for example,butterflies, and have a pupal stage. Others, however, undergo incomplete metamorphosis and lack a pupal stage – changing directly from larvae to adult. Within each stage of development, aquatic insects may periodically shed their exoskeleton to allow for increases in size and shape. This is known as molting. The periods between molts are known as instars. Most species have four to six instars, while some species may undergo between more than 30 instars!

While some species of aquatic insects can spend their entire lives in the water, many species grow wings and emerge from the water, spending their adult stage in terrestrial environments as flying insects.

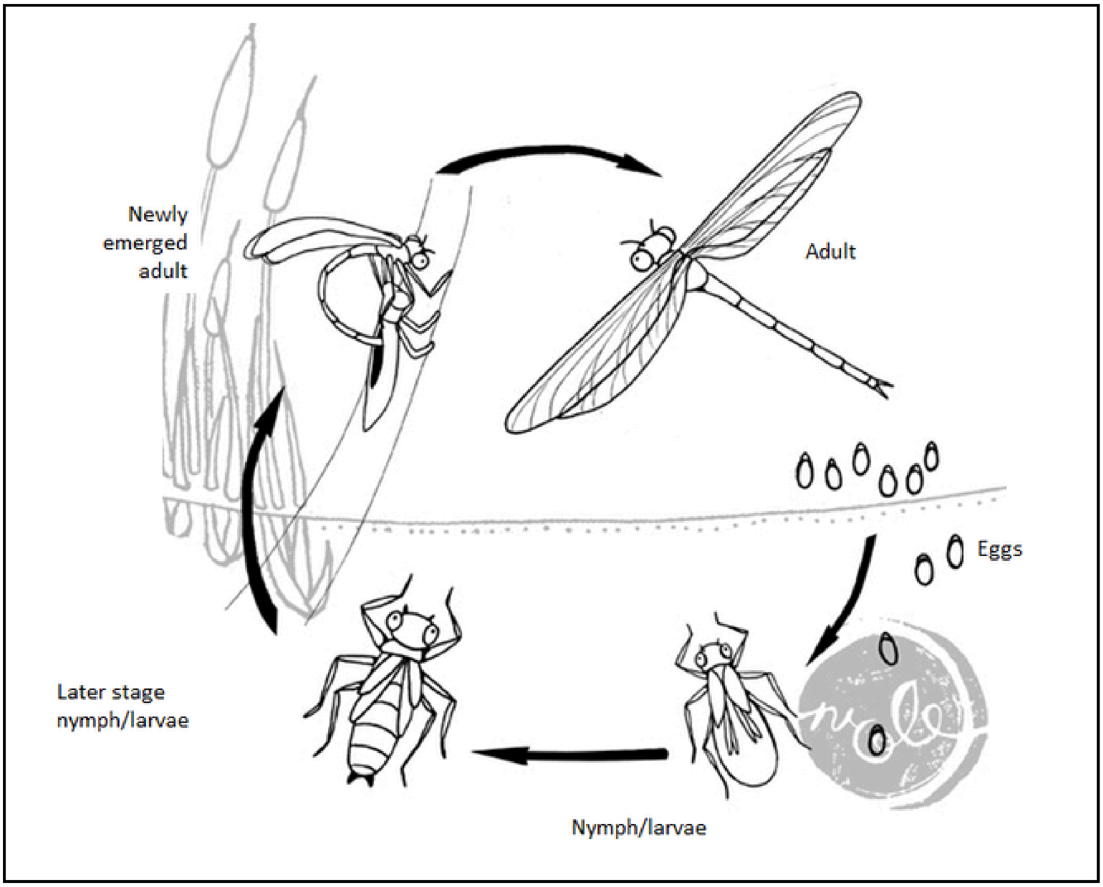


Figure 3. Example of the aquatic insect lifecycle.

WHAT IS BIOMONITORING?

Biomonitoring (biological monitoring, bioassessment) is the use of living organisms and/or their responses to ambient (surrounding) conditions and environmental stressors to make assessments of water quality, or stream health. There are two types of general biomonitoring surveys: 1) before and after an impact occurs, and 2) regular sampling on a routine basis (e.g., annually) to measure changes in condition over space and time. The former type of biomonitoring survey is a commonly used approached involving the use of aquatic macroinvertebrates. The latter type of survey can help scientists better understand long-term changes in water quality over time and along a stream gradient (i.e., upstream to downstream).

STREAM HEALTH: The structure, function, and sustainability of an ecosystem (Rapport et al. 1998)

Traditional approaches to measuring water quality were largely accomplished from a chemical-concentration approach, whereby the amount of a chemical pollutant(s) was/were measured for a given waterbody. While this approach helps to identify the causes of impairment to a waterbody, it does not identify the effects. And equally important, chemical tests do not identify ambient environmental factors that may be affecting water quality or compounding impairments. Aquatic organisms, however, are affected by both chemical pollution and environmental conditions. Therefore, their use in water quality surveys can provide extremely valuable information about the integrated effects of pollution and environment on stream health.

WHY ARE AQUATIC MACROINVERTEBRATES USED IN STREAM SURVEYS?

Bioassessments using aquatic macroinvertebrates has been a well-documented and widely accepted method for assessing water quality and impairment for many decades (Barbour et al. 1999, Rosenberg and Resh, 1993; Bode et al. 2002; Voshell, 2002; Davis and Simon, 1995). Through countless studies and surveys over many decades and in waterbodies across the globe, scientists have been able to describe the life history, habitat requirements, feeding habits, and pollution tolerances of thousands of aquatic macroinvertebrate species. This readily available, well-established information can then be applied to stream surveys where aquatic macroinvertebrates have been collected in order to make inferences about stream health. Traditional studies have used aquatic macroinvertebrates to assess the effects of organic pollution (Hilsenhoff 1987), non-point source pollution (Bode et al. 1995), and decreased habitat diversity (Erman and Erman 1984, Schmude et al. 1998) on stream health. While such studies continue today, the effects of land use and climate change on aquatic systems have become forefront issues and prime objectives of water quality monitoring programs today.

WHY AQUATIC BENTHIC MACROINVERTEBRATES MAKE GOOD BIOINDICATORS

(1) They are abundant in most streams.

(2) They are found in a wide range of habitats.

(3) They are reasonably easy and inexpensive to collect (Bode et al. 2002; Voshell, 2002.

(4) They are relatively stationary animals, in comparison to fish. Therefore, aquatic macroinvertebrates can provide valuable information about water quality at a specific location or area within a waterbody (Merritt and Cummins, 1996).

(5) They are sensitive to various environmental and anthropogenic impacts, such as chemical pollution, agricultural runoff, changes in temperature and habitat modifications (Bode et al, 2002).

(6) They allow for rapid assessment of stream conditions based on the presence or absence of certain species, as the sensitivity to various impacts varies between species (Merritt and Cummins, 1996; Barbour et al. 1999; Bode et al. 2002).

(7) They have comparatively long life cycles, making observations in temporal changes to population and abundance possible (Merritt and Cummins, 1996).

WHAT ARE THE DIFFERENCES BETWEEN POLLUTION TOLERANT AND POLLUTION INTOLERANT MACROINVERTERBATE COMMUNITIES?

Pollution occurs when a substance, chemical, or condition harms, contaminants, and/or poisons an ecosystem. Because aquatic macroinvertebrates have been repeatedly studied across a wide range of habitat types and water quality conditions all around the world, scientists have been able to describe the responses of aquatic macroinvertebrate species to varying degrees and types of pollution. As a result, a scale of pollution tolerance has been developed that helps categorize aquatic macroinvertebrates into distinctive groups: 1) species that are intolerant of pollution (i.e., pollution-sensitive), 2) species that are moderately tolerant to pollution (i.e., semi-tolerance), and 3) species that are very tolerant to pollution (i.e., pollution-tolerant). Depending on the study, the number of pollution-rating groups may vary, but all follow this general gradation. As a result, scientists can make predictions of water quality and pollution levels based on the macroinvertebrates found at a given location within a waterbody.

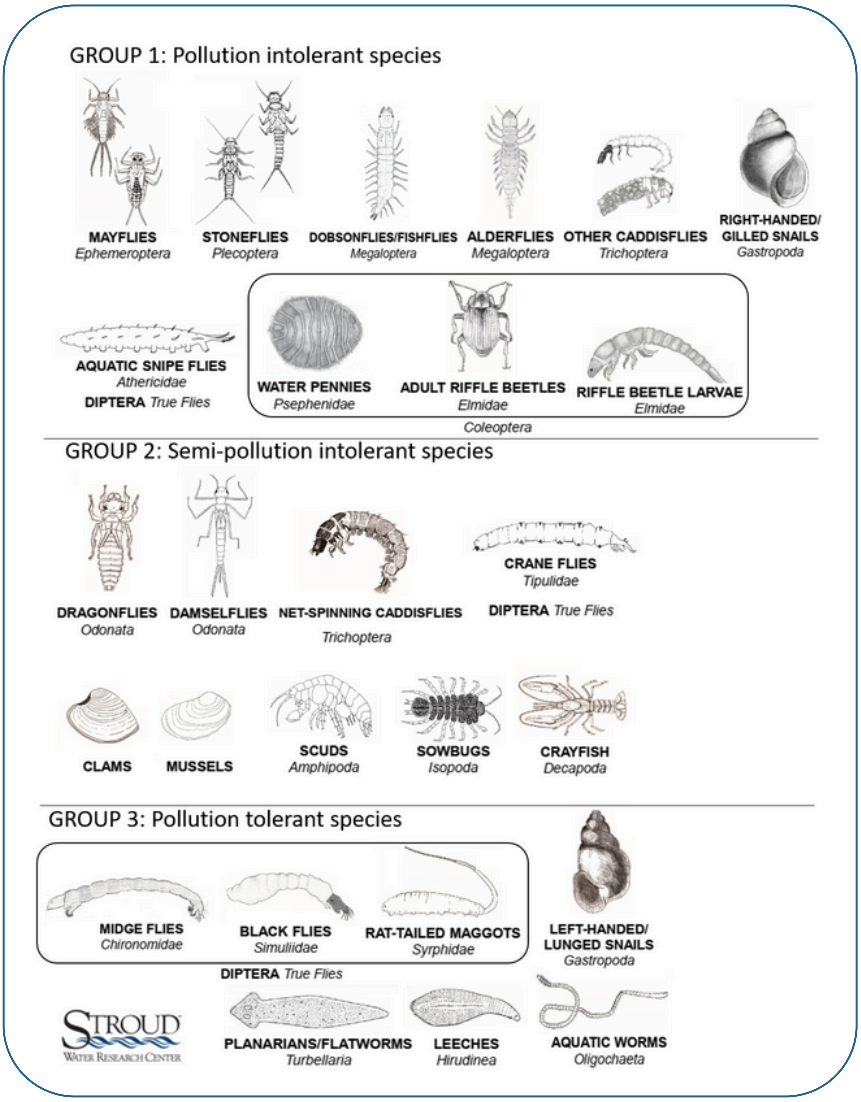


Figure 4. Example of macroinvertebrate pollution tolerance groupings. Source: Stroud Water Research Center (www.stroudcenter.org)

For example, groups such as Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) are generally considered pollution-sensitive taxa, whereas groups such as Annelida (worms), Chironomidae (midges), and Hirudinea (leeches) are considered pollution-tolerant. Therefore, if a stream sample contains a mixture of pollution-tolerant taxa, but lacks pollution-sensitive taxa, then it can be deduced that the site/waterbody is impacted by pollution, and is therefore, considered impaired.

HOW DOES MONITORING AQUATIC MACROINVERTEBRATES IN NEW YORK STATE HELP WITH UNDERSTANDING WATER QUALITY?

The New York State Department of Environmental Conservation (NYSDEC) relies heavily on aquatic macroinvertebrate monitoring to make assessments of water quality in streams, rivers, and lakes across New York. The NYSDEC Stream Biomonitoring Unit performs surveys of water quality each year throughout the state using aquatic macroinvertebrates, which ultimately help to develop and implement watershed plans, develop numeric criteria for nutrient pollution assessments, classify waterbodies under the NYS 303(d) List of Impaired Waterbodies, and to inform the State Permit Discharge Elimination System (SPDES) process.

The NYSDEC provides an interactive mapping service on their website that allows for interested parties to review the data and results collected during current and historical biomonitoring surveys.

MAPPING RESOURCE
https://nysdec.maps.arcgis.com/apps/webappviewer/index.html?id=692b72ae03f14508a0de97488e142ae1

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FISH AS BIOINDICATORS

WHAT IS THE RELATIONSHIP BETWEEN AN AQUATIC "ECOSYSTEM" AND A FISH "COMMUNITY"?

An aquatic ecosystem is made up of the interactions between biota and their physical and chemical surroundings (e.g., physical habitat, nutrients, oxygen, temperature) in a specific place. A fish community is one part of the ecosystem, including only fish and their interactions with each other. The physical and chemical surroundings usually determine the character of the fish community and can vary between places and change over time (e.g., due to seasons or human influences). Fish communities are likely to reflect those environmental differences. Common ways to group fish are described in Text Box 1.

TEXT BOX 1: HOW DO ECOLOGISTS REFER TO GROUPS OF FISH?

Ecologists frequently group fish into broad categories based on the behavior of the fish, their preferred environment, or human use. A single fish species may belong to several of the following groups:

BY TEMPERATURE PREFERENCE:

- Cold water (e.g., trout, salmon, whitefish)
- Cool water (e.g., walleye, muskellunge)
- Warm water (e.g., carp, bluegill, largemouth bass)

BY MOVEMENT PATTERN:

- Resident (e.g., brook trout, minnows)
- Transient (e.g., large predatory fish)
- Migratory (e.g., salmon, eel)
    - Diadromous – fish that spend part of their lives in freshwater and the other part in saltwater
    - Anadromous – fish that spawn in freshwater and live most of their life in saltwater (e.g., salmon)
    - Catadromous - fish that spawn in saltwater and live most of their life in freshwater (e.g., eel)

BY LOCATION WITHIN THE ECOSYSTEM OR TYPE OF ECOSYSTEM:

- Lotic – flowing water
- Lentic – still water
- Benthic – bottom-dwelling
- Littoral – near shore
- Pelagic – open water

BY THE FOOD THEY EAT:

- Herbivore – aquatic vegetation
- Planktivore – free-floating plankton (usually zooplankton)
- Benthivore – benthic macroinvertebrates (e.g., insect larvae, mussels, or worms), periphyton (small attached algae and microbes)
- Piscivore – fish
- Omnivore – plant and animal

WHAT IS THE RELATIONSHIP BETWEEN AN AQUATIC "ECOSYSTEM" AND A FISH "COMMUNITY"?

Ecosystem or fish community boundaries are arbitrary, but they are usually defined by natural patterns in environmental features. For example, lakes or ponds are commonly identified as distinct ecosystems. Watershed divides are frequently used as boundaries between lotic (i.e., stream or riverine) ecosystems. Boundaries within natural rivers and creeks can be more difficult to define because the character of the system changes, sometimes gradually, along its length (Fig. 1). However, obstructions to water or fish movement sometimes provide clear boundaries between fish communities. These include natural barriers such as waterfalls, and man-made barriers like dams or extensive reaches of degraded habitat.

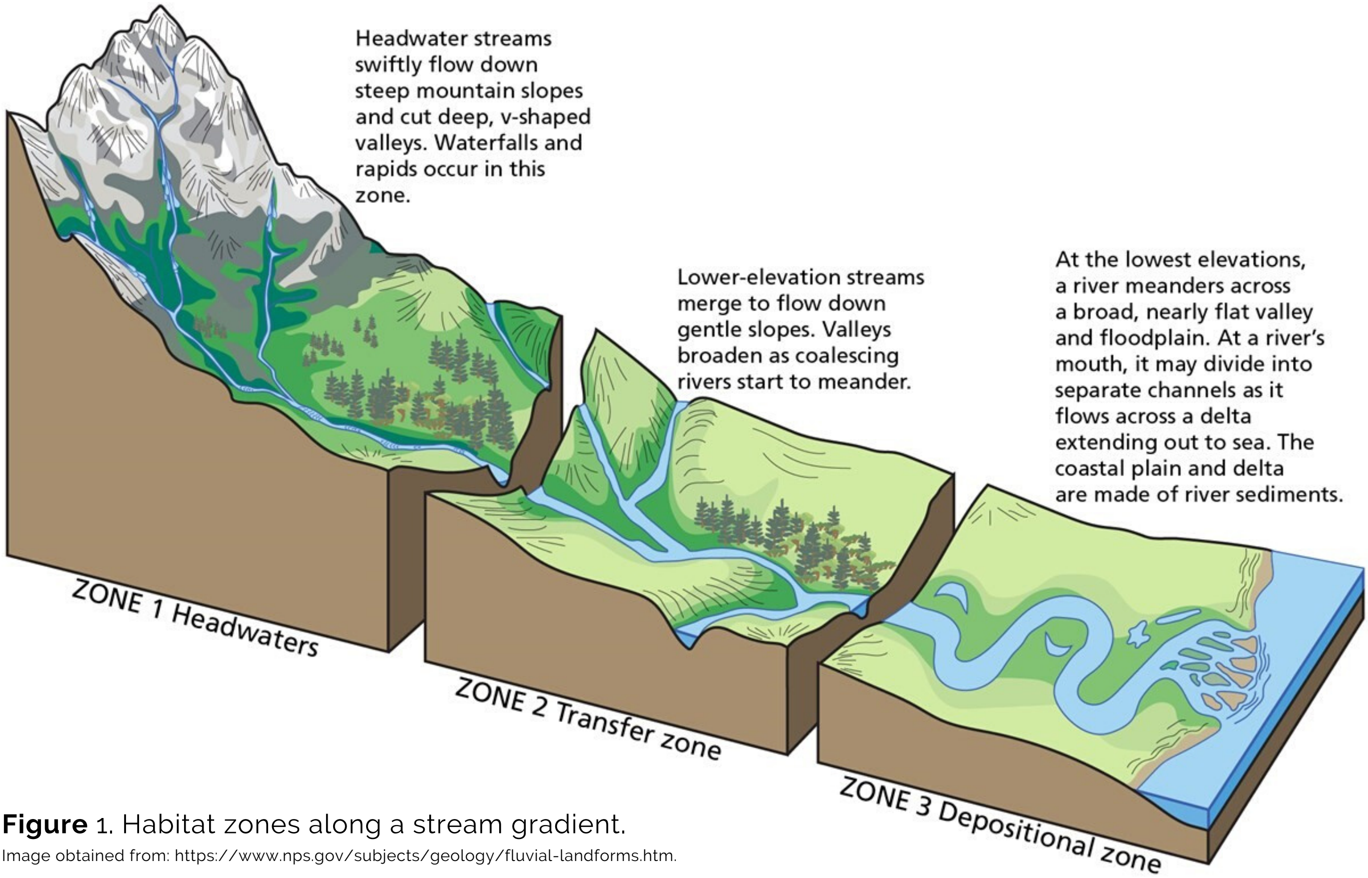

Figure 1. Habitat zones along a stream gradient.
Image obtained from: https://www.nps.gov/subjects/geology/fluvial-landforms.htm.

WHAT ARE FISH COMMUNITIES LIKE IN UNDISTURBED STREAMS?

Fish communities vary between headwaters and the mouth of a creek. In undisturbed streams, fish communities near headwaters are typically comprised of a few cold-water species, gradually transitioning to cool or warm water communities at the mouth, with the greatest diversity in between. This transition in species composition reflects changes in topographic, aquatic and riparian habitats, water quality, and food types along the length of a stream. Migratory and transient species may use parts of the creek seasonally for feeding, reproduction, or refuge, temporarily increasing diversity.

HOW ARE FISH COMMUNITIES STUDIED IN STREAMS?

Fish surveys can be used to investigate species, number, size, sex, reproductive status, and health of fish using many different field techniques. A common sampling technique for fish surveys in wadeable streams is backpack electroshocking (Fig. 2). Various types of nets can be used in deeper waters. Repeated sampling in an area enclosed with nets can be used to calculate the total number of fish at a location. Fish density (number / area) is the total abundance divided by the estimated stream area. During a particular fish survey, species composition at that time is affected by a number of environmental and circumstantial factors. The aquatic environment in Poesten Kill changes along its length, transitioning from a small, pond-fed stream in a largely undeveloped landscape to a wide, fast-moving stream containing several large waterfalls in a highly urbanized area of the watershed. Due to Poesten Kill's connection to the Hudson River estuary, as well as seasonal changes in stream condition, the fish community can change throughout the year. Multiple samples conducted at intervals along a creek and its tributaries, and at multiple times, can give an overall picture of local fish communities and their spatial relationships to natural and man-made conditions.

