

Monroe County Planning Commission

# 2015 Water Quality Study



## **ABSTRACT**

The Monroe County Planning Commission along with the Monroe County Conservation District studied 37 stream sites throughout Monroe County in the spring of 2015. The sites were studied based on four parameters, field surface water measurements, laboratory chemistry analysis, macro-invertebrate identification, and habitat assessment.

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# Materials & Methods

## 1. Field Chemistry Sampling (Appendix A)

The following parameters were measured and stored using HANNA Instruments-Multiparameter HI 9829 with a Multiparameter Probe 7609829 field meter and recorded on standard data forms:

- pH
- Temperature
- D.O. Concentration
- D.O. %
- Conductivity



## 2. Lab Chemistry Sampling (Appendix A)

The following table shows water chemistry parameters that were tested by Microbac Laboratories in the analysis of the stream samples.

Test	Units	Method	PQL
Total Organic Carbon (TOC)	mg/L	SM5310 C-2000	0.500
Aluminum, Total	mg/L	E200.7	0.200
Calcium, Total	mg/L	E200.7	0.500
Iron, Total	mg/L	E200.7	0.100
Magnesium, Total	mg/L	E200.7	0.500
Harness	mg/L	SM2340-B-1997	5.00
Chloride	mg/L	EPA 300.0, Rv 2.1	0.250
pH	pH Units	SM4500 H+ B-2000	0.100
Nitrogen, Total as N (Calc)	mg/L	Calculation	0.500
Ammonia as N	mg/L	EPA 350.1, Rv 2	0.0500
Total Kjeldahl Nitrogen (TKN)	mg/L	EPA 351.2, Rv 2	0.500
Nitrate-Nitrate as N	mg/L	EPA 353.2, Rv 2.0	0.0200
Alkalinity to pH 4.5	mg CaCO <sub>3</sub> /L	SM2320 B-1997	20.0
Total Dissolved Solids (TDS)	mg/L	SM2540 C-1997	20.0
Phosphorus - Total as P	mg/L	SM4500 P E-1999	0.0500
Biochemical Oxygen Demand	mg/L	SM5210 B-2001	3.00



# Materials & Methods

## 3. Macroinvertebrate Sampling (Appendix B)

At each site, macroinvertebrates were collected using 12" D-frame nets that were held on the stream bottom. The collector thoroughly disturbed the stream bottom to dislodge any macroinvertebrates from the substrate. This process was repeated 6 times for Riffle/Run streams and 10 times for Multihabitat streams.

### **Riffle/Run 6 Samples (At least one of each)**

- Fast & Shallow
- Fast & Deep
- Slow & Shallow
- Slow & Deep

### **Multihabitat 10 Samples (Based on abundance)**

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



## 4. Habitat Analysis (Appendix C)

The following tables show Habitat Assessment parameters for Riffle/Run and Low Gradient Streams. Each parameter is rated on a score from 1 to 20. 20 being the highest and 1 being the lowest

### **Riffle Run Streams**

- 1 Instream Fish Cover
- 2 Epifaunal Substrate
- 3 Embeddedness
- 4 Velocity/Depth Regimes
- 5 Channel Alteration
- 6 Sediment Deposition
- 7 Frequency of Riffles
- 8 Channel Flow Statues
- 9 Condition of Banks
- 10 Bank Vegetative Protection
- 11 Grazing or Other Disruptive Pressures
- 12 Riparian Vegetative Zone Width

### **Multihabitat/Low Gradient Streams**

- 1 Epifaunal Substrate/ Available Cover
- 2 Pool Substrate Characterization
- 3 Pool Variability
- 4 Sediment Deposition
- 5 Channel Flow Status
- 6 Channel Alteration
- 7 Bank Stability (score each bank)
- 8 Vegetative Protection (score each bank)
- 9 Riparian Vegetative Zone Width (score each bank)

# Appendix A:

## SURFACE WATER PARAMETERS

The chemical characterization of waterways is important for the general description of water quality conditions. The following parameters were measured in the field, water samples were also analyzed by Microbac Laboratories.

### *Field Measurements*

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#### pH

The pH of a solution refers to its hydrogen ion concentration. Measurement of pH is one of the most important and frequently used tests in water chemistry. The pH value of most natural waters falls within the range of 4 to 9. The pH scale ranges from 0 (acid) to 14 (base). The majority of waters are slightly basic because of the presence of carbonates and bicarbonates (generally, salts within the geology). Most fish can tolerate pH values from 5.0 to 9.0, however optimum fishing habitats fall within the range 6.5 to 8.2.

#### TEMPERATURE

Temperature is essential in determining if acceptable standards exist for a particular stream classification. Elevated temperatures from heated water discharges may have a significant ecological effect. Temperature also affects dissolved oxygen levels.

#### DISSOLVED OXYGEN

D.O. is a measure of oxygen that is dissolved in water. Different levels of D.O. are necessary to support various types of aquatic life. These levels in natural and waste waters are dependent on the physical, chemical, and biochemical activities prevailing in the water body. The minimum D.O. levels are as follows: HQ-CWF 7.0mg / L CWF 5.0. mg/L TSF (February 15<sup>th</sup> – July 31<sup>st</sup>) 6.0 mg/L; Remainder of year 5.0

#### SPECIFIC CONDUCTANCE

Conductivity is a numerical expression of the ability of water to carry an electrical current. It is an indication of the dissolved inorganic solids in the water. The higher the specific conductance, the more impurities are in the water. Freshly distilled water has a conductivity of 0.5 to 2.0 micromhos/cm. The conductivity of the drinking water in the U.S. generally ranges from 50 to 500 micromhos/cm ( $\mu$ S). It is an indirect measure of the presence of dissolved solids such as chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, and iron.



## *Laboratory Analysis*

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### TOTAL ORGANIC CARBON

TOC is a measurement of the amount of carbon containing compounds in a sample that can be quantified. This measurement is significant because the amount identified in a stream can be an indicator of the organic character of a stream. The larger the carbon or organic content, the more oxygen is consumed, thus a high content equates to an increase in of microorganisms that could contribute to the depletion of oxygen levels. Samples are preserved in the field by the addition of 1 ml of Sulfuric Acid (H<sub>2</sub>SO<sub>4</sub>). There is no numeric standard for TOC.

### ALUMINUM

Aluminum is found naturally in the environment and is found in water in a dissolved form. Its concentration is influenced by multiple factors including pH, surface water flow over soil and bedrock, and groundwater flow through soil horizons and underlying geologic material. The Aluminum concentrations of water in healthy streams and rivers usually range from 0.001 to 0.05 mg/L.

### CALCIUM

Calcium occurs most commonly in sedimentary rocks in the minerals calcite, dolomite and gypsum. Calcium is an important determinant of water harness, and it also functions as a pH stabilizer, because of its buffering qualities. Rivers generally contain 1-2 mg/L calcium, in limestone areas; rivers may contain calcium concentrations as high as 100 mg/L. There is no numeric standard for calcium.

### IRON

Surface and groundwater naturally contain iron along with metals. Rainwater infiltrates soil horizons and iron bearing rocks and dissolves the iron into the water solution. There are two kinds of iron that occur in water. The first kind is called ferrous which is soluble in the water, this results in clear colorless water. The other state is called ferric, which results in a reddish-brown color because the iron is not completely dissolved in the water. Iron can also be combined with naturally-occurring acids (tannins) which will stain the water a tea color.

### MAGNESIUM

This element is essential to chlorophyll and red blood cells. Magnesium commonly occurs in the minerals of magnesite (MgCO<sub>3</sub>) and dolomite. It contributes to water hardness and is used in alloys, fertilizers, pharmaceuticals, and foods.

## ***Laboratory Analysis*** (continued)

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### **TOTAL HARDNESS**

Hardness is defined as the total amount of calcium and magnesium salts that are present in the water. Hard water aids buffering capacity. Water can be defined by its total hardness as follows:

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

### **CHLORIDES**

Chlorides are salts that contain chlorine and metal. Common Chlorides are sodium chloride, calcium chloride and magnesium Chloride. Most productive fish habitats have a chloride concentration of less than 170 mg/L. The recommended maximum chloride levels are 250 mg/L for water supply.

### **NITROGEN**

Nitrate plus nitrite as nitrogen. The maximum recommended level for water supply is 10 mg/L as Nitrogen.

### **AMMONIA (NH<sub>3</sub>)**

Ammonia is naturally present in surface and ground water and in wastewater. Pure ammonia is strong smelling and colorless. In nature, ammonia is formed by the action of bacteria on proteins and urea. Ammonia concentrations of 0.06 mg/L can cause gill damage in fish; 0.1 mg/L may indicate domestic or agricultural wastes and 0.2 mg/L and above is lethal to trout.

### **NITRITE (NO<sub>2</sub>)**

Nitrite is the intermediate stage between nitrate and ammonia. It is relatively short-lived because it is quickly converted to nitrates by bacteria. Nitrite concentrations in drinking water seldom exceed 0.1 mg/L. There is no numeric standard for nitrite.

### **NITRATE (NO<sub>3</sub>)**

Nitrate is found only in small amounts in domestic wastewater and is a major ingredient in farm fertilizer. During precipitation events, varying amounts of this chemical wash into nearby waterways. Nitrates stimulate the growth of phytoplankton and algae. When these photosynthetic organisms die, bacteria consume the dead organic material. This process also requires oxygen which depletes dissolved oxygen levels in the water and the fish may not be able to respire. Because Nitrate can be the limiting nutrient for plant growth in many ecosystems, the discharge from a septic tank into the aquatic environment can trigger prolific plant growth including algal blooms. There is no numeric standard for nitrate.

## **Laboratory Analysis** (continued)

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### **TOTAL KJELDAHL NITROGEN**

T.K.N. is the sum of organic nitrogen and ammonia nitrogen. Samples are preserved in the field by the addition of 1 ml of Sulfuric Acid ( $H_2SO_4$ ). There is no numeric standard for TKN.

### **TOTAL ALKALINITY**

Alkalinity measures the water's ability to buffer acid or acid neutralizing capacity. It indicates the water's ability to protect fish and other aquatic life against sudden changes in pH. The best fishing waters are those with alkalinity of 100 - 120 mg/L. The minimum level of total alkalinity for aquatic life buffering capacity is 20 mg/L, except where natural conditions are less. Stream alkalinity can be influenced by geologic material, soil horizons, salts, plant activities and certain industrial wastewater discharges. Water flowing through Carbonate rich limestone generally has high alkalinity – hence good buffering capacity. Conversely, areas rich in granites and some conglomerates and sandstones may have low alkalinity and therefore poor buffering capacity.

### **T.D.S.**

Total dissolved solids (T.D.S.), also termed total filterable residue, refers to the portion of residue that passes through a filter of a particular size. The DEP, as well as the EPA, have established secondary maximum contaminant levels of 500 mg/L of TDS for the Commonwealth's drinking water and waterways. The maximum recommended value for T.D.S. is 750 mg/L.

### **TOTAL PHOSPHORUS**

Total Phosphorus is a measure of all the forms of phosphorus (dissolved or particulate) that are found in a sample. It occurs in natural waters and wastewaters almost solely in the form of phosphates. Phosphates enter waterways from animal wastes, phosphate rich rocks, fertilizers, and from the detritus of aquatic organisms. Phosphorus is essential to the growth of organisms and can be the limiting nutrient to plant growth. If high concentrations are present in streams the algae can grow more rapidly. This increase in algae is eventually consumed by bacteria which require oxygen. This process reduces dissolved oxygen in the water which can impact fish populations. Phosphate levels below 0.03 mg/L are generally considered to be unpolluted. The recommended maximum level is 0.01 mg/L for rivers and streams.

### **BIOLOGICAL OXYGEN DEMAND**

BOD is a measure of the dissolved oxygen required for the complete breakdown of organic matter, by aerobic bacteria over a five-day period. It is a key criterion used where organic loading must be restricted to maintain desired levels of dissolved oxygen in water. Sources of BOD, in addition to direct loading from STPs, include decaying algae, macrophytes and other biota. In streams that are polluted with sewage or high levels of other nutrients, the oxygen use or demand by microorganisms will be high, leaving little oxygen for other aquatic organisms. Most pristine rivers will have a 5-day carbonaceous BOD below 1 mg/L.



# Appendix B:

## Benthic Macroinvertebrates



### *What is a Macroinvertebrate?*

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A macroinvertebrate is an organism that is large enough to see with the naked eye (macro) and lacks a vertebrate (invertebrate). The organisms that are collected for this study are called benthic macroinvertebrates. Benthic refers to the bottom layer of an aquatic ecosystem including underneath stream sediment. These organisms include mayflies, caddisflies, stoneflies, snails, clams, crayfish, freshwater shrimp, beetle larvae, midges, leeches, dragonflies, and more.

### *Why collect Macroinvertebrates?*

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- They are relatively easy to collect.
- They play a key role in the ecosystem's food web.
- They are used as bio indicators for environmental stress and can show varying responses to water chemistry and physical habitat.
- Due to their relative immobility (unlike fish) they cannot move upstream or downstream to avoid poor water conditions.
- They are extremely diverse. Different macroinvertebrates will live in different water bodies due to water conditions, available food, and absence or abundance of sediment, nutrients, and detritus (dead organic matter).



## **Macroinvertebrate Analysis**

The protocols used in the development for the riffle/run Index of Biotic Integrity (IBI) were conducted from small first through third order riffle/run type streams, which totaled a drainage area of less than 50 square miles. The second protocol type is the multi-habitat assessment for low-gradient streams, which involved sampling a variety of habitat types. The difference between the two assessment protocols involved sampling different micro-habitats for macroinvertebrate collections and different habitat evaluation categories. These bio assessments were employed to cumulatively evaluate the ecological conditions of streams that are present within Monroe County.

### **Metric Calculations**

The following are the riffle/run metrics used for the benthic macroinvertebrate analysis. Metrics are the various counts, indexes, and ratios computed from the results of the subsamples.

Different metrics convey different types of information about the macroinvertebrate community. For example, taxa richness is an index of diversity and the Hilsenhoff Biotic Index measures an organism's pollution tolerance. By using a set of metrics that measures multiple aspects of the macroinvertebrate community, a complete picture of a community can be attained. This enables the reader to understand the importance of measuring the relative stability of the aquatic community.

The following is a list of metric calculations utilized during the 2015 study:

### **Freestone Riffle/Run (6 D Frame):**

#### **Modified Beck's Index (version 3)**

MBI metric is projected to decline in assessment score when anthropogenic stress to a stream ecosystem increases, therefore representing the loss of pollution-sensitive taxa. It should be noted that this index metric for this project, while similar in name and concept, differs slightly from the Beck's Index used in DEP's multihabitat protocol for assessing biological condition of low gradient pool-glides type streams.

#### **EPT Taxa Richness**

EPT Taxa Richness metric is a count of the number of taxa belonging to the orders Ephemeroptera, Plecoptera, and Trichoptera (EPT) in a sub-sample that represents community structure. These orders are commonly referred to as mayflies, stoneflies, and caddisflies, respectively. 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.

#### **Total Taxa Richness**

Total Taxa Richness is a community structure metric, which is a count of taxa in the sub sample. Generally, this metric is expected to decrease with increasing anthropogenic stress to the ecosystem, reflecting loss of taxa and increasing dominance of a few pollution tolerant taxa.

#### **Shannon Diversity Index**

SDI is a taxonomic composition metric that measures taxonomic richness and evenness of individuals across taxa of a sub-sample. This metric is expected to decrease in values with increasing anthropogenic stress to a stream ecosystem.

#### **Hilsenhoff Biotic Index**

HBI is a taxonomic composition metric and is calculated as an average pollution tolerance value weighted by the number of individuals of each taxa in the sub-sample. The Hilsenhoff Biotic Index generally increases with increasing ecosystem stress.

