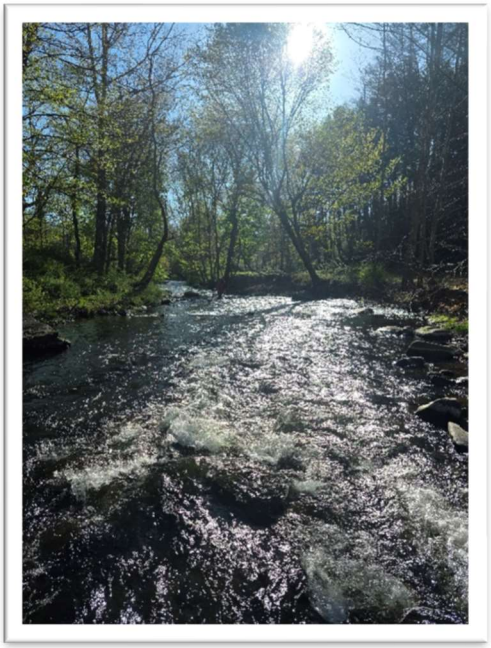
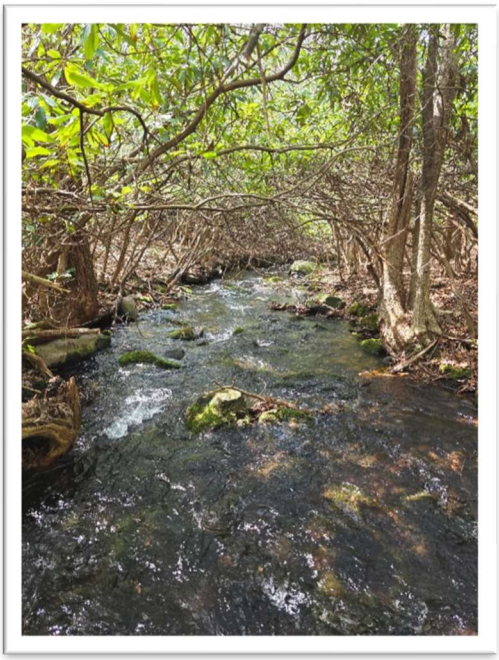
2026

Monroe County Water Quality Study









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Section I. Materials and Methods

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Field Chemistry Sampling

Field chemistry sampling was conducted using a hand-held YSI Professional Digital Sampling System (ProDSS) multiparameter water quality meter. The meter was calibrated to known standards/solutions at the beginning of each sampling day, and the following parameters were collected and recorded on standard data forms at each site.

- Temperature
- Dissolved Oxygen (D.O.) Concentration
- Dissolved Oxygen (D.O.) %
- Conductivity



Figure 1: Sample collection for lab analysis

Laboratory Chemistry Sampling

Chemical sampling was conducted using sampling bottles and directives by Microbac Laboratories. The samples were transported on ice to their facility via courier at the end of each sampling day. The following table shows the parameters that were collected and analyzed for each sampling location:

Table 1: Chemical testing parameters by Microbac Laboratories

Test	Units	Method	Reporting Limit (RL)
Nitrate Calculated	mg/L	EPA 353.2, Rv. 2 (1993)	0.0500
Biochemical Oxygen Demand (BOD5)	mg/L	SM 5210 B-2011	3.00
Hardness (as $CaCO_3$)	mg/L	Calculation by ICP	0.999
Aluminum	mg/L	EPA 200.7, Rv. 4.4 (1994)	0.160
Calcium	mg/L	EPA 200.7, Rv. 4.4 (1994)	0.400
Iron	mg/L	EPA 200.7, Rv. 4.4 (1994)	0.0800
Magnesium	mg/L	EPA 200.7, Rv. 4.4 (1994)	0.400
Chloride	mg/L	EPA 300.0, Rv. 2.1 (1993)	0.50
Alkalinity, Total to $CaCO_3$ to pH 4.5	mg $CaCO_3$/L	SM 2310 B-2011	6.0
Total Dissolved Solids (TDS)	mg/L	SM 2540 C-2011	10.0
pH	N/A	SM 4500-H+ B-2011	1.0
Ammonia as N	mg/L	SM 4500-NH3 F-2011	0.30
Total Kjeldahl Nitrogen (TKN)	mg/L	SM 4500-NH3 F-2011	1.25
Phosphorus, Total as P	mg/L	SM 4500-P E-2011	0.020
Total Organic Carbon (TOC)	mg/L	SM 5310 C-2011	0.50

Macroinvertebrate Sampling

Collection of macroinvertebrates began with delineating a 100-meter reach of each sampling location that best represented the habitat of the stream. Collections would be distributed throughout the 100-meter reach and would represent the variety of habitats shown in the bullet points below. In each case, macroinvertebrates were collected using a 12" 500 micron D-frame net that was held downstream from the substrate disturbance. The collection would be moved upstream along the 100-meter reach to limit disturbance to the study area. Six one-minute kicks were used in each of the riffle/run habitats and ten jabs or kicks were used in the multi-habitat locations (*Shull & Lookenbill, 2023*).

Riffle/Run Habitat – Six samples within 100-meter reach

- Fast/Shallow
- Fast/Deep
- Slow/Shallow
- Slow/Deep



Figure 2: Riffle/Run Habitat

Multi-Habitat/Low Gradient Collection – Ten samples within 100-meter reach

- Cobble/Gravel
- Snag
- Coarse Particulate Organic Matter (CPOM)
- Submerged Aquatic Vegetation (SAV)
- Sand/Fine Sediment



Figure 3: Multi-Habitat/Low Gradient

Each sample was placed in a round, wide-mouth plastic jar containing 95% ethanol and delivered to Michael D. Bilger for macroinvertebrate identification and analysis.

Habitat Analysis

Each sampling location was assessed as riffle/run or low gradient depending on the habitat. Each parameter listed below was rated as 1-20; 20 being the highest score possible. (*Shull & Lookenbill, 2023).*

Riffle/Run Streams
Instream Cover
Epifaunal Substrate
Embeddedness
Velocity/Depth Regimes
Channel Alteration
Sediment Deposition
Riffle Frequency
Channel Flow Status
Condition of Banks
Bank Vegetative Protection
Grazing or Other Disruptive Pressure
Riparian Vegetative Zone

Low Gradient Streams
Epifaunal Substrate/Available Cover
Pool Substrate Characterization
Pool Variability
Sediment Deposition
Channel Flow Status
Channel Alteration
Condition of Banks
Bank Vegetative Protection
Riparian Vegetative Zone



Figure 4: Riffle/Run Stream

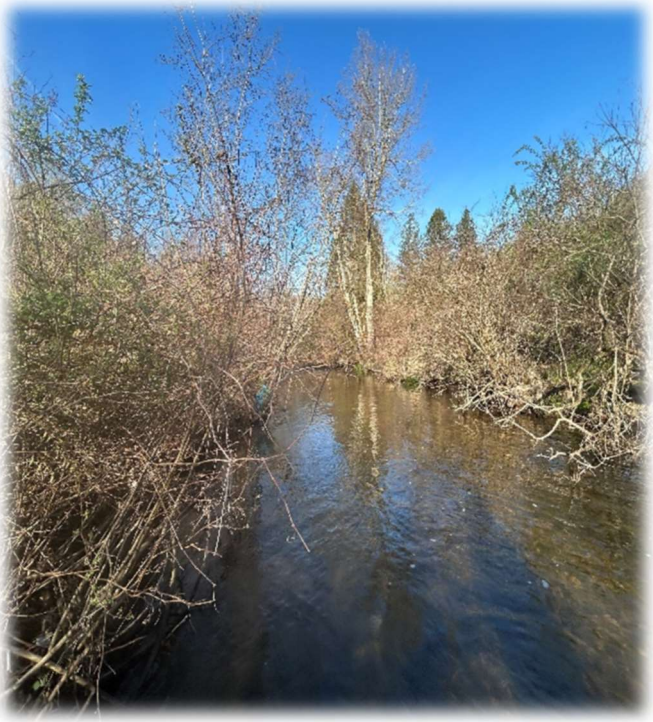


Figure 5: Multi-Habitat/Low Gradient

Section II. Surface Water Parameters

Field Measurements

Potential of Hydrogen (pH)

pH is an expression of the hydrogen ion concentration in water. The pH scale is used to determine the acidity or basicity of a solution on a scale of 0 to 14, with pH 7 being neutral. When the pH of a solution is below 7, the solution is acidic. If the pH of a solution is above 7, the solution is basic. pH impacts most chemical and biological process in water and different species flourish within different ranges of pH. Most aquatic organisms have an optimal pH range between 6.5 - 8. Slight changes in pH can shift community composition in streams. This is because pH alters the chemical state of many pollutants, changing their solubility, transport, and bioavailability. This can increase the exposure to and toxicity of metals and nutrients to aquatic organisms (EPA, 2018).

Temperature

Water temperature is influenced by many atmospheric and hydrologic processes and plays a fundamental role in shaping the structure and function of aquatic systems. Even a slight change in temperature can affect aquatic organism survival, growth, reproduction, and development. The temperature of the stream is also used as the basis for classifying streams. (EPA, 2018)

Dissolved Oxygen (DO)

Dissolved oxygen refers to the concentration of oxygen gas incorporated in water. It enters the water through direct absorption from the atmosphere and is enhanced by turbulence. Sufficient DO is essential to the growth and reproduction of aerobic aquatic life. Sources from non-point or point source runoff, impoundments, treatment outfalls, and removal of riparian vegetation can impact the DO of a water body (EPA, 2018). In 25 Pa Code Chapter 93.7, the current DO criteria for flowing waters is: CWF; 7-day average 6.0 mg/L; minimum 5.0 mg/L. WWF; 7-day average 5.5 mg/L; minimum 5.0 mg/L. TSF; For the period February 15 to July 31 of any year, 7-day average 6.0 mg/L; minimum 5.0 mg/L. For the remainder of the year, 7-day average 5.5 mg/L; minimum 5.0 mg/L.

Specific Conductance

Conductivity is a measure of waters ability to pass an electrical current and is used as a general measure of water quality. Dissolved salts and other inorganic compounds conduct electrical currents so as salinity in a waterbody increases, conductivity increases. Significant changes in the conductivity could be an indicator of a discharge or other source of pollution that is influencing the aquatic system (EPA, 2016). The conductivity in the United States can range from 50 to 1500 µS/cm, but inland freshwater streams supporting good mixed fisheries generally range from 150 to 500 µS/cm (EPA, 2012).

Water Chemistry Laboratory Analysis

Nitrogen

Nitrogen can be found in several types of species throughout the natural environment. Through nitrification and denitrification, bacteria can convert nitrogen which can increase or decrease availability of this essential limiting nutrient in a system. Nitrification is when bacteria transform ammonia (NH_3) into nitrite (NO_2^-) and then to nitrate (NO_3^-), and denitrification is when bacteria convert nitrate to nitrite and then nitrogen gas. Additionally, ammonia can be transformed from ammonium into low oxygen environments. Excessive nutrients in surface water promote eutrophication which is when algae and bacterial blooms are stimulated and causes a decrease in oxygen to other aquatic organisms. Sources such as fertilizer, effluent from treatment plants, urban stormwater runoff, and livestock waste can all contribute to an influx of nitrogen into a system (EPA, 2006). Early laboratory studies demonstrated that the lethal concentrations for a variety of fish range between 0.2 to 2.0 mg/L NH_3 with trout being the most sensitive species (EPA, 1976).

Biological Oxygen Demand (BOD)

BOD measures how much oxygen is consumed while microorganisms decompose organic matter. This directly affects the amount of oxygen dissolved. The higher the BOD, the more rapidly oxygen is consumed. Sources of BOD can include leafy debris, dead organisms, effluent wastewater treatment plants, urban storm water runoff, and feedlots. Generally, unpolluted natural waters have <5 mg/L BOD levels (EPA, 2006).

Total Hardness

Water hardness is caused by metallic ions, primarily calcium and magnesium, dissolving in water. Other metals such as iron, strontium, and manganese can also contribute to the hardness. Natural contributors of water hardness include dissolved limestone, however, inorganic chemical industries and abandoned mines can also contribute to increased water hardness (EPA, 1986). According to the USGS Water Science School (n.d.), general classification of waters are:

Soft Water	0 - 60 mg/L
Moderately Hard Water	60 - 120 mg/L
Hard Water	120 - 180 mg/L
Very Hard Water	180 mg/L and up

Aluminum

Aluminum is a natural element found in rocks and soil that can enter the water through natural processes. It can also be released by activities like mining and industrial processes that use aluminum. Elevated levels of aluminum in surface water can affect aquatic organism's ability to regulate ions and inhibit respiratory function. According to 25 Pa Code Chapter 93.8c, the water quality criteria for toxic substances maximum concentration is 750 µg/L. According to the Final Aquatic Life Ambient Water Quality Criteria for Aluminum, the concentration varied as a function of the sites pH, DOC, and total hardness but ranged between 1-4,800 µg/L (EPA, 2018).

Calcium
Calcium is a naturally occurring element in water bodies due to its abundance in the earth's crust. It enters waterways through the erosion process of sedimentary rocks such as limestone. It is a contributor of water hardness and can influence pH because of its buffering quality. Rivers generally contain 1-2 mg/L calcium. In limestone areas, rivers may contain calcium concentrations as high as 100 mg/L (Lenntech, 2020). Higher concentrations of calcium can be found in downstream sections of waterbodies.

Total Kjeldahl Nitrogen
T.K.N is the sum of free ammonia and organic nitrogen compounds. Samples in the field are preserved by the addition of Sulfuric Acid (H_2SO_4) (EPA, 1993).

Iron
Iron is the fourth most found element in the earth's crust which enters waterbodies in varying quantities depending on the surrounding geological formations and hydrological processes. In the aquatic environment there are two types of iron of most concern ferrous (Fe^{2+}) and ferric (Fe^{3+}), although other forms can be found. Ferrous iron can originate from mining operations and inorganic wastewater and can persist in anaerobic conditions. Ferric iron is highly insoluble and can originate from industrial waste or mine drainage (EPA, 1976).

Magnesium
Magnesium is the eighth most abundant element found in the earth's crust and is frequently used in manufacturing, fertilizer, and animal feed. Along with calcium, it contributes to the hardness and salinity of waterbodies (USGS, 2001).

Chloride
Chlorides are salts resulting from the combination of chlorine gas with metal. The major anthropogenic sources of chloride are deicing salts, urban and agricultural runoff, and effluent from wastewater plants (EPA, 1988). The EPA maximum criteria for chloride are 250 mg/L (25 Pa. Code § 93.7).

Total Organic Carbon (TOC)
TOC is the measure of the total amount of carbon in organic compounds in a water sample (Whitehead, 2020). This measurement is important to characterize the amount of oxygen being used by microorganisms thereby depleting the oxygen availability of other aquatic organisms. The samples collected in the field were preserved by the addition of 1 mL of sulfuric acid (H_2SO_4).

Total Alkalinity
Alkalinity is the measure of the capacity of water to neutralize acids. Alkaline compounds do this by combining with hydrogen ions to increase the pH of the solution. Alkalinity is influenced by geologic formations, salts, plant activity, and wastewater effluent. The ability for water to resist drastic pH change is crucial to the survival of aquatic life (EPA, 2006). The minimum criteria from EPA for alkalinity is a minimum of 20 mg/L as $CaCO_3$, except where natural conditions are less. If so, the discharge to the waterway should not further reduce the alkalinity of the receiving waters (25 Pa. Code § 93.7).

Total Dissolved Solids (TDS)

Total Solids refers to the suspended or dissolved matter that is left over after the sample of water is evaporated. Total Dissolved Solids are determined after the matter is filtered through a 2 μm or smaller pore size filter which retains the suspended particles. Regular monitoring can assist in determining increased erosion or sedimentation influx into the waterway (EPA, 2006). The criteria for TDS is 500 mg/L as a monthly average or a maximum value of 750 mg/L (25 Pa. Code § 93.7).

Total Phosphorus

Total phosphorus refers to the dissolved and particulate forms of phosphorus in a water sample. Phosphorus is an essential nutrient that can enter waterbodies in numerous ways. Fertilizers, waste treatment effluent, and agricultural/urban runoff are a few examples of how phosphorus can enter a system. Phosphorus tends to attach to soil particles, making them easily transported during high runoff events. Excessive nutrients in surface water promote eutrophication which is when algae and bacterial blooms are stimulated and causes a decrease in oxygen to other aquatic organisms (EPA, 2006).

Field Measurement Data Form

2026 Monroe County Water Quality Study Field Data Form			
Site Information			
Stream ID		Date	
		Time	
Stream Name		Air Temp	
Latitude DMS		Weather	
Longitude DMS		Studied by	
Location Description:			

Field Chemistry

Make sure there is complete mixing (similary readings across the stream)	pH	Dissolved Oxygen		Conductance		Temp (°C)
		%DO	mg/L DO	(µS/cm)	TDS (mg/L)	
Right Bank						
Right of Center						
Thalweg						
Left of Center						
Left Bank						

Macroinvertebrates Sampling

(12" diameter D-Frame net)

Multihabitat (10 samples)			Riffle/Run (6 Samples)		
Choose 10 sites based on in stream abundance	Target	Talley	At least 1 of each flow regimes	Talley	**Comments:**
Cobble/Gravel			slow/shallow		
Snag			fast/shallow		
CPOM			slow/deep		
Submerged Aquatic Veg			fast/deep		
Sand/Fine Sediment			**Total**	**6**	

Comments:

Section III. Benthic Macroinvertebrates

What Are Macroinvertebrates?