Figure 2. Fish sampling with the use of a backpack electrofisher in Poesten Kill, 2017. Photo credit: OEI.

THE ROLE OF FISH IN AQUATIC MONITORING PROGRAMS

Most water quality designations in the United States pertain to fish assemblages and fishing restrictions. In New York State, assigned designations such as "swimming/fishing", "fishing", "trout", and "trout spawning" are used to describe water quality and stream health. Fish is a common biotic assemblage that is incorporated into biological assessments of streams because (Barbour et al., 1999):

(1) Fish are long-lived and mobile; therefore, they are good indicators of temporal changes in habitat condition.

(2) Fish assemblages typically include species that occupy different trophic levels. Trophic structure is reflective of overall stream quality.

(3) Fish are of recreational and commercial value to humans.

(4) Fish are relatively easy to collect and identify to species

(5) Environmental requirements, life history, and distribution of fish are well known, and such data is usually easily obtainable.

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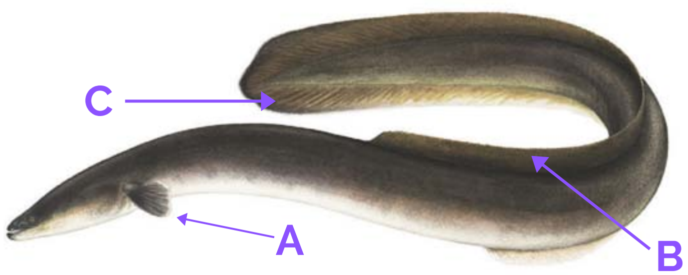
Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

AMERICAN EEL *(Anguilla rostrata)*



FAMILY: Anguillidae (Freshwater Eels)

SIZE: Common Length: 50 cm (19.7 in); Max Length recorded: 152 cm (59.8 in); Max published weight: 7.3 kg (16.6 lbs).

LIFESPAN: Eels generally live 15-20 years. The oldest recorded Eel was 43 years old.

FIELD CHARACTERISTICS: Eels have a **long, slimy snake-like body**. Unlike the similarly shaped lampreys, **eels have jaws and a pair of pectoral fins** **(A)**. Distinguishing eels from other fishes in the northeast, aside from lampreys, can be done by observing the absence of dorsal, pelvic, and anal fins. Eels also have a caudal fin (tail) that starts dorsally (top) **(B)** and wraps around the base of the body to the ventral (bottom) end **(C)** making a fan like appearance.

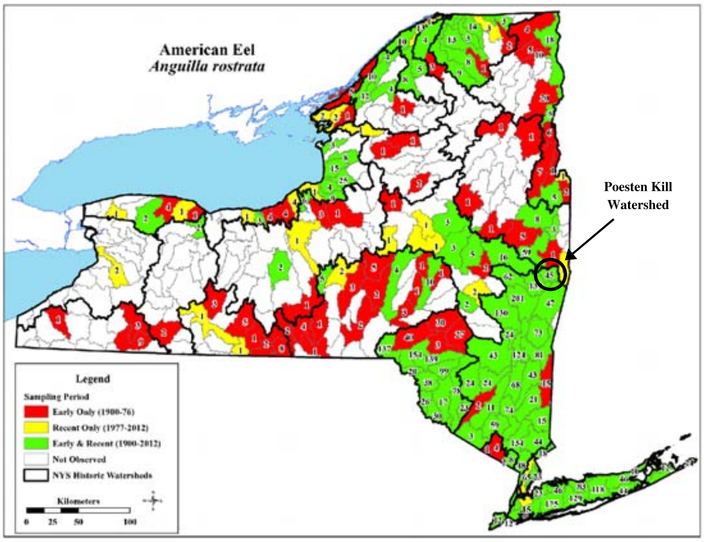
HABITAT: Eels are born in a marine environment but are carried on ocean currents into estuaries. The young eels will eventually move up into freshwater streams to live and grow as adults.

LIFESTAGES: As they mature, the young start to develop a brownish-yellow color and are now considered “Elvers”. As the elvers grow into adults, they are called “Yellow Eels” because they tend to have a distinct brownish-yellow coloration to their body.

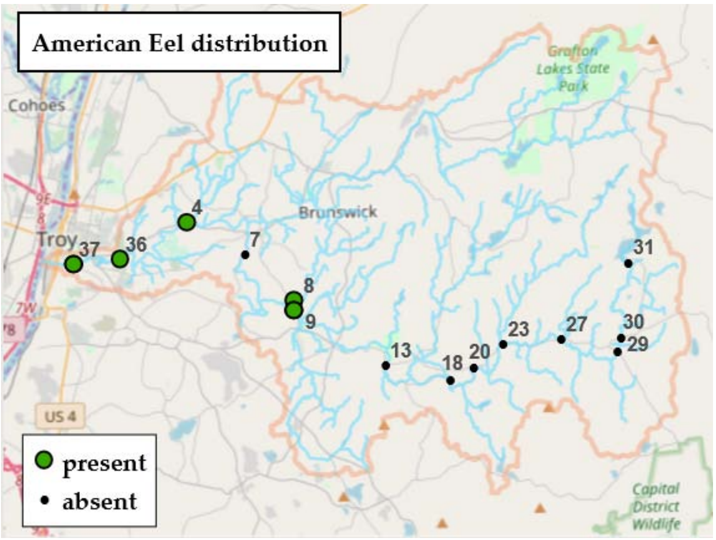
SPAWNING: When eels are mature enough to spawn, they will begin to migrate from freshwater streams to the ocean. The process of living in freshwater and spawning in ocean water is termed catadromy. Most other diadromous fish in our region, those that inhabit two different water types during their lifetime, are termed anadromous because they live in marine water as adults and migrate into freshwater to spawn. Biologists studying eels have observed that spawning eels congregate in the Sargasso Sea to reproduce. After spawning has finished, the adult eels die.

DIET: Eels are carnivorous fish with a diet mainly consisting of worms, crustaceans, small fish, clams and other mollusks.

NEW YORK STATE SPECIES DISTRIBUTION



POESTEN KILL SPECIES DISTRIBUTION



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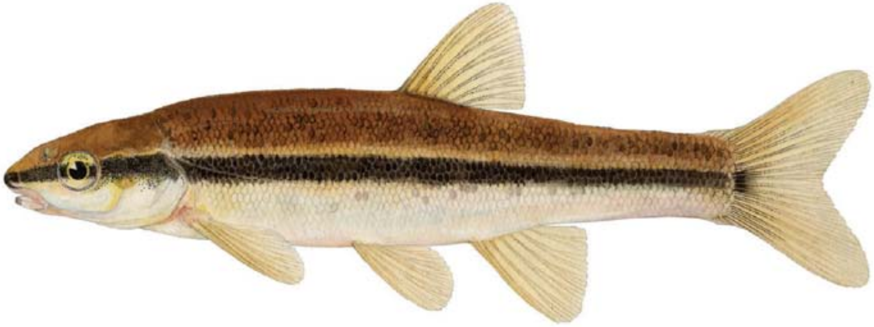
Photo/Map Credit: Carlson, Douglas. Daniels, Robert. Wright, Jeremy. 2016. Atlas of Inland Fishes of New York. The New York State Education Department. Pg. 28

BLACKNOSE DACE *(Rhinichthys atratulus)*



FAMILY: Cyprinidae (Minnows, Shiners, Dace, Chubs, Carp, Goldfish)

SIZE: Adult length: 5.08-7.62 cm (2-3 in).

LIFESPAN: Blacknose Dace generally live between 2-3 years.

FIELD CHARACTERISTICS: Along with the longnose dace, these daces can be distinguished from other minnows by their pointed snout and one barbel on each side of the base of the mouth. Black nose dace are so called because of the **prominent black band that extends from the tail to the very tip of the nose.** The band on the longnose dace is not as prominent and does not extend to the tip of the nose. Longnose dace also have a snout that protrudes far out from the mouth (see below).

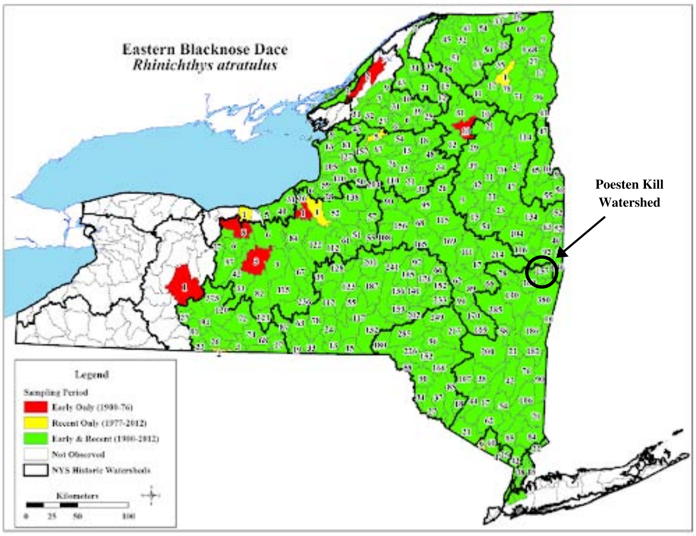
HABITAT: These fish are generally found in smaller, cool, clear streams with gravel bottoms.

LIFESTAGES: Aside from size, these fish do not have a distinct change from hatching to adulthood.

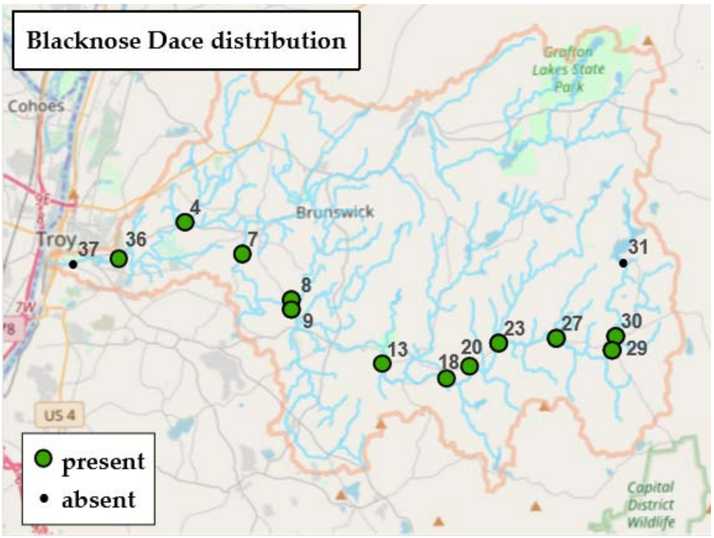
SPAWNING: These fish spawn in late May to June. Females will generally carry around 750 eggs. Females deposit eggs on gravel stream beds after being fertilized by the males.

DIET: Dace are omnivorous, eating insect larvae, small crustaceans, worms, and plant material.

NEW YORK STATE SPECIES DISTRIBUTION



POESTEN KILL SPECIES DISTRIBUTION



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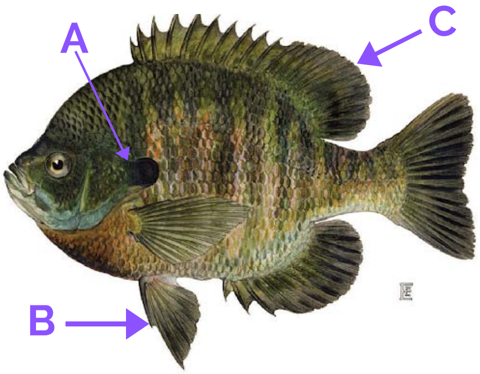
Photo/Map Credit: Carlson, Douglas. Daniels, Robert. Wright, Jeremy. 2016. Atlas of Inland Fishes of New York. The New York State Education Department. Pg. 119

BLUEGILL *(Lepomis macrochirus)*



FAMILY: Centrarchidae (Sunfish)

SIZE: Common Length: 19.1 cm (7.5 in), Max reported length: 41 cm (16 in), Heaviest published weight: 2.2 kg (4.8 lb)

LIFESPAN: Bluegill may live to 10 years old.

FIELD CHARACTERISTICS: These fish have a dark blue opercular (gill) flap **(A)**. Redbreast sunfish also have this trait, but bluegill can be distinguished by the presence of long, pointed pectoral fins **(B)** and a dusky "thumb-print" mark on their soft (second) dorsal fin **(C)**. Also, these fish have vertical bars lining their body.

HABITAT: Bluegill can live in streams, ponds, and lakes. They prefer to live and spawn in weedy aquatic vegetation.

LIFESTAGES: Aside from size, these fish do not have a distinct change from hatching to adulthood.

SPAWNING: Bluegill begin to spawn in early summer. Males will move into shallower water where they will create small depressions in the substrate. If a female is attracted to a male's nest, she will move into the space with him and release her eggs while he releases his sperm. After spawning, the male will guard the nest until the young are capable of leaving.

DIET: Smaller, younger individuals will feed on zooplankton while larger, older individuals will feed on invertebrates and smaller fish.

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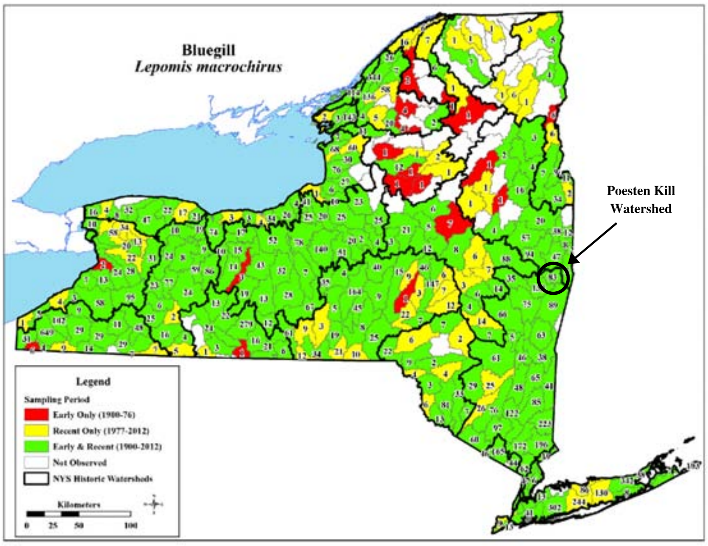
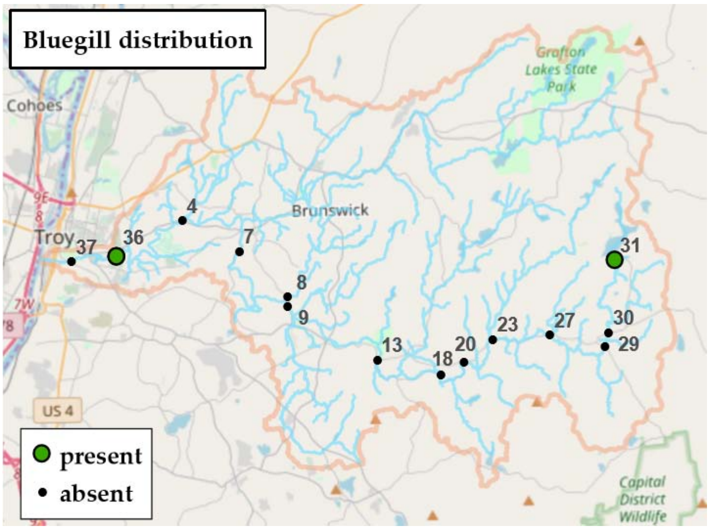


POESTEN KILL SPECIES DISTRIBUTION



(1) U.S. Fish and Wildlife Service. 2019. Freshwater Fish of America: Bluegill. [Internet] [Cited 11 October 2019]. Available from: https://www.fws.gov/fisheries/freshwater-fish-of-america/bluegill.html
(2) Werner, Robert. 2004. Freshwater Fishes of the Northeastern United States. Syracuse University Press. Pgs. 238-239.
Photo/Map Credit: Carlson, Douglas. Daniels, Robert. Wright, Jeremy. 2016. Atlas of Inland Fishes of New York. The New York State Education Department. Pg. 279

BROWN BULLHEAD *(Ameiurus nebulosus)*

FAMILY: Ictaluridae (Bullhead Catfish)

SIZE: Brown Bullhead average around 35.56-40.64 cm (14-16 in) in length and may reach a mass of 0.454-0.907 kg (1-2 lb).

LIFESPAN: These fish may live up to 6 years old.

FIELD CHARACTERISTICS: Brown Bullhead have a square to rounded caudal fin (tail), a free adipose fin**(A)** -smaller fin behind the dorsal fin, and dark chin barbels (Sensory appendages on the chin). Distinguishing a brown from a yellow bullhead can be done by looking at their chin barbels **(B)** (Browns with dark barbels and Yellows with white barbels), and distinguishing them from black bullheads can be done by looking at the barbs on their pectoral spines (Brown's have much larger barbs than Black's).

HABITAT: If Brown Bullhead are observed in creeks or rivers, they generally prefer pools or slower-moving runs. If they are observed in ponds or lakes, they generally prefer vegetated areas.

LIFESTAGES: The hatchlings may develop a much darker skin pigment than the adults. Other than size and coloration, there is no distinct change from hatching to adulthood.

SPAWNING: Brown Bullhead begin to spawn from late spring into early summer. Males create nests under sheltered areas. Females generally carry anywhere from 2,000-14,000 eggs. Both parents release their reproductive materials into the bottom of the nest for fertilization. Once fertilized, both the male and female (usually the male) guard the nest. The female incubates the eggs by vigorously vibrating her body in the bottom of the nest. This period will usually last between 5-20 days. Once hatched, the young remain in the nest until they are mature enough to leave. Once out of the nest, the parents corral the young into a tight pod and protect them until they are mature enough to live on their own.

DIET: Brown Bullhead are omnivorous. They will eat invertebrates, smaller fish, fish eggs, and plants.

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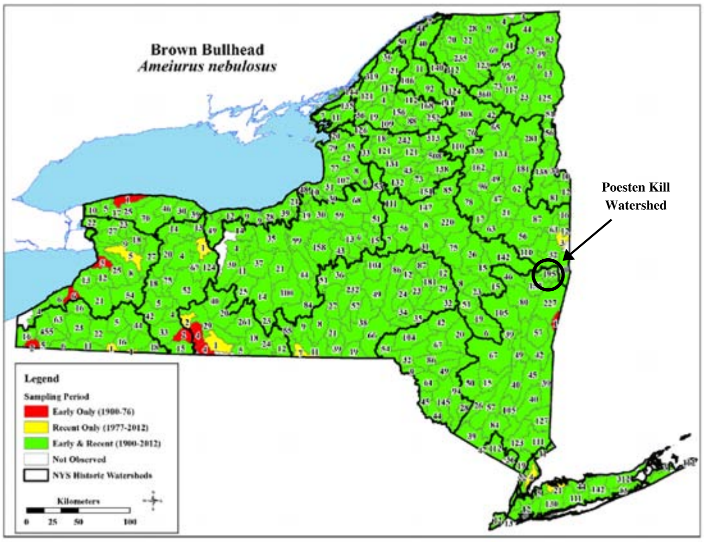

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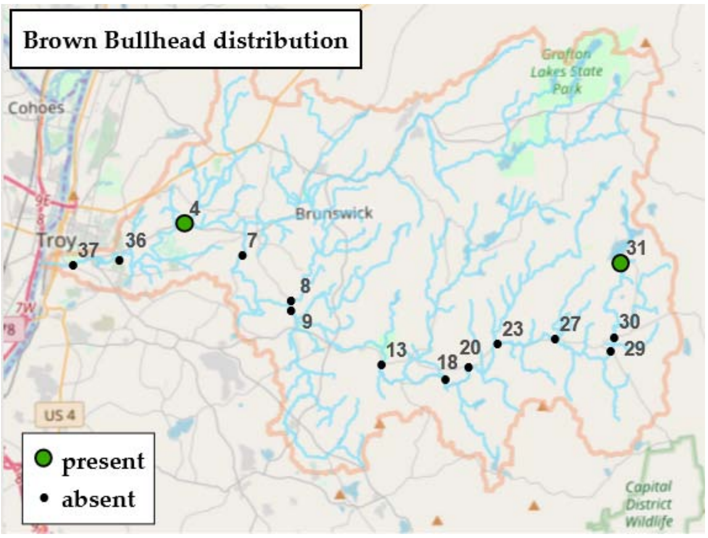

(1) Guth, Rachael. 2011. Ameiurus nebulosus, Animal Diversity Web. Webpage. [Internet] 2011 [cited 11 October 2019]. Available from: https://animaldiversity.org/accounts/Ameiurus_nebulosus/
(2) Werner, Robert. 2004. Freshwater Fishes of the Northeastern United States. Syracuse University Press. Pgs. 157-158.
Photo/Map Credit: Carlson, Douglas. Daniels, Robert. Wright, Jeremy. 2016. Atlas of Inland Fishes of New York. The New York State Education Department. Pg. 170.