#### **Percent Sensitive Individuals**

Percent Sensitive Individuals is a taxonomic composition metric which is the percentage of individuals with pollution tolerance values of three or less in a sub-sample and is expected to decrease in value with increasing anthropogenic stress to a stream ecosystem.



### **Index Calculation-Riffle/Run:**

Through the combination of these various metrics noted previously, standardization is needed. Table 1 depicts the standardization table with the associated standardized and adjusted metric scores with the total producing the IBI score. This index is a way to integrate data that is collected from the above equations. 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. There are six metrics involved, the Hilsenhoff Biotic Index (HBI) is the only one predicted to increase in value if the community is stressed. The other five IBI metrics are predicted to decrease in value if the community is exposed to increased stress. The index calculation and standardization is as follows.

**Table 1.** Metric Standardization Equations and Index calculations for sub-sampled sites.

<b>Metric</b>	<b>Standardized Equation</b>	<b>Observed Metric Value</b>	<b>Standardized Metric Score</b>	<b>Adjusted Standardized Metric Score</b> Maximum = 1.000
Modified Beck's Index	Observed value / 33			
EPT Taxa Richness	Observed value / 19			
Total Taxa Richness	Observed value / 38			
Shannon Diversity Index	Observed value / 2.86			
Hilsenhoff Biotic Index	(10 - Observed value) / (10 - 1.89)			
Percent Intolerant Individuals	Observed value / 84.5			
Average of adjusted standardized core metric scores * 100 = <b>IBI Score</b>				

## Aquatic Life Use Attainment Benchmarks

Table 2 depicts the Aquatic Life Use (ALU) IBI scoring benchmarks utilized by DEP for assessment purposes. DEP implements a multi-tiered benchmark decision process for small wadeable freestone riffle/run streams in Pennsylvania that incorporates sampling season as a factor for determining ALU attainment and impairment; this process is outlined in the diagram below (PADEP 2009). Title 25, Chapter 93 of the Pennsylvania Code provides further information on these uses.

**Table 2.** Aquatic Life Use (ALU) IBI scoring benchmarks for Instream Comprehensive Evaluation (ICE) assessment purposes.

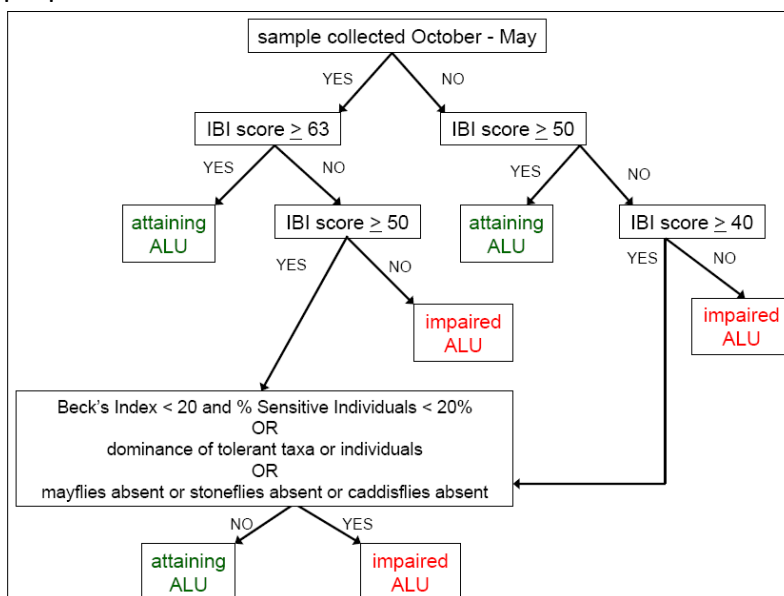


Table 2 depicts the adjusted and standardized Aquatic Life Use (ALU) IBI scoring benchmarks for ICE assessment purposes. For samples collected from smaller streams between October and May, an IBI score > 63 results in ALU attainment and an IBI score < 50 results in ALU impairment; an IBI score between 50 and 63 requires further evaluation to determine ALU impairment – three guidelines may be used:

- (1) If the Beck's Index score is < 20 and the % Sensitive Individuals in the sub-sample is < 20%, the ALU should be impaired without compelling reason otherwise;
- (2) If the sample is dominated by tolerant taxa or individuals, the ALU should be impaired without compelling reason otherwise; or
- (3) If mayflies, stoneflies or caddisflies are absent from the sub-sample the ALU should be impaired. For samples collected between June and September from smaller streams, an IBI score > 50 results in ALU attainment and an IBI score < 40 results in ALU impairment; an IBI score between 40 and 50 requires further evaluation to determine ALU impairment, guided by the same three guidelines outlined above for October to May samples scoring between 50-63.

### **Multi-habitat - Low Gradient (10 D Frame):**

**EPT Taxa Richness** - Refer to riffle/run definition.

**Total Taxa Richness** - Refer to riffle/run definition.

**Modified Beck's Index (version 4)** - This is a pollution weighted taxa richness measure that is based on the Hilsenhoff Biotic Index Score. It is a modified Beck's Index giving organisms with a Hilsenhoff score of 0 or 1 two points and Hilsenhoff scores of 2, 3, or 4 are given 1 point. This metric differs slightly from the Beck's Index used in DEP's riffle/run protocol for assessing the biological condition of freestone type streams.

**Shannon Diversity Index** - Refer to riffle/run definition.

**#Caddisfly Taxa** - Total number of Caddisflies (Trichoptera) in the sub-sample

**#Mayfly Taxa** - Total number of Mayflies (Ephemeroptera) in the sub-sample

### **Index Calculation-multihabitat:**

Through the combination of the various metrics noted above, normalization is needed. This index is a way to integrate data that is collected from the above equations. Table 3 depicts the standardization table with the associated normalized and adjusted metric scores with the total generating an IBI score. The sum of these specific metric equations builds an IBI, which then can be related to reflect the ecology & impacts to the aquatic community being studied. Of the six metrics utilized, all are predicted to decrease in value if the community is stressed. The normalized scores above 100 are adjusted to a score of 100. The index calculation and normalization is as follows:

**Table 3.** Normalization of Metric and Total Biological Score Calculation.

<b>Metric</b>	<b>Standardized Equation</b>	<b>Observed Value</b>	<b>Normalized Metric Score</b>	<b>Adjusted Metric Score Maximum = 100</b>
EPT	$(\text{Observed value} / 17) \times 100$			
Taxa Richness	$(\text{Observed value} / 31) \times 100$			
Beck4	$(\text{Observed value} / 22) \times 100$			
Shannon Diversity	$(\text{Observed value} / 2.43) \times 100$			
% Caddisfly Taxa	$(\text{Observed value} / 11) \times 100$			
% Mayfly Taxa	$(\text{Observed value} / 6) \times 100$			
<b>Total Biological Score</b>				

## **Aquatic Life Use Attainment Benchmarks**

The following depicts the aquatic life use (ALU) IBI scoring benchmarks utilized by DEP for assessment purposes. This multimetric approach simplifies management decisions, being presented as a single index score (PADEP 2007). If the total benchmark score of 55 is not reached, then the stream reach is not attaining the threshold for aquatic life. Title 25, Chapter 93 of the Pennsylvania Code provides further information on these uses.

The following summaries are presented in the sequence they were sampled. They depict the macroinvertebrate community per site, specifically genus level taxonomy, water pollution tolerances values (0 intolerant to 10 tolerant), trophic codes and the statistics that comprise the total standardized biological score. The trophic code is a general classification system, which is based on what type of feeding mechanism the macroinvertebrate utilized or how the food is acquired. These categories are presented to facilitate the descriptions on the following pages:

**SC - Scrapers:** graze or scrape materials from mineral and organic substrates

**SH - Shredders:** chew on plant and some animal material, breaking it down into smaller particles feeding directly on living vascular hydrophytes, or gouge decomposing wood submerged in streams

**CG - Collector/Gatherers:** feed primarily on fine pieces of decomposing particulate organic matter (< 1 mm diameter) deposited in streams;

**FC - Filterer/Collector:** remove particulate matter from suspension

**PR - Predators:** Organisms that feed on animal tissue by either engulfing or piercing and sucking body contents of prey (Merritt & Cummins 1984).

Monroe County executed two progressive stream evaluation surveys, the riffle-run and the multihabitat protocols, which are conducted within a 100 meter stream reach. These biological screening protocols were modified from the United States Environmental Protection Agency (EPA) Rapid Bioassessment Protocols (RBPs), for assessing stream macroinvertebrate communities (PADEP 2009). These biological screening protocols are specifically designed per stream type, to provide intensive field surveys and water quality assessment approaches. The riffle-run Index of Biological Integrity (IBI) applies to benthic macroinvertebrate samples collected using a handheld 500-micron mesh D-frame net, which employed the semi-quantitative (PADEP-RBP) method, applied for each Instream Comprehensive Evaluation (ICE). Staff conducted six swipes from shallow, fast and slow riffle areas within a 100-meter stream reach. Each swipe disturbed approximately one square meter, immediately upstream of the net for approximately one minute, to an approximate depth of 10 cm, as substrate permits (PADEP 2009). The second sampling protocol is the multihabitat approach for low gradient streams, which required 10 jabs utilizing a 500-micron mesh D-frame net distributed between

five possible habitat types: Cobble/Gravel Substrate; Snag; Coarse Particulate Organic Matter (CPOM); Submerged Aquatic Vegetation (SAV); Sand/Fine Sediment) (PADEP 2007).

For the riffle-run dominated streams, each sample is composited into one container preserved with 95% ethanol in the field and transported to the contracted entomologist for enumeration and identification and placed into a pan marked with 28 four square inch grids. Debris from four grids is randomly selected and extracted using a four-square inch circular "cookie cutter," then placed into another identical empty pan. From this second pan, organisms are randomly selected from the grids until a 200-organism sub-sample (+/- 40 organisms) is obtained. Organisms in the sub-sample are identified according to taxonomic groupings and enumerated. Midges are identified to the family level of Chironomidae. Roundworms and proboscis worms are identified to the phylum level, flatworms and segmented worms, aquatic earthworms, and tubificids are identified to class. Water mites are identified as Hydracarina, and all other macroinvertebrates are identified to genus level (PADEP 2009).

For low gradient dominated streams, each sample is composited into one container preserved with 95% ethanol in the field and transported to the contracted entomologist for enumeration and identification and placed into a pan marked with 28 2" x 2" grids. Debris from four grids is randomly selected and extracted until a 200-organism sub-sample (+/- 20 %) is obtained. Organisms in the sub-sample are identified according to taxonomic groupings. Midges are identified to the family level of Chironomidae. Roundworms and proboscis worms are identified to the phylum level; flatworms are identified to Phylum Turbellaria; segmented worms, aquatic earthworms and tubificids are identified to Class Oligochaeta. Water mites are identified as Hydracarina, weevils to family, sand flies to family Ceratopogonidae, Decapoda, Gastropoda, and Pelecypoda to family, and all other macroinvertebrates are identified to genus level (PADEP 2007). The specifics of the macroinvertebrate analyses are discussed in Appendix B of this report.

### **Precision Quantification**

To quantify precision methods, two of the biological samples were replicated and collected by the same investigator to minimize variability, and complies with the PADEP's quality assurance manual to verify identification work performed on macroinvertebrates. The Field data sheets are available for review at the MCPC office.

### **Quality Assurance**

Accuracy was determined through the use of routine laboratory protocols that required random spiking of samples as per *consistency with the Quality Assurance Manual for PADEP*. Data quality requirements were maintained in the field throughout the collections. Calibration of field equipment was performed daily. During the field sampling, water samples were collected at mid-depth and mid-channel. These water samples were stored in coolers with ice packs in order for stabilization and then transported to Microbac Laboratories, which is EPA certified for analysis. The specifics of the chemical parameters are discussed in Appendix A of this report.

**2015 MONROE COUNTY MACROINVERTEBRATE DATA**

TAXON	Pollution Tolerance	NUMBER COLLECTED AT SAMPLING STATION												
		01	02	03	04	05	06	07	08	09	10	11	12	13
ORDER														
GENERA/SPECIES														
AMPHIPODA (shrimp)														
<i>Gammarus spp.</i>	4		30	5	20	63					3		4	1
BIVALVIA (clams)														
<i>Pisidium spp.</i>	8	2												
COLEOPTERA (beetles)														
<i>Berosus spp.</i>	5				1									
<i>Stenelmis spp.</i>	5		18	3	6		1		12	22				
<i>Promoresia spp.</i>	2										7		1	
<i>Dubiraphia spp.</i>	6	3											1	
<i>Optioservus spp.</i>	4	6	7	1	3		8	14	1	1	2	11	13	
<i>Ectopria spp.</i>	5										1			
<i>Psephenus herricki</i>	4	1	6	2	4		11		7	3		2	1	
DECAPODA (crayfish)														
<i>Cambarus spp.</i>	6													
DIPTERA (true flies)														
Chironomidae	8	44	99	106	64	129	51	27	18	36	57	17	55	123
<i>Blepharicera spp.</i>	0								1					
<i>Tipula spp.</i>	4						1							
<i>Hexatoma spp.</i>	2							16						3
<i>Pericoma spp.</i>	4											1		
<i>Hemerodromia spp.</i>	6											1	1	14
<i>Tabanus spp.</i>	5				1					1				
<i>Atherix spp.</i>	2				1				1	1	1			
<i>Antocha spp.</i>	3	3	7	19	21		11	1	3	1				9
<i>Simulium spp.</i>	6	1	1	2	1	1	2			1			13	
EPHEMEROPTERA (mayflies)														
<i>Epeorus spp.</i>	0		4				1	58	5	3	3	4		1
<i>Mccaffertium spp.</i>	3	1	5		2		4	3	10	1	5	3	12	
<i>Stenacron spp.</i>	4										1			
<i>Ephemerella spp.</i>	1	51	11	1	1		17	30	24	16	45	23	52	2
<i>Eurylophella spp.</i>	4	10	1			9	9		1				1	
<i>Drunella spp.</i>	1		6				6	1	5	14	7	18		
<i>Seratella spp.</i>	2		5		3		1		5	4			1	
<i>Leucrocuta spp.</i>	1											1		
<i>Paraleptophlebia spp.</i>	1							4	9	29		19		
<i>Leptophlebia spp.</i>	4												1	
<i>Heterocloen spp.</i>	2										1			
<i>Cinygmula spp.</i>	1							8						
<i>Nixe spp.</i>	2								1	6				
<i>Rithrogena spp.</i>	3							6						
Heptageniidae	3											1		
<i>Isonychia spp.</i>	3	5	1				1		2	3	13			
<i>Ameletus spp.</i>	0							1					2	
<i>Baetis spp.</i>	6						1	11				2	7	5
<i>Acerpenna spp.</i>	6										2		3	
<i>Acentrella spp.</i>	4		4	30	31		11		71	30				
GASTROPODA (snails)														
Physinae	8						1							
HEMIPTERA (true bugs)														
<i>Dasyorixa spp.</i>	8					1								
HIRUDINEA (leeches)	8													
<i>Myzobdella spp.</i>						1								
ISOPODA (scuds)														
<i>Caecidotea spp.</i>	6		2											
MEGALOPTERA (hellgramites)														
<i>Sialis spp.</i>	6	1										1	3	
<i>Corydalus spp.</i>	4		2							1				
<i>Nigronia spp.</i>	2				1		3							29