The organisms collected during the water quality study are called benthic macroinvertebrates. Benthic defines the zone in which they occupy which is on, in, or near the stream bottom. Macroinvertebrates are animals without a backbone and large enough to see with the naked eye. Macroinvertebrates are an important link in the food web between producers and higher consumers such as fish. They are commonly used to study water quality for several reasons: They are fairly easy to sample and identify, they are sensitive to pollution and changes in their habitats, they are common in most streams and rivers, and they offer an indicator of water quality over time due to their relatively long-life cycle (Stroud Water Research, 2020).



Figure 6: Collecting macroinvertebrates.

Macroinvertebrates can be divided into several groups based on pollution tolerance. Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) and many others can be an indicator of the best water quality because they are intolerant of frequent or prolonged pollution in their habitats. Macroinvertebrates such as aquatic worms and blood midge larvae can tolerate a significant amount of pollution but can also live in a broader range of quality conditions. The ongoing collection of macroinvertebrate populations can indicate drastic change in conditions, offer a clearer picture of water quality, and provide overall environmental oversight in a stream (Penn State Extension, 2020).

Chalfant (2012) defines how PADEP assigns numeric pollution tolerance values (PTV) to most macroinvertebrates found in Pennsylvania in *A benthic index of biotic integrity for wadeable freestone streams in Pennsylvania*. The values range from zero to ten, with ten representing a relative tolerance for pollution. Most of the values reflect the response to pollution related to organic enrichment and sedimentation and not necessarily reflect other types of pollution such as low pH related to stream acidification.

Macroinvertebrate Analysis

The PA Department of Environmental Protection (PADEP) has designed several assessment methods for Aquatic Life Use determinations based on the type of biological attributes and gradient conditions of a stream. For the Monroe County study sampling locations, the wadeable freestone riffle-run stream macroinvertebrate assessment method and the wadeable multihabitat stream macroinvertebrate assessment method was applied and described below. The published protocols and equations are designed to find the index of biotic integrity (IBI). This index helps to quantify the health of the stream and assist in management decisions (Shull & Pulket, 2023).

Aquatic Life Use (ALU) Attainment Benchmarks

PADEP implemented a multi-tiered benchmark decision flowchart (Figure 8) for the decision process of assessing if a wadeable, freestone, or riffle-run stream has achieved its attainment. The simplified matrix should guide most decisions however; situations exist where the simplified matrix will not apply exactly as outlined.

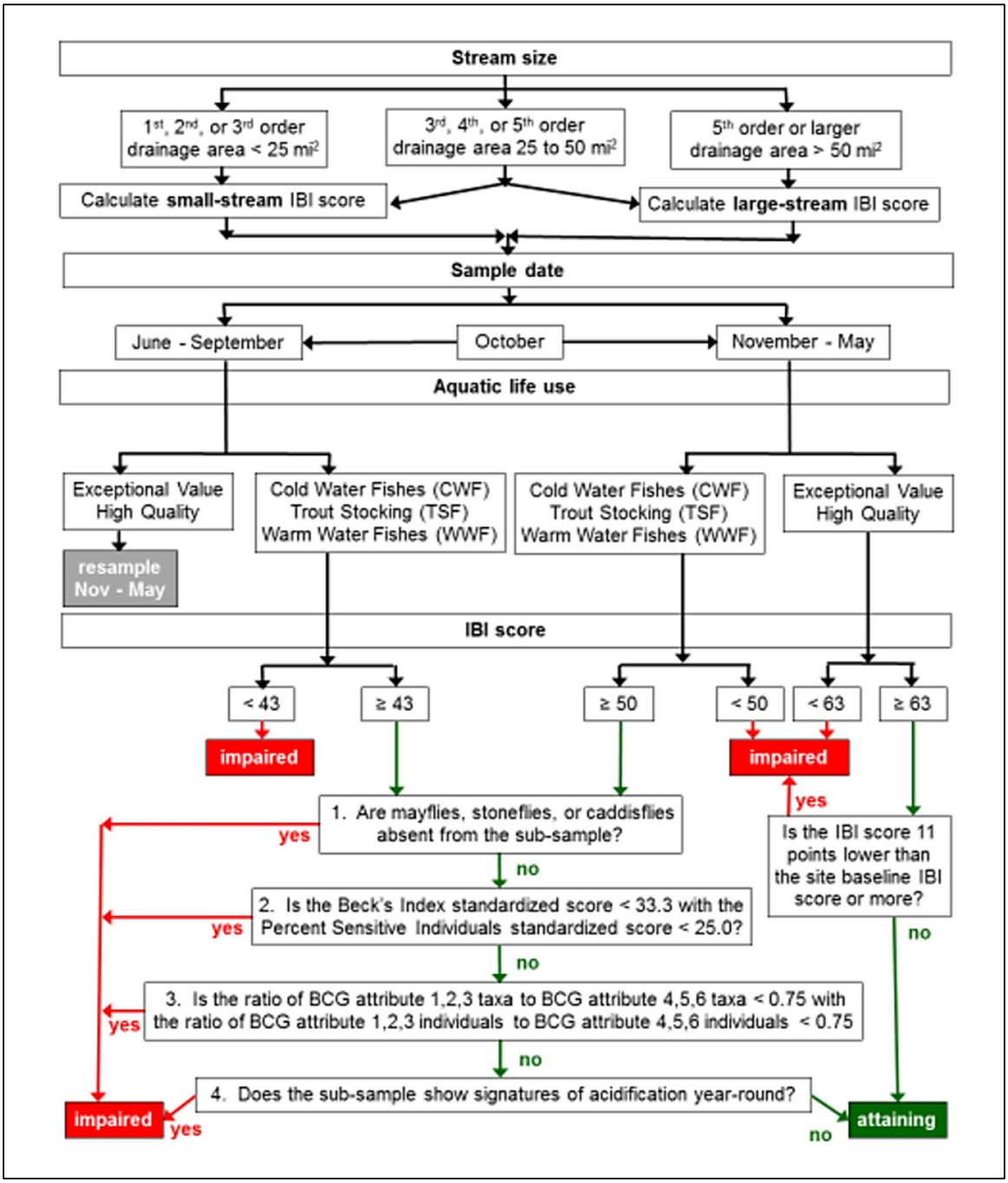


Figure 7: Aquatic Life Use Simplified Assessment Schematic (Shull & Pulket, 2023).

For further clarification on the Aquatic Life Uses 25 Pa. Code § 93 offers the water quality criteria defined by the Pennsylvania Water Quality Standards.

Considerations for the stream that must be made prior to analyzing the IBI are shown in Figure 8.

- **Stream Size:** This is based on considerations given by DEP in the *Assessment Methodology for Rivers and Streams* (2023) and discussed above.
- **Sample Date:** The Monroe County water quality study is conducted annually between April and May
- **Aquatic Life Use:** The stream designated use is defined in 25 Pa. Code § 93.9 and the existing use is defined in PADEP's *Existing Use Classification* (2025). These are noted prior to approaching this benchmark.

For samples collected in Exceptional Value (EV) or High Quality (HQ) streams, a score of ≥ 63 results in ALU attainment if the IBI score is not lower than the baseline when available. A score of < 63 means that the stream was potentially not attaining its Aquatic Life Use when it was sampled. For streams designated Cold Water Fishery (CWF), Trout Stocked Fishery (TSF), or Warm Water Fishery (WWF), an IBI score < 50 means that the stream was potentially not attaining its Aquatic Life Use when it was sampled. Additionally, the following evaluations should be used to determine attainment in CWF, WWF, and TSF, regardless of the IBI (Shull & Pulket, 2023).

1. **Are mayflies, stoneflies, or caddisflies absent from the sub-sample?** These organisms are typically found in most healthy streams therefore if any or all of these orders are absent, it could indicate some sort of impact to the stream. Note that this question does not have to be applied to samples from larger streams and samples collected between June and September but must be applied to small stream samples collected between November and May.
2. **Is the standardized metric score for the Beck's Index metric < 33.3 with the standardization metric score for the Percent Sensitive Individuals metric < 25.0?** This serves as a double check that the sample has substantial richness and abundance of the most sensitive organism.
3. **Is the ratio of Biological Condition Gradient (BCG) attribute 1, 2, 3 taxa to BCG attribute 4, 5, 6 taxa < 0.75 with the ratio of BCG attribute 1, 2, 3 individuals to BCG attribute 4, 5, 6 individuals < 0.75?** This evaluates the balance of pollution tolerant organisms with sensitive organisms in terms of taxonomic richness and organismal abundance. This question must be applied to small-stream samples collected between November and May but does not have to be applied to samples from larger streams and samples collected between June and September.
4. **Does the sub-sample show signatures of acidification year-round?** The primary acidification signatures in a sub-sample include low mayfly abundance and low mayfly diversity (i.e., scarce mayfly individuals and few mayfly taxa), especially when combined with high abundance of Amphinemura and/or Leuctra stoneflies, occasionally combined with high abundance of Simuliidae and/or Chironomidae individuals. This information can be difficult to determine if low pH conditions are natural, so sampling water chemistry and/or fish communities can inform the assessment. With this protocol, PADEP will only list

impaired sites that show persistent acidification signatures year-round (Shull & Pulket, 2023).

Large vs. Small Stream Metric Standardization

To account for differences in habitat and water quality found in large and small streams, different standardization values are used for the above-mentioned metrics. Table 2 provides the standardization values used in small and large stream evaluations. Generally, the small stream values are used for first, second, and third order streams draining less than 25 mi^2, while larger stream values are appropriate for fifth and larger streams draining more than 50 mi^2. PADEP does not set a single cutoff for drainage area or stream order and offers other screening considerations when making an assessment decision (Shull & Pulket, 2023).

Table 2: Metric standardization values for small and large streams (Shull & Pulket, 2023).

Metric	**Metric Standardization Values**	
	Smaller Streams	**Larger Streams**
Total Taxa Richness	33	31
EPT Taxa Richness	19	16
Beck's Index	38	22
Hilsenhoff Biotic Index	1.89	3.05
Shannon Diversity	2.86	2.86
Percent Sensitive Individuals	84.5	66.7

Table 3 shows the process for index calculations to ultimately obtain an IBI for each sampling site. The average sum of these specific metric equations constructs an IBI, which then can be related to reflect the ecology and impacts to the aquatic community being studied.

Table 3: Index calculation process for freestone riffle/run streams (Shull & Pulket, 2023).

Metric	**Standardization Equation** (using small-stream standardization values)	**Observed Metric Value**	**Standardized Metric Score**	**Adjusted Standardized Metric Score** Maximum = 100
Total Taxa Richness	(Observed value / 33)*100			
EPT Taxa Richness	(Observed value / 19)*100			
Beck's Index	(Observed value / 38) *100			
Hilsenhoff Biotic Index	[(10-observed value) / (10-1.89)] *100			
Shannon Diversity	(Observed / 2.86)*100			
Percent Sensitive Individuals	(Observed value / 84.5)*100			
Average of adjusted standardized metric scores = **IBI Score** =				

Wadeable Freestone Riffle-Run Stream

The metrics used to evaluate the macroinvertebrate population in freestone riffle-run streams exhibited a strong ability to distinguish between pristine and heavily impacted conditions while measuring different aspects of the benthic macroinvertebrate communities.

Freestone riffle/run stream macroinvertebrate collection is conducted with a D-framed net with 500 µm mesh. A 100-meter reach is chosen which best represents the ideal habitats describe in the methods section. Each of the six kicks disturbs 1 m^2 of substrate immediately upstream of the net to an approximate depth of 10 cm. The kicks are completed from downstream to upstream to avoid disturbance (Shull & Lookenbill, 2023). Once the sampling is complete, each sample is composited into one container preserved with 95% ethanol in the field and transported to the contracted entomologist for enumeration and identification.

The following metric descriptions are from Shull & Pulket (2023) Wadeable Freestone Riffle-run Stream Macroinvertebrate Assessment Method in PA DEPs *Assessment Methodology for Rivers and Streams*:

Total Taxa Richness

This metric is the count of the total number of taxa in a sub-sample. As anthropogenic stress increases on a stream ecosystem, it is expected that the total taxa will decrease while generally increasing the dominance of a few pollutant tolerant taxa.

EPT Taxa Richness

EPT taxa richness metric is the count of the number of taxa belonging to the orders Ephemeroptera, Plecoptera, and Trichoptera (EPT) in a sub-sample. The aquatic life stages of these three insect orders are generally considered sensitive to, or intolerant of, many types of pollution (Lenat and Penrose 1996), although sensitivity to different types of pollution varies among taxa in these insect orders. The version of this metric used here only counts EPT taxa with pollution tolerance values (PTVs) of 0 to 4, excluding a few of the most tolerant mayfly and caddisfly taxa. This metric is expected to decrease in value with increasing anthropogenic stress to a stream ecosystem, reflecting the loss of taxa from these largely pollution-sensitive orders.

Modified Beck's Index *(Version 3)*

Modified Beck's index is a weighted count of taxa with a pollution tolerance value of 0, 1, or 2. The metric is expected to decrease as anthropogenic stress is increased. It should be noted that the version of the Beck's Index metric used for riffle/run evaluations, although similar in name and concept, differs slightly in its calculation from the Beck's Index used in DEP's multihabitat protocol for assessing biological condition of low gradient, pool-glide type streams.

Shannon Diversity
This index measures taxa abundance and evenness in the sub-sample by dividing the # of individuals in a taxon by the total # of individuals in the sub-sample and then multiplying by the natural logarithm of this proportion. This is done for all taxa in the sub-sample; the products are then summed and the answer multiplied by -1.

$$= -1 \left(\sum_{i=1}^{Rich} [(n_i/N) \ ln(n_i/N)] \right)$$

Where ni = the number of individuals in each taxon (relative abundance); N = the total number of individuals in a sub-sample; and Rich = the total number of taxa in a sub-sample (total taxa richness).

Hilsenhoff Biotic Index
This community composition and tolerance metric is calculated as an average of the number of individuals in a sub-sample, weighted by pollution tolerance values. The index increases with ecosystem stress and reflects increasing dominance of pollution tolerant organisms.

Percent Sensitive Individuals
This community composition and tolerance metric is the percentage of individuals with pollution tolerance values of 0 to 3 in a sub-sample and is expected to decrease in value with increasing anthropogenic stress to a stream ecosystem, reflecting loss of pollution-sensitive organisms. (Shull & Pulket 2023)

Wadeable Multihabitat Stream

The metrics used to evaluate the macroinvertebrate population in multihabitat streams exhibited a strong ability to distinguish between pristine and heavily impacted conditions of various low gradient habitats while measuring different aspects of the benthic macroinvertebrate communities.

Multihabitat stream macroinvertebrate collection is conducted with a D-framed net with 500 µm mesh. A 100-meter reach is chosen which best represents the five habitat types described in the methods section and in Table 4 (Shull & Lookenbill, 2023). Once the ten samples are obtained, each sample is composited into one container preserved with 95% ethanol in the field and transported to the contracted entomologist for enumeration and identification (Shull & Lookenbill, 2023).

Table 4: Habitat Types and Field Sampling Techniques (Shull & Lookenbill, 2023).

Habitat Type	Description	Sample Technique
Cobble/Gravel Substrate	Stream bottom areas consisting of mixed gravel and larger substrate particles.	Place the net on the substrate near the downstream end of an area of gravel or larger substrate particles and simultaneously pushing down on the net while pulling it in an upstream direction with adequate force to dislodge organisms.
Snag	Submerged sticks, branches, and other woody debris that appears to have been submerged long enough to be adequately colonized.	The net is placed immediately downstream of the snag in an area where water is flowing; The snag is then kicked in a manner such attached organisms are dislodged.
Coarse Particulate Organic Matter (CPOM)	Mix of plant parts (leaves, bark, twigs, seeds, etc.) that have accumulated on the stream bottom in "depositional" areas of the stream channel.	Pass the net along a 30in path through the accumulated organic material to collect the material and its associated aquatic macroinvertebrates.
Submerged Aquatic Vegetation (SAV)	Rooted aquatic macrophytes.	Draw the net in an upstream direction along a 30in path through the vegetation; Efforts should be made to avoid collecting stream bottom sediments.
Sand/Fine Sediment	Stream bottom areas that are composed primarily of sand, silt, and/or clay.	Bump and tap the net along the substrate along a 30in path.

The following metrics and analyses are from Shull and Pulket (2023) wadeable multihabitat stream macroinvertebrate assessment method in PADEP's *Assessment Methodology for Rivers and Streams*:

Total Taxa Richness
Total taxa richness is similar to the freestone riffle/run metric. This metric is the count of the total number of taxa in a sub-sample.

EPT Taxa Richness
Similar to the freestone riffle/run metric, this metric is the count of the number of taxa belonging to the orders Ephemeroptera, Plecoptera, and Trichoptera (EPT) in a sub-sample. The aquatic life stages of these three insect orders are generally considered sensitive to, or intolerant of, many types of pollution (Lenat and Penrose 1996), although sensitivity to different types of pollution varies among taxa in these insect orders. The version of this metric used here only counts EPT taxa with pollution tolerance values (PTVs) of 0 to 4, excluding a few of the most tolerant mayfly and caddisfly taxa. This metric is expected to decrease in value with increasing anthropogenic stress to a stream ecosystem, reflecting the loss of taxa from these largely pollution-sensitive orders.

Beck4
Beck4 is a weighted taxa richness measure. It is based on Hilsenhoff Biotic Index Scores which measures the pollution tolerance of an organism on a scale of zero to ten, where the organisms' tolerance level decreases with score. This is chosen because it better represents low-gradient streams. For Beck4, taxa with an HBI score of 0 or 1 are given 2 points and HBI scores of 2, 3, or 4 are given 1 point.