BROWN TROUT *(Salmo trutta)*

FAMILY: Salmonidae (Trout, Salmon, Whitefish)

SIZE: Most individuals will be around 0.454 kg (1 lb) in weight. However, these fish can reach weights of 9.072-18.144 kg (20-40 lb).

LIFESPAN: These fish may reach up to 9-10 years old.

FIELD CHARACTERISTICS: These fish have **large dark spots on a lighter body** background. These **spots may either be black, brown, or orange and are usually encircled in a silver halo**. As the name suggests, these fish usually have a distinct brown coloration.

HABITAT: Brown Trout are capable of living in both streams and lakes. However, spawning habitat is mainly in streams, even for lake living individuals. Like other salmonids, they prefer cold water, but Brown Trout may endure higher temperatures than species like Brook Trout (Salvelinus fontinalis).

LIFESTAGES: Like many other salmonids, Brown Trout exhibit a fascinating life history cycle. When young hatch from their eggs, they are called alevins or "sac-fry" because of the yolk sac that is still attached to their bodies. Alevins continue to get nutrients from their yolk sac until it is empty. After the sac-fry is finished the alevins are now considered "fry". After living as fry, the individual will eventually mature into a "parr", Vertical body markings develop during this stage and are called "parr" marks. OEI staff were lucky enough to sample some Brown Trout in the "parr" stage of their life (See fact sheet for site 9). Once the parr mature further, they lose their parr marks and become adults.

SPAWNING: Brown Trout spawn in the fall, usually between October and November. Females generally carry between 200-2,000 eggs. Like other species of Trout, Brown Trout females create a nest called a "Redd". Once the redd is completed, the male and female will release reproductive materials into the nest for fertilization. Once this is done, the female will then sweep gravel and sand over the eggs. The eggs will hatch in around 65-100 days.

DIET: Brown Trout are carnivorous. Hatchlings will start on smaller insects, making their way up to larger food items as they grow until their adult diet mainly consists of insects, amphipods, mollusks, and fishes.

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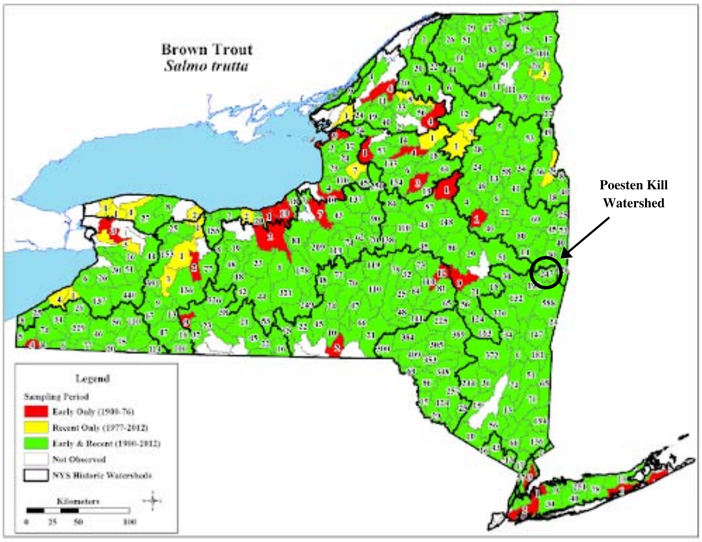
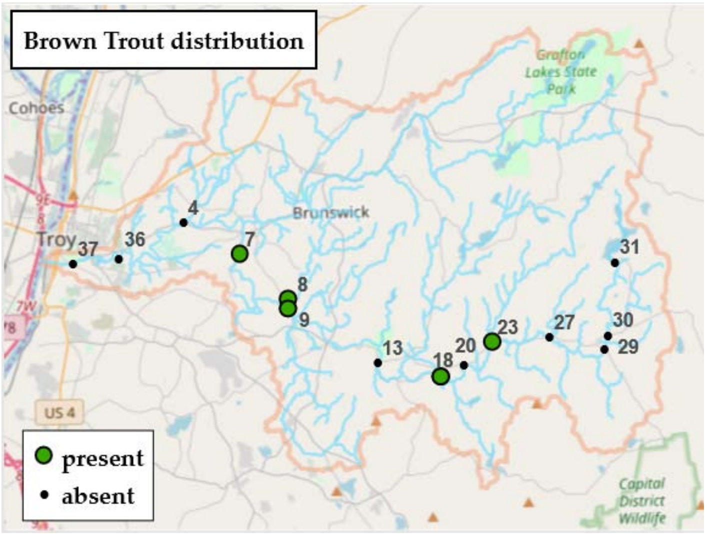


POESTEN KILL SPECIES DISTRIBUTION



(1) Werner, Robert. 2004. Freshwater Fishes of the Northeastern United States. Syracuse University Press. Pgs. 189-190.

Photo/Map Credit: Carlson, Douglas. Daniels, Robert. Wright, Jeremy. 2016. Atlas of Inland Fishes of New York. The New York State Education Department. Pg. 206

CHAIN PICKEREL *(Esox niger)*

FAMILY: Esocidae (Pike, Pickerel, Muskellunge)

SIZE: Adults generally grow to lengths of 38.1-45.72 cm (15-18 in) and masses of 0.68 kg (1.5 lb).

LIFESPAN: Most individuals do not live long after sexual maturity around 3-4 years old, but some may live up to 8-9 years old.

FIELD CHARACTERISTICS: Chain Pickerels, like the other esocidae species, have an **elongate body** with their dorsal (back) fin positioned very close to the tail. The pickerels have a distinct **black "tear-drop" marking under their eyes.** Distinguishing the chain pickerel from the other pickerel species can be done by observing the **"chain" like patterning** on the body.

HABITAT: Chain Pickerel can be found in lakes, streams, swamps, and ponds. These fish prefer submerged cover like logs and aquatic vegetation. Dense cover is a requirement when chain pickerel hunt because they are ambush predators.

LIFESTAGES: Aside from size, these fish do not have a distinct change from hatching to adulthood.

SPAWNING: Chain Pickerel spawn in early spring shortly after ice out, in marshy areas and shallow bays. The spawning window is short, only between 7-10 days. Females generally carry between 6,000-7,000 eggs, but as many as 50,000 have been reported. Males and females release reproductive materials into vegetation and then mix them up using vigorous tail undulations. The eggs will hatch in 6-12 days.

DIET: Larval pickerel will feed on plankton before switching to insects in their first summer. Around the age of one is when they switch to a fish diet.

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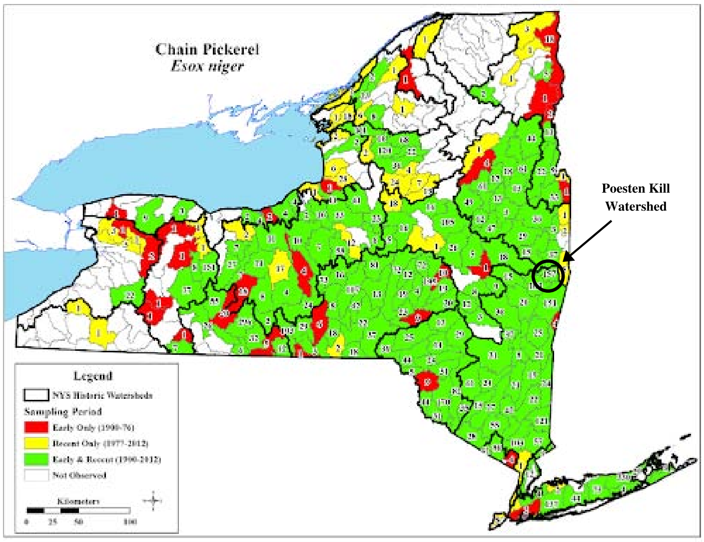

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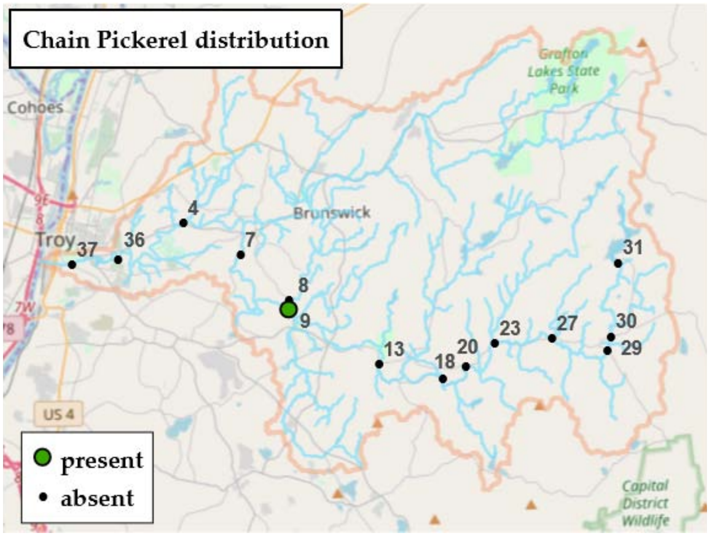
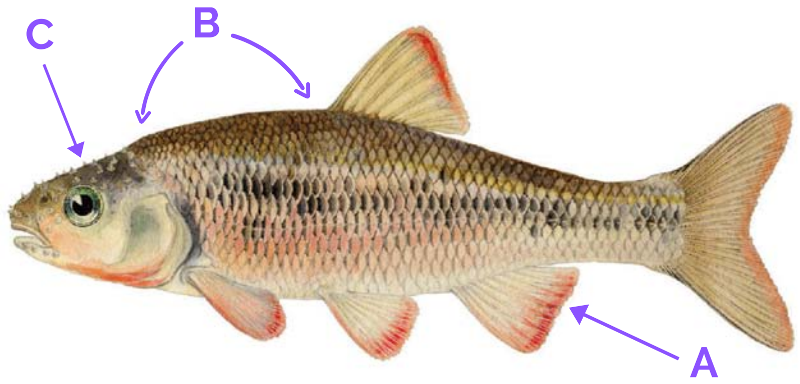


(1) Werner, Robert. 2004. Freshwater Fishes of the Northeastern United States. Syracuse University Press. Pgs. 166.
(2) Shelburne, Jacob. 2017. Esox niger, Animal Diversity Web. Webpage. [Internet] 2017 [cited 11 October 2019]. Available from: https://animaldiversity.org/accounts/Esox_niger/
Photo/Map Credit: Carlson, Douglas. Daniels, Robert. Wright, Jeremy. 2016. Atlas of Inland Fishes of New York. The New York State Education Department. Pg. 228.

COMMON SHINER *(Luxilus cornutus)*



FAMILY: Cyprinidae (Minnows, Shiners, Dace, Chubs, Carp, Goldfish)

SIZE: Common Shiners may grow to 17.78-20.32 cm (7-8 in) in length.

LIFESPAN: These fish may live up to 5 years.

FIELD CHARACTERISTICS: These fish have 9 anal rays (the bones in the anal fin **(A)**). The scales in front of the dorsal (back) fin, look crowded and small and are not outlined in dark pigment **(B)**. Distinguishing these fish from the Striped Shiner (Luxilus chrysocephalus) can be done by noting the absence of V-shaped markings on the sides of their body. During the breeding season, these fish may develop red tinges to their fins, and the males may develop nuptial tubercles **(C)** (hard bumps in the facial area).

HABITAT: Common Shiners are mainly found in small to moderate sized streams with gravel bottoms.

LIFESTAGES: Aside from size, these fish do not have a distinct change from hatching to adulthood.

SPAWNING: Spawning generally occurs in May and June when water temperatures reach 15.56-18.33 C (60-65 F). Females generally carry around 1,000 eggs. Males create depressions in the gravel that may or may not attract a female. In the event the female is attracted, she will enter the nest and deposit around 50 eggs which the male will then fertilize. The fertilized eggs are adhesive and will attach to the substrate in the bottom of the nest. Because females carry a lot more eggs than they release in a given males nest, it is assumed that she will repeat the spawning process many more times. Diet: Common Shiners prefer to eat insects, algae, and aquatic plants.

DIET: Common Shiners prefer to eat insects, algae, and aquatic plants.

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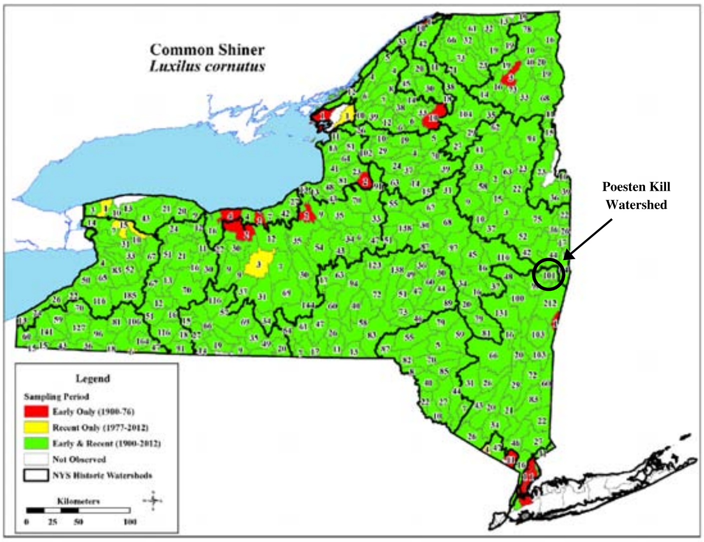
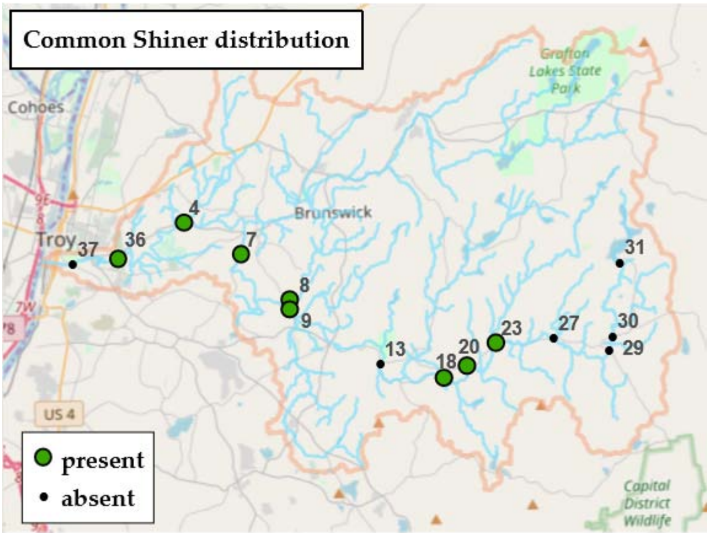


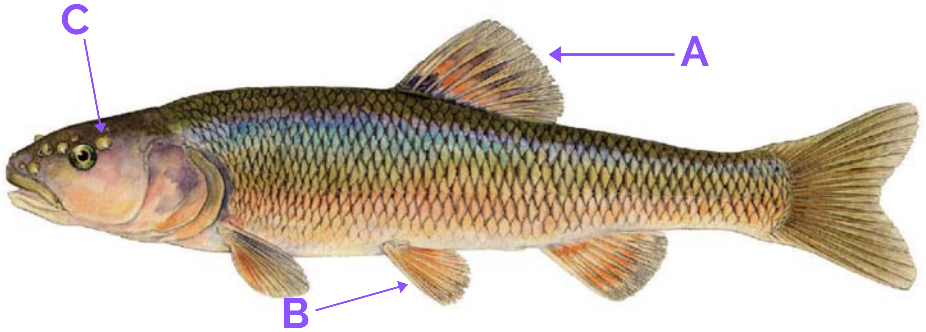
POESTEN KILL SPECIES DISTRIBUTION



(1) Werner, Robert. 2004. Freshwater Fishes of the Northeastern United States. Syracuse University Press. Pgs. 104-105.

Photo/Map Credit: Carlson, Douglas. Daniels, Robert. Wright, Jeremy. 2016. Atlas of Inland Fishes of New York. The New York State Education Department. Pg. 73.

CREEK CHUB *(Semotilus atromaculatus)*



FAMILY: Cyprinidae (Minnows, Shiners, Dace, Chubs, Carp, Goldfish)

SIZE: The average adult length is 10.16-15.24 cm (4-6 in), but some may reach 25.4 cm (10 in).

LIFESPAN: Individuals may live between 3-8 years with an average of 5 years. Sexual maturity is reached around 1-4 years of age.

FIELD CHARACTERISTICS: These fish have a large mouth as well as a large dorsal **(A)**(back) fin that originates (positioning of the first ray of the fin) before the pelvic fin **(B)**. It is not uncommon to observe a dark band that extends from the tail to the tip of the snout. Further differentiating this fish from the Fallfish (Semotilus corporalis) can be done by observing the black spot at the front of the Creek Chubs dorsal fin. During the breeding season, the males may develop large nuptial tubercles-hard bumps **(C)**.

HABITAT: This species is common in headwater creeks, and small streams with gravel bottoms.

LIFESTAGES: Aside from size, these fish do not have a distinct change from hatching to adulthood.

SPAWNING: Creek Chub spawn in the spring. Males undertake a fascinating excavating project by transporting gravel upstream. During this process, the male creates a pit extending downstream and a large gravel mound upstream. If a female is attracted to the male's gravel mound display, she will join him in the pit. Swimming side by side, the male will flip the female vertically with his pectoral fin, wrap himself around her, and release sperm while she releases her eggs. After this 2-3 second event, the female will drift downstream appearing dead, and the male will cover the fertilized eggs with gravel from his mound. Once she has recovered, she will continue to visit this male or other nests and repeat the process. An average female will deposit around 3,000-4,000 eggs during a spawning season.

DIET: Creek Chub are termed "opportunistic omnivores" and will eat insects, small fish, and a lot of plant material.

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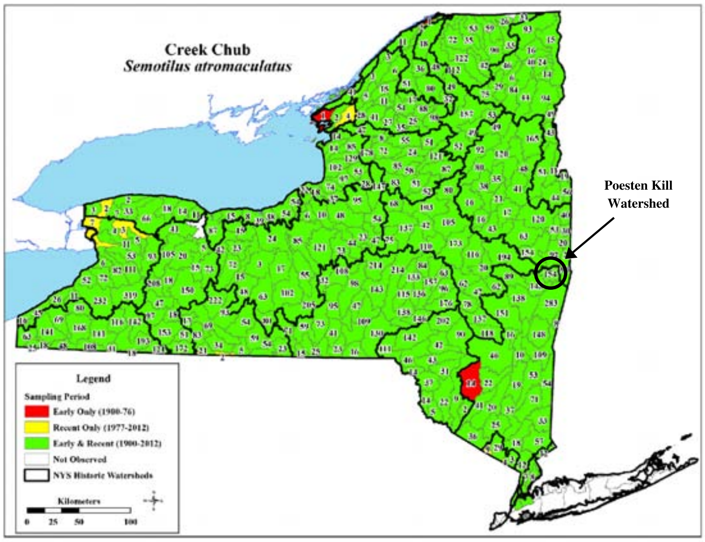
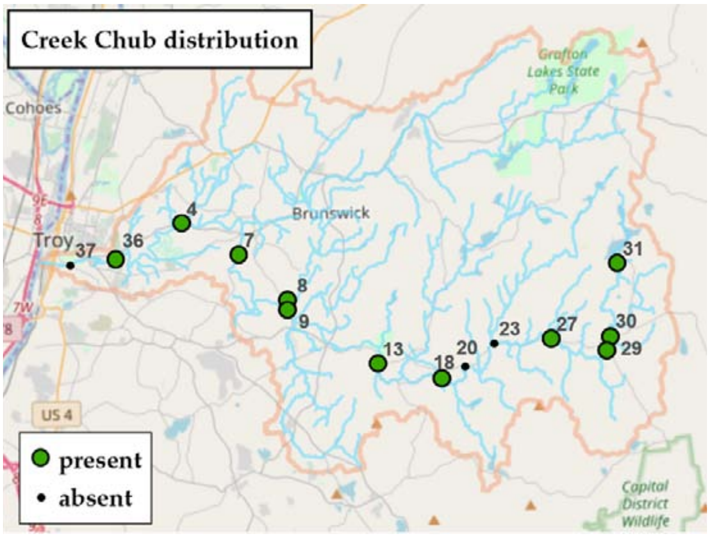


POESTEN KILL SPECIES DISTRIBUTION



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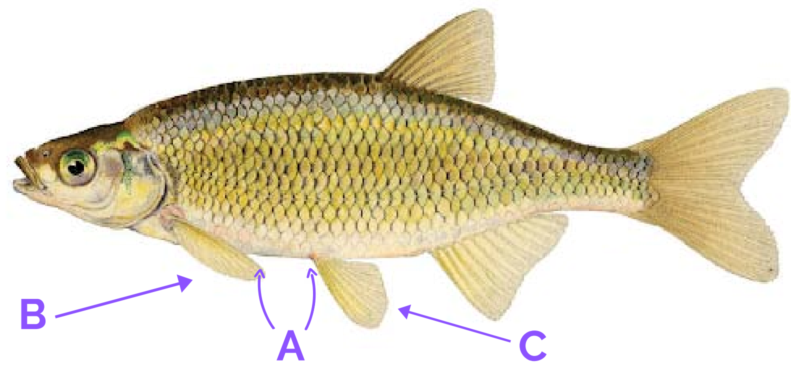
(2) Werner, Robert. 2004. Freshwater Fishes of the Northeastern United States. Syracuse University Press. Pgs. 131-132.