TAXON (continued)	Pollution Tolerance	NUMBER COLLECTED AT SAMPLING STATION (continued)												
ORDER		01	02	03	04	05	06	07	08	09	10	11	12	13
GENERA/SPECIES														
ODONATA (dragon flies)														
Libellula spp.	8					1								
Calopteryx spp.	6										2			
Boyeria spp.	2										1			1
Ophiogomphus spp.	1					1								
Lanthus spp.	5													1
Gomphidae	4						2							
OLIGOCHAETA (worms)	10	56	1				31			4				
PLECOPTERA (stoneflies)														
Leuctra spp.	0	1					2							
Taeniopteryx spp.	2												1	
Amphinemura spp.	3	1					3					4	4	
Pteronarcys spp.	0							1						
Acroneuria spp.	0	1	2	1					2	1				2
Paragnetina spp.	1			1					2	7				
Agnetina spp.	1							7	1					1
Perlesta spp.	4	1	2											
Suwallia/Sweltsa spp.	0							8						7
Shipsa spp.	2												1	
Tallaperla spp.	0							3						
Diploperla spp.	2							10	1			6		
Clioperla spp.	2										1			
Diura spp.	2							4			1			
Isoperla spp.	2							2	1	2			1	1
TURBELLARIA (flatworms)														
Macrostemum spp.	8								1					
TRICHOPTERA (caddisflies)														
Chimarra spp.	4	2	12	4	1		5			5	1	1	6	5
Dolophilodes spp.	0									1		1		
Neophylax spp.	3	1					2						1	1
Hydropsyche spp.	5			2		1			1				4	11
Ceratopsyche spp.	5	14	11	3	6		7	7	13	8	9	1	2	2
Cheumatopsyche spp.	6	8	42	18	41		15		17	10	5	2	13	3
Diplectrona spp.	0											36		
Rhyacophila spp.	1				1		3	8		2	2	3		5
Lepidostoma spp.	1	1	2	2	6	2	1	3	1					
Protoptila spp.	1			6	9									
Psychomyia spp.	2						3							
Lype spp.	2	1												
Micrasema spp.	2			1					1		5			
Ceraclea spp.	3								1					
Orthotrichia spp.	6										1			
Leucotrichia spp.	6		1											
Oxyethira spp.	3										1			
Hydatophylax spp.	2	5												
Polycentropus spp.	6	1					5	1		1	2	3		1
Nectopsyche spp.	3										1			
Pycnopsyche spp.	4												1	2
TOTAL		221	282	207	224	209	219	234	218	214	180	161	205	230
METRICS		01	02	03	04	05	06	07	08	09	10	11	12	13
Total Taxa Richness		25	25	18	21	10	30	24	29	28	27	23	27	23
Shannon Diversity Index		2.21	2.34	1.75	2.22	0.99	2.46	2.60	2.49	2.68	2.30	2.48	2.37	1.86
EPT Taxa Richness		16	15	11	10	3	19	20	22	18	19	17	18	15
Hilsenhoff Biotic Index		5.30	4.78	4.99	4.63	0.90	4.99	2.06	3.56	3.51	3.54	1.99	4.03	4.73
Percent Intolerant Individuals		32%	15%	15%	20%	1%	27%	71%	35%	43%	53%	74%	37%	27%
Modified Beck's Index		12	13	12	11	4	17	34	25	23	17	20	10	17

**Index of Biotic Integrity (New)**

60.8	68.8	56.2	60.9	25.9	68.3	89.2	86.7	90.3	86.2	80.8	67.2	59.2
Aquashicola	Brookhead	Brookhead	Brookhead	Brookhead	Buckwha	Buck Hill	Bushkill	Bushkill	Bushkill	Cherry	Cherry	Coolmoor

**2015 MONROE COUNTY MACROINVERTEBRATE DATA**

TAXON	Pollution Tolerance	NUMBER COLLECTED AT SAMPLING STATION													
ORDER		14	15	16	17	18	19	20	21	22	23	24	25	26	
GENERA/SPECIES															
AMPHIPODA (shrimp)															
Gammarus spp.	4					1	32	4	3		1				
BIVALVIA (clams)															
Pisidium spp.	8		6												
COLEOPTERA (beetles)															
Berosus spp.	5							4	2						
Lutrochus spp.	6	3													
Microcylloepus spp.	2			2									1		
Stenelmis spp.	5								1						
Dubiraphia spp.	6		1				2								
Promoresia spp.	2	17	1	33	6				1		2				
Stenelmis spp.	5		20		10						1				
Optioservus spp.	4	1	7		2	10		1	3	5	1				
Psephenus herricki	4		12	10	10	13		14	4	22	15		23	20	
DECAPODA (crayfish)															
DIPTERA (true flies)															
Chironomidae	8	23	24	17	21	8	186	65	7	7	36	9	28	55	
Bezzia spp.	6											1			
Hemerodromia spp.	6	2	2	3	1	1			2	1	5		1	1	
Blepharicera spp.	0										1				
Limnophora spp.	6													1	
Muscidae	6													2	
Tipula spp.	4	2	1		4							1			
Hexatoma spp.	2	9										7			
Atherix spp.	2		1	7	1						1			1	
Antocha spp.	3	3				1				2	1	1	5	6	
Tabanus spp.	5							1							
Proimulium spp.	0	1													
Simulium spp.	6				1	7			4	1	6		1		
EPHEMEROPTERA (mayflies)															
Epeorus spp.	0	8		2	7	2			1	3		8	2	2	
Mccaffertium spp.	3	6	10	6	6	8	1	28	15	10			4	8	
Stenacron spp.	4							8							
Ephemerella spp.	1	45	42	44	70	44		10	53	27		76	5	12	
Eurylophella spp.	4	3	3	3		1	12	14						8	
Serratella spp.	2	3	3	1	3	14			19	12			4	3	
Drunella spp.	1	6	4	8	26	9		6	10	5			6	7	
Heterocloen spp.	2			1											
Paraleptophlebia spp.	1	2	3	7	5										
Isonychia spp.	3	4	2	4		1		3	8	1					
Ameletus spp.	0	1													
Caenis spp.	7						2	3							
Baetis spp.	6			17		1				3	1	29	7	2	
Acerpenna spp.	6			1						70					
Acentrella spp.	4		12		4	24		2	2				36	45	
GASTROPODA (snails)															
Gyraulus spp.	6							2	1						
Valvata spp.	2		2												
HEMIPTERA (true bugs)															
HIRUDINEA (leeches)															
ISOPODA (scuds)															
MEGALOPTERA (hellgramites)	6	1	1			1									
Sialis spp.	2	3		2	1	1			1		2				
Nigronia spp.	4								1						
Corydalus spp.															

TAXON (continued)	Pollution Tolerance	NUMBER COLLECTED AT SAMPLING STATION (continued)													
ORDER		14	15	16	17	18	19	20	21	22	23	24	25	26	
GENERA/SPECIES															
ODONATA (dragon/damselflies)	4					1									
Gomphidae	5		1	3	2										
Lanthus spp.	4		1												
Stylogomphus spp.	10					4	5	10	5	2	9		4	2	
OLIGOCHAETA (worms)															
PLECOPTERA (stoneflies)	0	2													
Leuctra spp.	3				1	17							1	1	
Amphinemura spp.	0	3		4	1										
Pteronarcys spp.	0	1		13	9			1	2	2	4			2	
Acro-neuria spp.	1			1		1					3		2	1	
Paragnetina spp.	1				5							5	1		
Agneta spp.	0	1	2	4	3	1						3			
Suwallia/Sweltsa spp.	4		2												
Perlesta spp.	0			1											
Tallaperla spp.	2	3	1	2				1	1		1				
Diploperla spp.	2											2			
Cultus spp.	2	3		2	1						3	25		1	
Isoperla spp.															
TURBELLARIA (flatworms)															
TRICHOPTERA (caddisflies)	4	1	2		2	9			2	2	3		8	3	
Chimarra spp.	0			1								1		3	
Dolophilodes spp.	5		2		7				2			1			
Hydropsyche spp.	6	13	2	4	15	12	1	14	45	26	15		3	12	
Cheumatopsyche spp.	5	3	4	8	6	6		2	4	5	12	34	22	6	
Ceratopsyche spp.	0	7		10	2							1			
Diplectrona spp.	1	19		3	1	2				3	13	1	3		
Rhyacophila spp.	0		2												
Glossosoma spp.	7		1		1			4							
Neureclipsis spp.	1		26			1	2		6	2	5	1	2	5	
Lepidostoma spp.	6		1												
Leucotrichia spp.	2		2	1											
Micrasema spp.	3	3			1				3		1				
Neophylax spp.															
Brachycentrus spp.	1	3													
Agapetus spp.	0					1									
Psychomyia spp.	2								4				1	1	
Nectopsyche spp.	3													2	
Mystacides spp.	4		6				4								
Polycentropus spp.	6	1				2				1	1				
Pycnopsyche spp.	4	1						1							
TOTAL		207	212	225	235	204	247	198	212	212	143	206	170	212	
METRICS		14	15	16	17	18	19	20	21	22	23	24	25	26	
Total Taxa Richness		35	35	32	32	30	10	22	29	22	25	18	23	27	
Shannon Diversity Index		2.92	2.86	2.88	2.69	2.76	0.93	2.38	2.57	2.31	2.55	1.98	2.51	2.50	
EPT Taxa Richness		24	21	24	21	19	6	14	16	15	12	13	16	19	
Hilsenhoff Biotic Index		2.44	3.26	2.46	2.63	3.26	5.65	4.87	3.25	4.32	4.59	2.82	4.25	4.15	
Percent Intolerant Individuals		74%	48%	71%	61%	51%	1%	25%	60%	32%	27%	61%	21%	26%	
Modified Beck's Index		38	20	40	28	21	2	8	20	15	17	21	16	21	

96.8	82.1	95.7	88.0	81.0	29.2	60.6	93.6	62.3	61.9	68.0	63.3	71.2
Cranberry	Marshall's	Marshall's	Marshall's	Marshall's	McMichael	McMichael	Mc Michael	Pocono	Pocono	Pocono	Pocono	Pocono

**2015 MONROE COUNTY MACROINVERTEBRATE DATA**

TAXON	Pollution Tolerance	NUMBER COLLECTED AT SAMPLING STATION											
ORDER		27	28	29	30	31	32	33	34	35	36	37	
GENERA/SPECIES													
AMPHIPODA (shrimp)													
<i>Gammarus spp.</i>	4				1							3	
BIVALVIA (clams)													
COLEOPTERA (beetles)													
<i>Lutrochus spp.</i>	6				1								
<i>Microcylloepus spp.</i>	2	1			4			1					
<i>Macronychus spp.</i>	2							2					
<i>Stenelmis spp.</i>	5								1				
<i>Promoresia spp.</i>	2				13		3	2		2	1		
<i>Stenelmis spp.</i>	5	1		11	8			3		5	2		
<i>Optioservus spp.</i>	4	1		11	6	2	2	2				23	
<i>Psephenus herricki</i>	4	64		10				2		3		15	
DECAPODA (crayfish)													
<i>Orconectes spp.</i>	6				1								
DIPTERA (true flies)													
Chironomidae	8	21	28	43	26	10	37	38	84	94	4	39	
<i>Blepharicera spp.</i>	0	1											
<i>Hemerodromia spp.</i>	6	5	3	1			1						
Empididae	6			1	2								
Muscidae	6						2						
<i>Tipula spp.</i>	4					1					1		
<i>Hexatoma spp.</i>	2		7			5	2				1		
<i>Atherix spp.</i>	2									2			
<i>Antocha spp.</i>	3	8		4	2	1		2		4			
<i>Proimulium spp.</i>	0	5					12			1	38		
<i>Simulium spp.</i>	6	3			10				10		23	1	
EPHEMEROPTERA (mayflies)													
<i>Epeorus spp.</i>	0		7	1	1		2	1			7		
<i>Mccaffertium spp.</i>	3	5		7	11		1	8	6	22		6	
<i>Stenacron spp.</i>	4								1	1			
<i>Cinygmula spp.</i>	1										1		
<i>Ephemerella spp.</i>	1	12	72	12	55	1	57	21		6	59	21	
<i>Eurylophella spp.</i>	4				1	3		1	20	5		44	
<i>Serratella spp.</i>	2	2		8	2								
<i>Drunella spp.</i>	1	1		5	4	1		6	7		1		
<i>Paraleptophlebia spp.</i>	1						1		11		2		
<i>Leptophlebia spp.</i>	4									1			
<i>Habrophlebiodes spp.</i>	6											2	
<i>Isonychia spp.</i>	3				1			15	23				
<i>Ameletus spp.</i>	0												
<i>Baetis spp.</i>	6	7	16	7	9	3	10		1		5	1	
<i>Diphetor spp.</i>	6				1								
<i>Acerpenna spp.</i>	6			1									
<i>Acentrella spp.</i>	4	41		17								11	
GASTROPODA (snails)													
HEMIPTERA (true bugs)													
HIRUDINEA (leeches)													
ISOPODA (scuds)													
<i>Caecidotea spp.</i>	6				1			2				28	
MEGALOPTERA (hellgramites)													
<i>Sialis spp.</i>	6					1				2		1	
<i>Nigronia spp.</i>	2		2						1	4		1	
<i>Corydalus spp.</i>	4									1			

TAXON (continued)	Pollution Tolerance	NUMBER COLLECTED AT SAMPLING STATION (continued)										
		27	28	29	30	31	32	33	34	35	36	37
ORDER												
GENERA/SPECIES												
ODONATA (dragon/damselflies)												
<i>Boyeria spp.</i>	2							1	1	2		
<i>Cordulegaster spp.</i>	3							2				
<i>Ophiogomphus spp.</i>	1									1		
<i>Gomphus spp.</i>	5							4		1		
<i>Hagenius spp.</i>	3									1		
<i>Lanthus spp.</i>	5					1						
<i>Stylogomphus spp.</i>	4							5		2		
OLIGOCHAETA (worms)	10	1		9	6							3
PLECOPTERA (stoneflies)												
<i>Leuctra spp.</i>	0					11			1	3		
<i>Amphinemura spp.</i>	3	1		5	1	6					1	1
<i>Pteronarcys spp.</i>	0						2					
<i>Acronuria spp.</i>	0	2	1		1			2	2	17		
<i>Paragnetina spp.</i>	1	1	12	3				4		3		
<i>Agnetina spp.</i>	1				2							
<i>Suwallia/Sweltsa spp.</i>	0		3			6	3					
<i>Paranemoura spp.</i>	2										10	
<i>Tallaperla spp.</i>	0						3					
<i>Diploperla spp.</i>	2						3			2		
<i>Clioperla spp.</i>	2		1									
<i>Diura spp.</i>	2				2	1						
<i>Cultus spp.</i>	2		2									
<i>Taeniopteryx spp.</i>	2								7			
<i>Isoperla spp.</i>	2		23				2			1	1	
TURBELLARIA (flatworms)												
TRICHOPTERA (caddisflies)												
<i>Chimarra spp.</i>	4	1		14	3			2				1
<i>Dolophilodes spp.</i>	0	3	3	10			2		1	2	2	
<i>Hydropsyche spp.</i>	5									1		5
<i>Cheumatopsyche spp.</i>	6	13	1	28			19	10	3	6		5
<i>Ceratopsyche spp.</i>	5	12	26	4	6		31	4	3	2	4	
<i>Diplectrona spp.</i>	0				1					1	51	
<i>Wormaldia spp.</i>	0										1	
<i>Rhyacophila spp.</i>	1	1	2	4	10	9	4	3		4	13	
<i>Neureclipsis spp.</i>	7								5			
<i>Lepidostoma spp.</i>	1	1	1			13	1				3	2
<i>Micrasema spp.</i>	2											2
<i>Neophylax spp.</i>	3						1		2			
<i>Psilotreta spp.</i>	0									2		
<i>Agarodes spp.</i>	0									1		
<i>Baetis spp.</i>	6				10							
<i>Diphetera spp.</i>	6				2							
Limnephilidae	4											1
<i>Phylocentropus spp.</i>	5									1		
<i>Polycentropus spp.</i>	6			1	2			1	1		2	
<i>Pycnopsyche spp.</i>	4		1		1	5	4	9	6	3		
TOTAL		214	211	217	207	80	205	153	197	209	233	216
METRICS		27	28	29	30	31	32	33	34	35	36	37
Total Taxa Richness		26	19	24	32	18	24	27	22	35	23	22
Shannon Diversity Index		2.38	2.16	2.76	2.65	2.49	2.33	2.70	2.14	2.36	2.23	2.40
EPT Taxa Richness		15	15	16	19	11	17	14	17	20	16	13
Hilsenhoff Biotic Index		4.07	2.74	4.39	3.50	2.53	3.44	3.74	3.11	4.06	1.81	4.44
Percent Intolerant Individuals		21%	65%	27%	53%	64%	48%	46%	62%	39%	82%	15%
Modified Beck's Index		22	25	15	19	16	28	18	4	33	29	6