Shannon Diversity
This index measures taxa abundance and evenness in the sub-sample by dividing the # of individuals in a taxon by the total # of individuals in the sub-sample and then multiplying by the natural logarithm of this proportion. This is done for all taxa in the sub-sample; the products are then summed and the answer multiplied by -1.

$$= -1\left(\sum_{i=1}^{Rich}[(n_i/N)\ ln(n_i/N)]\right)$$

Where ni = the number of individuals in each taxon (relative abundance); N = the total number of individuals in a sub-sample; and Rich = the total number of taxa in a sub-sample (total taxa richness).

Number of Caddisfly Taxa
The metric is the sum of the Caddisfly taxa present in the subsample.

Number of Mayfly Taxa
The metric is the sum of the Mayfly taxa present in the subsample.

Table 5 shows the process for index calculations to ultimately obtain an IBI for each sampling site. The sum of these specific metric equations constructs an IBI, which then can be related to reflect the ecology and impacts to the aquatic community being studied.

Table 5: Index calculation process for multihabitat streams (Shull & Pulket, 2023).

Metric	**Equation**	**Observed Metric Value**	**Normalized Metric Score**	**Adjusted Metric Score** Maximum = 100
Total Taxa Richness	(Observed / 31)*100			
EPT Taxa Richness	(Observed / 17)*100			
Beck4	(Observed / 22)*100			
Shannon Diversity	(Observed / 2.43)*100			
# of Caddisfly Taxa	(Observed / 11)*100			
# of Mayfly Taxa	(Observed / 6)*100			
Average of adjusted standardized metric scores = **IBI Score** =				
The benchmark for Aquatic Life Use attainment in multihabitat streams is an IBI score of 55*				

Aquatic Life Use Attainment Benchmarks

The benchmark for Aquatic Life Use attainment in multihabitat streams is 55 therefore, if the score is ≥ 55 the stream has reached attainment, and if the score is < 55 the sample reach has not achieved attainment. (Shull & Pulket, 2023)

Section IV. Physical Habitat Evaluation

PA DEP Physical Habitat Evaluation Method

The habitat assessment is a modification of the habitat evaluation methods from the USEPA *Rapid Bioassessment Protocols*. It is used to evaluate key physical characteristics of the available habitat and conditions to aquatic biota which impacts the community structure and composition. The habitat assessment scores on the site summary sheets are calculated based off an overall total scored at each site of the 12 metrics below. The threshold for wadeable streams ALU assessment impairment is 140 or less. The couplet of embeddedness + sediment deposition, and the couplet of the condition of banks + vegetative protection are calculated to determine the impairment threshold. The impairment threshold for the two couplets is a score of 24 or less for either combination. The following descriptions of the habitat assessment parameters are directly from Shull and Lookenbill (2023) *Water Quality Monitoring Protocols for Streams and Rivers* and are followed by examples of the data sheets from the protocols:

Riffle/Run Habitat Evaluation Parameters

1. **Instream Fish Cover** – Evaluates the percent makeup of the substrate (boulders, cobble, other rock material) and submerged objects (logs, undercut banks) that provide refuge for a variety of fish including both large bodied pelagic species as well as smaller benthic specialists.

2. **Epifaunal Substrate** – Evaluates riffle quality, i.e., areal extent relative to stream width and dominant substrate materials (cobble, boulders, gravel) that are present.

3. **Embeddedness** – Evaluates the extent to which rocks (gravel, cobble, and boulders) and snags are covered or sunken into the silt, sand, or mud of the stream bottom. The rating of this parameter may be variable depending on where the observations are taken. To avoid confusion with sediment deposition (another habitat parameter), observations of embeddedness should be taken in the upstream and central portions of riffles and cobble substrate areas.

4. **Velocity Depth Regimes** – Evaluates the presence/absence of four velocity/depth regimes (fast-deep, fast-shallow, slow-deep, and slow-shallow). Generally, shallow is < 0.5m and slow is < 0.3m/sec.

5. **Channel Alteration** – Evaluates the extent of channelization or dredging but can include any other large-scale changes in the shape of the stream channel that would be detrimental to the habitat. Channel alteration is present when artificial embankments, riprap, and other forms of artificial bank stabilization or structures are present; when the stream is very straight for significant distances; when dams and bridges are present; and when other such changes have occurred.

6. **Sediment Deposition** – Estimates the extent of sediment effects in the formation of islands, point bars, and pool deposition. Deposition is typically evident in areas that are obstructed by natural or manmade debris and areas where the stream flow decreases, such as bends.

7. **Riffle Frequency** – Estimates the frequency of riffle occurrence based on stream width and thus the heterogeneity occurring in a stream. For riffle/run prevalent streams where distinct riffles are uncommon, a run/bend ratio is used as a measure of meandering or sinuosity.

8. **Channel Flow Status** – Estimates the areal extent of exposed substrates due to water level or flow conditions. The flow status will change as the channel enlarges (e.g., aggrading stream beds with actively widening channels) or as flow decreases as a result of dams and other obstructions, diversions for irrigation, or drought. In riffle/run prevalent streams, riffles and cobble substrate are exposed; in low gradient streams, the decrease in water level exposes logs and snags, thereby reducing the areas of good habitat.

9. **Condition of Banks** – Evaluates the extent of bank failure, signs of erosion, or the potential for erosion. The stream bank is defined as the area from the water's surface to the bankfull delineation. Steep banks are more likely to collapse and suffer from erosion than are gently sloping banks and are therefore considered to be unstable. Signs of erosion include crumbling, unvegetated banks, exposed tree roots, and exposed soil.

10. **Bank Vegetative Protection** – Estimates the extent of stream bank that is covered by plant growth providing stability through well-developed root systems. The stream bank is defined as the area from the water's surface to the bankfull delineation. This parameter supplies information on the ability of the bank to resist erosion as well as some additional information on the uptake of nutrients by the plants, the control of instream scouring, and stream shading. This parameter is made more effective by defining the native vegetation for the region and stream type (i.e., shrubs, trees, etc.). In some regions, the introduction of exotics has virtually replaced all native vegetation. The value of exotic vegetation to the quality of the habitat structure and contribution to the stream ecosystem must be considered in this parameter.

11. **Grazing or Other Disruptive Pressures** – Evaluates disruptions to surrounding land vegetation due to common human activities, such as crop harvesting, lawn care, excavations, fill, construction projects, and other intrusive activities.

12. **Riparian Vegetative Zones** – Estimates the width of natural vegetation from the edge of the stream bank out through the riparian zone. Narrow riparian zones occur when roads, parking lots, fields, lawns, bare soil, rocks, or buildings are near the stream bank. Residential developments, urban centers, golf courses, and rangeland are the common causes of anthropogenic degradation of the riparian zone. Conversely, the presence of "old field" (i.e., a previously developed field not currently in use), paths, and walkways in an otherwise undisturbed riparian zone may be judged to be inconsequential to altering the riparian zone and may be given relatively high scores. (Shull & Lookenbill, 2023)

Riffle/Run Habitat Evaluation Form

Physical Habitat Evaluation Form for Riffle/Run Prevalence				
Waterbody Name:		GIS Key (YYYYMMDD-hhmm-User):		
Location:				
Investigators:		Completed By:		
Parameter	**Optimal**	**Suboptimal**	**Marginal**	**Poor**
†**1. Instream Cover**[1] *(fish)*	Greater than 50% mix of boulder, cobble, submerged logs, undercut banks, or other stable habitat.	30-50% mix of boulder, cobble, or other stable habitat; adequate habitat.	10-30% mix of boulder, cobble, or other stable habitat; habitat availability less than desirable.	Less than 10% mix of boulder, cobble, or other stable habitat; lack of habitat is obvious.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
†**2. Epifaunal Substrate**[1] *(riffle quality)*	Well-developed riffle and run; riffle is as wide as stream and length extends two times the width of stream; abundance of cobble.	Riffle is as wide as stream but length is less than two times width; abundance of cobble; boulders and gravel common.	Run area may be lacking; riffle not as wide as stream and its length is less than 2 times the stream width; gravel or large boulders and bedrock prevalent; some cobble present.	Riffles or run virtually nonexistent; large boulders and bedrock prevalent; cobble lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
†**3. Embeddedness**[1] *(evaluate in upstream & central portions of riffles)*	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment.	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.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
4. Velocity/Depth Regimes[1]	All four velocity/depth regimes present (slow-deep, slow shallow, fast-deep, fast shallow)	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 lower than if missing other regimes).	Dominated by 1 velocity/depth regime (usually slow-deep).
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
5. **Channel Alteration**[2] *(only include downstream alteration when affecting reach)*	No channelization or dredging present.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging (greater than 20 yr.) may be present, but recent channelization is not present.	New embankments 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.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
*†**6. Sediment Deposition**[2] *(evaluate in pools & depositional areas)*	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 information, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel coarse sand on old and new bars; 30-50% of the bottom affected; sediment deposits at obstruction, construction and bends, moderate depositions 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.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

Note: Wadeable couplet scores only calculated if the Wadeable Riffle-Run Protocol (Chapter 3.1) is used. Semiwadable couplet score only calculated if Semiwadeable Large River Protocol (Chapter 3.4) is used.

* **WADEABLE COUPLET SCORE (EMBEDDEDNESS + SEDIMENT DEPOSITION)** _____

† **SEMIWADEABLE TRIPLET SCORE (INSTREAM COVER + EPIFANUAL SUBSTRATE + EMBEDDEDNESS)** _____

Note: Wadeable couplet scores only calculated if the Wadeable Riffle-Run Protocol (Chapter 3.1) is used. Semiwadable triplet score only calculated if Semiwadeable Large River Protocol (Chapter 3.4) is used.

Parameter	Optimal	Suboptimal	Marginal	Poor
7. Riffle Frequency[2] *(riffle quantity; consider run:bend ratio)*	Occurrence of riffles relatively frequent; distance between riffles divided by the width of the stream equals 5 to 7; variety of habitat.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream equals 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 >25.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
8. Channel Flow Status[2]	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.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
****9. Condition of Banks**[3] *(edge of water to bankfull delineation)*	Banks stable; no evidence of erosion or bank failure.	Moderately stable; infrequent, small areas of erosion mostly healed over.	Moderately unstable; up to 60% of banks in reach have areas of erosion.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; on side slopes, 60-100% of bank has erosional scars.
LDB	10 9 8	7 6	5 4 3	2 1
Total RDB	10 9 8	7 6	5 4 3	2 1
****10. Bank Vegetative Protection**[3] *(edge of water to bankfull delineation)*	More than 90% of the stream bank surfaces covered by vegetation.	70-90% of the stream bank surfaces covered by vegetation.	50-70% of the stream bank surfaces covered by vegetation.	Less than 50% of the stream bank surfaces covered by vegetation.
LDB	10 9 8	7 6	5 4 3	2 1
Total RDB	10 9 8	7 6	5 4 3	2 1
11. Grazing or Other Disruptive Pressure[3] *(bankfull through riparian zone)*	Vegetative disruption through grazing or mowing is minimal or not evident; almost all plants allowed to grow naturally.	Disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	Disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Disruption of stream bank vegetation is very high; vegetation has been removed to 2 inches or less in average stubble height.
LDB	10 9 8	7 6	5 4 3	2 1
Total RDB	10 9 8	7 6	5 4 3	2 1
12. Riparian Vegetative Zone[3] *(bankfull through riparian zone)*	Width or 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.
LDB	10 9 8	7 6	5 4 3	2 1
Total RDB	10 9 8	7 6	5 4 3	2 1

**** WADEABLE COUPLET SCORE (CONDITION OF BANKS + BANK VEGETATIVE PROTECTION) _____**

TOTAL HABITAT SCORE _____

[1] Reach scale: Evaluate parameter within the immediate vicinity of biological sampling reach.

[2] Expanded scale Evaluate parameter within sampling reach and at least 100m UPS of sampled reach, longer if visual extent allows.

[3] Macro scale: Evaluate parameter based on expanded scale; can be extended further to account for characteristics within representative reach.

Low Gradient Habitat Evaluation Parameters

The habitat assessment scores on the site summary sheets are calculated based off an overall total scored at each site of the 9 metrics below, the couplet of pool substrate characterization + sediment deposition, and the couplet of bank stability + bank vegetative protection. The threshold for low gradient streams ALU assessment impairment is 105 or less. The impairment threshold for the two couplets is a score of 20 or less for either combination.

Epifaunal Substrate/Available Cover – Evaluates the relative quantity and variety of natural structures in the stream, such as large rocks, fallen trees, logs and branches, and undercut banks. Evaluates the percent makeup of the substrate (boulders, cobble, other rock material) and submerged objects (logs, undercut banks) that provide refuge for a variety of fish including both large bodied pelagic species as well as smaller benthic specialists.

1. **Pool Substrate Characterization** – Evaluates the type and condition of bottom substrates found in pools. Firmer sediment types (e.g., gravel, sand) and rooted aquatic plants support a wider variety of organisms and are scored higher than a pool substrate dominated by mud or bedrock and no plants.

2. **Pool Variability** – Evaluates the overall mixture of pool types found in streams, according to size and depth (large-shallow, large-deep, small-shallow, and small-deep).

3. **Sediment Deposition** – Estimates the extent of sediment effects in the formation of islands, point bars, and pool deposition. Deposition is typically evident in areas that are obstructed by natural or manmade debris and areas where the stream flow decreases, such as bends.

4. **Channel Flow Status** – Estimates the areal extent of exposed substrates due to water level or flow conditions. The flow status will change as the channel enlarges (e.g., aggrading stream beds with actively widening channels) or as flow decreases as a result of dams and other obstructions, diversions for irrigation, or drought. In riffle/run prevalent streams, riffles and cobble substrate are exposed; in low gradient streams, the decrease in water level exposes logs and snags, thereby reducing the areas of good habitat.

5. **Channel Alteration** – Evaluates the extent of channelization or dredging but can include any other large-scale changes in the shape of the stream channel that would be detrimental to the habitat. Channel alteration is present when artificial embankments, riprap, and other forms of artificial bank stabilization or structures are present; when the stream is very straight for significant distances; when dams and bridges are present; and when other such changes have occurred.

6. **Condition of Banks** – Evaluates the extent of bank failure, signs of erosion, or the potential for erosion. The stream bank is defined as the area from the water's surface to the bankfull delineation. Steep banks are more likely to collapse and suffer from erosion than are gently

sloping banks and are therefore considered to be unstable. Signs of erosion include crumbling, unvegetated banks, exposed tree roots, and exposed soil.

7. **Bank Vegetative Protection** – Estimates the extent of stream bank that is covered by plant growth providing stability through well-developed root systems. The stream bank is defined as the area from the water's surface to the bankfull delineation. This parameter supplies information on the ability of the bank to resist erosion as well as some additional information on the uptake of nutrients by the plants, the control of instream scouring, and stream shading. This parameter is made more effective by defining the native vegetation for the region and stream type (i.e., shrubs, trees, etc.). In some regions, the introduction of exotics has virtually replaced all native vegetation. The value of exotic vegetation to the quality of the habitat structure and contribution to the stream ecosystem must be considered in this parameter.