Photo/Map Credit: Carlson, Douglas. Daniels, Robert. Wright, Jeremy. 2016. Atlas of Inland Fishes of New York. The New York State Education Department. Pg. 128.

GOLDEN SHINER *(Notemigonus crysoleucas)*



FAMILY: Cyprinidae (Minnows, Shiners, Dace, Chubs, Carp, Goldfish)

SIZE: Golden Shiners may reach up to 25.4 cm (10 in) in length.

LIFESPAN: These fish may live to 8-9 years old. On average, males and females will reach sexual maturity around 1 year of age.

FIELD CHARACTERISTICS: These are a **deep-bodied fish**, meaning that the distance from the highest point of the back to the lowest point of the belly is comparatively long. These fish have a **fleshy keel** **(A)**, defined as a section where the body turns inward that is located along the underside of the fish between the pectoral **(B)** and pelvic fins **(C)**. They also have 10-15 anal (bones in the anal fin) rays. The adults generally have a distinct golden coloration while juveniles are green in color.

HABITAT: Golden Shiners may be found in lakes, ponds, swamps, creeks, and rivers. They generally prefer weedy, vegetated areas with stagnant water. Due to this fact, creek or stream dwelling individuals will mainly be found in pool sections of a reach.

LIFESTAGES: Aside from coloration and size, these fish do not have a distinct change from hatching to adulthood.

SPAWNING: Golden Shiners breed from May to August in ponds or lakes. These fish are “broadcast spawners”, meaning that they release reproductive materials over a given area without building a nest. In the case of this species, eggs and sperm are broadcasted over plots of vegetation. The eggs have an adhesive quality allowing them to stick to the vegetation. The eggs will hatch in 4-7 days.

DIET: Golden Shiners diet primarily consists of zooplankton, phytoplankton, and small insects.

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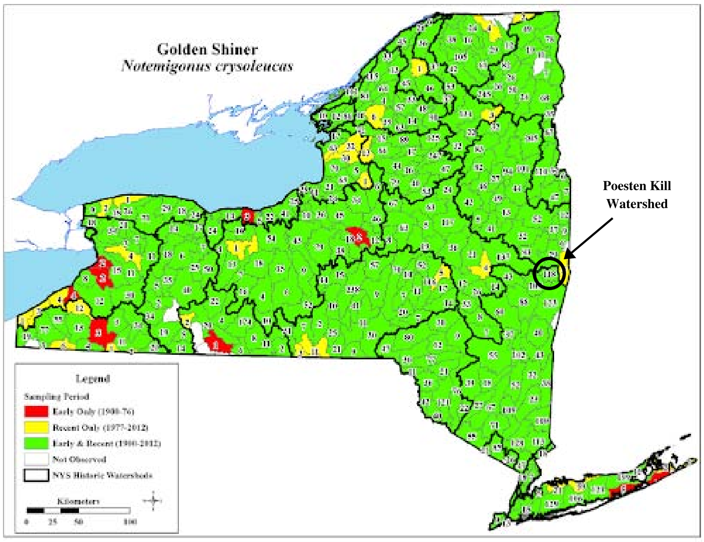
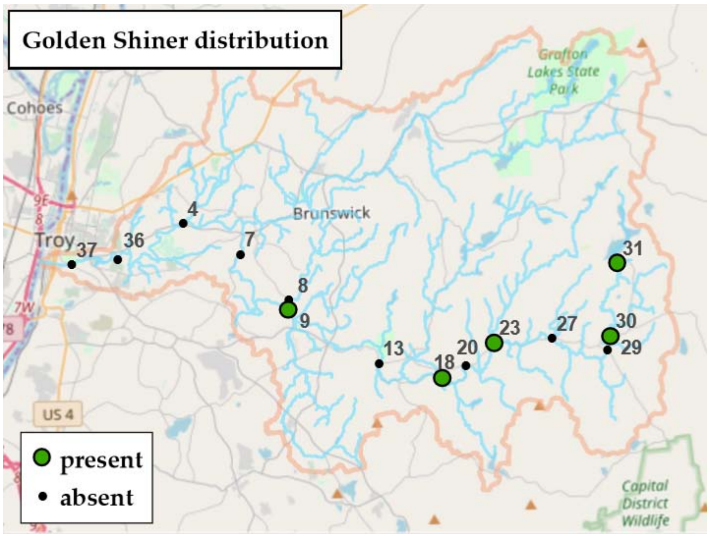


POESTEN KILL SPECIES DISTRIBUTION



(1) Sims, Joshua. 2006. Notemigonus crysoleucas, Animal Diversity Web. Webpage. [Internet] 2006 [cited 14 October 2019]. Available from: http://www.biokids.umich.edu/critters/Notemigonus_crysoleucas/.3.

(2) Werner, Robert. 2004. Freshwater Fishes of the Northeastern United States. Syracuse University Press. Pgs. 109-110.

Photo/Map Credit: Carlson, Douglas. Daniels, Robert. Wright, Jeremy. 2016. Atlas of Inland Fishes of New York. The New York State Education Department. Pg. 85.

LARGEMOUTH BASS *(Micropterus salmoides)*

FAMILY: Centrarchidae (Sunfish)

SIZE: Adults may reach 30-97 cm (11.81-38.19 in) in length with an average of 45 cm (17.72 in). They may weigh 0.45-10.1 kg (0.99-22.25 lb) with an average of 1.36 kg (3 lb).

LIFESPAN: Individuals may live up to 15 years old.

FIELD CHARACTERISTICS: As the name suggests, these fish have **large mouths**, with the maxilla (jawbone) reaching behind the orbit of the eye. These fish have a **dark horizontal band** running along their body and a **deep notch between their dorsal (back) fins**.

HABITAT: These fish are mainly found in lakes and rivers among weedy, vegetated areas with soft, shallow substrate.

LIFESTAGES: Aside from size, these fish do not have a distinct change from hatching to adulthood.

SPAWNING: Largemouth Bass spawn from late spring to early summer in shallow, weedy habitat. Males construct nests in hopes of attracting a female. If a female is attracted, she will release eggs into the nest while the male releases sperm. She may carry up 60,000 eggs. The eggs will hatch in 3-5 days, and the young will be strong enough to swim well in about one week. During this time, the male will constantly be on guard. He will continue to protect the babies for another month when they leave nest.

DIET: Hatchlings begin feeding on microscopic crustaceans and then make their way to small insects. As the individual grows, they will switch to frogs, fish, worms, and crayfish.

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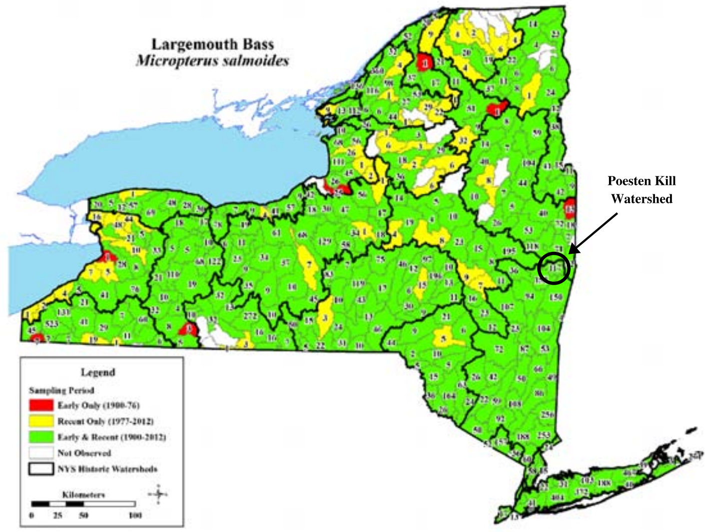

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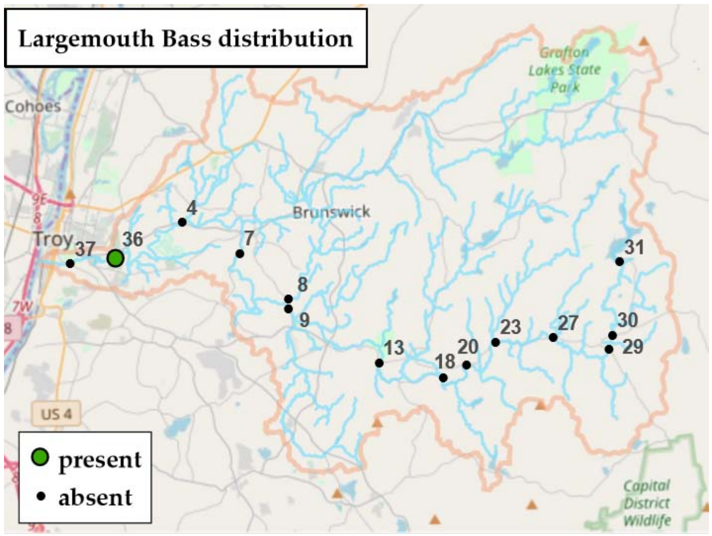

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(2) Werner, Robert. 2004. Freshwater Fishes of the Northeastern United States. Syracuse University Press. Pgs. 242-243.
Photo/Map Credit: Carlson, Douglas. Daniels, Robert. Wright, Jeremy. 2016. Atlas of Inland Fishes of New York. The New York State Education Department. Pg. 285.

LONGNOSE DACE *(Rhinichthys cataractae)*

FAMILY: Cyprinidae (Minnows, Shiners, Dace, Chubs, Carp, Goldfish)

SIZE: Adults may reach 60-225 mm (2.36-8.86 in)

LIFESPAN: Longnose Dace may live to 3-5 years old with an average of 3 years. Sexual maturity is reached at 1-2 years old.

FIELD CHARACTERISTICS: Longnose Dace are said to **look like miniature sharks**. They are very similar looking to Blacknose Dace, but they have a much longer snout and do not have a distinct black, horizontal line on their bodies.

HABITAT: These fish will mainly be found in the fast-flowing, cold waters of the riffle habitats of streams. They generally prefer areas with rocky or gravel substrate.

LIFESTAGES: Besides size, these fish do not have a distinct change from hatching to adulthood.

SPAWNING: Longnose Dace spawn between May and July. Males construct small nests in the gravely substrate. Females will carry around 1,155-2,534 eggs. After both parents release their reproductive materials, little parental care is given to the eggs and young. The eggs will hatch 3-4 days after spawning.

DIET: Longnose Dace feed on a variety of food including fish, fish eggs, insects, zooplankton, algae, and phytoplankton.

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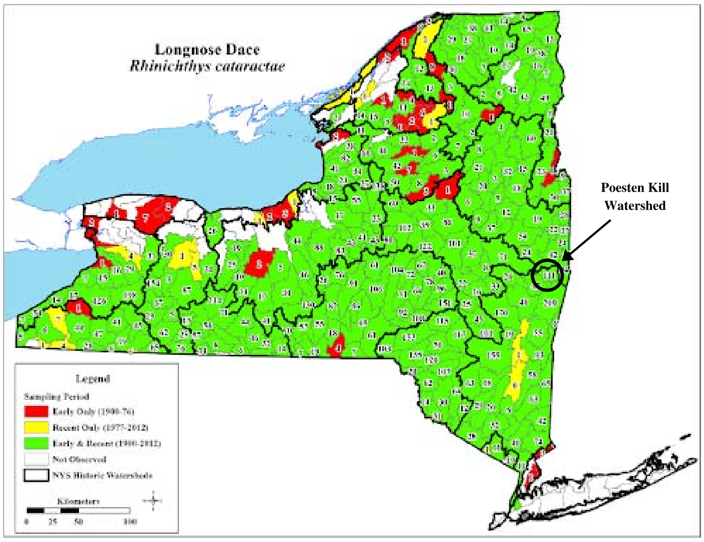

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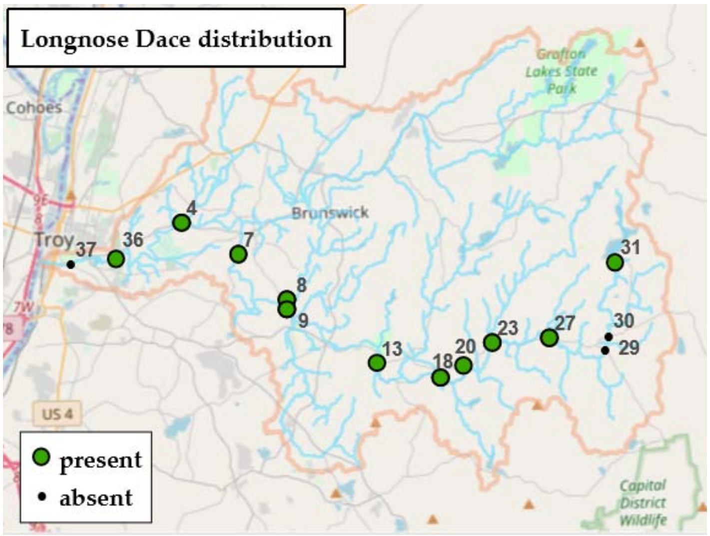

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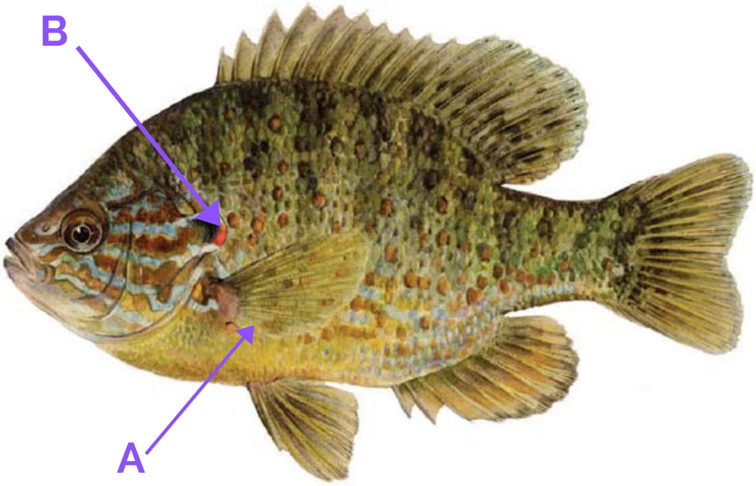
Photo/Map Credit: Carlson, Douglas. Daniels, Robert. Wright, Jeremy. 2016. Atlas of Inland Fishes of New York. The New York State Education Department. Pg. 285.

PUMPKINSEED *(Lepomis gibbosus)*



FAMILY: Centrarchidae (Sunfish)

SIZE: Adults may max out around 25.4 cm (10 in) in length and 0.227 kg (0.5 lbs) in mass.

LIFESPAN: These fish may live up to 8-9 years.

FIELD CHARACTERISTICS: Common characteristics of this species are long, pointed pectoral fins **(A)**, a red spot **(B)** on the opercular (gill) flap, and "lightning-streak" turquoise bands on their face. These fish generally have a sandy, yellow coloration to their body.

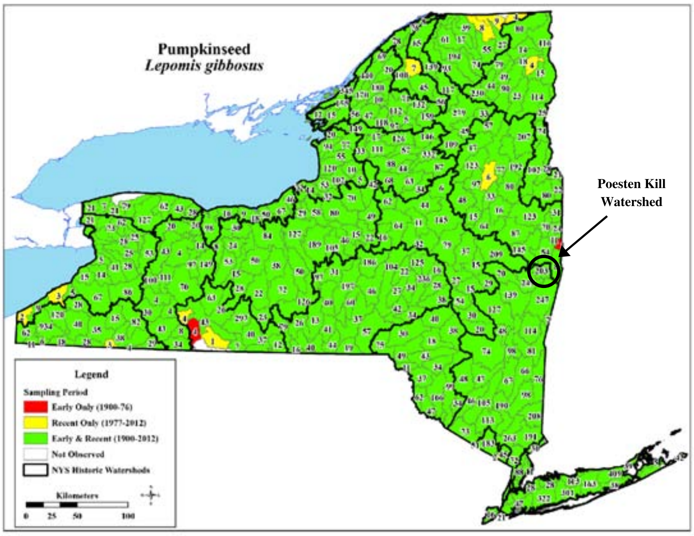
HABITAT: These fish are generally found in lakes and ponds but can be found in streams and rivers. In either scenario, lotic (stream/river) or lentic (Lake), these fish prefer vegetative or brushy cover.

LIFESTAGES: Aside from size, these fish do not have a distinct change from hatching to adulthood.

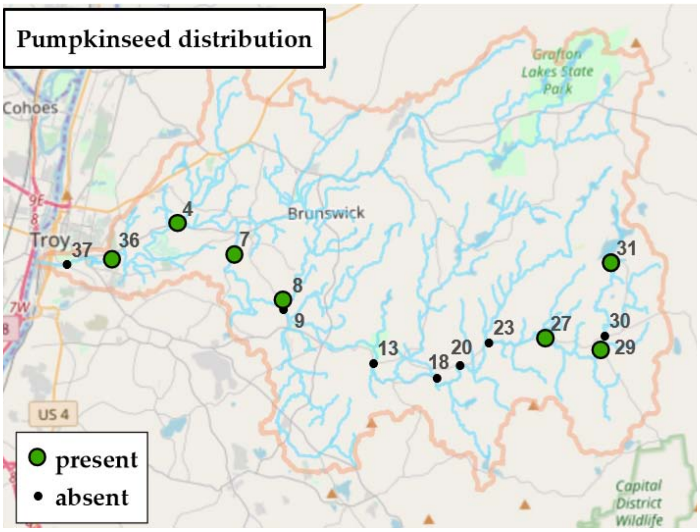
SPAWNING: Adults begin spawning in early summer. Males create small nests. Females will generally carry between 1,500-3,000 eggs. If a female is attracted to a male's nest, she will join him and begin a circular swimming courtship which results in both parents releasing reproductive materials into the bottom of the nest. The adhesive eggs become attached to the substrate of the nest. The males are the primary protectors of the eggs and hatchlings, guarding the young until they are ready to leave the nest. In particular, Pumpkinseed males are considered to be very aggressive defenders of their young.

DIET: These fish will feed on insects, small invertebrates, mollusks, and small fish.

NEW YORK STATE SPECIES DISTRIBUTION

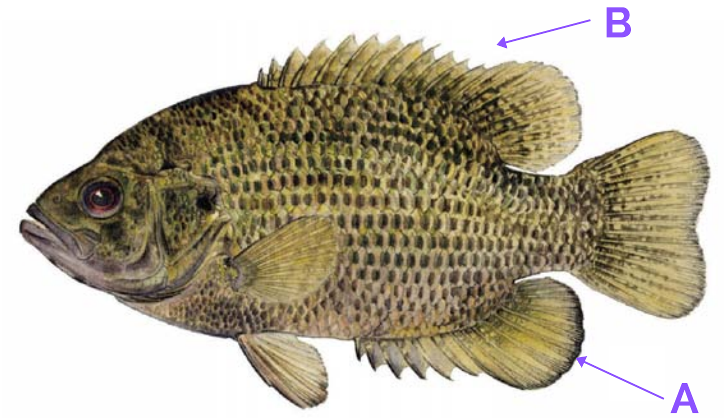


POESTEN KILL SPECIES DISTRIBUTION



(1) Werner, Robert. 2004. Freshwater Fishes of the Northeastern United States. Syracuse University Press. Pgs. 236-237.
Photo/Map Credit: Carlson, Douglas. Daniels, Robert. Wright, Jeremy. 2016. Atlas of Inland Fishes of New York. The New York State Education Department. Pg. 276.

ROCK BASS *(Ambloplites rupestris)*



FAMILY: Centrarchidae (Sunfish)

SIZE: The average Rock Bass will measure 20-25 cm (7.87-9.84 in) in length. These fish may weigh a maximum of 3 kg (6.61 lbs), but the average is around 0.454 kg (1 lb).