66.1 74.0 65.7 80.4 68.2 75.8 85.6 76.0 81.5 84.2 53.5

Pocono Pocono Pohopoco Pohopoco Swiftwater Swiftwater Tobyhanna Tobyhanna Tunkhannock Tunk Trib Weir

# Appendix C:

## Habitat Assessment

Both the quality and quantity of available habitat affects the macroinvertebrate community. A healthy biological community not only requires good water quality, but also a supporting habitat. There are two types of rating systems for 2015. One is for a Riffle/Run prevalent stream, like most of the streams in Monroe County, which incorporates three categories for a total of 12 parameters. The second is the Multihabitat Low-Gradient stream for the low gradient streams that utilize 9 parameters. The following is an explanation of the habitat parameters:

### *Habitat Parameter Descriptions*

### *Riffle/Run Streams*

1. **Instream Cover:**  
This is a measure of quantity and variety of natural structures in the stream that will provide a habitat for fish. (fallen trees, branches, logs, undercut banks, and large rocks)
2. **Substrate for Benthic Macroinvertebrates:**  
This measures the amount of hard substrate available for insects and snail habitat. Many insect larvae attach themselves to submerged substrate. Areas with rocky bottoms are critical for maintaining a healthy variety of insects.
3. **Embeddedness:**  
This refers to the degree to which rocks are covered or sunken into the silt, sand or mud. As substrates become embedded in the stream bottom, the amount of adequate surface space for insects to attach themselves decreases and the quantity and quality of the macroinvertebrate community is predicted to decrease.
4. **Velocity/Depth Regime:**  
There are four basic velocity/depth combinations:  
Shallow/Fast, Shallow/Slow, Deep/Fast, and Deep/Slow
5. **Channel Alteration:**  
This parameter is a measure of changes to the shape of the stream channel. When streams have been altered in any way (i.e., straightened, deepened, diverted, concrete channelized, artificial embankments or stabilization, dams or bridges), it can affect the macroinvertebrate community.
6. **Sediment Deposition:**  
This parameter measures the sediment, which has accumulated on the stream bottom



as a result of deposition. Deposition occurs as a result of large-scale movement of sediment caused by watershed erosion. This deposition may cause the formation of islands or point bars in the stream, which decreases the available habitat for macroinvertebrates.

7. **Frequency of Riffles:**

This parameter assumes that a stream with riffles or bends provides more diverse habitat than any straight or uniform depth stream. The ratio is calculated by dividing the average distance between riffles or bends by the average depth. The smaller ratio is an indicator of good habitat.

8. **Channel Flow Status:**

This is a measure of the degree to which the channel is filled with water. When the water reaches the base of both banks and a minimal amount of channel substrate is exposed, optimal conditions exist.

9. **Condition of Banks:**

This parameter addresses stream bank erosion (or potential for erosion). Steep banks are generally more susceptible to erosion and failure. Signs of erosion include crumbling banks, unvegetated banks, and exposed tree roots and soil.

10. **Bank Vegetative Protection:**

This measures the amount of stream bank covered by vegetation. Plant root systems on stream banks facilitate soil stability which reduces erosion. This parameter also provides information such as stream shading and nutrient uptake. Banks that support natural plant growth are indicative for supporting a healthier habitat for macroinvertebrates and fish.

11. **Grazing Disruptive Pressure:**

This parameter measures the impact to the riparian zone due to livestock grazing or human activities such as urbanization, golf courses, and residential developments.

12. **Riparian Zone Width:**

This is a measure of the width of the natural vegetation from the edge of the stream bank. This zone serves as a buffer to pollutants entering the stream from surface runoff.

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## ***Habitat Parameter Descriptions    Multihabitat Low-Gradient Streams***

1. **Epifaunal Substrate for Macroinvertebrate:**

The substrate in muddy bottom streams consists mostly of submerged logs, snags and aquatic vegetation.

2. **Pool Substrate Characterization:**

This is an evaluation of the type and condition of bottom substrates found in pools. Firm sediment types such as gravel and sand as well as rooted aquatic plants support a wider variety of organisms. A pool substrate dominated by mud or bedrock will not support a diverse community.

3. **Pool Variability:**

This parameter rates the overall mixture of pool types found in the streams. The four basic types of pools are: Large-shallow, Small-deep, Small-shallow, Large-deep. General guidelines are as follows: greater than one half the cross-section to separate large from small and one meter separating shallow and deep.

4. **Sediment Deposition:**

This parameter measures the sediment, which has accumulated on the bottom as a result of deposition.

5. **Channel Flow Status:**

This is a determination of the percent of the channel that is filled with water. The flow status changes as the channel enlarges or as flow is decreased as a result of dams or obstructions, diversions for irrigation, or drought. When water does not cover as much of the streambed the available habitat is decreased.

6. **Channel Alteration:**

This parameter is a measure of changes to the shape of the stream channel. Streams that run through agricultural or urban areas may have been altered many times. When streams have been changed in any way (i.e., straightened, deepened, diverted, concrete channelized, artificial embankments or stabilization, dams or bridges) it can affect the macroinvertebrate community. Streams that have been altered have fewer natural habitats for fish, macroinvertebrates and plants.

7. **Bank Stability:**

This parameter addresses stream bank erosion (or potential for erosion). Steep banks are generally more susceptible to erosion and failure. Signs of erosion include crumbling and unvegetated banks and exposed tree roots and soil.

9. **Vegetative Protection:**

This measures the amount of stream bank, which is covered by vegetation. Plant root systems on stream banks facilitate soil stability, which reduces the stream bank erosion. Banks that support full natural plant growth are indicative for supporting a healthier habitat for macroinvertebrates and fish.

10. **Riparian Vegetative Zone Width:**

Refer to riffle/run definition.

# Habitat Assessment Results

		1	2	3	4	5	6	7	8	9	10	11	12	
Riffle/ Run Streams		Instream Fish Cover	Epifaunal Substrate	Embeddedness	Velocity/ Depth Regimes	Channel Alteration	Sediment Deposition	Frequency of Riffles	Channel Flow Statuses	Condition of Banks	Bank Vegetative Protection	Other Disruptive Pressures	Riparian Vegetative Zone Width	Total Score
1	AQUACR14	18	5	7	10	20	7	6	19	18	19	19	13	161
2	BRODCR17	14	19	16	14	6	19	19	16	18	2	7	5	155
3	BRODCR19	15	18	15	16	19	12	18	10	11	14	18	18	184
4	BRODCR19	15	18	15	16	19	12	18	10	11	14	18	18	184
5	BRODCR24	19	12	16	12	19	16	12	13	19	15	19	18	190
6	BUCKCR02	14	12	14	18	18	16	12	14	16	15	15	15	179
7	BUHICR07	19	19	17	20	19	18	19	17	14	11	19	19	211
8	BUSHCR07	17	18	17	15	19	18	19	15	17	18	18	20	211
9	BUSHCR10	19	19	18	18	15	17	19	16	17	17	15	6	196
10	BUSHCR11	18	19	16	20	19	16	17	18	16	18	13	10	200
11	CHERCR06													147
12	CHERCR06													147
13	COOLCR01	14	16	11	15	11	14	16	14	17	16	17	10	171
14	CRCRPA02	14	15	14	18	17	14	16	17	16	14	18	5	178
15	MARSCR03	17	17	13	16	16	18	18	14	16	15	15	10	185
16	MARSCR11	18	19	18	17	19	18	19	17	18	16	15	12	206
17	MARSCR12	14	16	15	15	11	18	17	17	17	17	11	2	170
18	MARSCR13	17	13	16	17	15	16	13	16	18	14	13	11	179
19	MCMICR20	8	1	2	10	15	3	1	15	14	18	15	11	113
20	MCMICR35	11	11	9	8	19	10	6	17	3	7	13	10	124
21	MCMICR37	16	12	14	16	17	11	15	18	16	18	16	6	175
22	POCOCR14	13	16	11	18	19	12	14	15	18	14	17	16	183
23	POCOCR18	19	19	18	17	17	18	19	17	12	14	18	18	206
24	POCOCR23	19	19	17	18	16	16	19	17	18	13	15	12	199
25	POCOCR24	16	18	17	15	17	19	19	13	12	14	18	13	191
26	POCOCR25	18	18	16	19	18	16	17	15	16	15	15	11	194
27	POCOCR26	16	14	16	16	16	17	15	12	1	2	5	6	136
28	POCOCR27	15	18	16	16	7	19	19	16	16	4	11	8	165
29	POHOCR02	12	18	13	16	7	15	17	16	17	15	11	5	162
30	POHOCR06	18	18	16	18	20	14	17	19	16	19	19	15	209
31	SWIFCR09	17	18	18	18	14	18	19	15	11	12	17	15	192
32	SWIFCR10	19	18	16	18	14	16	19	17	12	11	16	13	189
33	TOBYCR01	18	18	18	18	16	19	18	18	17	18	18	18	214
34	TOBYCR14	18	19	17	19	13	17	18	19	18	17	16	17	208
35	TUNKCR03	17	18	19	20	17	17	18	19	18	17	17	15	212
36	KEIPRN01	18	19	17	18	19	18	19	18	17	16	19	19	217
37	WEIRCR01	10	13	9	16	15	15	13	19	19	18	18	14	179
Low Gradient Streams		Epifaunal Substrate	Pool Substrate Characterization	Pool Variability	Sediment Deposition	Channel Flow	Channel Alteration	Bank Stability	Vegetative Protection	Riparian Vegetation				
11	CHERCR06	18	15	17	13	17	18	17	16	16				147
12	CHERCR06	18	15	17	13	17	18	17	16	16				147
Average Values		16	16	15	16	16	15	16	16	15	14	16	12	182

# Site Map

# Site Chart

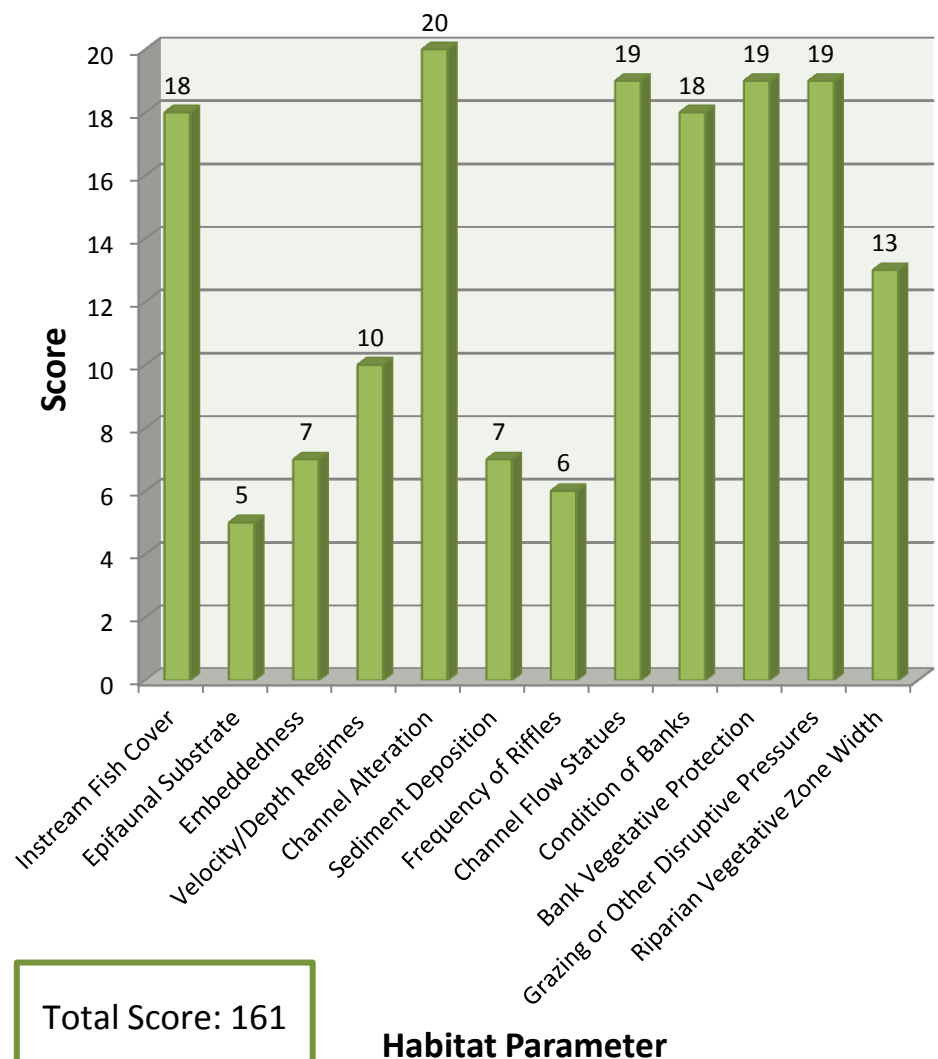
## Site # 1

Site ID	AQUACR14	
Stream	Aquashicola Creek	
Date	5/4/2015	
Time	10:08	
Lat/Long DD	40°49'46.4" N	75°26'47.0" W
Lat/Long DMS	40.82955556	-75.44638889
Municipality	Eldred Township	
Location	100 yards upstream of Lower Smith Gap Road Bridge	

### Field Measurements

Temp C°	13.56
pH	7.70
Press. inHg	29.86
D.O. %	103.1
D.O. mg/L	10.70
Conductivity [μS/cm]	175

### Habitat Assessment for AQUACR14 #1





## Lab Chemistry Analysis

Total Organic Carbon (TOC)	N/A	mg/L
Aluminum, Total	N/A	mg/L
Calcium, Total	N/A	mg/L
Iron, Total	N/A	mg/L
Magnesium, Total	N/A	mg/L
Harness	N/A	mg CaCO <sub>3</sub> /L
Chloride	N/A	mg/L
pH	N/A	pH Units
Nitrogen, Total as N (Calc)	N/A	mg/L
Ammonia as N	N/A	mg/L
Total Kjeldahl Nitrogen (TKN)	N/A	mg/L
Nitrate-Nitrate as N	N/A	mg/L
Alkalinity to pH 4.5	N/A	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	N/A	mg/L
Phosphorus - Total as P	N/A	mg/L
Biochemical Oxygen Demand	N/A	mg/L

ORDER	
AMPHIPODA (shrimp)	
BIVALVIA (clams)	2
COLEOPTERA (beetles)	10
DECAPODA (crayfish)	
DIPTERA (true flies)	48
EPHEMEROPTERA (mayflies)	67
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	1
ODONATA (dragon flies)	
OLIGOCHAETA (worms)	56
PLECOPTERA (stoneflies)	4
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	33
TOTAL	221