8. **Riparian Vegetative Zone** – Estimates the width of natural vegetation from the edge of the stream bank out through the riparian zone. Narrow riparian zones occur when roads, parking lots, fields, lawns, bare soil, rocks, or buildings are near the stream bank. Residential developments, urban centers, golf courses, and rangeland are the common causes of anthropogenic degradation of the riparian zone. Conversely, the presence of "old field" (i.e., a previously developed field not currently in use), paths, and walkways in an otherwise undisturbed riparian zone may be judged to be inconsequential to altering the riparian zone and may be given relatively high scores. (Shull & Lookenbill, 2023)

Multihabitat/Low Gradient Habitat Evaluation Form

Physical Habitat Evaluation Form for Low Gradient (Pool/Glide) Streams

Waterbody Name:	GIS Key (YYYYMMDD-hhmm-User):
Location:	
Investigators:	Completed By:

Parameter	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 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 new fall, 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.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
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.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
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.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
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.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
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.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

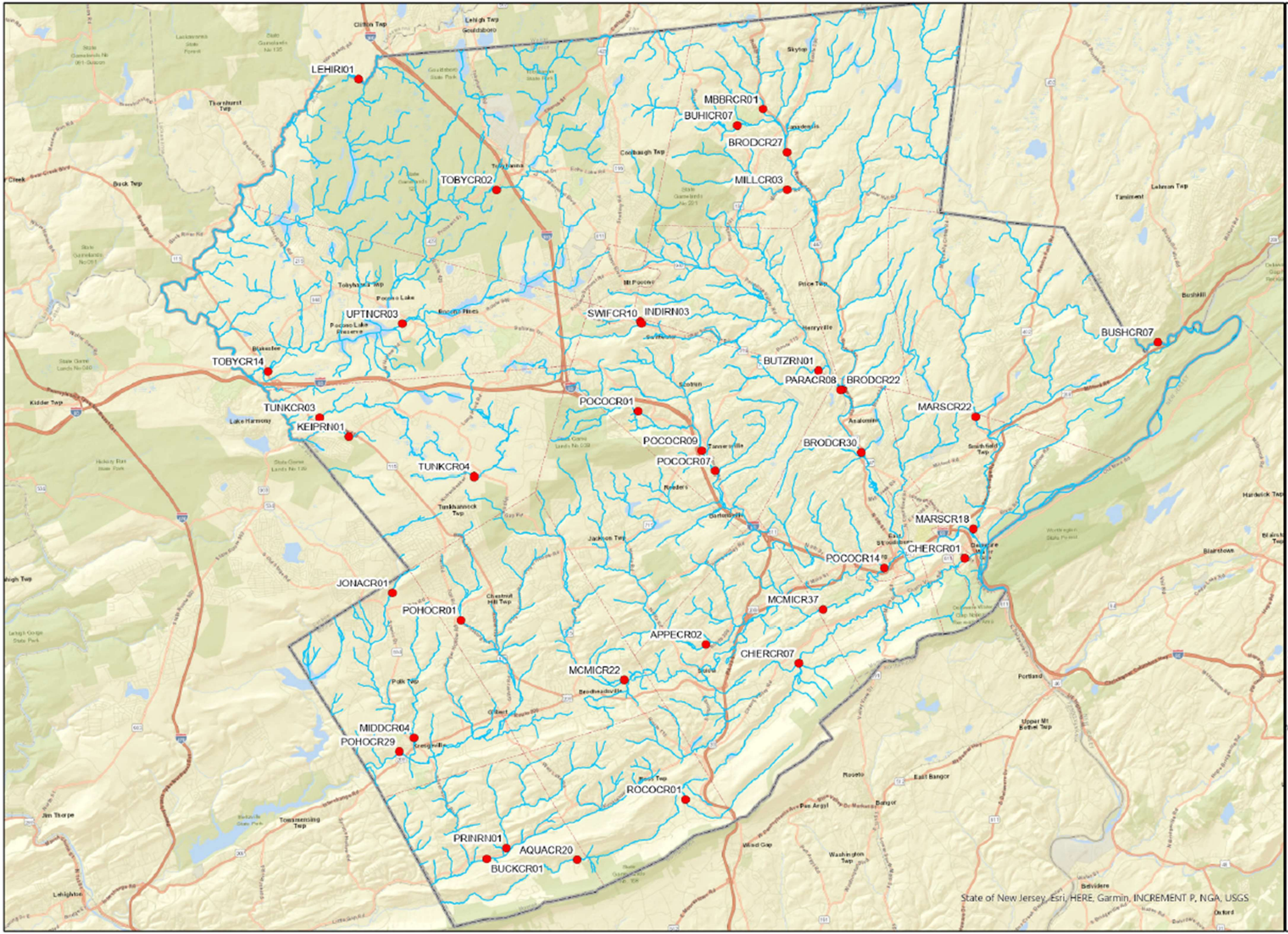
Parameter	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but 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
	20 19 18 17 16	**15 14 13 12 11**	**10 9 8 7 6**	**5 4 3 2 1**
7. Condition of Banks	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 sealed 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.
	20 19 18 17 16	**15 14 13 12 11**	**10 9 8 7 6**	**5 4 3 2 1**
8. Bank Vegetative Protection	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 stubble height.
	20 19 18 17 16	**15 14 13 12 11**	**10 9 8 7 6**	**5 4 3 2 1**
9. Riparian Vegetative Zone	Width or 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.
	20 19 18 17 16	**15 14 13 12 11**	**10 9 8 7 6**	**5 4 3 2 1**

Section V. Sample Locations & Results

Location Descriptions:

Sites are broken into groups by watersheds, and proximity to maximize effectiveness for collection. A site selection meeting is held every year with the Monroe County Planning Commission, Monroe County Conservation District and local watersheds to evaluate the proposed sites for the year.

Site ID	Stream Name	Location	Township	Latitude	Longitude
AQUACR20	Aquashicola Creek	315 meters east from intersection of Upper Smith Gap Rd and Camp Hill Rd	Eldred	40.845375	-75.395691
BUCKCR01	Buckwha Creek	200 meters west of Chestnut Ridge Rd bridge	Eldred	40.847275	-75.451532
PRINRN01	Princess Run	Walter W. Mock Memorial Park off Fiddletown Rd	Eldred	40.851843	-75.440199
ROCOCR01	Ross Commons	95 meters east from intersection of Mount Eaton Rd and Spruce Rd to bridge over Ross Commons then 100 m south from bridge	Ross	40.872833	-75.326028
CHERCR07	Cherry Creek	125 meters south of bridge on Kemmertown Rd.	Hamilton	40.93657	-75.252769
TUNKCR04	Tunkhannock Creek	Off Fire Ln. Near Bethlehem Water Authority dam	Tunkhannock	41.029496	-75.451954
POHOCR29	Pohopoco Creek	700 meters west on Whitey B Ln. from intersection of Whitey B Ln. and Rt. 209.	Polk	40.89951	-75.506215
MIDDCR04	Middle Creek	Downstream of observation deck on Cliff Woodring Trail.	Polk	40.905822	-75.496614
MCMICR22	McMichael Creek	115m south of intersection of Mcilhaney Rd. and Kennel Rd.	Chestnuthill	40.930902	-75.363567
POHOCR01	Pohopoco Creek	330m southeast from intersection of Merwinsburg Rd. and Burger Hollow Rd.	Chestnuthill	40.961684	-75.465
JONACR01	Jonas Creek	150m north of the Laurel Ln cul-de-sac	Polk	40.97567	-75.507843
BRODCR27	Brodhead Creek	170 meters northeast of Pasold Farm Dr. parking area.	Barrett	41.180941	-75.25091
MILLCR03	Mill Creek	560m west of instersection of Sand Spring Rd. and Mill Creek Rd.	Barrett	41.163201	-75.251528
MBBRCR01	Middle Branch Brodhead Creek	High Acres Park upstream of Buck Hill Falls property on Barrett Township property	Barrett	41.201715	-75.265098
BUHICR07	Buck Hill Creek	165 meters upstream of Buck Hill Golf Club off of Cresco Rd.	Barrett	41.194403	-75.281357
BRODCR22	Brodhead Creek	Sugar Cane Ln. access off of Rt. 191 Bridge upstream of confluence of PARACR08.	Stroud	41.066523	-75.220216
PARACR08	Paradise Creek	Sugar Cane Ln. access off of Rt. 191 Bridge. 150m west from Sugar Cane Ln, walk across Brodhead to site.	Stroud	41.066498	-75.221395
BUSHCR07	Bushkill Creek	340 meters north of Route 209 through ROW.	Middle Smithfield	41.084861	-75.019417
BRODCR30	Brodhead Creek	120 meters southeast of Rt. 191 bridge near intersection of Rt.191 and Rt. 447	Stroud	41.036093	-75.209176
MARSCR22	Marshalls Creek	275 meters south of intersection of Orchard Rd and Marshalls Creek Rd off of Marshalls Creek Rd on Smithfield Twp property Marshalls Falls Park	Smithfield	41.051664	-75.136892
MCMICR37	McMichael Creek	Hickory Valley Park 60m southeast from parking area.	Stroud	40.962041	-75.236508
CHERCR07R	Cherry Creek	125 meters south of bridge on Kemmertown Rd.	Hamilton	40.93657	-75.252769
APPECR02	Appenzel Creek	Near residential housing, 160m west of the Foundry St. bridge.	Hamilton	40.946838	-75.310513
MARSCR18	Marshalls Creek	Next to Minisink Hotel parking lot off of Post Office Rd.	Smithfield	40.998555	-75.139952
CHERCR01	Cherry Creek	Edge of the Woods Outfitters 100m from the intersection of 611 and Broad St.	Delaware Water Gap	40.984712	-75.145848
POCOCR09	Pocono Creek	65m north of Old Mill Rd. bridge.	Pocono	41.039252	-75.309729
POCOCR14	Pocono Creek	70m south from S. 10th St and Ann St.	Stroudsburg	40.981165	-75.197009
POCOCR01	Pocono Creek	300m south on Camelback Rd from intersection of Camelback Rd. and Wilke Rd.	Pocono	41.058983	-75.34886
POCOCR07	Pocono Creek	220 meters South from intersection of Warner Road and Rt 611.	Pocono	41.029336	-75.301604
TOBYCR02	Tobyhanna Creek	770 meters east from I 80, access through State Game Land Road	Coolbaugh	41.166930	-75.435260
LEHIRI01	Lehigh River	1 Mile East on Coolbaugh Road from intersection with Monroe Ave.	Coolbaugh	41.22172	-75.52100
TOBYCR14	Tobyhanna Creek	50m east of Rt. 115 bridge near Austin T. Blakeslee Natural Area.	Tobyhanna	41.082791	-75.583083
UPTNCR03	Upper Tunkhannock Creek	Tunkhannock Creek association club house. Plunge pool to cummings pool.	Tobyhanna	41.103919	-75.49708
TUNKCR03	Tunkhannock Creek	160m north of Tunkhannock Fishing Association Parking area off SR115.	Tunkhannock	41.059541	-75.552735
KEIPRN01	Keiper Run	Upstream of culverts on Schoch's Mill Rd	Tunkhannock	41.050654	-75.532966
SWIFCR10	Swiftwater Creek	25m north of Manor Dr. bridge.	Pocono	41.100894	-75.346355
INDIRN03	Indian Run	150 meters north of Manor Dr. Bridge upstream of confluence with Swiftwater Creek.	Pocono	41.10211	-75.346358
BRODCR27R	Brodhead Creek	170 meters northeast of Pasold Farm Dr. parking area.	Barrett	41.180941	-75.25091
BUTZRN01	Butz Run	1.14 miles down Sylvan Cascades Rd from intersection of Rt. 191	Paradise	41.076071	-75.235002



2026 Water Quality Study

Sampling Locations

MONROE COUNTY
PENNSYLVANIA

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W E
S

0 2 4
Miles

Legend

- Sample Locations
- County Boundary
- Municipal Boundary

MONROE COUNTY PLANNING

The County of Monroe makes no express or implied warranties concerning the release of this information. The County of Monroe is unaware of the use or uses to be made of this data. Consequently, the County of Monroe does not warrant this data as fit for any particular purpose.

PREPARED BY:

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March 2026

26-007

Site Summary Sheets

Site Summary Sheet: APPECR02

Stream Name	Appenzel Creek	**Latitude**	40.946838
Date Sampled	4/27/2026	**Longitude**	-75.310513
Time Sampled	8:30 AM	**Municipality**	Hamilton
Drainage Area (sq mi)	15.1	**Habitat Type**	Riffle/Run
Location Description	Near residential housing, 160m west of the Foundry St. bridge.		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	86.2
Dissolved Oxygen (mg/L)	9.76
Conductivity (µS/cm)	126.0
Total Dissolved Solids (mg/L)	82
Temperature (°C)	9.8

Lab Chemistry Results

Total Organic Carbon (mg/L)	1.83	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	20.4	**Temperature (Lab) (°C)**	18.9
Hardness (mg CaCO3/L)	31.1	**pH (Lab)**	6.5
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	0.418	**Calcium (mg/L)**	8.30
Nitrate-Nitrite as N (mg/L)	0.418	**Iron (mg/L)**	<0.200
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	2.52
Total Dissolved Solids (Lab) (mg/L)	55.0	**Alkalinity to pH 4.5 (mg CaCO3/L)**	<20.0
Total Kjeldahl Nitrogen (mg/L)	0.620	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	1
Fast/Shallow	2
Slow/Deep	1
Fast/Deep	2

Macroinvertebrate Metrics

Total Taxa Richness	37
EPT Taxa Richness	23
Beck's Index	38
Shannon Diversity Index	3.12
Hilsenhoff Biotic Index	3.27
Percent Sensitive Individuals	47.8
Index of Biotic Integrity	89.9

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	35
Condition of Banks + Vegetative Protection	26
Habitat Assessment Score (Overall)	185

Site Summary Sheet: AQUACR20

Stream Name	Aquashicola	**Latitude**	40.845611
Date Sampled	4/21/2026	**Longitude**	-75.394982
Time Sampled	11:10 AM	**Municipality**	Eldred
Drainage Area (sq mi)	12.7	**Habitat Type**	Riffle/Run
Location Description	180 meters west of bridge on game commission property		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	109.8
Dissolved Oxygen (mg/L)	12.44
Conductivity (µS/cm)	180.2
Total Dissolved Solids (mg/L)	117
Temperature (°C)	9.8

Lab Chemistry Results

Total Organic Carbon (mg/L)	1.79	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	12.3	**Temperature (Lab) (°C)**	18.7
Hardness (mg CaCO3/L)	70.6	**pH (Lab)**	7.2
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	0.353	**Calcium (mg/L)**	20.0
Nitrate-Nitrite as N (mg/L)	0.353	**Iron (mg/L)**	0.270
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	5.05
Total Dissolved Solids (Lab) (mg/L)	93.8	**Alkalinity to pH 4.5 (mg CaCO3/L)**	62.0
Total Kjeldahl Nitrogen (mg/L)	<0.500	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	1
Fast/Shallow	2
Slow/Deep	2
Fast/Deep	1

Macroinvertebrate Metrics

Total Taxa Richness	32
EPT Taxa Richness	14
Beck's Index	24
Shannon Diversity Index	2.77
Hilsenhoff Biotic Index	4.04
Percent Sensitive Individuals	24.5
Index of Biotic Integrity	72.7

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	36
Condition of Banks + Vegetative Protection	33
Habitat Assessment Score (Overall)	204

Site Summary Sheet: BRODCR22

Stream Name	Brodhead Creek	**Latitude**	41.066523
Date Sampled	4/30/2026	**Longitude**	-75.220216
Time Sampled	9:50 AM	**Municipality**	Stroud
Drainage Area (sq mi)	70.6	**Habitat Type**	Riffle/Run
Location Description	Sugar Cone Ln. access off of Rt. 191 Bridge upstream of confluence of PARACR08.		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	104.6
Dissolved Oxygen (mg/L)	11.65
Conductivity (µS/cm)	72.4
Total Dissolved Solids (mg/L)	47
Temperature (°C)	10.6

Lab Chemistry Results

Total Organic Carbon (mg/L)	2.65	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	11.6	**Temperature (Lab) (°C)**	18.8
Hardness (mg CaCO3/L)	16.9	**pH (Lab)**	6.1
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	0.186	**Calcium (mg/L)**	4.70
Nitrate-Nitrite as N (mg/L)	0.186	**Iron (mg/L)**	<0.200
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	1.26
Total Dissolved Solids (Lab) (mg/L)	36.3	**Alkalinity to pH 4.5 (mg CaCO3/L)**	<20.0
Total Kjeldahl Nitrogen (mg/L)	<0.500	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	1
Fast/Shallow	2
Slow/Deep	1
Fast/Deep	2

Macroinvertebrate Metrics

Total Taxa Richness	39
EPT Taxa Richness	21
Beck's Index	33
Shannon Diversity Index	3.00
Hilsenhoff Biotic Index	3.98
Percent Sensitive Individuals	24.3
Index of Biotic Integrity	87.2

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	39
Condition of Banks + Vegetative Protection	34
Habitat Assessment Score (Overall)	216

Site Summary Sheet: BRODCR27

Stream Name	Brodhead Creek	**Latitude**	41.180941
Date Sampled	4/24/2026	**Longitude**	-75.25091
Time Sampled	1:00 PM	**Municipality**	Barrett
Drainage Area (sq mi)	30.4	**Habitat Type**	Riffle/Run
Location Description	170 meters northeast of Pasold Farm Dr. parking area.		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	86.0
Dissolved Oxygen (mg/L)	8.97
Conductivity (µS/cm)	69.2
Total Dissolved Solids (mg/L)	45.0
Temperature (°C)	13.4

Lab Chemistry Results

Total Organic Carbon (mg/L)	2.06	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	11.1	**Temperature (Lab) (°C)**	18.4
Hardness (mg CaCO3/L)	14.4	**pH (Lab)**	6.3
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	0.227	**Calcium (mg/L)**	3.85
Nitrate-Nitrite as N (mg/L)	0.227	**Iron (mg/L)**	<0.200
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	1.17
Total Dissolved Solids (Lab) (mg/L)	<31.3	**Alkalinity to pH 4.5 (mg CaCO3/L)**	<20.0
Total Kjeldahl Nitrogen (mg/L)	<0.500	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	1
Fast/Shallow	2
Slow/Deep	1
Fast/Deep	2

Macroinvertebrate Metrics

Total Taxa Richness	39
EPT Taxa Richness	19
Beck's Index	39
Shannon Diversity Index	3.15
Hilsenhoff Biotic Index	3.78
Percent Sensitive Individuals	41.5
Index of Biotic Integrity	87.6

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	35
Condition of Banks + Vegetative Protection	36
Habitat Assessment Score (Overall)	208

Site Summary Sheet: BRODCR27R

Stream Name	Brodhead Creek	**Latitude**	41.180941
Date Sampled	4/28/2026	**Longitude**	-75.25091
Time Sampled	9:50 AM	**Municipality**	Barrett
Drainage Area (sq mi)	30.4	**Habitat Type**	Riffle/Run
Location Description	170 meters northeast of Pasold Farm Dr. parking area.		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	85.8
Dissolved Oxygen (mg/L)	9.54
Conductivity (µS/cm)	64.1
Total Dissolved Solids (mg/L)	42
Temperature (°C)	10.6

Lab Chemistry Results

Total Organic Carbon (mg/L)	2.78	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	10.4	**Temperature (Lab) (°C)**	18.0
Hardness (mg CaCO3/L)	13.7	**pH (Lab)**	6
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	0.210	**Calcium (mg/L)**	3.77
Nitrate-Nitrite as N (mg/L)	0.210	**Iron (mg/L)**	<0.200
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	1.04
Total Dissolved Solids (Lab) (mg/L)	35.0	**Alkalinity to pH 4.5 (mg CaCO3/L)**	<20.0
Total Kjeldahl Nitrogen (mg/L)	0.653	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	1
Fast/Shallow	2
Slow/Deep	0
Fast/Deep	3