LIFESPAN: An average Rock Bass will live between 5-8 years. The maximum recorded age was around 18 years. Both males and females will become reproductively mature around 2-3 years old.

FIELD CHARACTERISTICS: These fish have around 5-7 anal spines (the bones making up the anal fin **(A)**). To distinguish these fish from crappies, another species of sunfish with this trait, one can observe that the Rock Bass has an anal fin base length smaller than their dorsal (back) fin **(B)** base length where as the crappies are almost equivalent. Another distinguishing feature is the series of 8-10 lines of black spots below the lateral line. Above the lateral line (Sensory line running the length of the body), the body has a mottling of dark and irregular blotches.

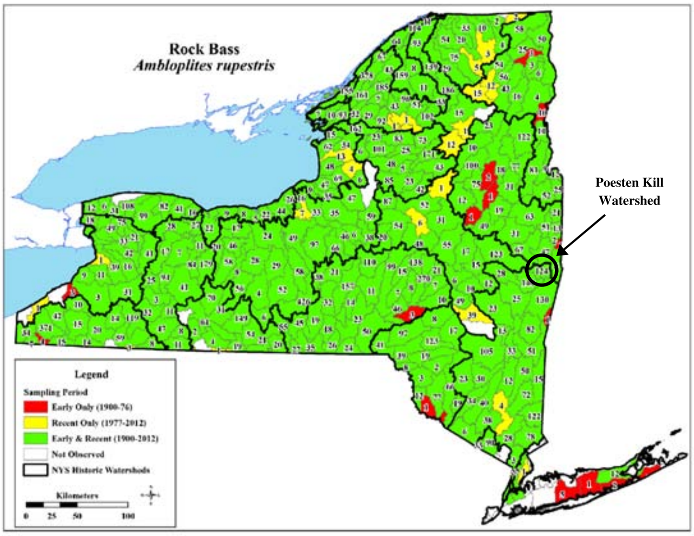
HABITAT: These fish may be found in lakes, ponds, streams, and rivers. They generally prefer vegetated areas with rocky or sandy substrate.

LIFESTAGES: Aside from size, these fish do not have a distinct change from hatching to adulthood.

SPAWNING: These fish are early summer spawners. Males create nests. Females will generally carry around 5,000 eggs. Females may visit and reproduce with more than one male, and males may be visited and reproduce with more than one female. Males are aggressive defenders of their eggs, which hatch between 3-4 days after spawning. He continues to guard his young until they are ready to leave the nest.

DIET: Rock Bass feed on insects, crayfish, mollusks, and small fish.

NEW YORK STATE SPECIES DISTRIBUTION



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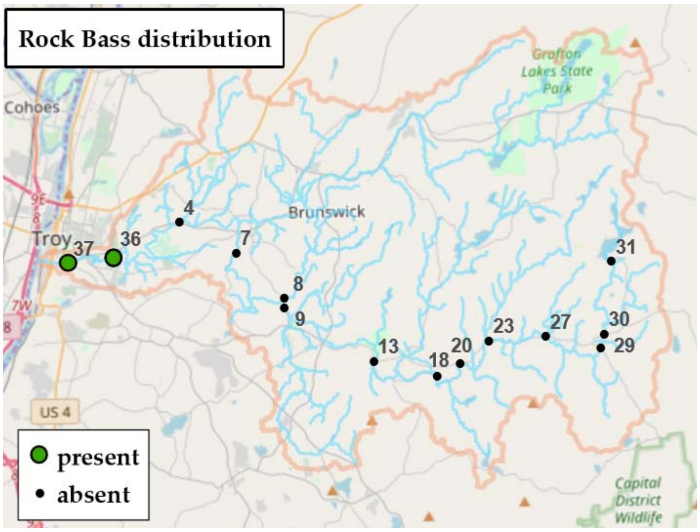
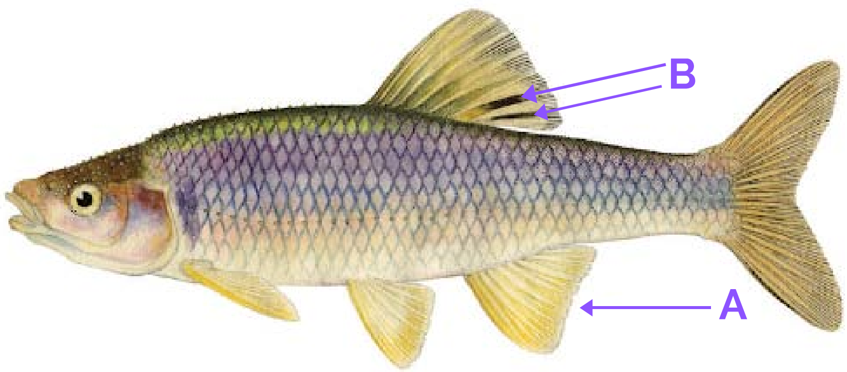


(1) Schnell, Brendan. 2014. Ambloplites rupestris, Animal Diversity Web. Webpage. [Internet] 2014 [cited 15 October 2019]. Available from: https://animaldiversity.org/accounts/Ambloplites_rupestris/.
(2) Werner, Robert. 2004. Freshwater Fishes of the Northeastern United States. Syracuse University Press. Pgs. 231-232.
Photo/Map Credit: Carlson, Douglas. Daniels, Robert. Wright, Jeremy. 2016. Atlas of Inland Fishes of New York. The New York State Education Department. Pg. 267.

SPOTFIN SHINER *(Cyprinella spiloptera)*



FAMILY: Cyprinidae (Minnows, Shiners, Dace, Chubs, Carp, Goldfish)

SIZE: Adults may reach 7.62-10.16 cm (3-4 in) in length.

LIFESPAN: These fish may live up to 4 years.

FIELD CHARACTERISTICS: These fish are described to be the only shiner species to have 8 anal rays (bones making up the anal fin **(A)**). Also, these fish have a **deep-body** (the distance from the highest point of the back to the lowest point of the belly is long compared to other species) and **dark pigmentation (B) on the fin membranes** (soft tissue of the fin) **between the last three dorsal (back) fin rays** (bones making up the dorsal fin).

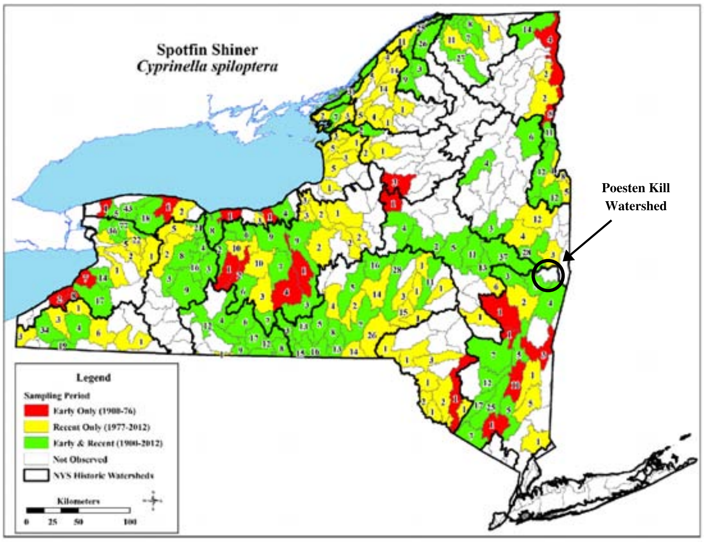
HABITAT: These fish generally inhabit creeks and lakes. It has been documented that this species can tolerate silty and turbid water conditions.

LIFESTAGES: Besides size, these fish do not have a distinct change from hatching to adulthood.

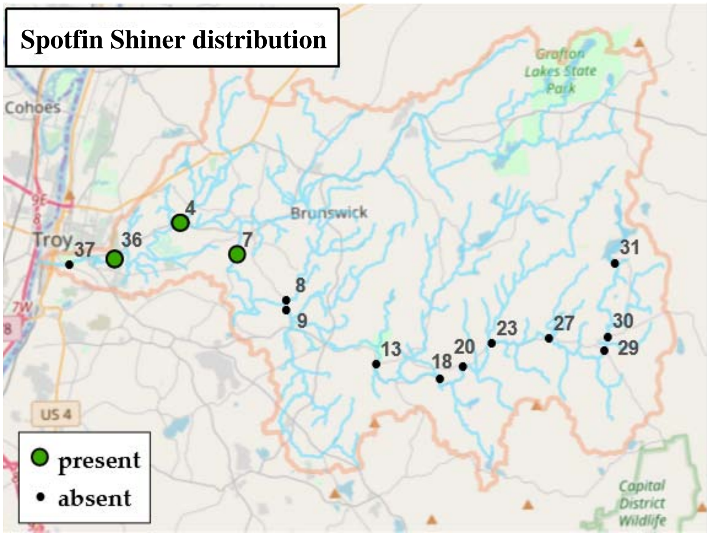
SPAWNING: Spotfin Shiners are fractional spawners, meaning that they will reproduce in day long intervals over a given spawning season. For this species, spawning is carried out over the summer months. Adults will use the crevices of rocks and logs to lay their eggs and spread their sperm. In general, adults will do this in 5-day intervals over the summer.

DIET: This species generally eats insects.

NEW YORK STATE SPECIES DISTRIBUTION



POESTEN KILL SPECIES DISTRIBUTION



(1) Werner, Robert. 2004. Freshwater Fishes of the Northeastern United States. Syracuse University Press. Pg. 95.

Photo/Map Credit: Carlson, Douglas. Daniels, Robert. Wright, Jeremy. 2016. Atlas of Inland Fishes of New York. The New York State Education Department. Pg. 57.

TESSELATED DARTER *(Estheostoma olmstedi)*

FAMILY: Percidae (Perch, Darters)

SIZE: Adults may reach up to 6.35 cm (2.5 in) in length.

LIFESPAN: These fish may live 3-4 years.

FIELD CHARACTERISTICS: These fish have 9-11 X, W, M, or V shaped markings along their bodies. They also have around 12-14 rays (bones in the fin) in their soft (second) dorsal fin **(A)**. Distinguishing these fish from the Johnny Darter can be done by counting the rays in the soft dorsal fin. Johnny's only have 10-12. Tessellated Darters will commonly have a black "tear-drop" marking under both eyes.

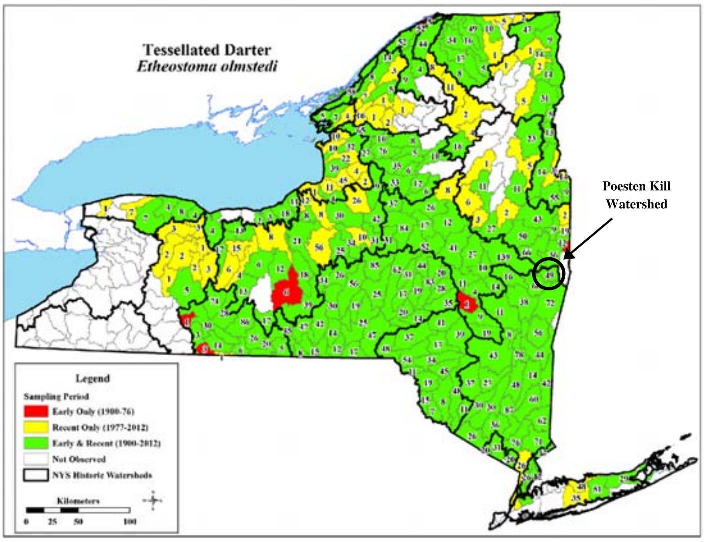
HABITAT: These fish are mainly found in the fast-flowing riffle habitats of streams. If they are found in lentic (lake) environments it will mainly be near the mouth and along the shores having silty or gravely substrate.

LIFESTAGES: Besides size, these fish do not have a distinct change from hatching to adulthood.

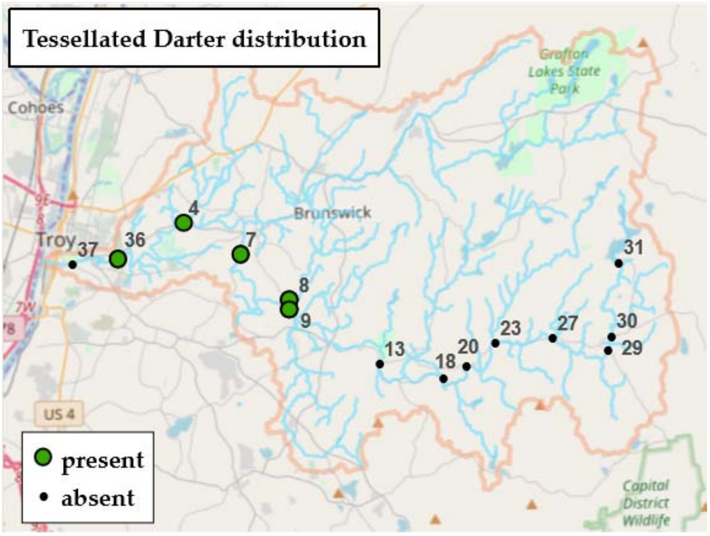
SPAWNING: Adults will reproduce any time from late April to May. Males will establish territories with rocky substrate that they defend vigorously. If a female is attracted, she will enter his territory and lay her eggs (usually 30-200) on the underside of a rock. The male will fertilize them right after. He will continue to guard the eggs and even fan them to keep water circulating over them. The eggs will hatch in 5-8 days.

DIET: These fish will generally feed on microscopic crustaceans, small insects, and organic benthic (bottom) debris.

NEW YORK STATE SPECIES DISTRIBUTION

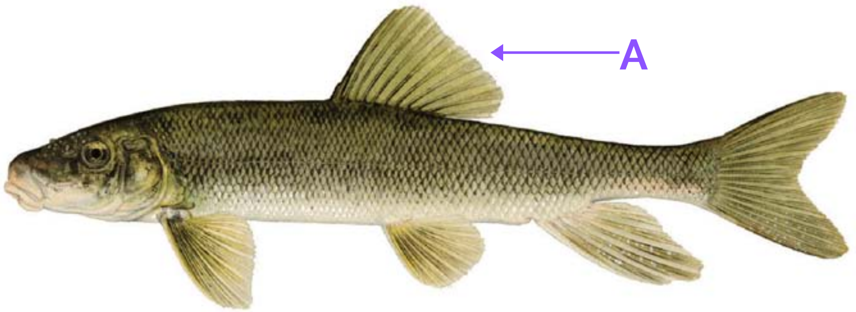


POESTEN KILL SPECIES DISTRIBUTION



((1) Werner, Robert. 2004. Freshwater Fishes of the Northeastern United States. Syracuse University Press. Pg. 260-261.
Photo/Map Credit: Carlson, Douglas. Daniels, Robert. Wright, Jeremy. 2016. Atlas of Inland Fishes of New York. The New York State Education Department. Pg. 306.

WHITE SUCKER *(Catostomus commersoni)*



FAMILY: Catostomidae (Suckers, Redhorses)

SIZE: Adults may reach 45.72-50.8 cm (18-20 in) in length, but the average is around 24.1 cm (9.49 in). They may also reach 1.36-1.81 kg (3-4 lbs) in mass with an average of 0.4 kg (0.88 lb) and a maximum of 2.5 kg (5.51 lb).

LIFESPAN: These fish may live up to 10 years, but certain dwarf varieties can reach up to 18 years. Both males and females will become sexually mature around 3-8 years old.

FIELD CHARACTERISTICS: These fish have a short, blunt snout and 10-13 rays (bones of the fin) in their dorsal fin **(A)**.

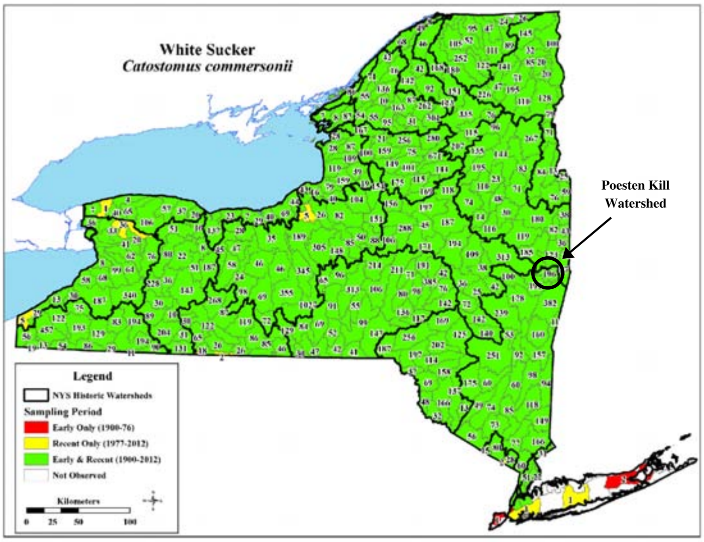
HABITAT: White Suckers may be found in creeks, streams, or lakes. Generally, these fish prefer cold, clear rivers that are small to medium in size. However, these fish are tolerant of polluted waters that may be murky and anoxic (Having very low dissolved oxygen concentrations).

LIFESTAGES: Besides size, these fish do not have a distinct change from hatching to adulthood.

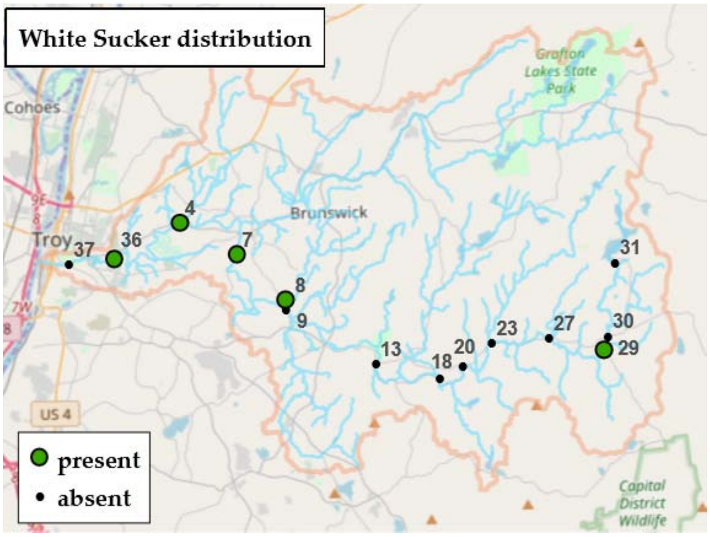
SPAWNING: White Suckers spawn between April and May. The preferred locations are upstream sections with gravel and good current, but some have been reported to spawn in pools and lakes. Males will generally develop nuptial tubercles (small bumps) on their anal and tail fins, and females have been reported to develop them at times as well. Females will generally carry between 20,000-50,000 eggs with a maximum being 140,000. The males and females will broadcast their reproductive materials over the substrate. The eggs are adhesive and will attach to the substrate after fertilization. The eggs will hatch in 5-10 days, and the hatchlings will receive no parental care.

DIET: Hatchlings, or "sac-fry" will obtain nutrients from their yolk sac until it is depleted. Once finished with their yolk sac, the fry will move downstream and feed on microcrustaceans, rotifers and algae. Adults will generally eat insects, crustaceans, snails, and clams.

NEW YORK STATE SPECIES DISTRIBUTION

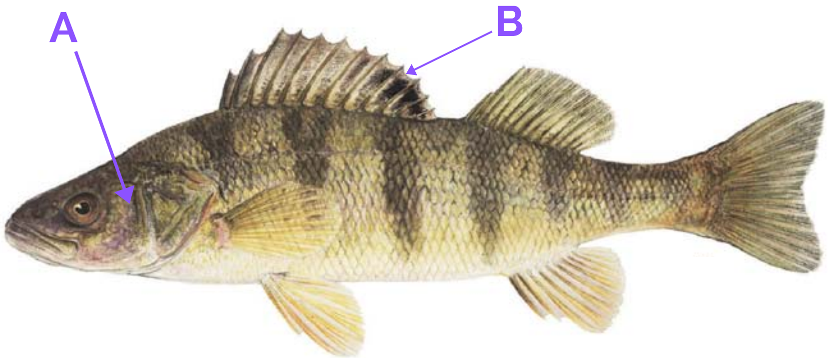


POESTEN KILL SPECIES DISTRIBUTION



(1) Hernandez, Aldo. 2014. Catostomus commersonii, Animal Diversity Web. Webpage. [Internet] 2014 [cited 15 October 2019]. Available from: https://animaldiversity.org/accounts/Catostomus_commersonii/.
(2) Werner, Robert. 2004. Freshwater Fishes of the Northeastern United States. Syracuse University Press. Pg. 142
Photo/Map Credit: Carlson, Douglas. Daniels, Robert. Wright, Jeremy. 2016. Atlas of Inland Fishes of New York. The New York State Education Department. Pg. 138

YELLOW PERCH *(Perca flavescens)*



FAMILY: Percidae (Perch, Darters)

SIZE: Adults may reach 25.4-27.94 cm (10-11 in) in length and average 1.06 kg (2.34 lbs) in mass.