METRICS	
Total Taxa Richness	25
Shannon Diversity Index	2.21
EPT Taxa Richness	16
Hilsenhoff Biotic Index	5.30
Percent Intolerant Individuals	32%
Modified Beck's Index	12
Index of Biotic Integrity	60.8

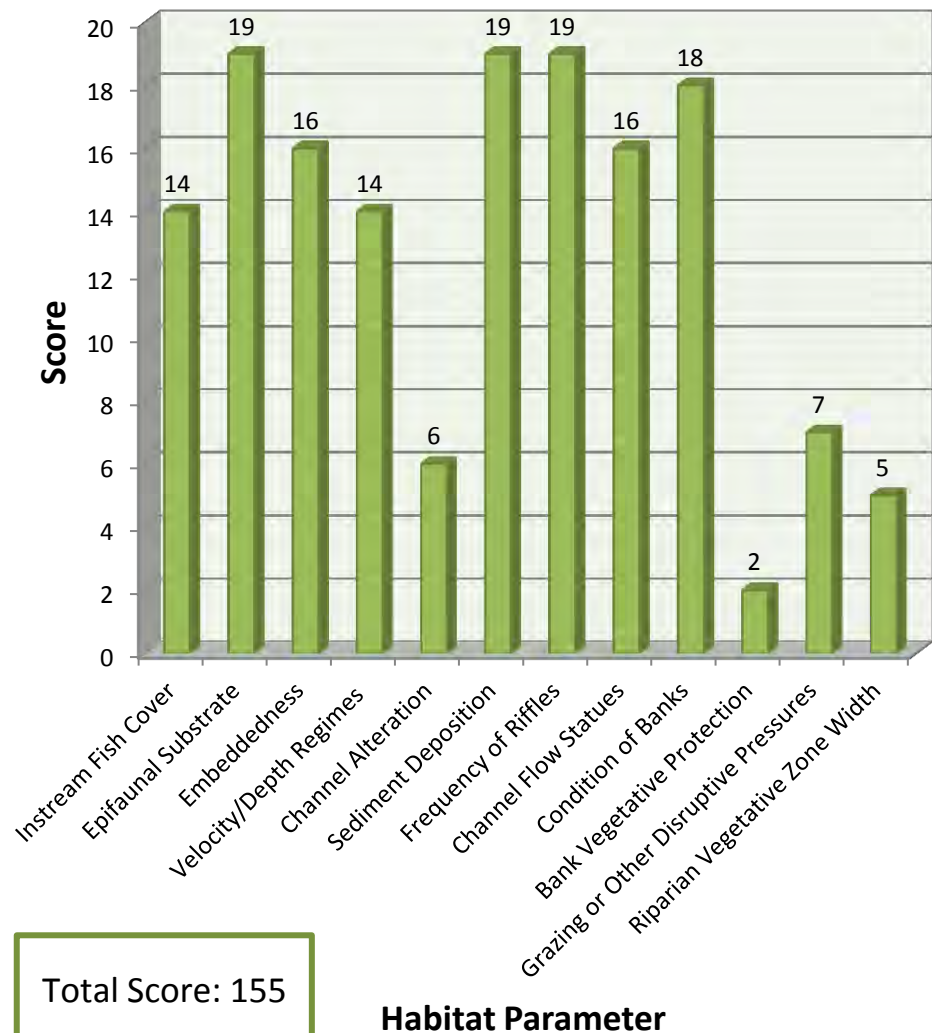
## Site # 2

Site ID	BRODCR17	
Stream	Brodhead Creek	
Date	4/29/2015	
Time	07:14	
Lat/Long DD	40°59'23.9" N	75°11'07.3" W
Lat/Long DMS	40.98997222	-75.18536111
Municipality	East Stroudsburg Borough	
Location	Above East Stroudsburg STP Discharge (above McMichael Confluence)	

### Field Measurements

Temp C°	9.49
pH	7.19
Press. inHg	29.32
D.O. %	103.1
D.O. mg/L	12.18
Conductivity [μS/cm]	199

### Habitat Assessment for BRODCR17 #2



## Lab Chemistry Analysis

Total Organic Carbon (TOC)	1.470	mg/L
Aluminum, Total	<0.0200	mg/L
Calcium, Total	11	mg/L
Iron, Total	<0.100	mg/L
Magnesium, Total	2.070	mg/L
Harness	36.1	mg CaCO <sub>3</sub> /L
Chloride	34.9	mg/L
pH	6.13	pH Units
Nitrogen, Total as N (Calc)	<0.500	mg/L
Ammonia as N	0.104	mg/L
Total Kjeldahl Nitrogen (TKN)	<0.500	mg/L
Nitrate-Nitrate as N	0.2240	mg/L
Alkalinity to pH 4.5	20.00	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	272.0	mg/L
Phosphorus - Total as P	<0.0500	mg/L
Biochemical Oxygen Demand	<2.00	mg/L

ORDER	
AMPHIPODA (shrimp)	30
BIVALVIA (clams)	
COLEOPTERA (beetles)	31
DECAPODA (crayfish)	
DIPTERA (true flies)	107
EPHEMEROPTERA (mayflies)	37
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	2
MEGALOPTERA (hellgramites)	2
ODONATA (dragon flies)	
OLIGOCHAETA (worms)	1
PLECOPTERA (stoneflies)	4
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	68
<b>TOTAL</b>	<b>282</b>

METRICS	
Total Taxa Richness	25
Shannon Diversity Index	2.34
EPT Taxa Richness	15
Hilsenhoff Biotic Index	4.78
Percent Intolerant Individuals	15%
Modified Beck's Index	13
<b>Index of Biotic Integrity</b>	<b>68.8</b>

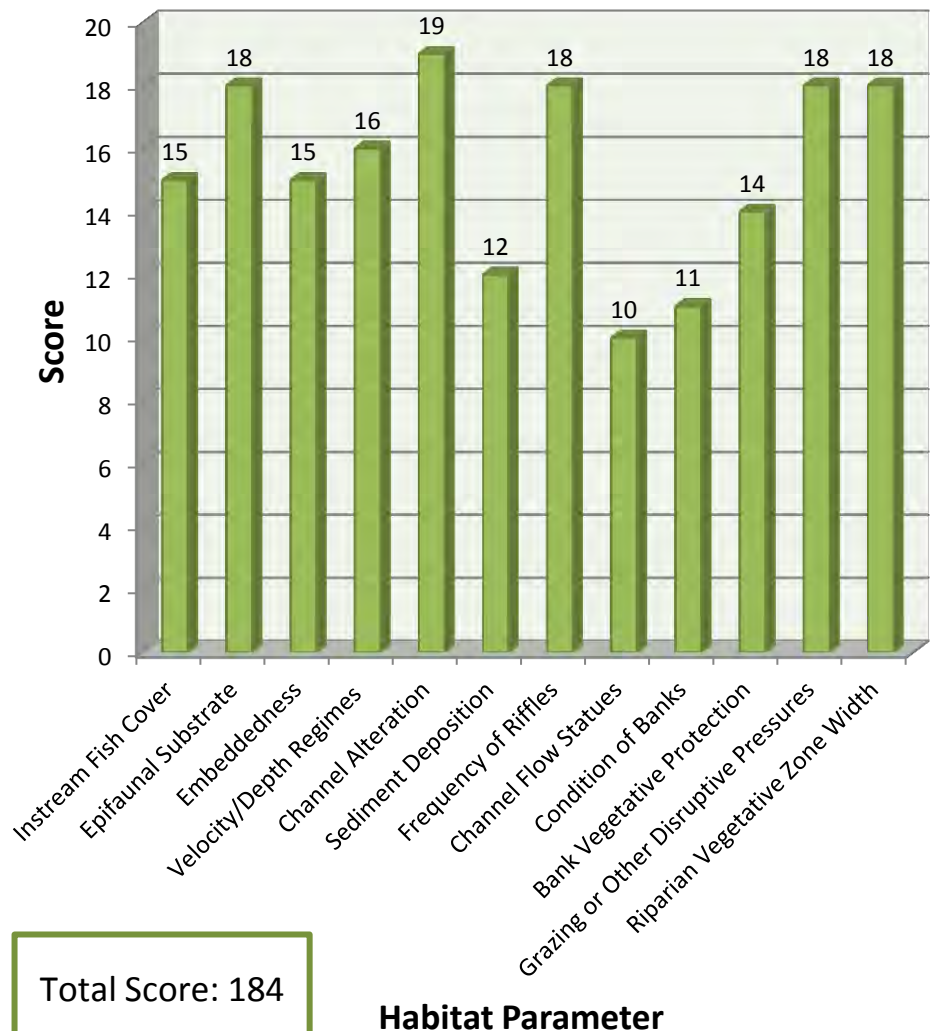
## Site # 3

Site ID	BRODCR19	
Stream	Brodhead Creek	
Date	5/6/2015	
Time	10:00	
Lat/Long DD	40°59'37.2" N	75°08'16.2" W
Lat/Long DMS	40.99366667	-75.13783333
Municipality	East Stroudsburg Borough	
Location	Below Rock-Tenn / Below Marshalls Creek	

### Field Measurements

Temp C°	15.04
pH	7.53
Press. inHg	29.96
D.O. %	103.9
D.O. mg/L	10.47
Conductivity [μS/cm]	257

### Habitat Assessment for BRODCR19 #3



## Lab Chemistry Analysis

Total Organic Carbon (TOC)	1.740	mg/L
Aluminum, Total	<0.0200	mg/L
Calcium, Total	15.1	mg/L
Iron, Total	<0.100	mg/L
Magnesium, Total	2.630	mg/L
Harness	48.5	mg CaCO <sub>3</sub> /L
Chloride	42.7	mg/L
pH	6.65	pH Units
Nitrogen, Total as N (Calc)	<0.500	mg/L
Ammonia as N	<0.0500	mg/L
Total Kjeldahl Nitrogen (TKN)	<0.500	mg/L
Nitrate-Nitrate as N	0.4530	mg/L
Alkalinity to pH 4.5	26.00	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	54.0	mg/L
Phosphorus - Total as P	<0.0500	mg/L
Biochemical Oxygen Demand	<3.00	mg/L

ORDER	
AMPHIPODA (shrimp)	5
BIVALVIA (clams)	
COLEOPTERA (beetles)	6
DECAPODA (crayfish)	
DIPTERA (true flies)	127
EPHEMEROPTERA (mayflies)	31
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	
ODONATA (dragon flies)	
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	2
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	36
TOTAL	207

METRICS	
Total Taxa Richness	18
Shannon Diversity Index	1.75
EPT Taxa Richness	11
Hilsenhoff Biotic Index	4.99
Percent Intolerant Individuals	15%
Modified Beck's Index	12
Index of Biotic Integrity	56.2

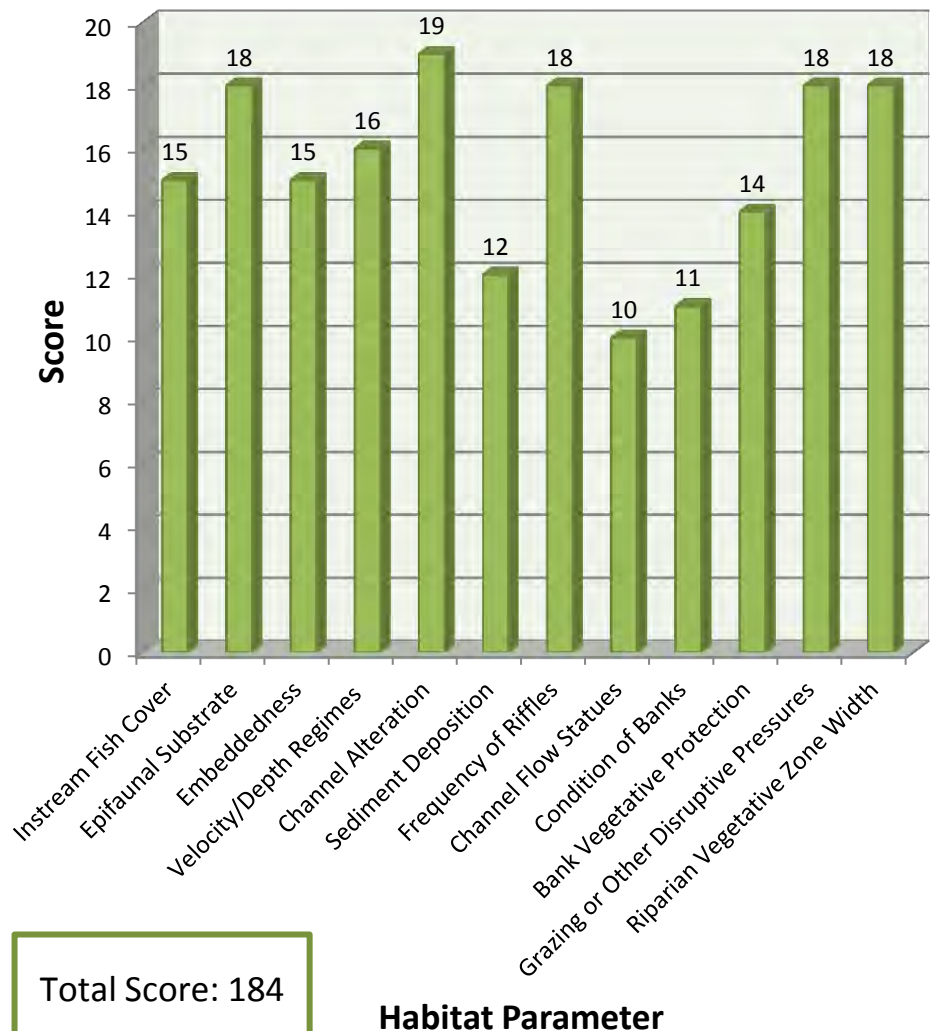
## Site # 4

Site ID	BRODCR19	
Stream	Brodhead Creek	
Date	5/6/2015	
Time	10:00	
Lat/Long DD	40°59'37.2" N	75°08'16.2" W
Lat/Long DMS	40.99366667	-75.13783333
Municipality	East Stroudsburg Borough	
Location	Below Rock-Tenn/ Below Marshalls Creek	

### Field Measurements

Temp C°	15.04
pH	7.53
Press. inHg	29.96
D.O. %	103.9
D.O. mg/L	10.47
Conductivity [μS/cm]	257

### Habitat Assessment for BRODCR19 #4



## Lab Chemistry Analysis

Total Organic Carbon (TOC)	1.720	mg/L
Aluminum, Total	<0.0200	mg/L
Calcium, Total	14.1	mg/L
Iron, Total	<0.100	mg/L
Magnesium, Total	2.470	mg/L
Harness	45.5	mg CaCO <sub>3</sub> /L
Chloride	42.6	mg/L
pH	6.67	pH Units
Nitrogen, Total as N (Calc)	<0.500	mg/L
Ammonia as N	0.050	mg/L
Total Kjeldahl Nitrogen (TKN)	<0.500	mg/L
Nitrate-Nitrate as N	0.4620	mg/L
Alkalinity to pH 4.5	28.00	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	<20	mg/L
Phosphorus - Total as P	<0.0500	mg/L
Biochemical Oxygen Demand	<3.00	mg/L

ORDER	
AMPHIPODA (shrimp)	20
BIVALVIA (clams)	
COLEOPTERA (beetles)	14
DECAPODA (crayfish)	
DIPTERA (true flies)	88
EPHEMEROPTERA (mayflies)	37
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	1
ODONATA (dragon flies)	
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	64
<b>TOTAL</b>	<b>224</b>