Macroinvertebrate Metrics

Total Taxa Richness	38
EPT Taxa Richness	23
Beck's Index	51
Shannon Diversity Index	2.99
Hilsenhoff Biotic Index	3.47
Percent Sensitive Individuals	44.9
Index of Biotic Integrity	88.9

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	36
Condition of Banks + Vegetative Protection	31
Habitat Assessment Score (Overall)	185

Site Summary Sheet: BRODCR30

Stream Name	Brodhead Creek	**Latitude**	41.036093
Date Sampled	4/22/2026	**Longitude**	-75.209176
Time Sampled	11:30 AM	**Municipality**	Stroud
Drainage Area (sq mi)	122	**Habitat Type**	Riffle/Run
Location Description	120 meters southeast of Rt. 191 bridge near intersection of Rt.191 and Rt. 447		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	111.0
Dissolved Oxygen (mg/L)	12.69
Conductivity (µS/cm)	134.2
Total Dissolved Solids (mg/L)	87
Temperature (°C)	9.4

Lab Chemistry Results

Total Organic Carbon (mg/L)	1.51	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	26.4	**Temperature (Lab) (°C)**	18.4
Hardness (mg CaCO3/L)	25.0	**pH (Lab)**	6.5
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	0.282	**Calcium (mg/L)**	6.85
Nitrate-Nitrite as N (mg/L)	0.282	**Iron (mg/L)**	<0.200
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	1.92
Total Dissolved Solids (Lab) (mg/L)	75.0	**Alkalinity to pH 4.5 (mg CaCO3/L)**	<20.0
Total Kjeldahl Nitrogen (mg/L)	<0.500	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	2
Fast/Shallow	1
Slow/Deep	1
Fast/Deep	2

Macroinvertebrate Metrics

Total Taxa Richness	31
EPT Taxa Richness	21
Beck's Index	27
Shannon Diversity Index	2.73
Hilsenhoff Biotic Index	4.11
Percent Sensitive Individuals	31.6
Index of Biotic Integrity	87.9

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	38
Condition of Banks + Vegetative Protection	30
Habitat Assessment Score (Overall)	197

Site Summary Sheet: BUCKCR01

Stream Name	Buckwha Creek	**Latitude**	40.847275
Date Sampled	4/21/2026	**Longitude**	-75.451532
Time Sampled	9:20 AM	**Municipality**	Eldred
Drainage Area (sq mi)	19.5	**Habitat Type**	Riffle/Run
Location Description	200 meters west of Chestnut Ridge Rd bridge		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	107.6
Dissolved Oxygen (mg/L)	13.25
Conductivity (µS/cm)	121.5
Total Dissolved Solids (mg/L)	79
Temperature (°C)	6.4

Lab Chemistry Results

Total Organic Carbon (mg/L)	1.32	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	15.0	**Temperature (Lab) (°C)**	19.0
Hardness (mg CaCO3/L)	35.6	**pH (Lab)**	6.5
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	1.24	**Calcium (mg/L)**	9.65
Nitrate-Nitrite as N (mg/L)	1.24	**Iron (mg/L)**	<0.200
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	2.80
Total Dissolved Solids (Lab) (mg/L)	66.3	**Alkalinity to pH 4.5 (mg CaCO3/L)**	22.0
Total Kjeldahl Nitrogen (mg/L)	0.580	**Biochemical Oxygen Demand (mg/L)**	<,3.00

Habitat Sampled

Slow/Shallow	1
Fast/Shallow	2
Slow/Deep	1
Fast/Deep	2

Macroinvertebrate Metrics

Total Taxa Richness	37
EPT Taxa Richness	16
Beck's Index	25
Shannon Diversity Index	2.74
Hilsenhoff Biotic Index	4.62
Percent Sensitive Individuals	17.4
Index of Biotic Integrity	72.1

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	33
Condition of Banks + Vegetative Protection	27
Habitat Assessment Score (Overall)	182

Site Summary Sheet: BUHICR07

Stream Name	Buck Hill Creek	**Latitude**	41.194403
Date Sampled	4/28/2026	**Longitude**	-75.281357
Time Sampled	8:10 AM	**Municipality**	Barrett
Drainage Area (sq mi)	5.92	**Habitat Type**	Riffle/Run
Location Description	165 meters upstream of Buck Hill Golf Club off of Cresco Road		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	83.4
Dissolved Oxygen (mg/L)	9.90
Conductivity (µS/cm)	42.7
Total Dissolved Solids (mg/L)	28
Temperature (°C)	7.9

Lab Chemistry Results

Total Organic Carbon (mg/L)	2.29	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	5.87	**Temperature (Lab) (°C)**	18.1
Hardness (mg CaCO3/L)	10.2	**pH (Lab)**	6.1
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	0.217	**Calcium (mg/L)**	2.82
Nitrate-Nitrite as N (mg/L)	0.217	**Iron (mg/L)**	<0.200
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	0.758
Total Dissolved Solids (Lab) (mg/L)	<31.3	**Alkalinity to pH 4.5 (mg CaCO3/L)**	<20.0
Total Kjeldahl Nitrogen (mg/L)	0.780	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	1
Fast/Shallow	1
Slow/Deep	2
Fast/Deep	2

Macroinvertebrate Metrics

Total Taxa Richness	31
EPT Taxa Richness	18
Beck's Index	46.00
Shannon Diversity Index	3.01
Hilsenhoff Biotic Index	2.48
Percent Sensitive Individuals	65.1
Index of Biotic Integrity	93.0

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	34
Condition of Banks + Vegetative Protection	24
Habitat Assessment Score (Overall)	187

Site Summary Sheet: BUSHCR07

Stream Name	Bushkill Creek	Latitude	41.084861
Date Sampled	4/24/2026	Longitude	-75.019417
Time Sampled	7:45 AM	Municipality	Middle Smithfield
Drainage Area (sq mi)	120	Habitat Type	Riffle/Run
Location Description	340 meters north of Route 209 through ROW.		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	83.9
Dissolved Oxygen (mg/L)	9.14
Conductivity (µS/cm)	64.9
Total Dissolved Solids (mg/L)	16
Temperature (°C)	11.5

Lab Chemistry Results

Total Organic Carbon (mg/L)	3.50	Phosphorus as P (mg/L)	<0.0250
Chloride (mg/L)	9.49	Temperature (Lab) (°C)	18.9
Hardness (mg CaCO3/L)	15.2	pH (Lab)	6.5
Ammonia as N (mg/L)	<0.200	Aluminum (mg/L)	<0.200
Nitrate as N (mg/L)	<0.0500	Calcium (mg/L)	4.05
Nitrate-Nitrite as N (mg/L)	<0.0500	Iron (mg/L)	<0.200
Nitrite as N (mg/L)	<0.0250	Magnesium (mg/L)	1.24
Total Dissolved Solids (Lab) (mg/L)	38.0	Alkalinity to pH 4.5 (mg CaCO3/L)	<20.0
Total Kjeldahl Nitrogen (mg/L)	<0.500	Biochemical Oxygen Demand (mg/L)	<3.00

Habitat Sampled

Slow/Shallow	2
Fast/Shallow	2
Slow/Deep	0
Fast/Deep	2

Macroinvertebrate Metrics

Total Taxa Richness	37
EPT Taxa Richness	25
Beck's Index	27
Shannon Diversity Index	3.01
Hilsenhoff Biotic Index	3.85
Percent Sensitive Individuals	32.2
Index of Biotic Integrity	89.5

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	35
Condition of Banks + Vegetative Protection	31
Habitat Assessment Score (Overall)	211

Site Summary Sheet: BUTZRN01

Stream Name	Butz Run	**Latitude**	41.076071
Date Sampled	4/30/2026	**Longitude**	-75.235002
Time Sampled	08:22 AM	**Municipality**	Paradise
Drainage Area (sq mi)	3.74	**Habitat Type**	Riffle/Run
Location Description	1.14 miles down Sylvan Cascades Rd from intersection of Rt. 191		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	103.1
Dissolved Oxygen (mg/L)	11.41
Conductivity (µS/cm)	127.5
Total Dissolved Solids (mg/L)	83
Temperature (°C)	10.8

Lab Chemistry Results

Total Organic Carbon (mg/L)	3.29	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	20.5	**Temperature (Lab) (°C)**	18.6
Hardness (mg CaCO3/L)	32.1	**pH (Lab)**	6.5
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	0.348	**Calcium (mg/L)**	9.75
Nitrate-Nitrite as N (mg/L)	0.348	**Iron (mg/L)**	<0.200
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	1.88
Total Dissolved Solids (Lab) (mg/L)	71.3	**Alkalinity to pH 4.5 (mg CaCO3/L)**	<20.0
Total Kjeldahl Nitrogen (mg/L)	0.571	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	2
Fast/Shallow	2
Slow/Deep	1
Fast/Deep	1

Macroinvertebrate Metrics

Total Taxa Richness	33
EPT Taxa Richness	18
Beck's Index	36
Shannon Diversity Index	2.86
Hilsenhoff Biotic Index	3.32
Percent Sensitive Individuals	36.4
Index of Biotic Integrity	85.8

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	31
Condition of Banks + Vegetative Protection	27
Habitat Assessment Score (Overall)	208

Site Summary Sheet: CHERCR01

Stream Name	Cherry Creek	**Latitude**	40.984712
Date Sampled	4/27/2026	**Longitude**	-75.145848
Time Sampled	11:47 AM	**Municipality**	Delaware Water Gap
Drainage Area (sq mi)	20.4	**Habitat Type**	Riffle/Run
Location Description	Located near Edge of the Woods Outfitters 100m from the intersection of 611 and Broad St.		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	91.5
Dissolved Oxygen (mg/L)	9.72
Conductivity (µS/cm)	221.1
Total Dissolved Solids (mg/L)	144
Temperature (°C)	12.6

Lab Chemistry Results

Total Organic Carbon (mg/L)	3.22	**Phosphorus as P (mg/L)**	0.0283
Chloride (mg/L)	12.8	**Temperature (Lab) (°C)**	19.0
Hardness (mg CaCO3/L)	90.6	**pH (Lab)**	7.3
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	0.178	**Calcium (mg/L)**	26.7
Nitrate-Nitrite as N (mg/L)	0.178	**Iron (mg/L)**	0.238
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	5.81
Total Dissolved Solids (Lab) (mg/L)	129	**Alkalinity to pH 4.5 (mg CaCO3/L)**	74.0
Total Kjeldahl Nitrogen (mg/L)	0.663	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	1
Fast/Shallow	3
Slow/Deep	1
Fast/Deep	1

Macroinvertebrate Metrics

Total Taxa Richness	29
EPT Taxa Richness	14
Beck's Index	20
Shannon Diversity Index	2.90
Hilsenhoff Biotic Index	3.69
Percent Sensitive Individuals	33.9
Index of Biotic Integrity	71.0

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	34
Condition of Banks + Vegetative Protection	29
Habitat Assessment Score (Overall)	169

Site Summary Sheet: CHERCR07

Stream Name	Cherry Creek	**Latitude**	40.93657
Date Sampled	4/21/2026	**Longitude**	-75.252769
Time Sampled	1:00 PM	**Municipality**	Hamilton
Drainage Area (sq mi)	9	**Habitat Type**	Low Gradient
Location Description	125 meters south of bridge on Kemmertown Road.		

Field Measurements

pH	
Dissolved Oxygen (%)	112.9
Dissolved Oxygen (mg/L)	12.48
Conductivity (µS/cm)	188.2
Total Dissolved Solids (mg/L)	122
Temperature (°C)	10.9

Lab Chemistry Results

Total Organic Carbon (mg/L)	1.14	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	7.41	**Temperature (Lab) (°C)**	18.6
Hardness (mg CaCO3/L)	80.9	**pH (Lab)**	7.3
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	0.283	**Calcium (mg/L)**	23.4
Nitrate-Nitrite as N (mg/L)	0.283	**Iron (mg/L)**	<0.200
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	5.46
Total Dissolved Solids (Lab) (mg/L)	103	**Alkalinity to pH 4.5 (mg CaCO3/L)**	70.0
Total Kjeldahl Nitrogen (mg/L)	<0.500	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Cobble/Gravel	2
Snag	2
CPOM	1
Submerged Aquatic Vegetation	3
Sand/Fine Sediment	2

Macroinvertebrate Metrics

Total Taxa Richness	26
EPT Taxa Richness	13
Beck4	14
Shannon Diversity Index	2.47
# of Caddisfly Taxa	10
# of Mayfly Taxa	6
Index of Biotic Integrity	83.2

Habitat Assessment Metrics

Pool Substrate Characterization + Sediment Deposition	37
Bank Vegetative Protection + Bank Stability	28
Habitat Assessment Score (Overall)	149

Site Summary Sheet: CHERCR07R

Stream Name	Cherry Creek	**Latitude**	40.93657
Date Sampled	4/27/2026	**Longitude**	-75.252769
Time Sampled	10:30 AM	**Municipality**	Hamilton
Drainage Area (sq mi)	9	**Habitat Type**	Low Gradient
Location Description	125 meters south of bridge on Kemmertown Road.		

Field Measurements

pH	
Dissolved Oxygen (%)	90.0
Dissolved Oxygen (mg/L)	10.10
Conductivity (µS/cm)	187.6
Total Dissolved Solids (mg/L)	122
Temperature (°C)	10.2

Lab Chemistry Results

Total Organic Carbon (mg/L)	1.60	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	7.97	**Temperature (Lab) (°C)**	18.5
Hardness (mg CaCO3/L)	80.5	**pH (Lab)**	7.2
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	0.257	**Calcium (mg/L)**	23.7
Nitrate-Nitrite as N (mg/L)	0.257	**Iron (mg/L)**	<0.200
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	5.20
Total Dissolved Solids (Lab) (mg/L)	104	**Alkalinity to pH 4.5 (mg CaCO3/L)**	68.0
Total Kjeldahl Nitrogen (mg/L)	0.700	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Cobble/Gravel	2
Snag	2
CPOM	2
Submerged Aquatic Vegetation	3
Sand/Fine Sediment	1

Macroinvertebrate Metrics

Total Taxa Richness	33
EPT Taxa Richness	13
Beck4	7
Shannon Diversity Index	2.15
# of Caddisfly Taxa	9
# of Mayfly Taxa	6
Index of Biotic Integrity	82.4

Habitat Assessment Metrics

Pool Substrate Characterization + Sediment Deposition	27
Bank Vegetative Protection + Bank Stability	29
Habitat Assessment Score (Overall)	127

Site Summary Sheet: INDIRN03

Stream Name	Indian Run	Latitude	41.10211
Date Sampled	4/24/2026	Longitude	-75.346358
Time Sampled	11:40 AM	Municipality	Pocono
Drainage Area (sq mi)	1.94	Habitat Type	Riffle/Run
Location Description	150 meters upstream of confluence with Swiftwater Creek		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	83.3
Dissolved Oxygen (mg/L)	9.37
Conductivity (µS/cm)	237.9
Total Dissolved Solids (mg/L)	155
Temperature (°C)	10.1

Lab Chemistry Results

Total Organic Carbon (mg/L)	0.513	Phosphorus as P (mg/L)	<0.0250
Chloride (mg/L)	57.9	Temperature (Lab) (°C)	18.5
Hardness (mg CaCO3/L)	39.5	pH (Lab)	6.5
Ammonia as N (mg/L)	<0.200	Aluminum (mg/L)	<0.200
Nitrate as N (mg/L)	0.652	Calcium (mg/L)	10.4
Nitrate-Nitrite as N (mg/L)	0.652	Iron (mg/L)	<0.200
Nitrite as N (mg/L)	<0.0250	Magnesium (mg/L)	3.33
Total Dissolved Solids (Lab) (mg/L)	154	Alkalinity to pH 4.5 (mg CaCO3/L)	<20.0
Total Kjeldahl Nitrogen (mg/L)	<0.500	Biochemical Oxygen Demand (mg/L)	<3.00

Habitat Sampled

Slow/Shallow	1
Fast/Shallow	2
Slow/Deep	1
Fast/Deep	2

Macroinvertebrate Metrics

Total Taxa Richness	33
EPT Taxa Richness	19
Beck's Index	41
Shannon Diversity Index	2.88
Hilsenhoff Biotic Index	3.22
Percent Sensitive Individuals	50.2
Index of Biotic Integrity	90.5

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	29
Condition of Banks + Vegetative Protection	19
Habitat Assessment Score (Overall)	190

Site Summary Sheet: JONACR01

Stream Name	Jonas Creek	Latitude	40.97567
Date Sampled	4/20/2026	Longitude	-75.507843
Time Sampled	11:06 AM	Municipality	Polk
Drainage Area (sq mi)	2.14	Habitat Type	Riffle/Run
Location Description	150m north of the Laurel Ln cul-de-sac.		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	103.0
Dissolved Oxygen (mg/L)	12.24
Conductivity (µS/cm)	105.9
Total Dissolved Solids (mg/L)	69
Temperature (°C)	7.9

Lab Chemistry Results

Total Organic Carbon (mg/L)	<0.500	Phosphorus as P (mg/L)	<0.0250
Chloride (mg/L)	23.5	Temperature (Lab) (°C)	20.2
Hardness (mg CaCO3/L)	15.6	pH (Lab)	6.1
Ammonia as N (mg/L)	<0.200	Aluminum (mg/L)	<0.200
Nitrate as N (mg/L)	0.923	Calcium (mg/L)	3.72
Nitrate-Nitrite as N (mg/L)	0.923	Iron (mg/L)	<0.200
Nitrite as N (mg/L)	<0.0250	Magnesium (mg/L)	1.54
Total Dissolved Solids (Lab) (mg/L)	61.3	Alkalinity to pH 4.5 (mg CaCO3/L)	<20.0
Total Kjeldahl Nitrogen (mg/L)	<0.500	Biochemical Oxygen Demand (mg/L)	<3.00