LIFESPAN: Yellow Perch may live up to 8-9 years. Sexual maturity is reached around 3-4 years.

FIELD CHARACTERISTICS: These fish are easily identified by the presence of **wide, vertical, olive bands on a yellow body background.** They also have a serrated preoperculum **(A)** (edge at the front of the gill flap) and a dusky black print **(B)** at the back of their spiny (first) dorsal fin.

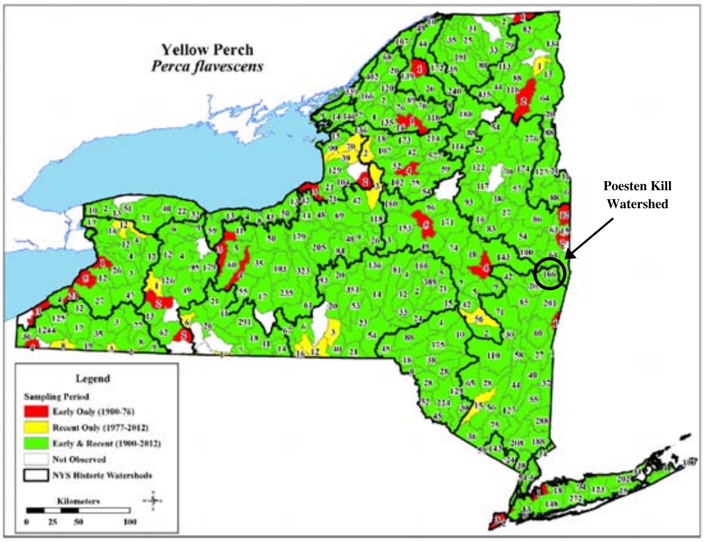
HABITAT: Yellow Perch are a primarily lentic (lake) dwelling species. They prefer water low in turbidity (cloudiness) and silt but can handle anoxic conditions.

LIFESTAGES: Besides size, these fish do not have a distinct change from hatching to adulthood.

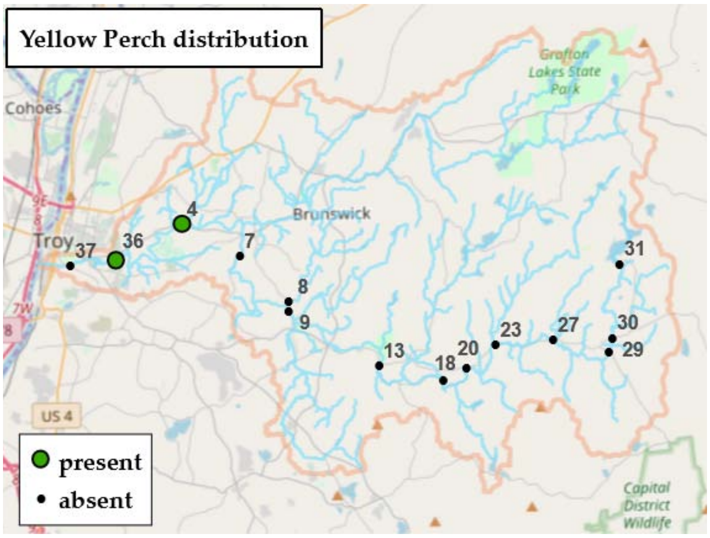
SPAWNING: Adults begin to spawn in early spring with water temperatures between 44-54 F. Spawning occurs in shallower water, sometimes in tributary streams. Females can carry anywhere from 3,000-100,000 eggs with an average of 20,000-30,000. The females will lead a train of males until she is ready to release a long gelatinous mass of eggs. The pursuing males will then release sperm to fertilize the eggs. The egg mass is semi buoyant in nature, allowing it to be suspended in the water column. The current moving through the mass allows for a constant flow of fresh water that keeps the eggs healthy and aerated. The eggs will hatch in 7-10 days and the young will not receive parental care.

DIET: Newborns feed on their yolk-sac until it is depleted. Once they have finished their yolk-sac, the fry will then begin feeding on zooplankton until they are large enough to start feeding on insects and crustaceans. They will continue this diet until the end of their first year. As adults, Perch will continue eating insects but also start on crayfish and small fishes.

NEW YORK STATE SPECIES DISTRIBUTION



POESTEN KILL SPECIES DISTRIBUTION



(1) Creque, Sara. 2000. Perca flavescens, Animal Diversity Web. Webpage. [Internet] 2000 [cited 15 October 2019]. Available from: https://animaldiversity.org/accounts/Perca_flavescens/.
(2) Werner, Robert. 2004. Freshwater Fishes of the Northeastern United States. Syracuse University Press. Pg. 1263-264.
Photo/Map Credit: Carlson, Douglas. Daniels, Robert. Wright, Jeremy. 2016. Atlas of Inland Fishes of New York. The New York State Education Department. Pg. 310

FISH FACT SHEET GLOSSARY

FAMILY: A taxonomic family is a grouping of organisms that share similar characteristics. These characteristics are ones that can easily distinguish species of a family from those of another family.

SIZE: Fish size classifications generally refer to their body lengths, from the tips of their snouts to the tips of their tails, and body mass, or how much they weigh. For the sake of simplicity, these are the measurements OEI reported in the following fact sheets. More advanced studies of fish anatomy by ichthyologists and anatomists may study specific “morphometric” traits which are measurements relating to various parts of the fish’s body that grow in length, width, depth, or mass.

LIFESPAN: This is the amount of time that a given individual of a particular species will live. This time is generally represented as an average for a given species, but there are constant cases of unique individuals living well beyond the average.

FIELD CHARACTERISTICS: These are the traits that a species has that helps biologists in differentiating the many species they will observe while sampling. These are generally traits that are not difficult to observe in the field and will yield a high degree of accuracy in identifying a species. These traits vary from things like color, anatomical features (e.g., number of fin rays, ratio of eye to head size, etc.), and size. In general, anatomical features tend to be more reliable than color and size due to their lack of variability. For example, a given species may vary widely in the color template that an individual can have, but certain structures that are coded for by their DNA will take many thousands of years to vary widely enough to confuse individual-to-individual in a species.

HABITAT: These are the particular areas where a species can be found. For a given species, these areas will generally consist of similar components that the species prefers for their survival and reproduction. There may even be fish species that occupy drastically different habitats at different points in their life history. These are generally the species that migrate vast distances to reproduce. Simple observations of a fish species habitat can be things like the depth of water they are found in, how much vegetation is present, and what type of substrate they use for building nests.

LIFESTAGES: These are the distinct points of development for a species. Unlike most mammal species (humans for example), fish can vary greatly in how a baby will look in comparison to when they are adults. Different life stages are where a biologist can observe the greatest variation in things like where a species will live, what they will look like, what they eat, and how they behave.

SPAWNING: Spawning is term used for fish reproduction. A general trend in fish spawning consists of a mating pair building a nest by creating depressions in the substrate, which can be soft sediment or coarse stone. Females will deposit eggs into the nest over which males release dense mixtures of sperm to fertilize the eggs. The fertilized eggs undergo an incubation period until hatching. The hatchlings are generally termed as “fry”. The fry will grow into “young-of-the-year” in their first year of life. The timing of fish reproduction generally occurs in the spring or fall.

DIET: This is what the animal eats.

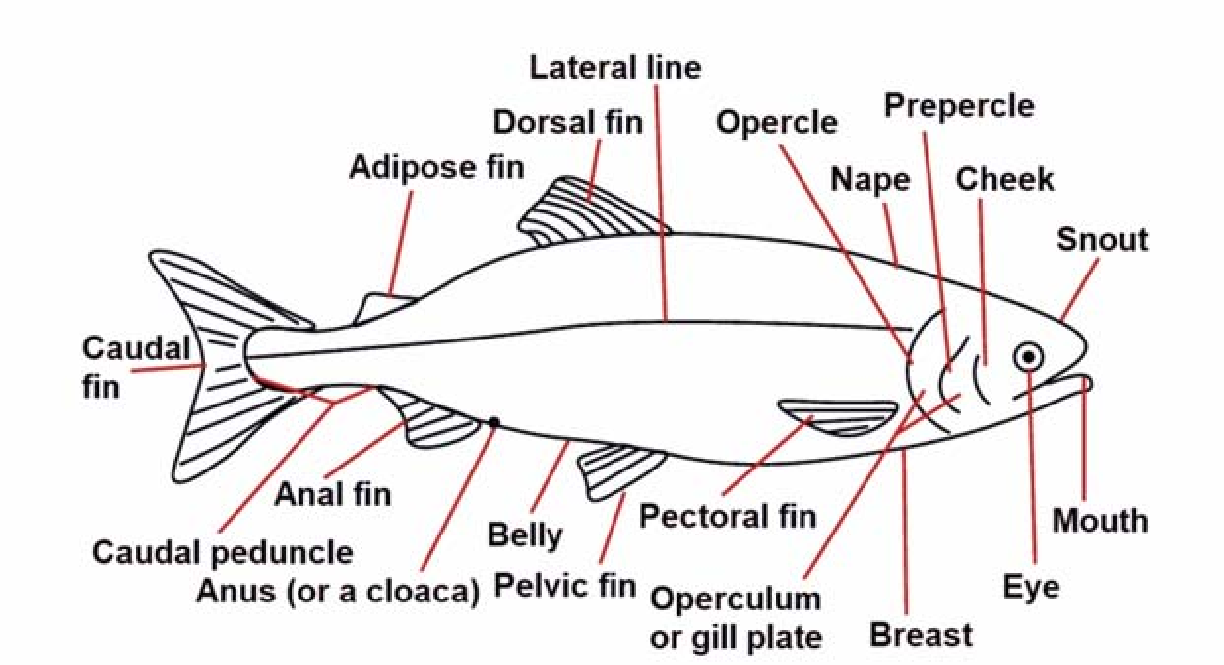


Figure 1. Generalized anatomy of bony fishes. (Image obtained from: https://www.pngtube.com/viewm/iiJmmwx_pull-fish-out-of-water/)

POESTEN KILL SITE-SPECIFIC FACTSHEETS

The Factsheets Presented in this section contain the physical, chemical, and biological data collected at each site, during the 2017 and 2019 surveys. Sites are arranged in downstream order; however, sites numbers are not consecutively ordered. Sites were numbered based on initial site reconnaissance.

DATA TABLE ABBREVIATIONS

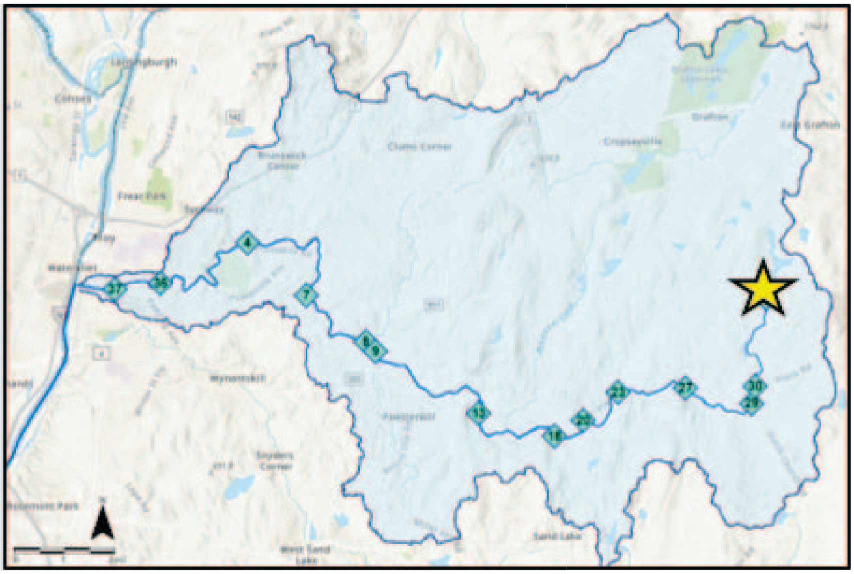
WATER QUALITY UNITS

Temperature (˚C) – reported as degrees-Celsius
Conductivity (µS/cm) – reported in microsiemens per centimeter
pH – unitless, measure of the hydrogen ion concentration
Turbidity (NTU) – reported in Nephelometric Turbidity Units
Dissolved oxygen (mg/L) – reported in milligrams per liter; also known as parts per million (ppm)

BIOLOGICAL UNITS

IBI – Index of Biotic Integrity
EPT richness – Ephemeroptera-Plecoptera-Trichoptera species richness
NCO richness – Non-Chironomidae and Oligochaeta richness
HBI – Hilsenhoff Biotic Index
PMA – Percent Model Affinity
NBI-P – Nutrient Biotic Index for Phosphorus
BAP – Biological Assessment Profile

POESTEN KILL SAMPLING DATA: SITE #31



SITE DESCRIPTION:

This site marks the beginning of the Poestenkill and is located right below Dyken Pond at Fifty Six Rd. The predominant surrounding land use consists of a mixture of forest, residential homes, and agriculture. The riparian zone of the stream is lined with a mixture of trees and shrubs.

SITE COORDINATES:

42.71704 N, -73.4278 W

2017 Downstream View

2019 Upstream View

2019 Downstream View

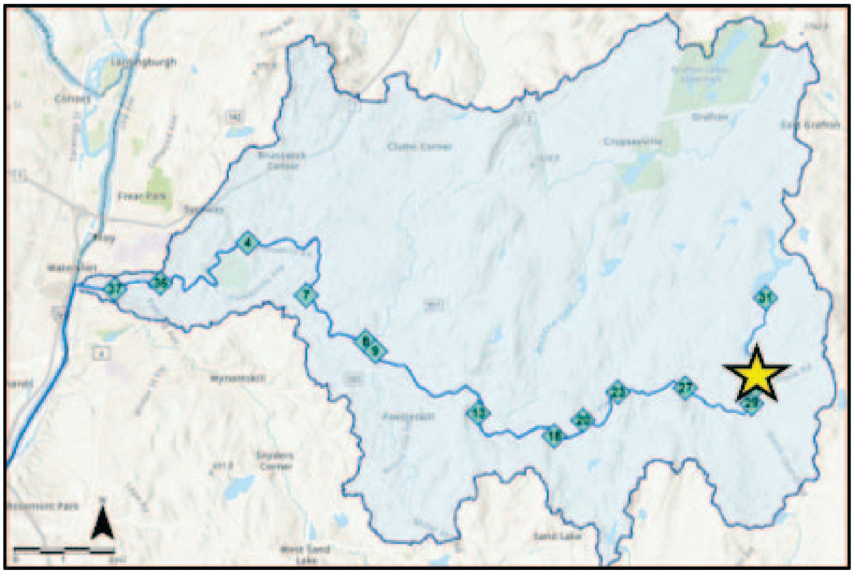
WQ	YEAR	
Measure	2017	2019
Temperature	21.93	19.35
Conductivity	30	24
pH	7.21	8.49
Turbidity	2.5	0
Dissolved oxygen	8.13	8.74

FISH SPP/COUNTS	YEAR	
Species	2017	2019
Bluegill	0	5
Brown Bullhead	1	0
Creek Chub	3	46
Golden Shiner	0	6
Longnose Dace	0	5
Pumpkinseed	14	22

FISH IBI	YEAR	
Measure	2017	2019
Abundance	18	84
Total Species Richness	3	5
Native Species Richness	3	5
Exotic Species Richness	0	0
Benthic Insectivore Species Richness	0	1
Water Column Species Richness	0	0
Terete minnow Species Richness	1	1
% Dominant	77.78	54.76
% White sucker	0.00	0.00
% Generalists	100.0	94.05
% Insectivores	0.00	5.95
% Top carnivore	0.00	0.00
Shannon Diversity	0.65	1.20
IBI Score	28	32
IBI Rating	Poor	Poor

INVERTEBRATES	YEAR	
Measure	2017	2019
Abundance	100	100
Richness	9	6
EPT Richness	3	3
NCO Richness	8	5
Diversity	1.57	0.47
Dominance-3	80	97
HBI	6.23	5.81
PMA	39	31
NBI-P	6.30	5.60
BAP	6.83	6.42
BAP Rating	Slight	Slight

POESTEN KILL SAMPLING DATA: SITE #30



SITE DESCRIPTION:

Located on Plank Rd, approximately 450 m north of Site 29. The surrounding land is predominately made up of forest. The riparian zone of the stream is lined with trees.

SITE COORDINATES:

42.69155 N, -73.43182 W

2017 Downstream View

2019 Downstream View

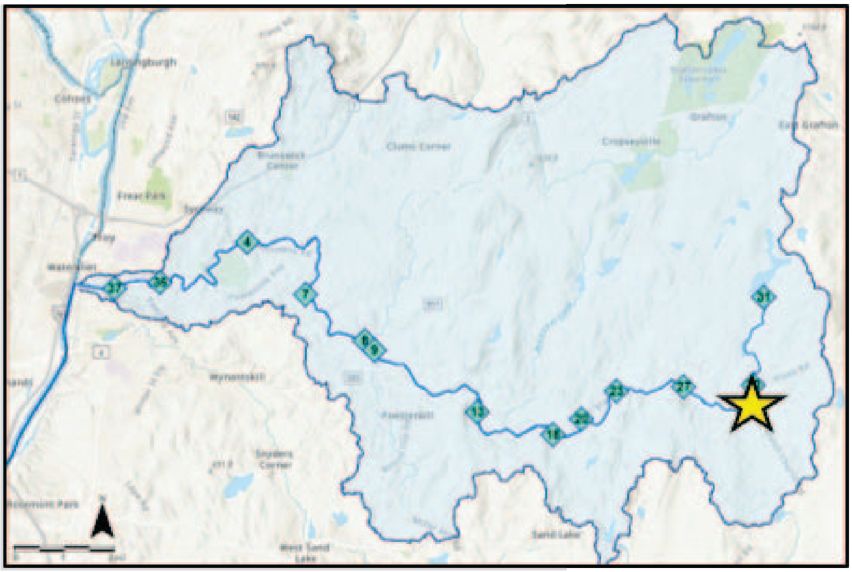
WQ	YEAR	
Measure	2017	2019
Temperature	18.15	15.93
Conductivity	52	44
pH	6.23	8.2
Turbidity	0	0
Dissolved oxygen	Not Sampled	8.24

FISH SPP/COUNTS	YEAR	
Species	2017	2019
Blacknose Dace	28	33
Creek Chub	25	36
Golden Shiner	0	1

FISH IBI	YEAR	
Measure	2017	2019
Abundance	53	70
Total Species Richness	2	3
Native Species Richness	2	3
Exotic Species Richness	0	0
Benthic Insectivore Species Richness	0	0
Water Column Species Richness	0	0
Terete Minnow Species Richness	1	1
% Dominant	52.83	51.43
% White sucker	0.00	0.00
% Generalists	100.00	100.00
% Insectivores	0.00	0.00
% Top carnivore	0.00	0.00
Shannon Diversity	0.69	0.75
IBI Score	26	26
IBI Rating	Poor	Poor

INVERTEBRATES	YEAR	
Measure	2017	2019
Abundance	100	100
Richness	17	12
EPT Richness	6	8
NCO Richness	16	11
Diversity	2.138	1.875
Dominance-3	62	75
HBI	4.62	4.89
PMA	53	59
NBI-P	6.919	6.379
BAP	8.602	8.615
BAP Rating	Non	Non

POESTEN KILL SAMPLING DATA: SITE #29



SITE DESCRIPTION:

Located on Dutch Church Rd, approximately 300 m east of Plank Rd. The surrounding land is predominately made up of forest and wetland. The riparian zone of the stream is lined with grass fields. There is a bridge that passes over this site.