METRICS	
Total Taxa Richness	21
Shannon Diversity Index	2.22
EPT Taxa Richness	10
Hilsenhoff Biotic Index	4.63
Percent Intolerant Individuals	20%
Modified Beck's Index	11
<b>Index of Biotic Integrity</b>	<b>60.9</b>



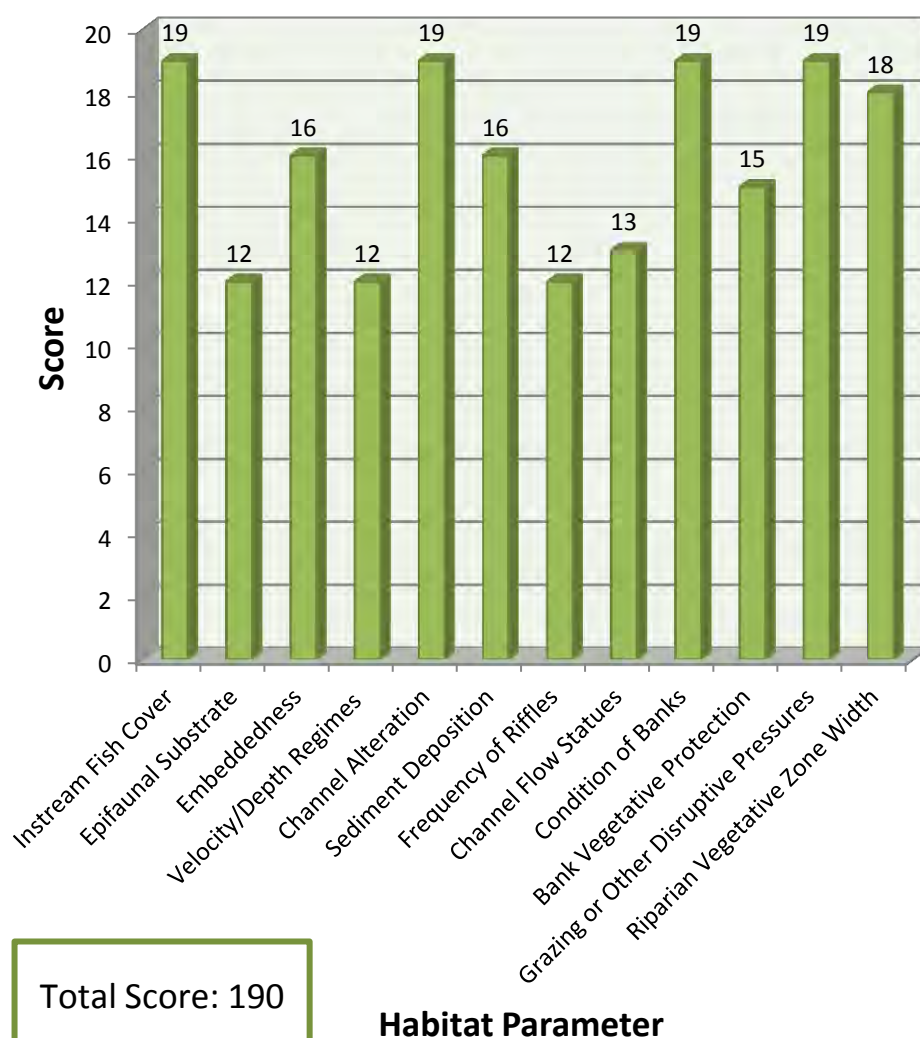
## Site # 5

Site ID	BRODCR24	
Stream	Brodhead Creek	
Date	5/6/2015	
Time	08:33	
Lat/Long DD	40°59'06.6" N	75°10'37.7" W
Lat/Long DMS	40.98516667	-75.17713889
Municipality	Stroud Township	
Location	Above Rock-Tenn and below East Stroudsburg STP at Glenn Park	

### Field Measurements

Temp C°	14.83
pH	7.55
Press. inHg	29.87
D.O. %	97.5
D.O. mg/L	9.83
Conductivity [μS/cm]	263

### Habitat Assessment for BRODCR24 #5





## Lab Chemistry Analysis

Total Organic Carbon (TOC)	1.590	mg/L
Aluminum, Total	<0.0200	mg/L
Calcium, Total	13.8	mg/L
Iron, Total	<0.100	mg/L
Magnesium, Total	2.600	mg/L
Harness	45.2	mg CaCO <sub>3</sub> /L
Chloride	41.9	mg/L
pH	6.68	pH Units
Nitrogen, Total as N (Calc)	<0.500	mg/L
Ammonia as N	0.050	mg/L
Total Kjeldahl Nitrogen (TKN)	<0.500	mg/L
Nitrate-Nitrate as N	0.4060	mg/L
Alkalinity to pH 4.5	38.00	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	122.0	mg/L
Phosphorus - Total as P	<0.0500	mg/L
Biochemical Oxygen Demand	<3.00	mg/L

ORDER	
AMPHIPODA (shrimp)	63
BIVALVIA (clams)	
COLEOPTERA (beetles)	
DECAPODA (crayfish)	
DIPTERA (true flies)	130
EPHEMEROPTERA (mayflies)	9
GASTROPODA (snails)	
HEMIPTERA (true bugs)	1
HIRUDINEA (leeches)	1
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	
ODONATA (dragon flies)	2
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	3
TOTAL	209

METRICS	
Total Taxa Richness	10
Shannon Diversity Index	0.99
EPT Taxa Richness	3
Hilsenhoff Biotic Index	0.90
Percent Intolerant Individuals	1%
Modified Beck's Index	4
<b>Index of Biotic Integrity</b>	<b>25.9</b>

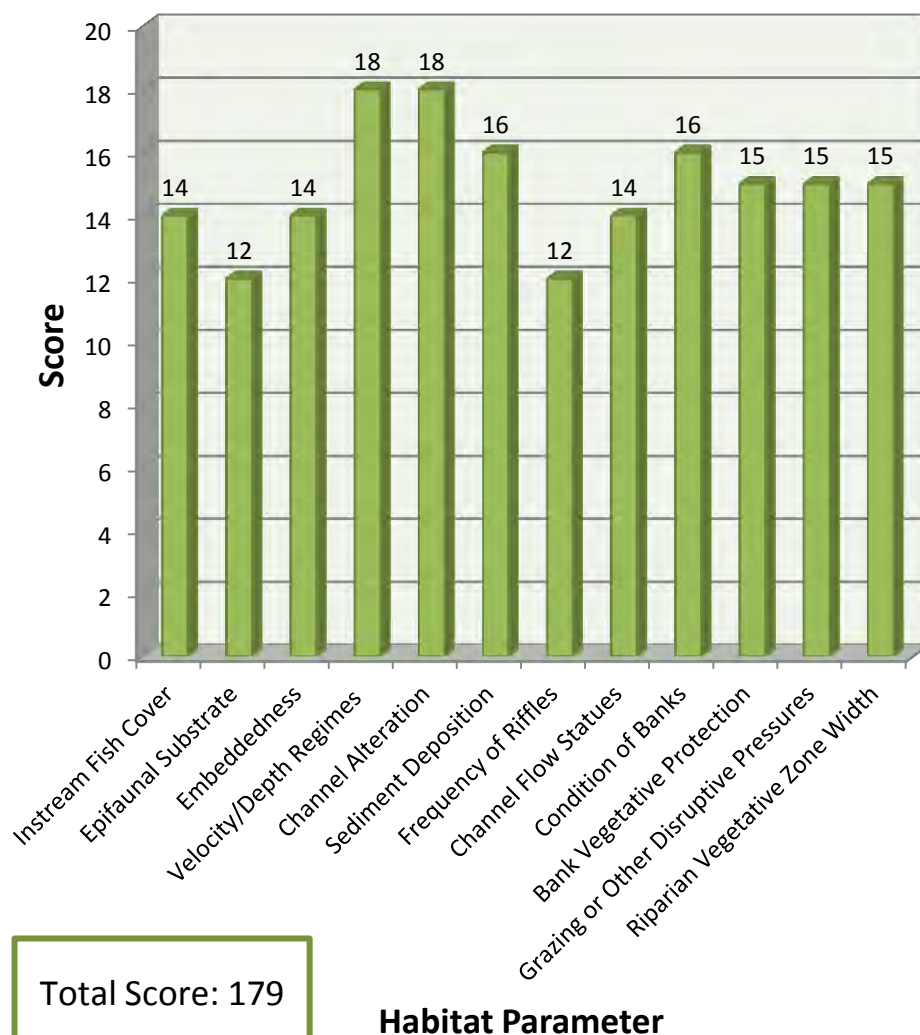
## Site # 6

Site ID	BUCKCR02	
Stream	Buckwha Creek	
Date	5/4/2015	
Time	09:14	
Lat/Long DD	40°50'50.4" N	75°27'02.7" W
Lat/Long DMS	40.8473333	-75.45075000
Municipality	Eldred Township	
Location	200 yards D/S of Chestnut Ridge in Kunkletown	

### Field Measurements

Temp C°	11.93
pH	7.31
Press. inHg	29.79
D.O. %	104.4
D.O. mg/L	11.21
Conductivity [μS/cm]	138

### Habitat Assessment for BUCKCR02 #6



## Lab Chemistry Analysis

Total Organic Carbon (TOC)	1.150	mg/L
Aluminum, Total	<0.0200	mg/L
Calcium, Total	8.36	mg/L
Iron, Total	<0.100	mg/L
Magnesium, Total	2.350	mg/L
Harness	30.6	mg CaCO <sub>3</sub> /L
Chloride	14.3	mg/L
pH	7.16	pH Units
Nitrogen, Total as N (Calc)	1.170	mg/L
Ammonia as N	<0.0500	mg/L
Total Kjeldahl Nitrogen (TKN)	<0.500	mg/L
Nitrate-Nitrate as N	1.1700	mg/L
Alkalinity to pH 4.5	16.80	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	80.0	mg/L
Phosphorus - Total as P	<0.0500	mg/L
Biochemical Oxygen Demand	<3.00	mg/L

ORDER	
AMPHIPODA (shrimp)	
BIVALVIA (clams)	
COLEOPTERA (beetles)	20
DECAPODA (crayfish)	0
DIPTERA (true flies)	65
EPHEMEROPTERA (mayflies)	51
GASTROPODA (snails)	1
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	3
ODONATA (dragon flies)	2
OLIGOCHAETA (worms)	31
PLECOPTERA (stoneflies)	5
TURBELLARIA (flatworms)	0
TRICHOPTERA (caddisflies)	41
<b>TOTAL</b>	<b>219</b>

METRICS	
Total Taxa Richness	30
Shannon Diversity Index	2.46
EPT Taxa Richness	19
Hilsenhoff Biotic Index	4.99
Percent Intolerant Individuals	27%
Modified Beck's Index	17
<b>Index of Biotic Integrity</b>	<b>68.3</b>

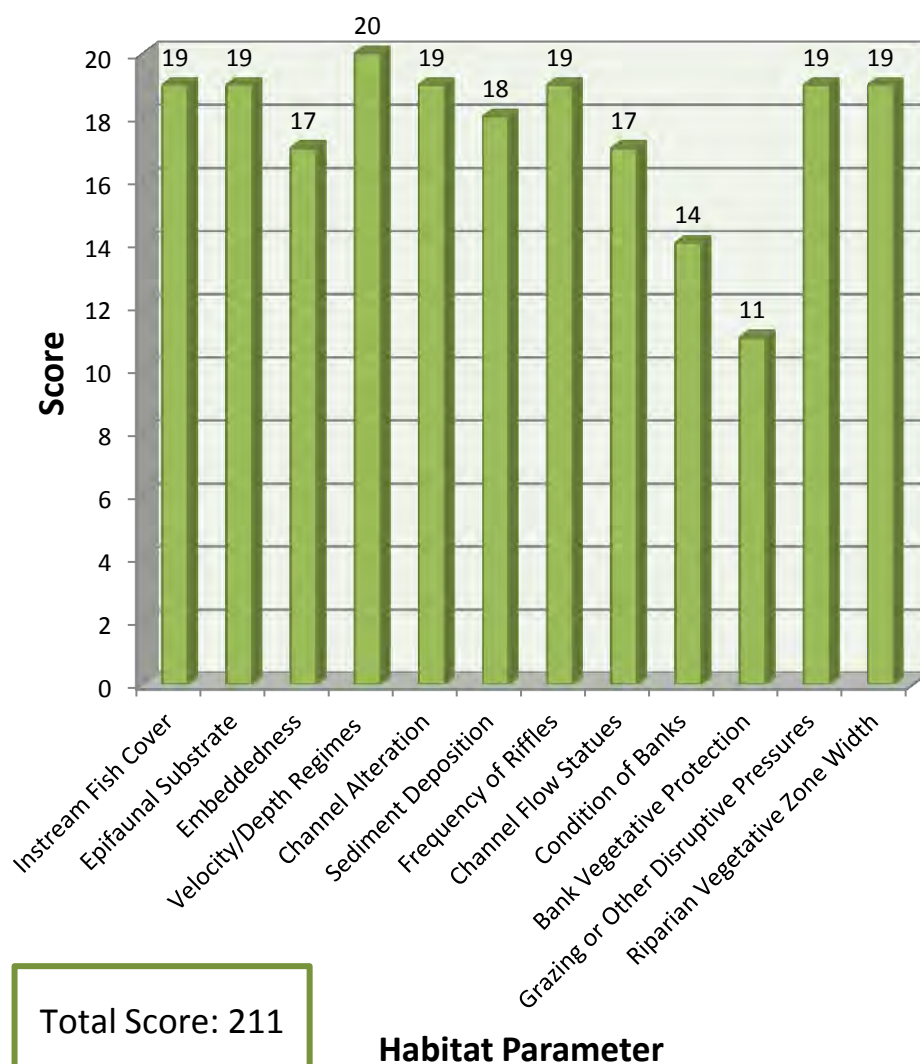
## Site # 7

Site ID	BUHICR07	
Stream	Buck Hill Creek	
Date	4/29/2015	
Time	09:39	
Lat/Long DD	41°11'39.3" N	75°16'53.0" W
Lat/Long DMS	41.19425000	-75.28138889
Municipality	Middle Smithfield Township	
Location	Just U/S of golf course fairway at clubhouse, above falls	

### Field Measurements

Temp C°	8.59
pH	7.18
Press. inHg	28.24
D.O. %	99.4
D.O. mg/L	10.94
Conductivity [μS/cm]	57

### Habitat Assessment for BUHICR07 #7



## Lab Chemistry Analysis

Total Organic Carbon (TOC)	1.430	mg/L
Aluminum, Total	<0.0200	mg/L
Calcium, Total	2.84	mg/L
Iron, Total	<0.100	mg/L
Magnesium, Total	0.716	mg/L
Harness	10.1	mg CaCO <sub>3</sub> /L
Chloride	5.9	mg/L
pH	6.16	pH Units
Nitrogen, Total as N (Calc)	3.200	mg/L
Ammonia as N	<0.0500	mg/L
Total Kjeldahl Nitrogen (TKN)	3.14	mg/L
Nitrate-Nitrate as N	0.0616	mg/L
Alkalinity to pH 4.5	4.00	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	21.0	mg/L
Phosphorus - Total as P	<0.0500	mg/L
Biochemical Oxygen Demand	<3.00	mg/L

ORDER	
AMPHIPODA (shrimp)	
BIVALVIA (clams)	
COLEOPTERA (beetles)	14
DECAPODA (crayfish)	
DIPTERA (true flies)	44
EPHEMEROPTERA (mayflies)	122
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	
ODONATA (dragon flies)	
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	35
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	19
<b>TOTAL</b>	<b>234</b>

METRICS	
Total Taxa Richness	24
Shannon Diversity Index	2.60
EPT Taxa Richness	20
Hilsenhoff Biotic Index	2.06
Percent Intolerant Individuals	71%
Modified Beck's Index	34
<b>Index of Biotic Integrity</b>	<b>89.2</b>