Habitat Sampled

Slow/Shallow	1
Fast/Shallow	2
Slow/Deep	1
Fast/Deep	2

Macroinvertebrate Metrics

Total Taxa Richness	30
EPT Taxa Richness	15
Beck's Index	35
Shannon Diversity Index	2.88
Hilsenhoff Biotic Index	2.27
Percent Sensitive Individuals	72.5
Index of Biotic Integrity	89.8

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	36
Condition of Banks + Vegetative Protection	40
Habitat Assessment Score (Overall)	228

Site Summary Sheet: KEIPRN01

Stream Name	Keiper Run	**Latitude**	41.050654
Date Sampled	4/23/2026	**Longitude**	-75.532966
Time Sampled	11:00 AM	**Municipality**	Tunkhannock
Drainage Area (sq mi)	60.9	**Habitat Type**	Riffle/Run
Location Description	Upstream of culverts on Schoch's Mill Road		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	76.6
Dissolved Oxygen (mg/L)	8.98
Conductivity (µS/cm)	142.1
Total Dissolved Solids (mg/L)	92
Temperature (°C)	8.4

Lab Chemistry Results

Total Organic Carbon (mg/L)	1.73	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	32.8	**Temperature (Lab) (°C)**	19.1
Hardness (mg CaCO3/L)	12.8	**pH (Lab)**	6.1
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	0.348	**Calcium (mg/L)**	3.75
Nitrate-Nitrite as N (mg/L)	0.348	**Iron (mg/L)**	<0.200
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	0.844
Total Dissolved Solids (Lab) (mg/L)	68.8	**Alkalinity to pH 4.5 (mg CaCO3/L)**	<20.0
Total Kjeldahl Nitrogen (mg/L)	<0.500	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	4
Fast/Shallow	2
Slow/Deep	0
Fast/Deep	0

Macroinvertebrate Metrics

Total Taxa Richness	15
EPT Taxa Richness	9
Beck's Index	13
Shannon Diversity Index	1.92
Hilsenhoff Biotic Index	5.54
Percent Sensitive Individuals	45.0
Index of Biotic Integrity	73.1

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	7
Condition of Banks + Vegetative Protection	17
Habitat Assessment Score (Overall)	120

Site Summary Sheet: LEHIRIO1

Stream Name	Lehigh River	**Latitude**	41.221306
Date Sampled	4/23/2026	**Longitude**	-75.520470
Time Sampled	7:50 AM	**Municipality**	Coolbaugh
Drainage Area (sq mi)	29.7	**Habitat Type**	Riffle/Run
Location Description	1 Mile East on Coolbaugh road from intersection with Monroe Ave		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	80.9
Dissolved Oxygen (mg/L)	9.26
Conductivity (µS/cm)	136.2
Total Dissolved Solids (mg/L)	89
Temperature (°C)	9.4

Lab Chemistry Results

Total Organic Carbon (mg/L)	4.54	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	29.4	**Temperature (Lab) (°C)**	18.9
Hardness (mg CaCO3/L)	21.4	**pH (Lab)**	6.2
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	0.289	**Calcium (mg/L)**	6.73
Nitrate-Nitrite as N (mg/L)	0.289	**Iron (mg/L)**	0.209
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	1.11
Total Dissolved Solids (Lab) (mg/L)	70.0	**Alkalinity to pH 4.5 (mg CaCO3/L)**	<20.0
Total Kjeldahl Nitrogen (mg/L)	<0.500	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	2
Fast/Shallow	2
Slow/Deep	0
Fast/Deep	2

Macroinvertebrate Metrics

Total Taxa Richness	31
EPT Taxa Richness	18
Beck's Index	21
Shannon Diversity Index	2.42
Hilsenhoff Biotic Index	4.17
Percent Sensitive Individuals	31.5
Index of Biotic Integrity	72.9

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	39
Condition of Banks + Vegetative Protection	38
Habitat Assessment Score (Overall)	217

Site Summary Sheet: MARSCR18

Stream Name	Marshalls Creek	**Latitude**	40.998555
Date Sampled	4/24/2026	**Longitude**	-75.139952
Time Sampled	9:45 AM	**Municipality**	Smithfield
Drainage Area (sq mi)	26.3	**Habitat Type**	Riffle/Run
Location Description	Next to Minisink Hotel parking lot off of Post Office Rd.		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	87.4
Dissolved Oxygen (mg/L)	9.28
Conductivity (µS/cm)	241.0
Total Dissolved Solids (mg/L)	157
Temperature (°C)	12.6

Lab Chemistry Results

Total Organic Carbon (mg/L)	1.93	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	35.9	**Temperature (Lab) (°C)**	18.8
Hardness (mg CaCO3/L)	68.9	**pH (Lab)**	7.1
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	0.216	**Calcium (mg/L)**	22.4
Nitrate-Nitrite as N (mg/L)	0.216	**Iron (mg/L)**	<0.200
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	3.14
Total Dissolved Solids (Lab) (mg/L)	135	**Alkalinity to pH 4.5 (mg CaCO3/L)**	44.0
Total Kjeldahl Nitrogen (mg/L)	<0.500	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	2
Fast/Shallow	2
Slow/Deep	1
Fast/Deep	1

Macroinvertebrate Metrics

Total Taxa Richness	31
EPT Taxa Richness	21
Beck's Index	20
Shannon Diversity Index	2.91
Hilsenhoff Biotic Index	4.02
Percent Sensitive Individuals	32.2
Index of Biotic Integrity	76.4

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	36
Condition of Banks + Vegetative Protection	22
Habitat Assessment Score (Overall)	163

Site Summary Sheet: MARSCR22

Stream Name	Marshalls Creek	**Latitude**	41.051664
Date Sampled	4/24/2026	**Longitude**	-75.136892
Time Sampled	9:11 AM	**Municipality**	Smithfield
Drainage Area (sq mi)	12.9	**Habitat Type**	Riffle/Run
Location Description	Marshalls Falls Park on Smithfield Twp property. Downstream 50m of walkway.		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	85.6
Dissolved Oxygen (mg/L)	9.64
Conductivity (µS/cm)	115.6
Total Dissolved Solids (mg/L)	75
Temperature (°C)	10.1

Lab Chemistry Results

Total Organic Carbon (mg/L)	1.78	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	17.6	**Temperature (Lab) (°C)**	19.3
Hardness (mg CaCO3/L)	29.2	**pH (Lab)**	6.6
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	0.236	**Calcium (mg/L)**	8.36
Nitrate-Nitrite as N (mg/L)	0.236	**Iron (mg/L)**	<0.200
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	2.01
Total Dissolved Solids (Lab) (mg/L)	48.8	**Alkalinity to pH 4.5 (mg CaCO3/L)**	<20.0
Total Kjeldahl Nitrogen (mg/L)	<0.500	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	1
Fast/Shallow	2
Slow/Deep	1
Fast/Deep	2

Macroinvertebrate Metrics

Total Taxa Richness	34
EPT Taxa Richness	19
Beck's Index	38
Shannon Diversity Index	2.90
Hilsenhoff Biotic Index	3.45
Percent Sensitive Individuals	42.3
Index of Biotic Integrity	88.5

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	29
Condition of Banks + Vegetative Protection	27
Habitat Assessment Score (Overall)	190

Site Summary Sheet: MBBRCR01

Stream Name	Middle Branch Brodhead Creek	**Latitude**	41.201715
Date Sampled	4/28/2026	**Longitude**	-75.265098
Time Sampled	8:45 AM	**Municipality**	Barrett
Drainage Area (sq mi)	5.04	**Habitat Type**	Riffle/Run
Location Description	High Acres Park upstream of Buck Hill Falls property on Barrett Township's property.		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	84.4
Dissolved Oxygen (mg/L)	9.67
Conductivity (µS/cm)	73.5
Total Dissolved Solids (mg/L)	48
Temperature (°C)	9.4

Lab Chemistry Results

Total Organic Carbon (mg/L)	2.04	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	11.9	**Temperature (Lab) (°C)**	18.4
Hardness (mg CaCO3/L)	17.0	**pH (Lab)**	6.2
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	0.287	**Calcium (mg/L)**	4.77
Nitrate-Nitrite as N (mg/L)	0.287	**Iron (mg/L)**	<0.200
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	1.23
Total Dissolved Solids (Lab) (mg/L)	47.5	**Alkalinity to pH 4.5 (mg CaCO3/L)**	<20.0
Total Kjeldahl Nitrogen (mg/L)	0.664	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	1
Fast/Shallow	1
Slow/Deep	2
Fast/Deep	2

Macroinvertebrate Metrics

Total Taxa Richness	39
EPT Taxa Richness	18
Beck's Index	51
Shannon Diversity Index	3.11
Hilsenhoff Biotic Index	2.75
Percent Sensitive Individuals	59.9
Index of Biotic Integrity	92.5

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	37
Condition of Banks + Vegetative Protection	25
Habitat Assessment Score (Overall)	208

Site Summary Sheet: MCMICR22

Stream Name	McMichael Creek	**Latitude**	40.930902
Date Sampled	4/20/2026	**Longitude**	-75.363567
Time Sampled	12:50 PM	**Municipality**	Chestnuthill
Drainage Area (sq mi)	17.7	**Habitat Type**	Riffle/Run
Location Description	115m south of intersection of Mcilhaney Rd. and Kennel Rd.		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	106.3
Dissolved Oxygen (mg/L)	12.29
Conductivity (µS/cm)	75.8
Total Dissolved Solids (mg/L)	49
Temperature (°C)	9.0

Lab Chemistry Results

Total Organic Carbon (mg/L)	1.05	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	12.1	**Temperature (Lab) (°C)**	20.3
Hardness (mg CaCO3/L)	19.0	**pH (Lab)**	6.7
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	0.482	**Calcium (mg/L)**	4.68
Nitrate-Nitrite as N (mg/L)	0.482	**Iron (mg/L)**	<0.200
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	1.79
Total Dissolved Solids (Lab) (mg/L)	33.8	**Alkalinity to pH 4.5 (mg CaCO3/L)**	<20.0
Total Kjeldahl Nitrogen (mg/L)	<0.500	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	1
Fast/Shallow	3
Slow/Deep	0
Fast/Deep	2

Macroinvertebrate Metrics

Total Taxa Richness	46
EPT Taxa Richness	27
Beck's Index	45
Shannon Diversity Index	3.27
Hilsenhoff Biotic Index	3.73
Percent Sensitive Individuals	44.7
Index of Biotic Integrity	88.4

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	34
Condition of Banks + Vegetative Protection	33
Habitat Assessment Score (Overall)	199

Site Summary Sheet: MCMICR37

Stream Name	McMichael Creek	**Latitude**	40.962041
Date Sampled	4/27/2026	**Longitude**	-75.236508
Time Sampled	9:15 AM	**Municipality**	Stroud
Drainage Area (sq mi)	63.1	**Habitat Type**	Riffle/Run
Location Description	Hickory Valley Park 60m southeast from parking area.		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	87.2
Dissolved Oxygen (mg/L)	9.89
Conductivity (µS/cm)	172.7
Total Dissolved Solids (mg/L)	112
Temperature (°C)	9.8

Lab Chemistry Results

Total Organic Carbon (mg/L)	2.47	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	24.5	**Temperature (Lab) (°C)**	18.7
Hardness (mg CaCO3/L)	46.6	**pH (Lab)**	6.7
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	0.593	**Calcium (mg/L)**	14.5
Nitrate-Nitrite as N (mg/L)	0.593	**Iron (mg/L)**	<0.200
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	2.56
Total Dissolved Solids (Lab) (mg/L)	104	**Alkalinity to pH 4.5 (mg CaCO3/L)**	28.0
Total Kjeldahl Nitrogen (mg/L)	0.770	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	2
Fast/Shallow	1
Slow/Deep	2
Fast/Deep	1

Macroinvertebrate Metrics

Total Taxa Richness	31
EPT Taxa Richness	17
Beck's Index	32
Shannon Diversity Index	2.81
Hilsenhoff Biotic Index	3.17
Percent Sensitive Individuals	44.9
Index of Biotic Integrity	93.9

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	33
Condition of Banks + Vegetative Protection	28
Habitat Assessment Score (Overall)	182

Site Summary Sheet: MIDDCR04

Stream Name	Middle Creek	**Latitude**	40.905822
Date Sampled	4/20/2026	**Longitude**	-75.496614
Time Sampled	11:50 AM	**Municipality**	Polk
Drainage Area (sq mi)	18.1	**Habitat Type**	Riffle/Run
Location Description	Downstream of observation deck on Cliff Woodring Trail.		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	108.7
Dissolved Oxygen (mg/L)	12.66
Conductivity (µS/cm)	86.1
Total Dissolved Solids (mg/L)	56
Temperature (°C)	8.7

Lab Chemistry Results

Total Organic Carbon (mg/L)	1.21	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	14.8	**Temperature (Lab) (°C)**	20.0
Hardness (mg CaCO3/L)	20.2	**pH (Lab)**	6.3
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	0.875	**Calcium (mg/L)**	4.62
Nitrate-Nitrite as N (mg/L)	0.875	**Iron (mg/L)**	<0.200
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	2.12
Total Dissolved Solids (Lab) (mg/L)	53.8	**Alkalinity to pH 4.5 (mg CaCO3/L)**	<20.0
Total Kjeldahl Nitrogen (mg/L)	<0.500	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	1
Fast/Shallow	3
Slow/Deep	0
Fast/Deep	2

Macroinvertebrate Metrics

Total Taxa Richness	40
EPT Taxa Richness	23
Beck's Index	40
Shannon Diversity Index	3.26
Hilsenhoff Biotic Index	3.42
Percent Sensitive Individuals	52.8
Index of Biotic Integrity	90.6

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	32
Condition of Banks + Vegetative Protection	28
Habitat Assessment Score (Overall)	184

Site Summary Sheet: MILLCR03

Stream Name	Mill Creek	**Latitude**	41.163201
Date Sampled	4/28/2026	**Longitude**	-75.251528
Time Sampled	10:40 AM	**Municipality**	Barrett
Drainage Area (sq mi)	6.79	**Habitat Type**	Riffle/Run
Location Description	560m west of intersection of Sand Spring Rd. and Mill Creek Rd.		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	86.3
Dissolved Oxygen (mg/L)	9.89
Conductivity (µS/cm)	90.6
Total Dissolved Solids (mg/L)	59
Temperature (°C)	9.4

Lab Chemistry Results

Total Organic Carbon (mg/L)	1.19	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	16.1	**Temperature (Lab) (°C)**	18.1
Hardness (mg CaCO3/L)	17.2	**pH (Lab)**	6.3
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	0.210	**Calcium (mg/L)**	4.78
Nitrate-Nitrite as N (mg/L)	0.210	**Iron (mg/L)**	<0.200
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	1.28
Total Dissolved Solids (Lab) (mg/L)	70.0	**Alkalinity to pH 4.5 (mg CaCO3/L)**	<20.0
Total Kjeldahl Nitrogen (mg/L)	0.646	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	1
Fast/Shallow	3
Slow/Deep	1
Fast/Deep	1

Macroinvertebrate Metrics

Total Taxa Richness	30
EPT Taxa Richness	19
Beck's Index	46
Shannon Diversity Index	2.90
Hilsenhoff Biotic Index	2.39
Percent Sensitive Individuals	64.5
Index of Biotic Integrity	93.5

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	39
Condition of Banks + Vegetative Protection	24
Habitat Assessment Score (Overall)	193

Site Summary Sheet: PARACR08

Stream Name	Paradise Creek	**Latitude**	41.066498
Date Sampled	4/30/2026	**Longitude**	-75.221395
Time Sampled	9:30 AM	**Municipality**	Stroud
Drainage Area (sq mi)	43.5	**Habitat Type**	Riffle/Run
Location Description	Sugar Cone Ln. access off of Rt. 191 Bridge upstream of confluence of Brodhead Creek.		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	1085
Dissolved Oxygen (mg/L)	12.03
Conductivity (µS/cm)	196.5
Total Dissolved Solids (mg/L)	128
Temperature (°C)	10.7

Lab Chemistry Results

Total Organic Carbon (mg/L)	1.74	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	42.8	**Temperature (Lab) (°C)**	18.8
Hardness (mg CaCO3/L)	34.9	**pH (Lab)**	6.6
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	0.410	**Calcium (mg/L)**	9.82
Nitrate-Nitrite as N (mg/L)	0.410	**Iron (mg/L)**	<0.200
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	2.53
Total Dissolved Solids (Lab) (mg/L)	108	**Alkalinity to pH 4.5 (mg CaCO3/L)**	<20.0
Total Kjeldahl Nitrogen (mg/L)	0.505	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	1
Fast/Shallow	1
Slow/Deep	2
Fast/Deep	2

Macroinvertebrate Metrics

Total Taxa Richness	31
EPT Taxa Richness	19
Beck's Index	25
Shannon Diversity Index	2.68
Hilsenhoff Biotic Index	3.59
Percent Sensitive Individuals	27.7
Index of Biotic Integrity	87.9

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	37
Condition of Banks + Vegetative Protection	24
Habitat Assessment Score (Overall)	195