SITE COORDINATES:

42.68668 N, -73.43312 W

2017 Upstream View

2019 Downstream View

2019 Upstream View

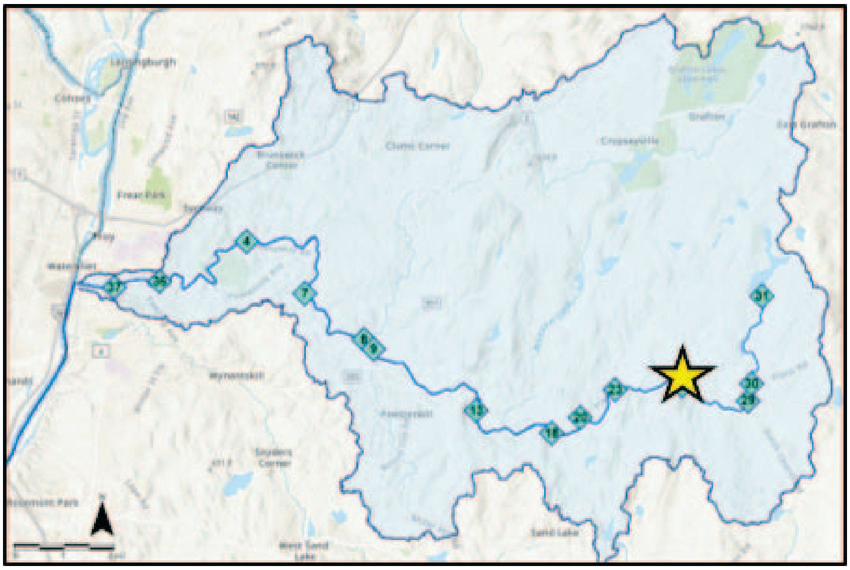
WQ	YEAR	
Measure	2017	2019
Temperature	18.45	15.95
Conductivity	53	46
pH	6.3	7.8
Turbidity	0.4	1.8
Dissolved oxygen	8.35	8.84

FISH SPP/COUNTS	YEAR	
Species	2017	2019
Blacknose Dace	33	25
Creek Chub	24	21
Pumpkinseed	3	0
White Sucker	0	4

FISH IBI	YEAR	
Measure	2017	2019
Abundance	60	50
Total Species Richness	3	3
Native Species Richness	3	3
Exotic Species Richness	0	0
Benthic Insectivore Species Richness	0	0
Water Column Species Richness	0	0
Terete minnow Species Richness	1	1
% Dominant	55.00	50.00
% White sucker	0.00	8.00
% Generalists	100.00	100.00
% Insectivores	0.00	0.00
% Top carnivore	0.00	0.00
Shannon Diversity	0.84	0.91
IBI Score	24	24
IBI Rating	Very Poor	Very Poor

INVERTEBRATES	YEAR	
Measure	2017	2019
Abundance	100	100
Richness	12	14
EPT Richness	3	10
NCO Richness	11	13
Diversity	1.00	1.64
Dominance-3	89	82
HBI	5.52	5.13
PMA	43	54
NBI-P	6.40	6.32
BAP	7.37	8.69
BAP Rating	Slight	Non

POESTEN KILL SAMPLING DATA: SITE #27



SITE DESCRIPTION:

Located on Plank Rd, just west of Dodge City Rd. The surrounding land is predominately made up of forest. The riparian zone of the stream is lined with trees. There is a bridge that passes over the site.

SITE COORDINATES:

42.69102 N, -73.45925 W

2017 Upstream View

2017 Downstream View

2019 Downstream View

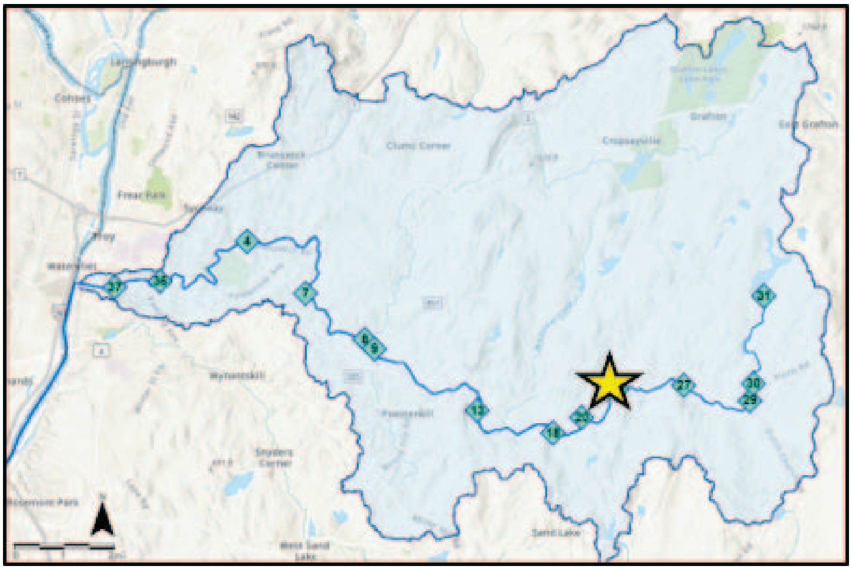
WQ	YEAR	
Measure	2017	2019
Temperature	17.94	15.66
Conductivity	46	41
pH	6.01	7.52
Turbidity	1.8	0
Dissolved oxygen	9.59	9.69

FISH SPP/COUNT	YEAR	
Species	2017	2019
Blacknose Dace	6	14
Creek Chub	7	9
Longnose Dace	7	2
Pumpkinseed	0	1

FISH IBI	YEAR	
Measure	2017	2019
Abundance	20	26
Total Species Richness	3	4
Native Species Richness	3	4
Exotic Species Richness	0	0
Benthic Insectivore Species Richness	1	1
Water Column Species Richness	0	0
Terete minnow Species Richness	1	1
% Dominant	35.00	53.85
% White sucker	0.00	0.00
% Generalists	65.00	92.31
% Insectivores	35.00	7.69
% Top carnivore	0.00	0.00
Shannon Diversity	1.09	1.02
IBI Score	30	28
IBI Rating	Poor	Poor

INVERTEBRATES	YEAR	
Measure	2017	2019
Abundance	100	100
Richness	8	13
EPT Richness	6	9
NCO Richness	7	12
Diversity	1.11	1.84
Dominance-3	89	72
HBI	2.82	4.73
PMA	32	75
NBI-P	2.29	5.34
BAP	5.64	9.19
BAP Rating	Slight	Non

POESTEN KILL SAMPLING DATA: SITE #23



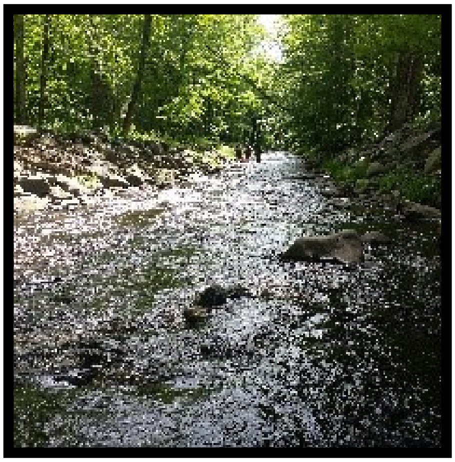
SITE DESCRIPTION:

Located on Fifty Six Rd, immediately north of the intersection with Plank Rd. The surrounding land is predominately made up of fields and residential homes. The riparian zone of the stream is lined with trees. There is a bridge that passes over the site..

SITE COORDINATES:

42.68987 N, -73.48589 W

2017 Upstream View



2017 Downstream View

2019 Downstream View

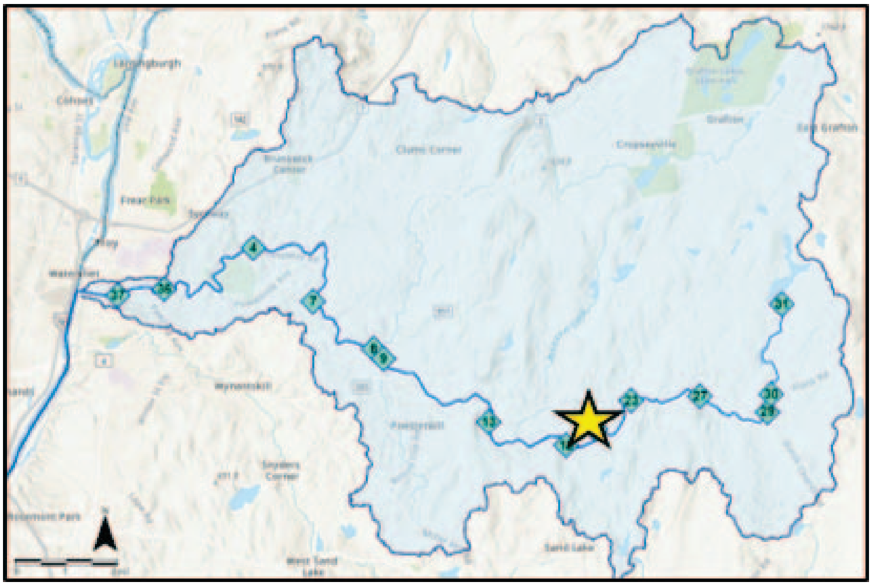
WQ	YEAR	
Measure	2017	2019
Temperature	19.03	14.72
Conductivity	51	35
pH	6.4	7.46
Turbidity	0.6	6
Dissolved oxygen	9.6	10.04

FISH SPP/COUNT	YEAR	
Species	2017	2019
Blacknose Dace	3	11
Brown Trout	0	2
Common shiner	0	4
Golden Shiner	0	1
Longnose Dace	15	2

FISH IBI	YEAR	
Measure	2017	2019
Abundance	18	20
Total Species Richness	2	5
Native Species Richness	2	4
Exotic Species Richness	0	1
Benthic Insectivore Species Richness	1	1
Water Column Species Richness	0	0
Terete minnow Species Richness	0	0
% Dominant	83.33	55.00
% White sucker	0.00	0.00
% Generalists	16.67	80.00
% Insectivores	83.33	10.00
% Top carnivore	0.00	10.00
Shannon Diversity	0.45	1.26
IBI Score	32	30
IBI Rating	Poor	Poor

INVERTEBRATES	YEAR	
Measure	2017	2019
Abundance	100	100
Richness	22	15
EPT Richness	13	11
NCO Richness	21	14
Diversity	2.65	1.77
Dominance-3	45	70
HBI	2.33	2.7
PMA	54	45
NBI-P	3.31	1.97
BAP	8.63	7.10
BAP Rating	Non	Slight

POESTEN KILL SAMPLING DATA: SITE #20



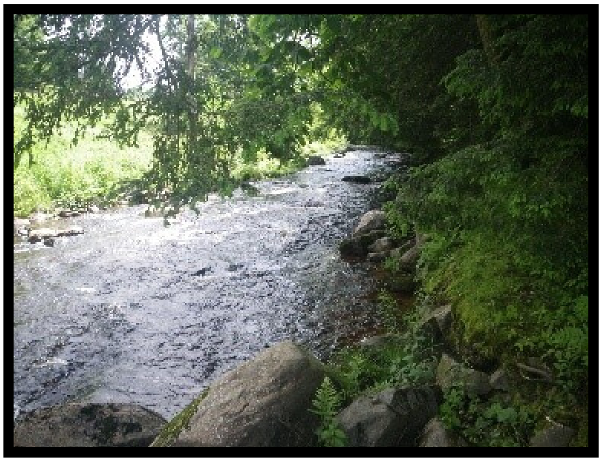
SITE DESCRIPTION:

Located on Columbia Hill Rd, immediately south of the intersection with Plank Rd. The surrounding land consists of a myriad of forest, fields, agriculture, and residential homes. The riparian zone of the stream is lined with trees. There is a bridge that passes over the site.

SITE COORDINATES:

42.68181 N, -73.49943 W

2019 Upstream View



2019 Downstream View

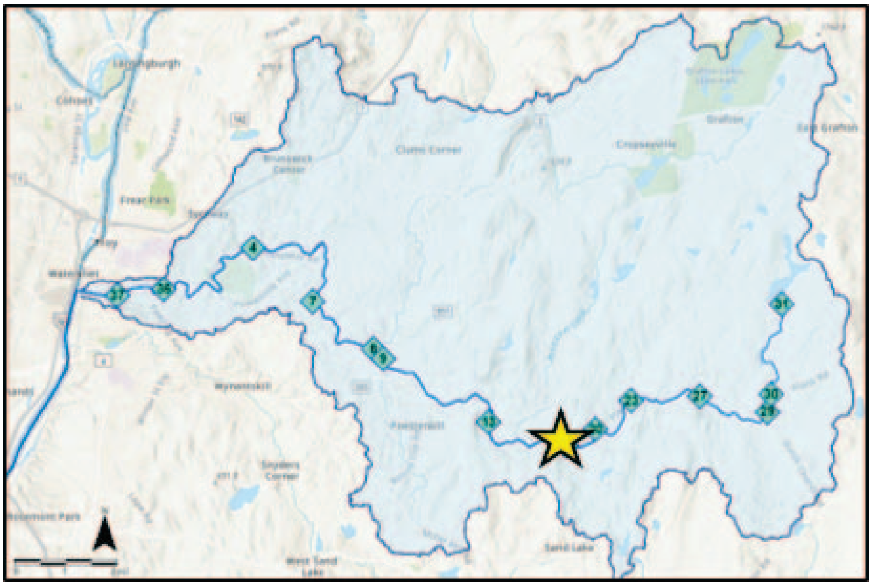
WQ	YEAR	
Measure	**2017**	**2019**
Temperature	19.32	15.33
Conductivity	128	43
pH	7.13	7.25
Turbidity	1.8	0
Dissolved oxygen	8.96	9.9

FISH SPP/COUNT	YEAR
Species	**2019**
Blacknose Dace	7
Common shiner	1
Longnose Dace	3

FISH IBI	YEAR
Measure	**2019**
Abundance	11
Total Species Richness	3
Native Species Richness	3
Exotic Species Richness	0
Benthic Insectivore Species Richness	1
Water Column Species Richness	0
Terete minnow Species Richness	0
% Dominant	63.64
% White sucker	0.00
% Generalists	72.73
% Insectivores	27.27
% Top carnivore	0.00
Shannon Diversity	0.86
IBI Score	26
IBI Rating	Poor

INVERTEBRATES	YEAR
Measure	**2019**
Abundance	100
Richness	15
EPT Richness	8
NCO Richness	14
Diversity	2.15
Dominance-3	63
HBI	3.94
PMA	79
NBI-P	4.24
BAP	7.96
BAP Rating	Non

POESTEN KILL SAMPLING DATA: SITE #18



SITE DESCRIPTION:

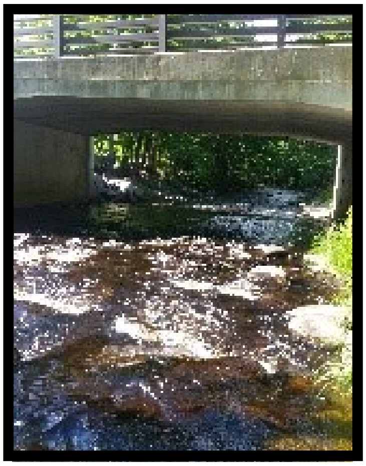
Located on Powers Rd, just east of the intersection of Catlin and Plank Rds. The surrounding land is predominately made up of forest and residential homes. The riparian zone is lined with trees. There is a bridge that passes over this site.

SITE COORDINATES:

42.67720 N, -73.51074 W

2017 Upstream View

2017 Downstream View



2019 Upstream View

2019 Downstream View

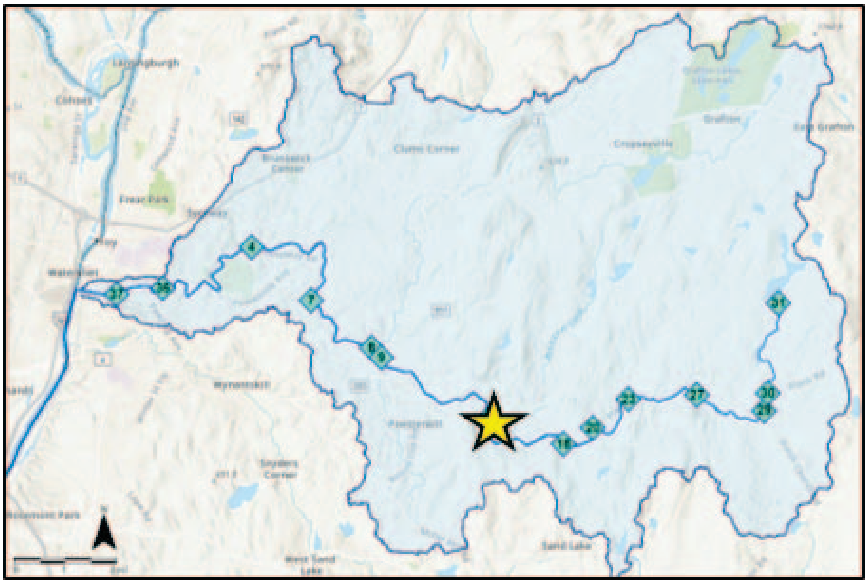
WQ	YEAR	
Measure	2017	2019
Temperature	20.21	17.33
Conductivity	56	50
pH	6.72	7.88
Turbidity	1	0
Dissolved oxygen	8.97	9.54

FISH SPP/COUNT	YEAR	
Species	2017	2019
Blacknose Dace	4	0
Brown Trout	1	1
Common shiner	0	3
Creek Chub	3	11
Golden Shiner	0	1
Longnose Dace	3	8
Shiner Spp.	1	0

FISH IBI	YEAR	
Measure	2017	2019
Abundance	12	24
Total Species Richness	5	5
Native Species Richness	4	4
Exotic Species Richness	1	1
Benthic Insectivore Species Richness	1	1
Water Column Species Richness	0	0
Terete minnow Species Richness	1	1
% Dominant	33.33	45.83
% White sucker	0.00	0.00
% Generalists	58.33	62.50
% Insectivores	25.00	33.33
% Top carnivore	8.33	4.17
Shannon Diversity	1.47	1.24
IBI Score	34	30
IBI Rating	Poor	Poor

INVERTEBRATES	YEAR	
Measure	2017	2019
Abundance	100	100
Richness	18	14
EPT Richness	13	11
NCO Richness	17	13
Diversity	2.33	1.35
Dominance-3	58	81
HBI	3.36	2.86
PMA	72	40
NBI-P	3.06	1.72
BAP	8.65	6.86
BAP Rating	Non	Slight

POESTEN KILL SAMPLING DATA: SITE #13



SITE DESCRIPTION:

Located on Plank Rd, just north of the intersection with Blue Factory Rd. Near the Barberville Falls Nature Preserved. The surrounding land is predominately residential homes. The riparian zone is lined with trees.

SITE COORDINATES:

42.68382 N, -73.54057 W

2017 Downstream View

2017 Upstream View

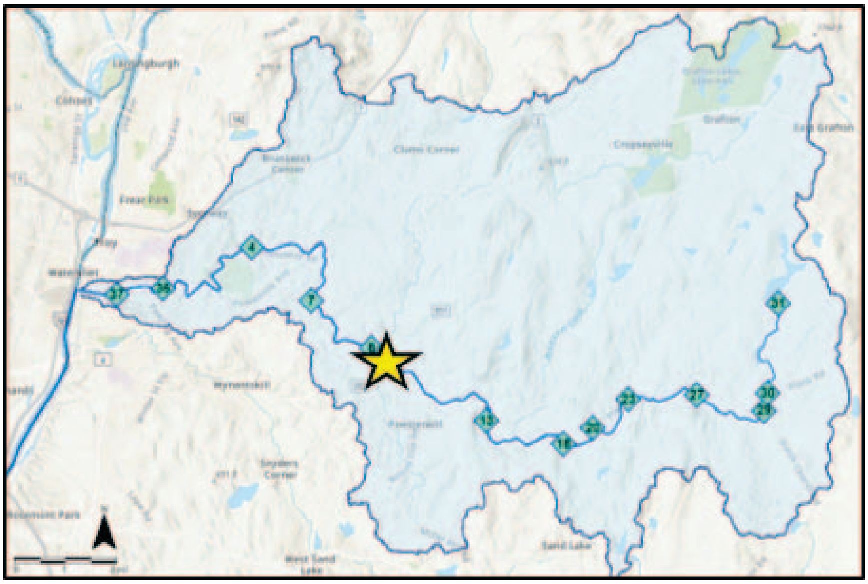
WQ	YEAR
Measure	2017
Temperature	20.69
Conductivity	69
pH	6.86
Turbidity	1.1
Dissolved oxygen	8.9

FISH SPP/COUNT	YEAR
Species	2017
Blacknose Dace	3
Creek Chub	1
Longnose Dace	13
Shiner Spp.	1

FISH IBI	YEAR
Measure	2017
Abundance	18
Total Species Richness	4
Native Species Richness	4
Exotic Species Richness	0
Benthic Insectivore Species Richness	1
Water Column Species Richness	0
Terete minnow Species Richness	1
% Dominant	72.22
% White sucker	0.00
% Generalists	22.22
% Insectivores	72.22
% Top carnivore	0.00
Shannon Diversity	0.85
IBI Score	30
IBI Rating	Poor

INVERTEBRATES	YEAR
Measure	2017
Abundance	100
Richness	19
EPT Richness	13
NCO Richness	18
Diversity	2.39
Dominance-3	56
HBI	3.75
PMA	65
NBI-P	3.13
BAP	8.53
BAP Rating	Non

POESTEN KILL SAMPLING DATA: SITE #9



SITE DESCRIPTION:

Located on Garfield Rd about 400 m north of Main St and the Poestenkill Fire Department. The surrounding land is predominately agricultural. The riparian zone is lined with trees and shrubs.