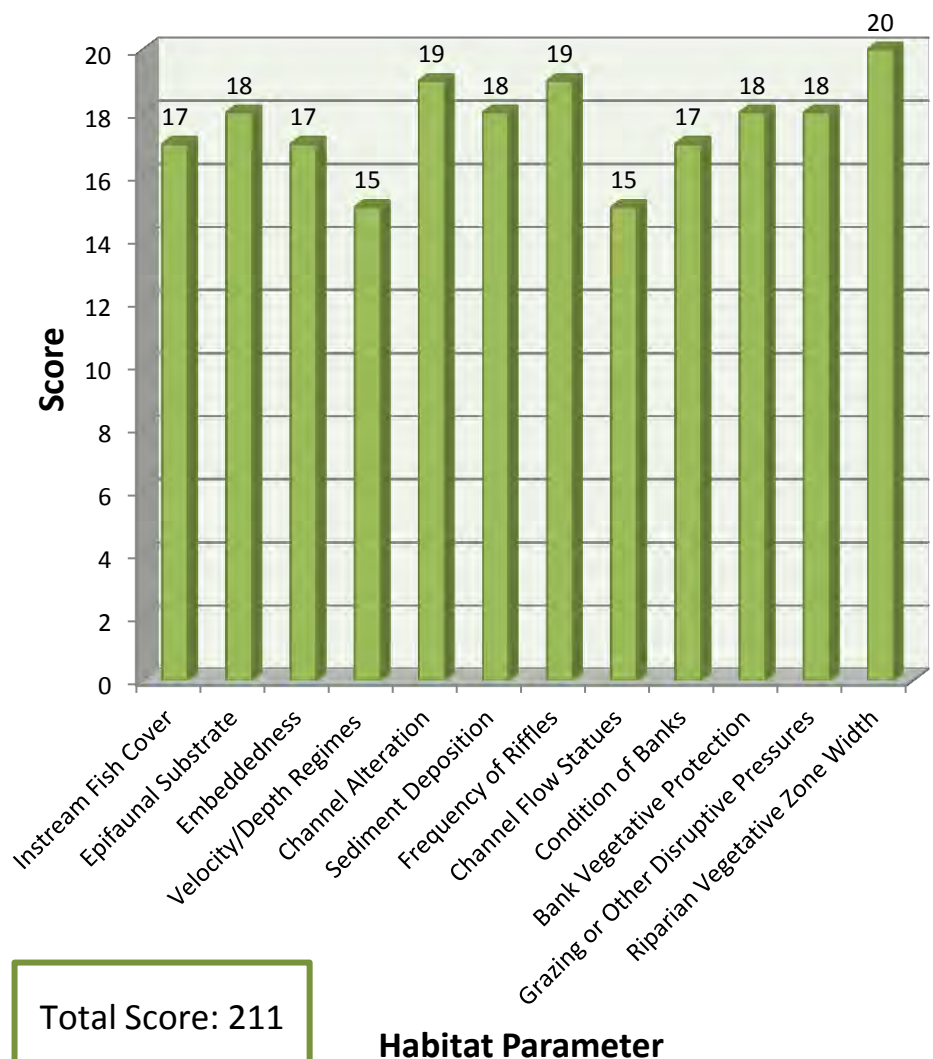
## Site # 8

Site ID	BUSHCR07	
Stream	Bushkill Creek	
Date	5/7/2015	
Time	07:22	
Lat/Long DD	41°05'05.2" N	75°01'14.8" W
Lat/Long DMS	41.08477778	-75.0207778
Municipality	Middle Smithfield Township	
Location	Approximately 100 yards D/S of Fernwood/Middle Smithfield STP discharge, DWGNRA boundary	

### Field Measurements

Temp C°	13.31
pH	7.01
Press. inHg	29.71
D.O. %	102.8
D.O. mg/L	10.67
Conductivity [μS/cm]	84

### Habitat Assessment for BUSHCR07 #8



## Lab Chemistry Analysis

Total Organic Carbon (TOC)	3.320	mg/L
Aluminum, Total	<0.0200	mg/L
Calcium, Total	8.17	mg/L
Iron, Total	<0.100	mg/L
Magnesium, Total	1.450	mg/L
Harness	26.4	mg CaCO <sub>3</sub> /L
Chloride	13.7	mg/L
pH	7.01	pH Units
Nitrogen, Total as N (Calc)	<0.500	mg/L
Ammonia as N	<0.0500	mg/L
Total Kjeldahl Nitrogen (TKN)	<0.500	mg/L
Nitrate-Nitrate as N	0.1460	mg/L
Alkalinity to pH 4.5	11.30	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	<20	mg/L
Phosphorus - Total as P	0.061	mg/L
Biochemical Oxygen Demand	9.56	mg/L

ORDER	
AMPHIPODA (shrimp)	
BIVALVIA (clams)	
COLEOPTERA (beetles)	20
DECAPODA (crayfish)	
DIPTERA (true flies)	23
EPHEMEROPTERA (mayflies)	133
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	
ODONATA (dragon flies)	
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	7
TURBELLARIA (flatworms)	1
TRICHOPTERA (caddisflies)	34
<b>TOTAL</b>	<b>218</b>

METRICS	
Total Taxa Richness	29
Shannon Diversity Index	2.49
EPT Taxa Richness	22
Hilsenhoff Biotic Index	3.56
Percent Intolerant Individuals	35%
Modified Beck's Index	25
<b>Index of Biotic Integrity</b>	<b>86.7</b>



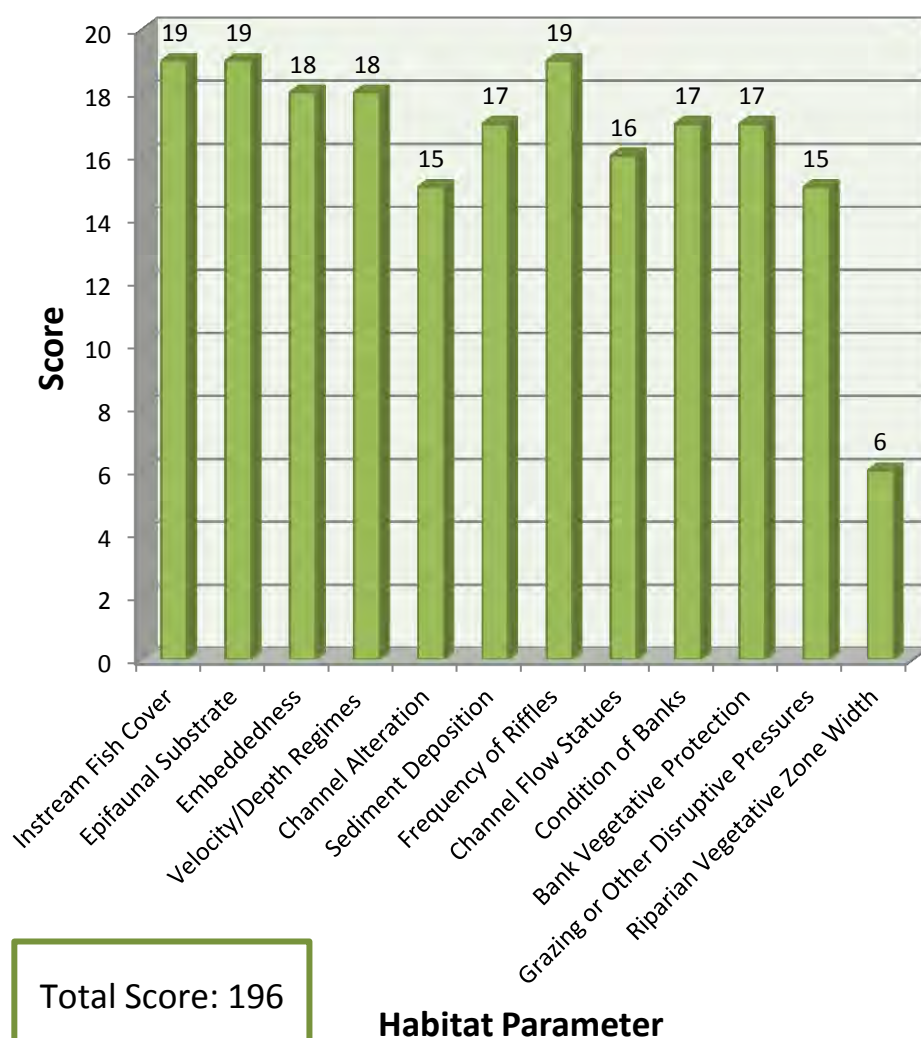
## Site # 9

<b>Site ID</b>	BUSHCR10	
<b>Stream</b>	Bushkill Creek	
<b>Date</b>	5/7/2015	
<b>Time</b>	08:06	
<b>Lat/Long DD</b>	41°05'19.4" N	75°02'22.5" W
<b>Lat/Long DMS</b>	41.08872222	-75.03955333
<b>Municipality</b>	Eldred Township	
<b>Location</b>	Approximately 200 yards U/S of Winona Falls Road Bridge (County Border)	

### Field Measurements

<b>Temp C°</b>	13.52
<b>pH</b>	6.94
<b>Press. inHg</b>	29.68
<b>D.O. %</b>	104.5
<b>D.O. mg/L</b>	10.79
<b>Conductivity [μS/cm]</b>	64

### Habitat Assessment for BUSHCR10 #9





## Lab Chemistry Analysis

Total Organic Carbon (TOC)	3.070	mg/L
Aluminum, Total	<0.0200	mg/L
Calcium, Total	3.37	mg/L
Iron, Total	<0.100	mg/L
Magnesium, Total	1.030	mg/L
Harness	13.6	mg CaCO <sub>3</sub> /L
Chloride	5.89	mg/L
pH	6.87	pH Units
Nitrogen, Total as N (Calc)	<0.500	mg/L
Ammonia as N	0.137	mg/L
Total Kjeldahl Nitrogen (TKN)	<0.500	mg/L
Nitrate-Nitrate as N	<0.0200	mg/L
Alkalinity to pH 4.5	5.25	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	<20	mg/L
Phosphorus - Total as P	<0.0500	mg/L
Biochemical Oxygen Demand	<3.00	mg/L

ORDER	
AMPHIPODA (shrimp)	
BIVALVIA (clams)	
COLEOPTERA (beetles)	26
DECAPODA (crayfish)	
DIPTERA (true flies)	40
EPHEMEROPTERA (mayflies)	106
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	1
ODONATA (dragon flies)	
OLIGOCHAETA (worms)	4
PLECOPTERA (stoneflies)	10
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	27
<b>TOTAL</b>	<b>214</b>

METRICS	
Total Taxa Richness	28
Shannon Diversity Index	2.68
EPT Taxa Richness	18
Hilsenhoff Biotic Index	3.51
Percent Intolerant Individuals	43%
Modified Beck's Index	23
<b>Index of Biotic Integrity</b>	<b>90.3</b>

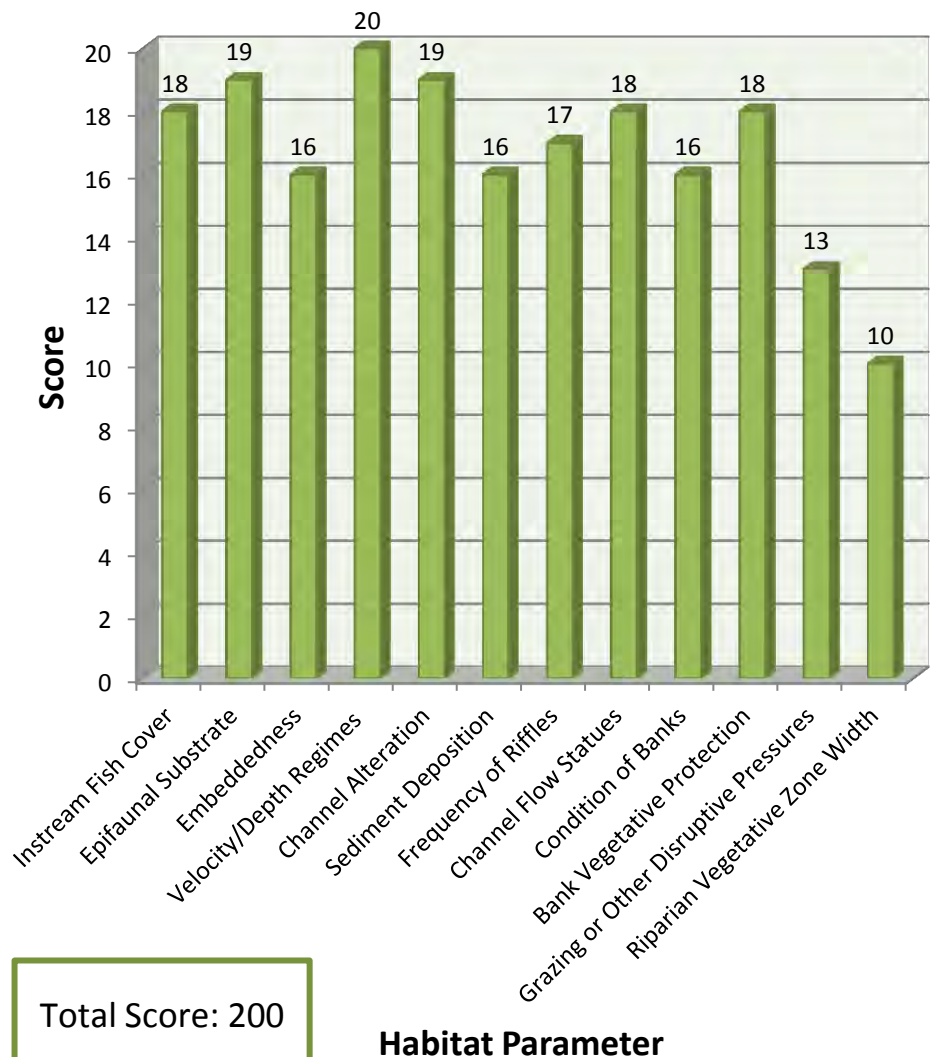
## Site # 10

Site ID	BUSHCR11	
Stream	Bushkill Creek	
Date	4/29/2015	
Time	11:11	
Lat/Long DD	41°10'58.2" N	75°09'36.2" W
Lat/Long DMS	41.1828333	-75.16005556
Municipality	Price Township	
Location	100 yards U/S of wooden bridge on Anglers Rd. off Snowhill Rd.	