Site Summary Sheet: POCOCR01

Stream Name	Pocono Creek	Latitude	41.058983
Date Sampled	4/22/2026	Longitude	-75.34886
Time Sampled	8:11 AM	Municipality	Pocono
Drainage Area (sq mi)	8.84	Habitat Type	Riffle/Run
Location Description	300m south on Camelback Rd from intersection of Camelback Rd. and Wilke Rd.		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	103.6
Dissolved Oxygen (mg/L)	12.31
Conductivity (µS/cm)	136.5
Total Dissolved Solids (mg/L)	89
Temperature (°C)	7.9

Lab Chemistry Results

Total Organic Carbon (mg/L)	1.34	Phosphorus as P (mg/L)	<0.0250
Chloride (mg/L)	30.5	Temperature (Lab) (°C)	18.7
Hardness (mg CaCO3/L)	21.0	pH (Lab)	6.8
Ammonia as N (mg/L)	<0.200	Aluminum (mg/L)	<0.200
Nitrate as N (mg/L)	0.209	Calcium (mg/L)	5.70
Nitrate-Nitrite as N (mg/L)	0.209	Iron (mg/L)	<0.200
Nitrite as N (mg/L)	<0.0250	Magnesium (mg/L)	1.65
Total Dissolved Solids (Lab) (mg/L)	62.5	Alkalinity to pH 4.5 (mg CaCO3/L)	<20.0
Total Kjeldahl Nitrogen (mg/L)	<0.500	Biochemical Oxygen Demand (mg/L)	<3.00

Habitat Sampled

Slow/Shallow	1
Fast/Shallow	2
Slow/Deep	1
Fast/Deep	2

Macroinvertebrate Metrics

Total Taxa Richness	30
EPT Taxa Richness	19
Beck's Index	45
Shannon Diversity Index	2.62
Hilsenhoff Biotic Index	3.16
Percent Sensitive Individuals	52.7
Index of Biotic Integrity	88.2

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	34
Condition of Banks + Vegetative Protection	30
Habitat Assessment Score (Overall)	192

Site Summary Sheet: POCOCR07

Stream Name	Pocono Creek	Latitude	41.029336
Date Sampled	4/22/2026	Longitude	-75.301604
Time Sampled	9:50 AM	Municipality	Pocono
Drainage Area (sq mi)	21.7	Habitat Type	Riffle/Run
Location Description	220 meters south from intersection of Warner Road and Route 611		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	105.9
Dissolved Oxygen (mg/L)	12.45
Conductivity (µS/cm)	270.9
Total Dissolved Solids (mg/L)	176
Temperature (°C)	8.2

Lab Chemistry Results

Total Organic Carbon (mg/L)	1.13	Phosphorus as P (mg/L)	<0.0250
Chloride (mg/L)	62.0	Temperature (Lab) (°C)	18.6
Hardness (mg CaCO3/L)	43.6	pH (Lab)	6.8
Ammonia as N (mg/L)	<0.200	Aluminum (mg/L)	<0.200
Nitrate as N (mg/L)	0.383	Calcium (mg/L)	12.1
Nitrate-Nitrite as N (mg/L)	0.383	Iron (mg/L)	<0.200
Nitrite as N (mg/L)	<0.0250	Magnesium (mg/L)	3.27
Total Dissolved Solids (Lab) (mg/L)	143	Alkalinity to pH 4.5 (mg CaCO3/L)	<20.0
Total Kjeldahl Nitrogen (mg/L)	<0.500	Biochemical Oxygen Demand (mg/L)	<3.00

Habitat Sampled

Slow/Shallow	1
Fast/Shallow	2
Slow/Deep	1
Fast/Deep	2

Macroinvertebrate Metrics

Total Taxa Richness	28
EPT Taxa Richness	14
Beck's Index	22
Shannon Diversity Index	2.42
Hilsenhoff Biotic Index	4.06
Percent Sensitive Individuals	23.4
Index of Biotic Integrity	67.0

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	36
Condition of Banks + Vegetative Protection	27
Habitat Assessment Score (Overall)	202

Site Summary Sheet: POCOCR09

Stream Name	Pocono Creek	**Latitude**	41.039252
Date Sampled	4/22/2026	**Longitude**	-75.309729
Time Sampled	9:00 AM	**Municipality**	Pocono
Drainage Area (sq mi)	18.6	**Habitat Type**	Riffle/Run
Location Description	65m north of Old Mill Rd. bridge.		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	106.8
Dissolved Oxygen (mg/L)	12.60
Conductivity (µS/cm)	227.6
Total Dissolved Solids (mg/L)	148
Temperature (°C)	8.1

Lab Chemistry Results

Total Organic Carbon (mg/L)	1.13	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	50.0	**Temperature (Lab) (°C)**	18.0
Hardness (mg CaCO3/L)	37.0	**pH (Lab)**	6.5
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	0.371	**Calcium (mg/L)**	9.94
Nitrate-Nitrite as N (mg/L)	0.371	**Iron (mg/L)**	<0.200
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	2.96
Total Dissolved Solids (Lab) (mg/L)	123	**Alkalinity to pH 4.5 (mg CaCO3/L)**	<20.0
Total Kjeldahl Nitrogen (mg/L)	<0.500	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	2
Fast/Shallow	2
Slow/Deep	0
Fast/Deep	2

Macroinvertebrate Metrics

Total Taxa Richness	28
EPT Taxa Richness	14
Beck's Index	29
Shannon Diversity Index	2.26
Hilsenhoff Biotic Index	4.01
Percent Sensitive Individuals	28.7
Index of Biotic Integrity	70.3

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	28
Condition of Banks + Vegetative Protection	20
Habitat Assessment Score (Overall)	152

Site Summary Sheet: POCOCR14

Stream Name	Pocono Creek	Latitude	40.981165
Date Sampled	4/22/2026	Longitude	-75.197009
Time Sampled	10:35 AM	Municipality	Stroudsburg
Drainage Area (sq mi)	49.4	Habitat Type	Riffle/Run
Location Description	70m south from S. 10th St and Ann St.		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	111.1
Dissolved Oxygen (mg/L)	12.55
Conductivity (µS/cm)	314.7
Total Dissolved Solids (mg/L)	205
Temperature (°C)	9.9

Lab Chemistry Results

Total Organic Carbon (mg/L)	1.86	Phosphorus as P (mg/L)	<0.0250
Chloride (mg/L)	68.4	Temperature (Lab) (°C)	19.5
Hardness (mg CaCO3/L)	56.7	pH (Lab)	6.9
Ammonia as N (mg/L)	<0.200	Aluminum (mg/L)	<0.200
Nitrate as N (mg/L)	0.339	Calcium (mg/L)	16.6
Nitrate-Nitrite as N (mg/L)	0.339	Iron (mg/L)	<0.200
Nitrite as N (mg/L)	<0.0250	Magnesium (mg/L)	3.69
Total Dissolved Solids (Lab) (mg/L)	174	Alkalinity to pH 4.5 (mg CaCO3/L)	28.0
Total Kjeldahl Nitrogen (mg/L)	<0.500	Biochemical Oxygen Demand (mg/L)	<3.00

Habitat Sampled

Slow/Shallow	1
Fast/Shallow	3
Slow/Deep	0
Fast/Deep	2

Macroinvertebrate Metrics

Total Taxa Richness	30
EPT Taxa Richness	13
Beck's Index	20
Shannon Diversity Index	2.62
Hilsenhoff Biotic Index	4.57
Percent Sensitive Individuals	11.7
Index of Biotic Integrity	64.0

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	35
Condition of Banks + Vegetative Protection	20
Habitat Assessment Score (Overall)	165

Site Summary Sheet: POHOCR01

Stream Name	Pohopoco Creek	**Latitude**	40.961684
Date Sampled	4/20/2026	**Longitude**	-75.465
Time Sampled	10:10 AM	**Municipality**	Chestnuthill
Drainage Area (sq mi)	5.86	**Habitat Type**	Riffle/Run
Location Description	330m southeast from intersection of Merwinsburg Rd. and Burger Hollow Rd.		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	104.2
Dissolved Oxygen (mg/L)	12.36
Conductivity (µS/cm)	134.8
Total Dissolved Solids (mg/L)	88
Temperature (°C)	8.0

Lab Chemistry Results

Total Organic Carbon (mg/L)	0.662	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	29.1	**Temperature (Lab) (°C)**	20.2
Hardness (mg CaCO3/L)	26.9	**pH (Lab)**	6.3
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	1.13	**Calcium (mg/L)**	5.96
Nitrate-Nitrite as N (mg/L)	1.13	**Iron (mg/L)**	<0.200
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	2.91
Total Dissolved Solids (Lab) (mg/L)	76.3	**Alkalinity to pH 4.5 (mg CaCO3/L)**	<20.0
Total Kjeldahl Nitrogen (mg/L)	<0.500	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	0
Fast/Shallow	4
Slow/Deep	0
Fast/Deep	2

Macroinvertebrate Metrics

Total Taxa Richness	30
EPT Taxa Richness	13
Beck's Index	25
Shannon Diversity Index	2.79
Hilsenhoff Biotic Index	3.52
Percent Sensitive Individuals	51.6
Index of Biotic Integrity	77.3

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	29
Condition of Banks + Vegetative Protection	35
Habitat Assessment Score (Overall)	189

Site Summary Sheet: POHOCR29

Stream Name	Pohopoco Creek	**Latitude**	40.89951
Date Sampled	4/21/2026	**Longitude**	-75.506215
Time Sampled	8:33 AM	**Municipality**	Polk
Drainage Area (sq mi)	50	**Habitat Type**	Riffle/Run
Location Description	700 meters west on Whitey B Ln. from intersection of Whitey B Ln. and Rt. 209.		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	102.8
Dissolved Oxygen (mg/L)	12.70
Conductivity (µS/cm)	141.4
Total Dissolved Solids (mg/L)	92
Temperature (°C)	6.4

Lab Chemistry Results

Total Organic Carbon (mg/L)	1.10	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	25.6	**Temperature (Lab) (°C)**	18.6
Hardness (mg CaCO3/L)	31.5	**pH (Lab)**	6.7
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	1.45	**Calcium (mg/L)**	7.52
Nitrate-Nitrite as N (mg/L)	1.45	**Iron (mg/L)**	<0.200
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	3.09
Total Dissolved Solids (Lab) (mg/L)	77.5	**Alkalinity to pH 4.5 (mg CaCO3/L)**	<20.0
Total Kjeldahl Nitrogen (mg/L)	<0.500	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	1
Fast/Shallow	3
Slow/Deep	0
Fast/Deep	2

Macroinvertebrate Metrics

Total Taxa Richness	41
EPT Taxa Richness	21
Beck's Index	35
Shannon Diversity Index	2.84
Hilsenhoff Biotic Index	4.18
Percent Sensitive Individuals	31.9
Index of Biotic Integrity	88.5

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	34
Condition of Banks + Vegetative Protection	35
Habitat Assessment Score (Overall)	208

Site Summary Sheet: PRINRN01

Stream Name	Princess Run	**Latitude**	40.851843
Date Sampled	4/21/2026	**Longitude**	-75.440199
Time Sampled	10:29 AM	**Municipality**	Eldred
Drainage Area (sq mi)	9.91	**Habitat Type**	Riffle/Run
Location Description	Adjacent to Walter Mock Municipal Park.		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	106.0
Dissolved Oxygen (mg/L)	13.07
Conductivity (µS/cm)	125.2
Total Dissolved Solids (mg/L)	81
Temperature (°C)	6.3

Lab Chemistry Results

Total Organic Carbon (mg/L)	0.925	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	18.2	**Temperature (Lab) (°C)**	19.0
Hardness (mg CaCO3/L)	34.5	**pH (Lab)**	6.5
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	1.79	**Calcium (mg/L)**	7.88
Nitrate-Nitrite as N (mg/L)	1.79	**Iron (mg/L)**	<0.200
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	3.61
Total Dissolved Solids (Lab) (mg/L)	74.0	**Alkalinity to pH 4.5 (mg CaCO3/L)**	<20.0
Total Kjeldahl Nitrogen (mg/L)	<0.500	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	2
Fast/Shallow	2
Slow/Deep	1
Fast/Deep	1

Macroinvertebrate Metrics

Total Taxa Richness	30
EPT Taxa Richness	17
Beck's Index	27
Shannon Diversity Index	2.77
Hilsenhoff Biotic Index	3.83
Percent Sensitive Individuals	42.6
Index of Biotic Integrity	79.1

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	36
Condition of Banks + Vegetative Protection	32
Habitat Assessment Score (Overall)	203

Site Summary Sheet: ROCOCR01

Stream Name	Ross Commons Creek	**Latitude**	40.872833
Date Sampled	4/21/2026	**Longitude**	-75.326028
Time Sampled	11:50 AM	**Municipality**	Ross
Drainage Area (sq mi)	3.75	**Habitat Type**	Riffle/Run
Location Description	95m East from interection of Mount Eaton Rd and Spruce Rd to bridge over Ross Commons. 100m South from bridge.		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	108.1
Dissolved Oxygen (mg/L)	12.62
Conductivity (µS/cm)	89.2
Total Dissolved Solids (mg/L)	58
Temperature (°C)	8.6

Lab Chemistry Results

Total Organic Carbon (mg/L)	0.782	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	13.4	**Temperature (Lab) (°C)**	18.5
Hardness (mg CaCO3/L)	21.1	**pH (Lab)**	6.6
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	0.455	**Calcium (mg/L)**	4.82
Nitrate-Nitrite as N (mg/L)	0.455	**Iron (mg/L)**	<0.200
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	2.19
Total Dissolved Solids (Lab) (mg/L)	40.0	**Alkalinity to pH 4.5 (mg CaCO3/L)**	<20.0
Total Kjeldahl Nitrogen (mg/L)	<0.500	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	1
Fast/Shallow	2
Slow/Deep	1
Fast/Deep	2

Macroinvertebrate Metrics

Total Taxa Richness	37
EPT Taxa Richness	20
Beck's Index	42
Shannon Diversity Index	2.85
Hilsenhoff Biotic Index	3.01
Percent Sensitive Individuals	59.5
Index of Biotic Integrity	92.7

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	33
Condition of Banks + Vegetative Protection	26
Habitat Assessment Score (Overall)	180

Site Summary Sheet: SWIFCR10

Stream Name	Swiftwater Creek	Latitude	41.100894
Date Sampled	4/24/2026	Longitude	-75.346355
Time Sampled	11:05 AM	Municipality	Pocono
Drainage Area (sq mi)	3.35	Habitat Type	Riffle/Run
Location Description	25m North of Manor Dr. Bridge		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	83.7
Dissolved Oxygen (mg/L)	9.58
Conductivity (µS/cm)	180.1
Total Dissolved Solids (mg/L)	117
Temperature (°C)	9.4

Lab Chemistry Results

Total Organic Carbon (mg/L)	0.575	Phosphorus as P (mg/L)	<0.0250
Chloride (mg/L)	43.2	Temperature (Lab) (°C)	18.7
Hardness (mg CaCO3/L)	27.9	pH (Lab)	6.5
Ammonia as N (mg/L)	<0.200	Aluminum (mg/L)	<0.200
Nitrate as N (mg/L)	0.766	Calcium (mg/L)	7.37
Nitrate-Nitrite as N (mg/L)	0.766	Iron (mg/L)	<0.200
Nitrite as N (mg/L)	<0.0250	Magnesium (mg/L)	2.31
Total Dissolved Solids (Lab) (mg/L)	96.3	Alkalinity to pH 4.5 (mg CaCO3/L)	<20.0
Total Kjeldahl Nitrogen (mg/L)	<0.500	Biochemical Oxygen Demand (mg/L)	<3.00

Habitat Sampled

Slow/Shallow	1
Fast/Shallow	2
Slow/Deep	1
Fast/Deep	2

Macroinvertebrate Metrics

Total Taxa Richness	37
EPT Taxa Richness	22
Beck's Index	41
Shannon Diversity Index	2.78
Hilsenhoff Biotic Index	4.13
Percent Sensitive Individuals	35.6
Index of Biotic Integrity	85.3

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	28
Condition of Banks + Vegetative Protection	29
Habitat Assessment Score (Overall)	191

Site Summary Sheet: TOBYCR02

Stream Name	Tobyhanna Creek	**Latitude**	41.166930
Date Sampled	4/23/2026	**Longitude**	-75.435260
Time Sampled	8:50 AM	**Municipality**	Coolbaugh
Drainage Area (sq mi)	19.5	**Habitat Type**	Riffle/Run
Location Description	770 meters East from I-80 accress through State Game Land Road		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	81.0
Dissolved Oxygen (mg/L)	9.09
Conductivity (µS/cm)	115.6
Total Dissolved Solids (mg/L)	75
Temperature (°C)	10.3

Lab Chemistry Results

Total Organic Carbon (mg/L)	5.75	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	23.4	**Temperature (Lab) (°C)**	19.1
Hardness (mg CaCO3/L)	19.3	**pH (Lab)**	5.8
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	0.263	**Calcium (mg/L)**	5.47
Nitrate-Nitrite as N (mg/L)	0.263	**Iron (mg/L)**	0.254
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	1.37
Total Dissolved Solids (Lab) (mg/L)	48.3	**Alkalinity to pH 4.5 (mg CaCO3/L)**	<20.0
Total Kjeldahl Nitrogen (mg/L)	0.599	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	1
Fast/Shallow	2
Slow/Deep	1
Fast/Deep	2

Macroinvertebrate Metrics

Total Taxa Richness	34
EPT Taxa Richness	15
Beck's Index	22
Shannon Diversity Index	2.74
Hilsenhoff Biotic Index	4.41
Percent Sensitive Individuals	26.4
Index of Biotic Integrity	72.1