SITE COORDINATES:

42.70163 N, -73.58137 W

2017 Downstream View

2017 Upstream View

2019 - Chain Pickerel

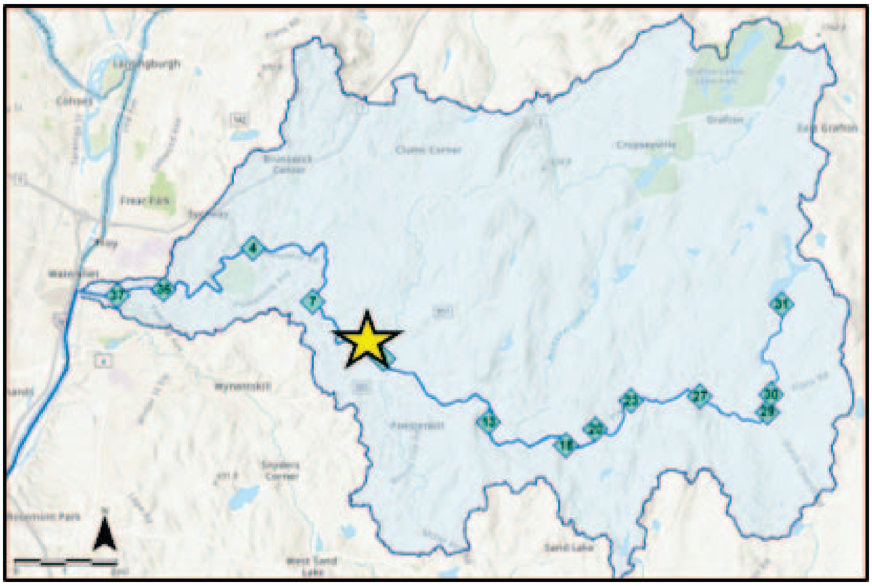
WQ	YEAR	
Measure	2017	2019
Temperature	20.49	17.58
Conductivity	75	86
pH	7.02	7.5
Turbidity	2.2	0
Dissolved oxygen	8.46	9.4

FISH SPP/COUNT	YEAR	
Species	2017	2019
American eel	1	2
Blacknose Dace	9	11
Brown Trout	0	2
Chain Pickerel	0	1
Common shiner	0	21
Creek Chub	5	3
Golden Shiner	0	1
Darter Spp.	2	0
Longnose Dace	14	4
Tessellated Darter	1	2

FISH IBI	YEAR	
Measure	2017	2019
Abundance	32	47
Total Species Richness	6	9
Native Species Richness	6	8
Exotic Species Richness	0	1
Benthic Insectivore Species Richness	3	2
Water Column Species Richness	0	0
Terete minnow Species Richness	1	1
% Dominant	43.75	44.68
% White sucker	0.00	0.00
% Generalists	43.75	76.60
% Insectivores	53.13	12.77
% Top carnivore	3.13	10.64
Shannon Diversity	1.39	1.65
IBI Score	38	34
IBI Rating	Fair	Poor

INVERTEBRATES	YEAR	
Measure	2017	2019
Abundance	100	100
Richness	11	11
EPT Richness	8	7
NCO Richness	10	10
Diversity	1.93	1.70
Dominance-3	60	75
HBI	3.22	4.07
PMA	36	51
NBI-P	4.00	2.62
BAP	6.65	6.39
BAP Rating	Slight	Slight

POESTEN KILL SAMPLING DATA: SITE #8



SITE DESCRIPTION:

This site is located at the Quacken Kill Public Fishing Access on Garfield Rd. Sampling occurred in Poesten Kill, immediately downstream of the confluence with Quacken Kill. The surrounding land is predominately agricultural. The riparian zone is lined with shrubs and trees.

SITE COORDINATES:

442.70457 N, -73.58498 W

2017 Downstream View

2017 Upstream View

2017 - American Eel

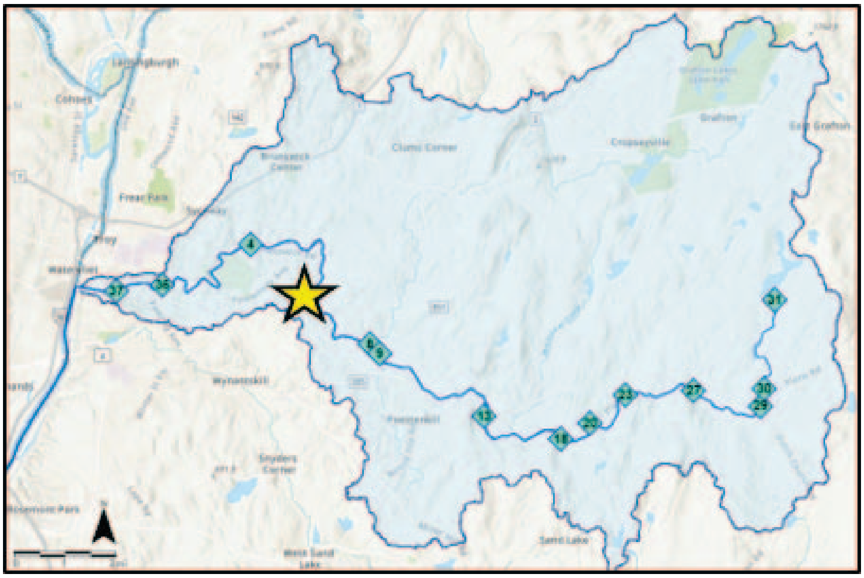
WQ	YEAR	
Measure	2017	2019
Temperature	19.06	18.29
Conductivity	119	118
pH	7.05	7.83
Turbidity	1.1	0.2
Dissolved oxygen	8.94	9.37

FISH SPP/COUNT	YEAR	
Species	2017	2019
American eel	2	0
Blacknose Dace	20	32
Brown Trout	0	10
Common shiner	3	0
Creek Chub	21	27
Longnose Dace	1	7
Pumpkinseed	3	0
Shiner Spp.	1	0
Tessellated Darter	11	3
White Sucker	6	0

FISH IBI	YEAR	
Measure	2017	2019
Abundance	68	79
Total Species Richness	9	5
Native Species Richness	9	4
Exotic Species Richness	0	1
Benthic Insectivore Species Richness	2	2
Water Column Species Richness	0	0
Terete minnow Species Richness	1	1
% Dominant	30.88	40.51
% White sucker	8.82	0.00
% Generalists	77.94	74.68
% Insectivores	17.65	12.66
% Top carnivore	2.94	12.66
Shannon Diversity	1.73	1.33
IBI Score	32	32
IBI Rating	Poor	Poor

INVERTEBRATES	YEAR	
Measure	2017	2019
Abundance	100	100
Richness	15	17
EPT Richness	9	12
NCO Richness	14	16
Diversity	2.07	2.08
Dominance-3	64	63
HBI	3.94	4.11
PMA	70	63
NBI-P	4.36	4.53
BAP	7.88	8.14
BAP Rating	Non	Non

POESTEN KILL SAMPLING DATA: SITE #7



SITE DESCRIPTION:

Located on Creek Rd, approximately 0.5 miles south of Brunswick Rd at a Public Fishing Access location. The surrounding land is predominately made up of agriculture and residential homes. This site has a very wide stream width and is shallow. The riparian zone of the stream is lined with trees.

SITE COORDINATES:

42.71778 N, -73.60834 W

2019 Downstream View

2019 Upstream View

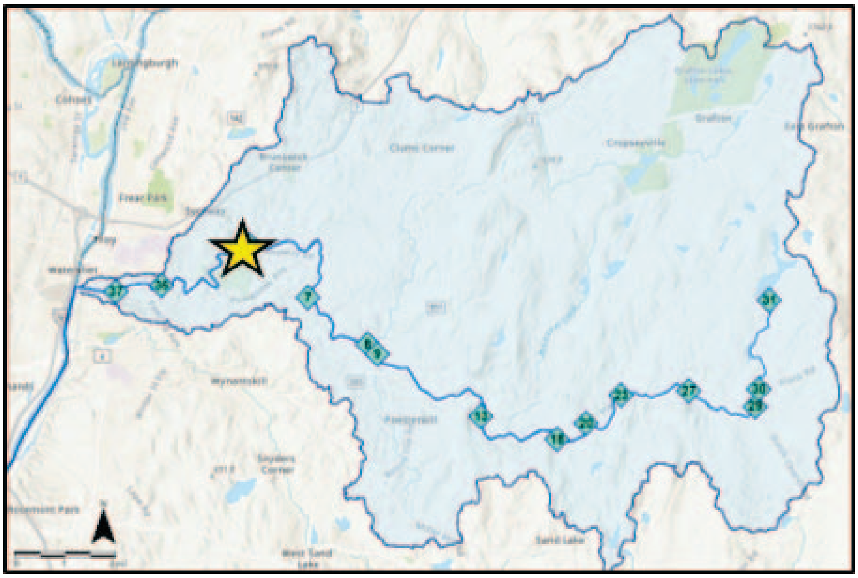
WQ	YEAR	
Measure	2017	2019
Temperature	20.87	18.99
Conductivity	105	110
pH	7.19	7.7
Turbidity	3.3	0.1
Dissolved oxygen	9.1	9.24

FISH SPP/COUNT	YEAR	
Species	2017	2019
Blacknose Dace	6	14
Brown Trout	0	1
Common shiner	0	5
Creek Chub	1	7
Longnose Dace	2	7
Pumpkinseed	1	0
Spotfin Shiner	0	12
Tessellated Darter	30	13
White Sucker	3	0

FISH IBI	YEAR	
Measure	2017	2019
Abundance	43	59
Total Species Richness	6	7
Native Species Richness	6	6
Exotic Species Richness	0	1
Benthic Insectivore Species Richness	2	2
Water Column Species Richness	0	1
Terete minnow Species Richness	1	2
% Dominant	69.77	23.73
% White sucker	6.98	0.00
% Generalists	25.58	44.07
% Insectivores	74.42	45.90
% Top carnivore	0.00	1.69
Shannon Diversity	1.02	1.78
IBI Score	32	40
IBI Rating	Poor	Fair

INVERTEBRATES	YEAR	
Measure	2017	2019
Abundance	100	100
Richness	10	18
EPT Richness	7	11
NCO Richness	10	17
Diversity	1.88	2.33
Dominance-3	70	57
HBI	3.29	5.09
PMA	28	87
NBI-P	3.98	4.91
BAP	6.16	8.36
BAP Rating	Slight	Non

POESTEN KILL SAMPLING DATA: SITE #4



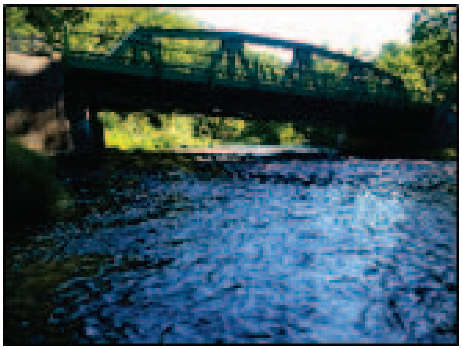
SITE DESCRIPTION:

Located north of the intersection of Brunswick Rd (Rte 2) and Shippey Lane. The surrounding land is predominately made up of forest and residential homes. The riparian zone is lined with trees.

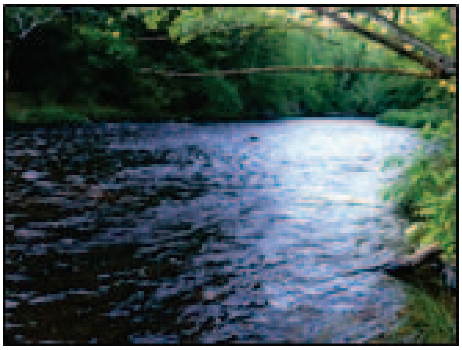
SITE COORDINATES:

42.73293 N, -73.63136 W

2017 Downstream View



2017 Upstream View



2019 - Brownhead Bull

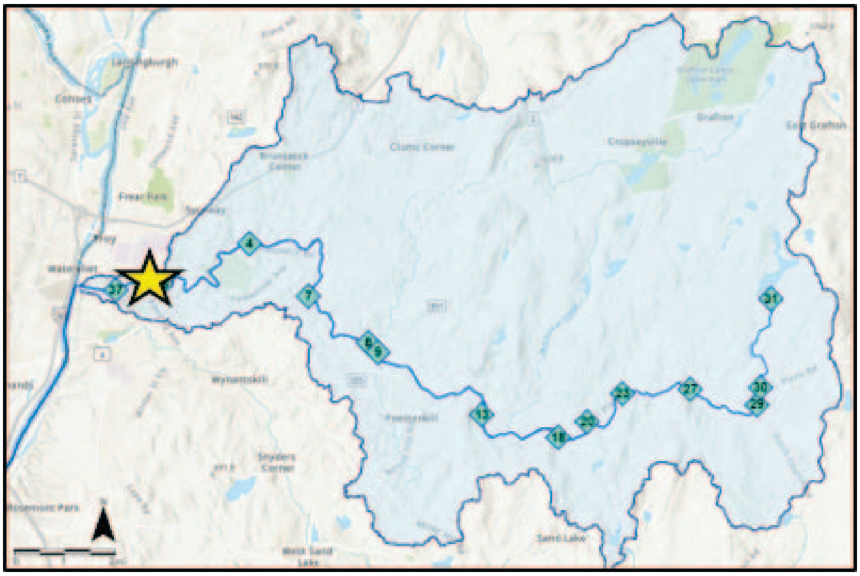
WQ	YEAR	
Measure	2017	2019
Temperature	21.49	19.07
Conductivity	110	116
pH	7.73	7.88
Turbidity	4.8	0
Dissolved oxygen	9.04	9.46

FISH SPP/COUNT	YEAR	
Species	2017	2019
American eel	1	0
Blacknose Dace	39	1
Brown Bullhead	0	1
Common shiner	0	2
Creek Chub	12	4
Longnose Dace	16	27
Pumpkinseed	2	0
Spotfin Shiner	1	1
Tessellated Darter	4	0
White Sucker	1	0
Yellow Perch	1	0

FISH IBI	YEAR	
Measure	2017	2019
Abundance	77	36
Total Species Richness	9	6
Native Species Richness	9	6
Exotic Species Richness	0	0
Benthic Insectivore Species Richness	2	1
Water Column Species Richness	1	1
Terete minnow Species Richness	1	2
% Dominant	50.65	75.00
% White sucker	1.30	0.00
% Generalists	70.13	22.22
% Insectivores	26.97	76.00
% Top carnivore	2.60	0.00
Shannon Diversity	1.43	0.92
IBI Score	34	34
IBI Rating	Poor	Poor

INVERTEBRATES	YEAR	
Measure	2017	2019
Abundance	100	100
Richness	14	14
EPT Richness	8	11
NCO Richness	13	13
Diversity	1.89	2.06
Dominance-3	67	61
HBI	3.91	5.27
PMA	39	75
NBI-P	6.32	5.62
BAP	8.28	9.35
BAP Rating	Non	Non

POESTEN KILL SAMPLING DATA: SITE #36



SITE DESCRIPTION:

Located immediately north of the Elmwood Hill Cemetery, located off of Pinewoods Ave. Access to the site occurred from the northern edge of the cemetery. The surrounding land is predominately forest. The riparian zone is lined with shrubs and trees. This site sits below a cemetery.

SITE COORDINATES:

42.72135 N, -73.66551 W

2017 Largemouth Bass

2019 Upstream View

2019 Rock Bass

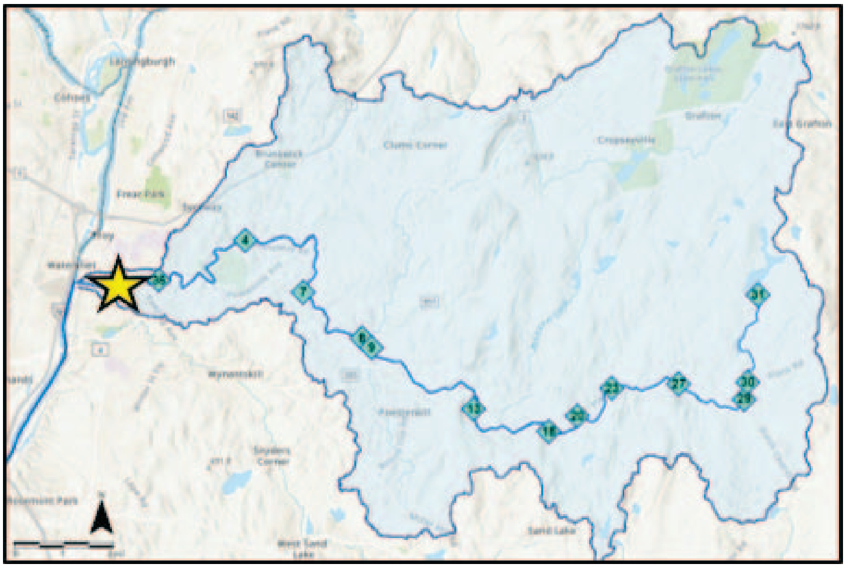
WQ	YEAR	
Measure	2017	2019
Temperature	21.26	17.8
Conductivity	123	134
pH	7.94	7.84
Turbidity	3.7	0
Dissolved oxygen	9.79	9.71

FISH SPP/COUNT	YEAR	
Species	2017	2019
American eel	1	0
Blacknose Dace	0	4
Bluegill	5	1
Common shiner	0	7
Creek Chub	1	7
Largemouth Bass	1	0
Longnose Dace	0	2
Pumpkinseed	4	0
Rock Bass	3	9
Spotfin Shiner	2	2
Tessellated Darter	3	4
White Sucker	0	1
Yellow Perch	1	0

FISH IBI	YEAR	
Measure	2017	2019
Abundance	21	37
Total Species Richness	9	9
Native Species Richness	9	9
Exotic Species Richness	0	0
Benthic Insectivore Species Richness	1	2
Water Column Species Richness	1	1
Terete minnow Species Richness	1	2
% Dominant	23.81	24.32
% White sucker	0.00	2.70
% Generalists	47.62	54.05
% Insectivores	16.29	18.22
% Top carnivore	28.57	24.32
Shannon Diversity	2.02	1.96
IBI Score	34	38
IBI Rating	Poor	Fair

INVERTEBRATES	YEAR	
Measure	2017	2019
Abundance	100	100
Richness	17	13
EPT Richness	12	7
NCO Richness	16	12
Diversity	2.23	1.72
Dominance-3	60	79
HBI	3.99	5.19
PMA	45	51
NBI-P	4.87	6.47
BAP	7.56	8.25
BAP Rating	Non	Non

POESTEN KILL SAMPLING DATA: SITE #37



SITE DESCRIPTION:

Located at end of Hill St, immediately northwest of Poesten Kill Gorge Park. The surrounding land is predominately made up of residential homes. This site marks the furthest downstream site closest to the Hudson River. The surrounding banks slope down at a very steep angle making this site difficult to access.

SITE COORDINATES:

42.71952 N, -73.68353 W

2017 Upstream View

2019 American Eel

WQ	YEAR	
Measure	2017	2019
Temperature	20.33	18.14
Conductivity	156	139
pH	7.65	7.86
Turbidity	2.1	0.9
Dissolved oxygen	9.42	9.66

FISH SPP/COUNT	YEAR	
Species	2017	2019
American eel	24	12
Rock Bass	0	1

FISH IBI	YEAR	
Measure	2017	2019
Abundance	24	13
Total Species Richness	1	2
Native Species Richness	1	2
Exotic Species Richness	0	0
Benthic Insectivore Species Richness	0	0
Water Column Species Richness	0	0
Terete minnow Species Richness	0	0
% Dominant	100.00	92.31
% White sucker	0.00	0.00
% Generalists	0.00	0.00
% Insectivores	0.00	0.00
% Top carnivore	100.00	100.00
Shannon Diversity	0.00	0.27
IBI Score	32	32
IBI Rating	Poor	Poor

INVERTEBRATES	YEAR	
Measure	2017	2019
Abundance	100	100
Richness	17	11
EPT Richness	14	9
NCO Richness	16	10
Diversity	2.34	1.46
Dominance-3	55	85
HBI	3.9	5.33
PMA	40	51
NBI-P	4.19	5.88
BAP	7.62	8.27
BAP Rating	Non	Non