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	38
Condition of Banks + Vegetative Protection	34
Habitat Assessment Score (Overall)	222

Site Summary Sheet: TOBYCR14

Stream Name	Tobyhanna Creek	**Latitude**	41.082791
Date Sampled	4/23/2026	**Longitude**	-75.583083
Time Sampled	12:10 PM	**Municipality**	Tobyhanna
Drainage Area (sq mi)	82.6	**Habitat Type**	Riffle/Run
Location Description	50m east of Rt. 115 bridge near Austin T. Blakeslee Natural Area.		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	84.3
Dissolved Oxygen (mg/L)	8.55
Conductivity (µS/cm)	123.4
Total Dissolved Solids (mg/L)	80
Temperature (°C)	14.7

Lab Chemistry Results

Total Organic Carbon (mg/L)	4.59	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	27.2	**Temperature (Lab) (°C)**	19.1
Hardness (mg CaCO3/L)	18.0	**pH (Lab)**	6.5
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	0.213	**Calcium (mg/L)**	5.23
Nitrate-Nitrite as N (mg/L)	0.213	**Iron (mg/L)**	<0.200
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	1.20
Total Dissolved Solids (Lab) (mg/L)	66.7	**Alkalinity to pH 4.5 (mg CaCO3/L)**	<20.0
Total Kjeldahl Nitrogen (mg/L)	<0.500	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	0
Fast/Shallow	2
Slow/Deep	2
Fast/Deep	2

Macroinvertebrate Metrics

Total Taxa Richness	33
EPT Taxa Richness	16
Beck's Index	22
Shannon Diversity Index	2.65
Hilsenhoff Biotic Index	4.31
Percent Sensitive Individuals	28.7
Index of Biotic Integrity	86.2

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	37
Condition of Banks + Vegetative Protection	24
Habitat Assessment Score (Overall)	182

Site Summary Sheet: TUNKCR03

Stream Name	Tunkhannock Creek	**Latitude**	41.059541
Date Sampled	4/23/2026	**Longitude**	-75.552735
Time Sampled	11:40 AM	**Municipality**	Tunkhannock
Drainage Area (sq mi)	21.7	**Habitat Type**	Riffle/Run
Location Description	160m north of Tunkhannock Fishing Association Parking area.		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	80.8
Dissolved Oxygen (mg/L)	8.99
Conductivity (µS/cm)	54.7
Total Dissolved Solids (mg/L)	36
Temperature (°C)	10.6

Lab Chemistry Results

Total Organic Carbon (mg/L)	6.40	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	11.8	**Temperature (Lab) (°C)**	19.3
Hardness (mg CaCO3/L)	8.70	**pH (Lab)**	5.5
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	0.132	**Calcium (mg/L)**	2.07
Nitrate-Nitrite as N (mg/L)	0.132	**Iron (mg/L)**	<0.200
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	0.859
Total Dissolved Solids (Lab) (mg/L)	<41.7	**Alkalinity to pH 4.5 (mg CaCO3/L)**	<20.0
Total Kjeldahl Nitrogen (mg/L)	<0.500	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	1
Fast/Shallow	2
Slow/Deep	1
Fast/Deep	2

Macroinvertebrate Metrics

Total Taxa Richness	42
EPT Taxa Richness	19
Beck's Index	33
Shannon Diversity Index	3.03
Hilsenhoff Biotic Index	4.20
Percent Sensitive Individuals	33.5
Index of Biotic Integrity	91.0

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	27
Condition of Banks + Vegetative Protection	27
Habitat Assessment Score (Overall)	168

Site Summary Sheet: TUNKCR04

Stream Name	Tunkhannock Creek	**Latitude**	41.029496
Date Sampled	4/20/2026	**Longitude**	-75.451954
Time Sampled	9:00 AM	**Municipality**	Tunkhannock
Drainage Area (sq mi)	8.81	**Habitat Type**	Low Gradient
Location Description	Off Fire Ln. near Bethlehem Water Authority dam		

Field Measurements

pH	
Dissolved Oxygen (%)	86.2
Dissolved Oxygen (mg/L)	10.47
Conductivity (µS/cm)	64.3
Total Dissolved Solids (mg/L)	42
Temperature (°C)	7.0

Lab Chemistry Results

Total Organic Carbon (mg/L)	9.82	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	14.6	**Temperature (Lab) (°C)**	20.5
Hardness (mg CaCO3/L)	8.97	**pH (Lab)**	5
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	0.209
Nitrate as N (mg/L)	0.0794	**Calcium (mg/L)**	2.25
Nitrate-Nitrite as N (mg/L)	0.0794	**Iron (mg/L)**	0.323
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	0.811
Total Dissolved Solids (Lab) (mg/L)	50.0	**Alkalinity to pH 4.5 (mg CaCO3/L)**	<20.0
Total Kjeldahl Nitrogen (mg/L)	0.535	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Cobble/Gravel	2
Snag	1
CPOM	1
Submerged Aquatic Vegetation	3
Sand/Fine Sediment	3

Macroinvertebrate Metrics

Total Taxa Richness	24
EPT Taxa Richness	11
Beck4	3
Shannon Diversity Index	1.7
# of Caddisfly Taxa	5
# of Mayfly Taxa	3
Index of Biotic Integrity	51.7

Habitat Assessment Metrics

Pool Substrate Characterization + Sediment Deposition	32
Bank Vegetative Protection + Bank Stability	35
Habitat Assessment Score (Overall)	154

Site Summary Sheet: UPTNCR03

Stream Name	Upper Tunkhannock Creek	**Latitude**	41.103919
Date Sampled	4/23/2026	**Longitude**	-75.49708
Time Sampled	10:00 AM	**Municipality**	Tobyhanna
Drainage Area (sq mi)	25.7	**Habitat Type**	Riffle/Run
Location Description	Tunkhannock Fishing Association clubhouse, from plunge pool to cummings pool.		

Field Measurements*No field pH as YSI probe was malfunctioning

pH	
Dissolved Oxygen (%)	82.1
Dissolved Oxygen (mg/L)	8.87
Conductivity (µS/cm)	181.2
Total Dissolved Solids (mg/L)	118
Temperature (°C)	11.9

Lab Chemistry Results

Total Organic Carbon (mg/L)	4.03	**Phosphorus as P (mg/L)**	<0.0250
Chloride (mg/L)	42.8	**Temperature (Lab) (°C)**	19.0
Hardness (mg CaCO3/L)	23.2	**pH (Lab)**	6.2
Ammonia as N (mg/L)	<0.200	**Aluminum (mg/L)**	<0.200
Nitrate as N (mg/L)	0.260	**Calcium (mg/L)**	6.82
Nitrate-Nitrite as N (mg/L)	0.260	**Iron (mg/L)**	<0.200
Nitrite as N (mg/L)	<0.0250	**Magnesium (mg/L)**	1.49
Total Dissolved Solids (Lab) (mg/L)	104	**Alkalinity to pH 4.5 (mg CaCO3/L)**	<20.0
Total Kjeldahl Nitrogen (mg/L)	<0.500	**Biochemical Oxygen Demand (mg/L)**	<3.00

Habitat Sampled

Slow/Shallow	2
Fast/Shallow	2
Slow/Deep	1
Fast/Deep	1

Macroinvertebrate Metrics

Total Taxa Richness	31
EPT Taxa Richness	15
Beck's Index	26
Shannon Diversity Index	2.69
Hilsenhoff Biotic Index	4.13
Percent Sensitive Individuals	35.5
Index of Biotic Integrity	74.9

Habitat Assessment Metrics

Embeddedness + Sediment Deposition	32
Condition of Banks + Vegetative Protection	25
Habitat Assessment Score (Overall)	174

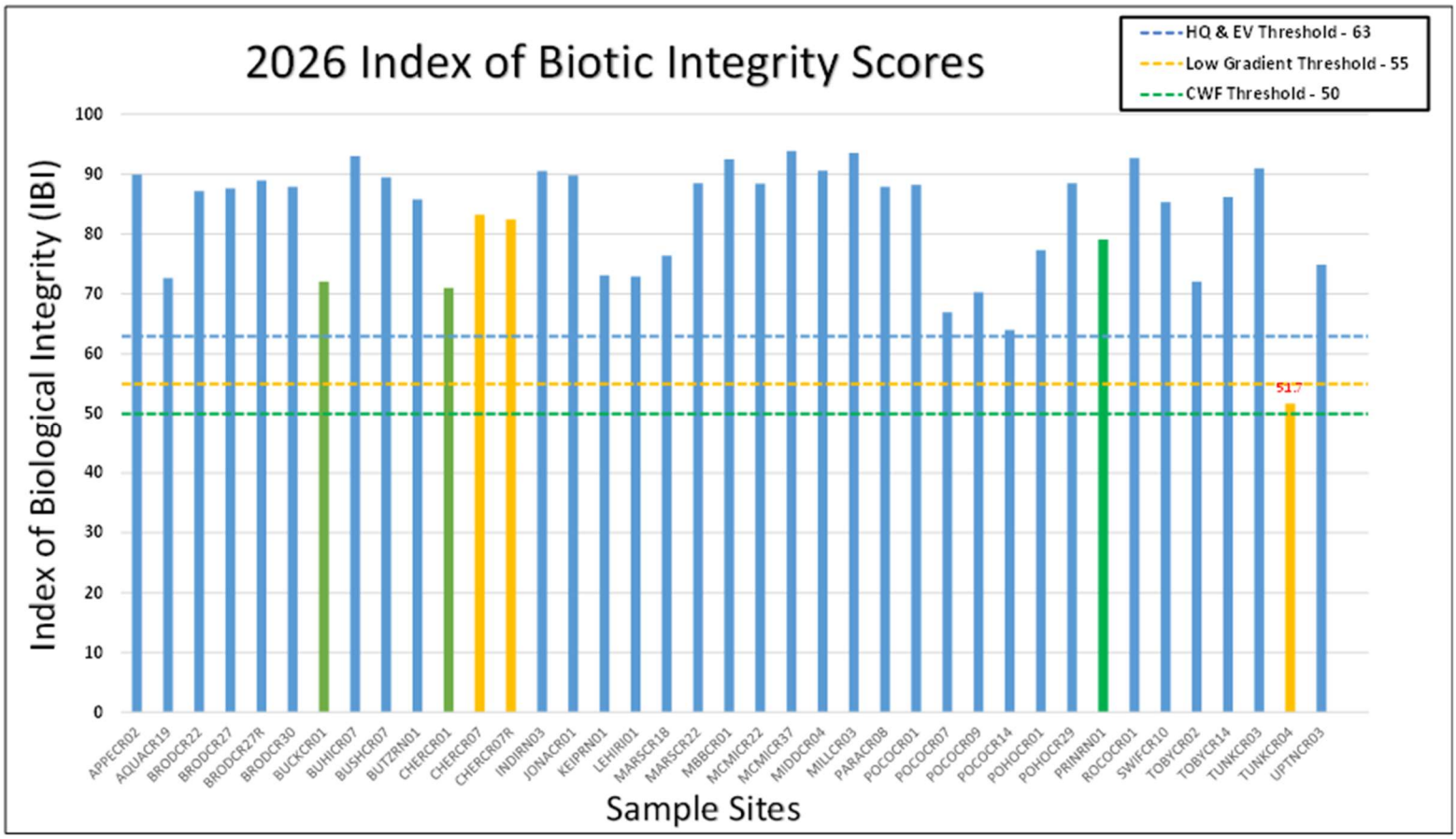
Section VI. Summary and Recommendations

Additional information used in drawing conclusions (including field data sheets, habitat assessment sheets, and macroinvertebrate identification) is available upon request.

2026 Index of Biotic Integrity

The 2026 IBI scores for Monroe County's Annual Water Quality Study are shown below in Figure 8, with target lines for the Aquatic Life Use (ALU) impairment thresholds for streams designated as High Quality-Cold Water Fisheries and Exceptional Value (HQ/EV) (Threshold: 63), Low Gradient (Threshold: 55) and Cold-Water Fisheries (CWF) (Threshold: 50). Sites scoring below the ALU attainment thresholds are listed below in Table 7.

Figure 8: IBI Scores at Monitoring Sites Sampled in 2026



Highlights for 2026

Macroinvertebrate populations found at the sites listed in the table below were some of the most diverse and pollution sensitive communities found in the county.

Table 6: Sites with exceptional macroinvertebrate communities

Waterbody	Site ID	Index of Biotic Integrity
Buckhill Creek	BUHICR07	93.0
Indian Run	INDIRN03	90.5
Middle Branch Brodhead Creek	MBBRCR01	92.5
McMichael Creek	MCMICR37	93.9
Middle Creek	MIDDCR04	90.6
Mill Creek	MILLCR03	93.5
Ross Commons Creek	ROCOCR01	92.7
Tunkhannock Creek	TUNKCR03	91.0

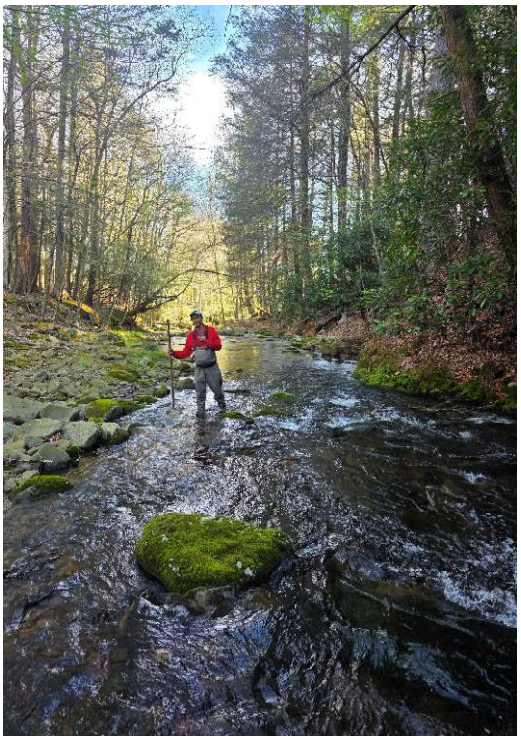


Figure 9: Site ID BUHICR07

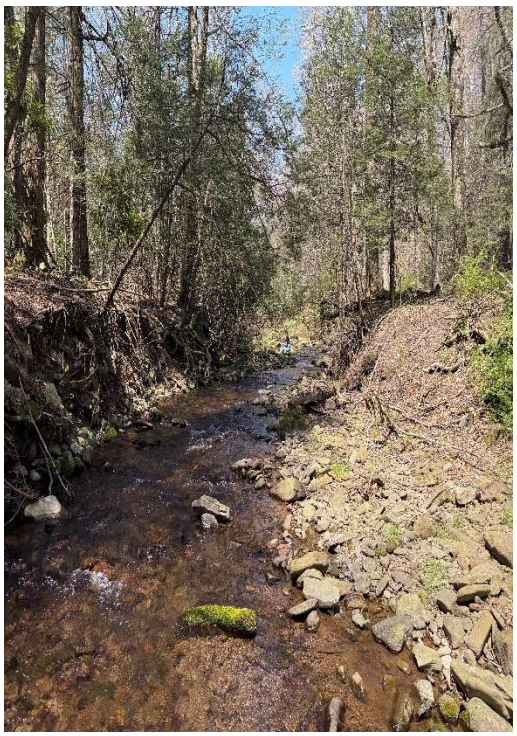


Figure 10: Site ID INDIRN03



Figure 11: Site ID TUNKCR03

Sites Scoring Below IBI Threshold

The Site TUNKCR04 was the only site scoring below the ALU Impairment threshold for 2026.

Table 7: Sample Site Scoring Below the ALU Impairment Threshold

Stream Name	Site ID	Ch. 93 Designation	IBI Score	ALU Impairment Threshold
Tunkhannock Creek	TUNKCR04	EV-Low Gradient	51.7	55

Tunkhannock Creek | TUNKCR04 (EV-Low Gradient)

Internal Metric Tracking	
Epifaunal Substrate/Available Cover	10
Pool Subtrate Characterization	18
Pool Variability	18
Sediment Deposition	14
Channel Flow Status	19
Channel Alteration	20
Condition of Banks	18
Bank Vegetative Protection	17
Riparian Vegetative Zone	20

Macroinvertebrate Summary

Tunkhannock Creek at this location is a low gradient stream. The Aquatic Life Use (ALU) threshold is 55. TUNKCR04 scored below the ALU threshold at 51.7. An overall lack of diversity in the macroinvertebrate community, a lack of pollution sensitive EPT taxa and approximately 95.09% of the individuals having pollution tolerance values of 4 or higher, resulted in an IBI score below the ALU threshold for Low gradient streams. Members of the *Simulium sp* (PTV: 6) were found in the highest concentrations, at 47.17% of the subsample (125/265).

Observations

- The channel upstream of this location is highly entrenched, leading to high velocity flows during strorms and accelerating erosion within the channel.
- Frequent channel movement throughout the reach resulted in a marginal score for Channel Flow Status on the habitat assessment sheet.
- This section of stream has a history of having tannic water, which could impact the IBI score.



Figure 12: Tunkhannock Creek Downstream



Figure 13: Tunkhannock Creek Upstream

Recommendations

- Continuing monitoring on low scoring sites, to get a better understanding of the fluctuations outside conditions can have on the samples.
- The addition of flow and depth measurements to monitor discharge at sample sites year to year is recommended. This will provide us with an additional variable to assess when reviewing our results.
- Evaluate the 2026 sites during the 2027 Water Quality Site Selection meeting to determine what sampling locations will benefit Monroe County the most.
- Submit data to PA DEP for the Integrated Water Quality Report.
- Continue to monitor Chloride found in streams.

Section VII. References

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