### Field Measurements

Temp C°	11.86
pH	6.54
Press. inHg	28.58
D.O. %	105.6
D.O. mg/L	10.89
Conductivity [μS/cm]	51

### Habitat Assessment for BUSHCR11#10



## Lab Chemistry Analysis

Total Organic Carbon (TOC)	3.390	mg/L
Aluminum, Total	<0.0200	mg/L
Calcium, Total	2.32	mg/L
Iron, Total	<0.100	mg/L
Magnesium, Total	0.840	mg/L
Harness	9.3	mg CaCO <sub>3</sub> /L
Chloride	4.48	mg/L
pH	6.24	pH Units
Nitrogen, Total as N (Calc)	2.210	mg/L
Ammonia as N	0.146	mg/L
Total Kjeldahl Nitrogen (TKN)	2.21	mg/L
Nitrate-Nitrate as N	<0.0200	mg/L
Alkalinity to pH 4.5	2.25	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	23.0	mg/L
Phosphorus - Total as P	<0.0500	mg/L
Biochemical Oxygen Demand	<2.00	mg/L

ORDER	
AMPHIPODA (shrimp)	3
BIVALVIA (clams)	
COLEOPTERA (beetles)	10
DECAPODA (crayfish)	
DIPTERA (true flies)	58
EPHEMEROPTERA (mayflies)	77
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	
ODONATA (dragon flies)	3
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	2
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	27
TOTAL	180

METRICS	
Total Taxa Richness	27
Shannon Diversity Index	2.30
EPT Taxa Richness	19
Hilsenhoff Biotic Index	3.54
Percent Intolerant Individuals	53%
Modified Beck's Index	17
<b>Index of Biotic Integrity</b>	<b>86.2</b>

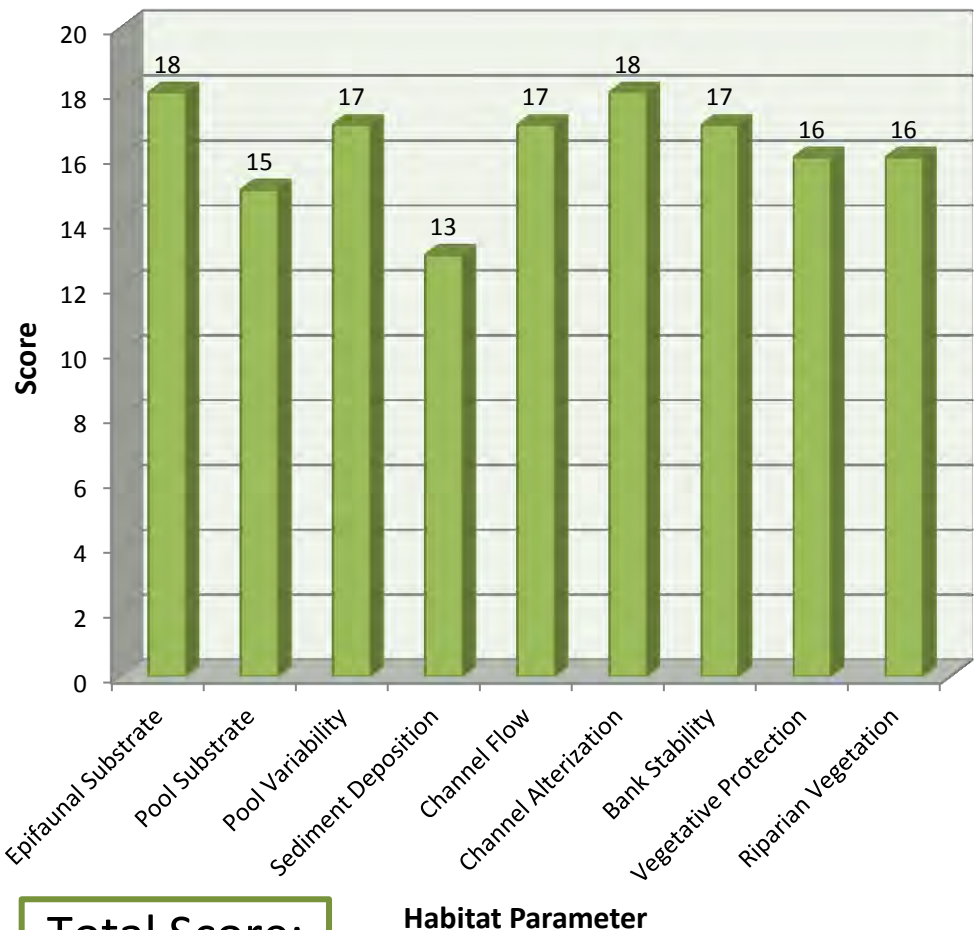
## Site # 11

Site ID	CHERCR06	
Stream	Cherry Creek	
Date	5/4/2015	
Time	10:08	
Lat/Long DD	40°49'46.4" N	75°26'47.0" W
Lat/Long DMS	40.82955556	-75.44638889
Municipality	Eldred Township	
Location	100 yards upstream of Lower Smith Gap Road Bridge	

### Field Measurements

Temp C°	13.56
pH	7.70
Press. inHg	29.86
D.O. %	103.1
D.O. mg/L	10.70
Conductivity [μS/cm]	175

### Habitat Assessment for CHERCR06 #11 (Low Gradient)



**Total Score:**  
**147**

## Lab Chemistry Analysis

Total Organic Carbon (TOC)	1.140	mg/L
Aluminum, Total	<0.0200	mg/L
Calcium, Total	21.7	mg/L
Iron, Total	<0.100	mg/L
Magnesium, Total	4.560	mg/L
Harness	72.9	mg CaCO <sub>3</sub> /L
Chloride	5.87	mg/L
pH	7.40	pH Units
Nitrogen, Total as N (Calc)	<0.500	mg/L
Ammonia as N	0.524	mg/L
Total Kjeldahl Nitrogen (TKN)	<0.500	mg/L
Nitrate-Nitrate as N	0.2500	mg/L
Alkalinity to pH 4.5	58.00	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	96.0	mg/L
Phosphorus - Total as P	<0.0500	mg/L
Biochemical Oxygen Demand	<3.00	mg/L

ORDER	
AMPHIPODA (shrimp)	
BIVALVIA (clams)	
COLEOPTERA (beetles)	13
DECAPODA (crayfish)	
DIPTERA (true flies)	19
EPHEMEROPTERA (mayflies)	71
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	1
ODONATA (dragon flies)	
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	10
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	47
<b>TOTAL</b>	<b>161</b>

METRICS	
Total Taxa Richness	23
Shannon Diversity Index	2.48
EPT Taxa Richness	17
Hilsenhoff Biotic Index	1.99
Percent Intolerant Individuals	74%
Modified Beck's Index	20
<b>Index of Biotic Integrity</b>	<b>80.8</b>

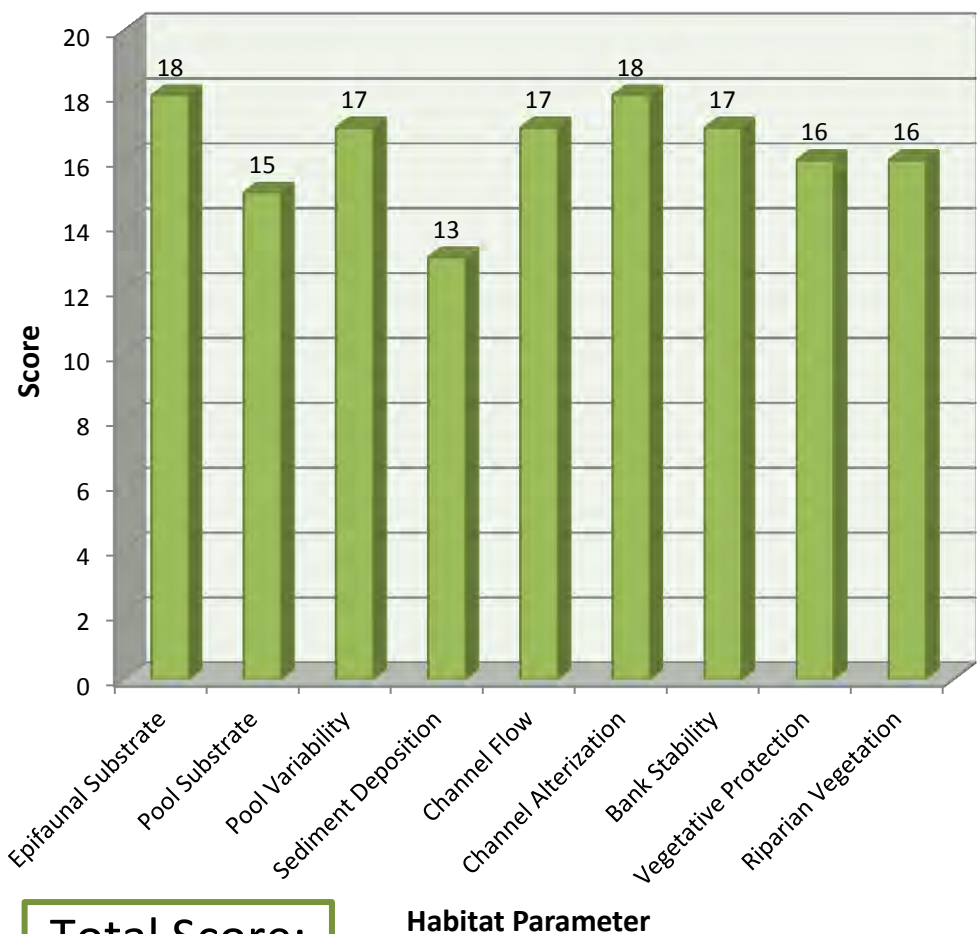
## Site # 12

Site ID	CHERCR06	
Stream	Cherry Creek	
Date	5/4/2015	
Time	10:08	
Lat/Long DD	40°49'46.4" N	75°26'47.0" W
Lat/Long DMS	40.82955556	-75.44638889
Municipality	Eldred Township	
Location	100 yards upstream of Lower Smith Gap Road Bridge	

### Field Measurements

Temp C°	13.56
pH	7.70
Press. inHg	29.86
D.O. %	103.1
D.O. mg/L	10.70
Conductivity [μS/cm]	175

### Habitat Assessment for CHERCR06 #12 (Low Gradient)



Total Score:  
147

## Lab Chemistry Analysis

Total Organic Carbon (TOC)	1.170	mg/L
Aluminum, Total	<0.0200	mg/L
Calcium, Total	21.9	mg/L
Iron, Total	<0.100	mg/L
Magnesium, Total	4.530	mg/L
Harness	73.3	mg CaCO <sub>3</sub> /L
Chloride	5.8	mg/L
pH	6.94	pH Units
Nitrogen, Total as N (Calc)	<0.500	mg/L
Ammonia as N	<0.0500	mg/L
Total Kjeldahl Nitrogen (TKN)	<0.500	mg/L
Nitrate-Nitrate as N	0.2320	mg/L
Alkalinity to pH 4.5	56.00	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	95.0	mg/L
Phosphorus - Total as P	<0.0500	mg/L
Biochemical Oxygen Demand	<3.00	mg/L

ORDER	
AMPHIPODA (shrimp)	4
BIVALVIA (clams)	
COLEOPTERA (beetles)	16
DECAPODA (crayfish)	
DIPTERA (true flies)	69
EPHEMEROPTERA (mayflies)	79
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	3
ODONATA (dragon flies)	
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	7
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	27
<b>TOTAL</b>	<b>205</b>

METRICS	
Total Taxa Richness	27
Shannon Diversity Index	2.37
EPT Taxa Richness	18
Hilsenhoff Biotic Index	4.03
Percent Intolerant Individuals	37%
Modified Beck's Index	10
<b>Index of Biotic Integrity</b>	<b>67.2</b>



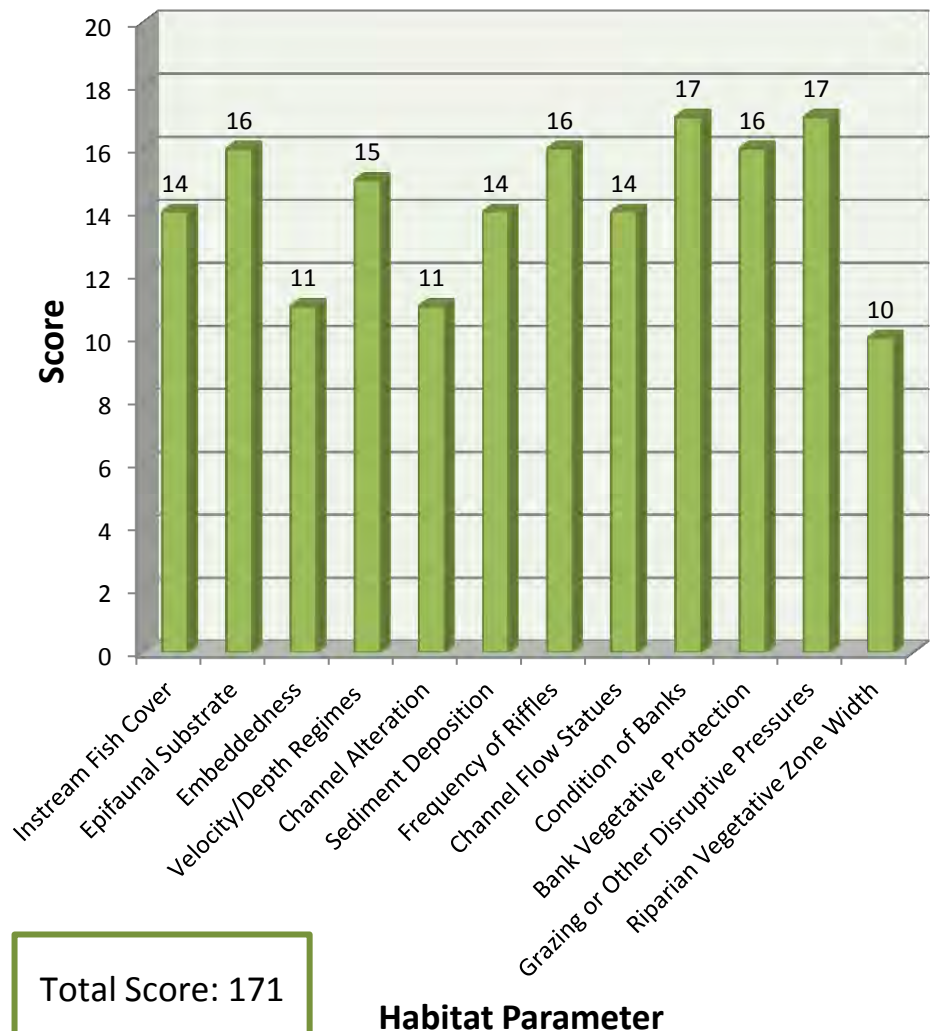
## Site # 13

Site ID	COOLCR01	
Stream	Coolmoor Creek	
Date	4/28/2015	
Time	11:45	
Lat/Long DD	41°03'05.7" N	75°20'20.3" W
Lat/Long DMS	41.05158333	-75.33897222
Municipality	Pocono Township	
Location	Just above confluence with Pocono	

### Field Measurements

Temp C°	9.19
pH	7.52
Press. inHg	29.86
D.O. %	109.9
D.O. mg/L	12.05
Conductivity [µS/cm]	383

### Habitat Assessment for COOLCR01#13





## Lab Chemistry Analysis

Total Organic Carbon (TOC)	0.957	mg/L
Aluminum, Total	0.0142	mg/L
Calcium, Total	15.4	mg/L
Iron, Total	0.052	mg/L
Magnesium, Total	3.840	mg/L
Harness	54.3	mg CaCO <sub>3</sub> /L
Chloride	83.7	mg/L
pH	6.67	pH Units
Nitrogen, Total as N (Calc)	<0.500	mg/L
Ammonia as N	<0.0500	mg/L
Total Kjeldahl Nitrogen (TKN)	<0.500	mg/L
Nitrate-Nitrate as N	0.3710	mg/L
Alkalinity to pH 4.5	13.00	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	188.0	mg/L
Phosphorus - Total as P	<0.0500	mg/L
Biochemical Oxygen Demand	<3.01	mg/L

ORDER	
AMPHIPODA (shrimp)	1
BIVALVIA (clams)	
COLEOPTERA (beetles)	
DECAPODA (crayfish)	
DIPTERA (true flies)	149
EPHEMEROPTERA (mayflies)	8
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	29
ODONATA (dragon flies)	2
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	11
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	30
<b>TOTAL</b>	<b>230</b>

METRICS	
Total Taxa Richness	23
Shannon Diversity Index	1.86
EPT Taxa Richness	15
Hilsenhoff Biotic Index	4.73
Percent Intolerant Individuals	27%
Modified Beck's Index	17
<b>Index of Biotic Integrity</b>	<b>59.2</b>

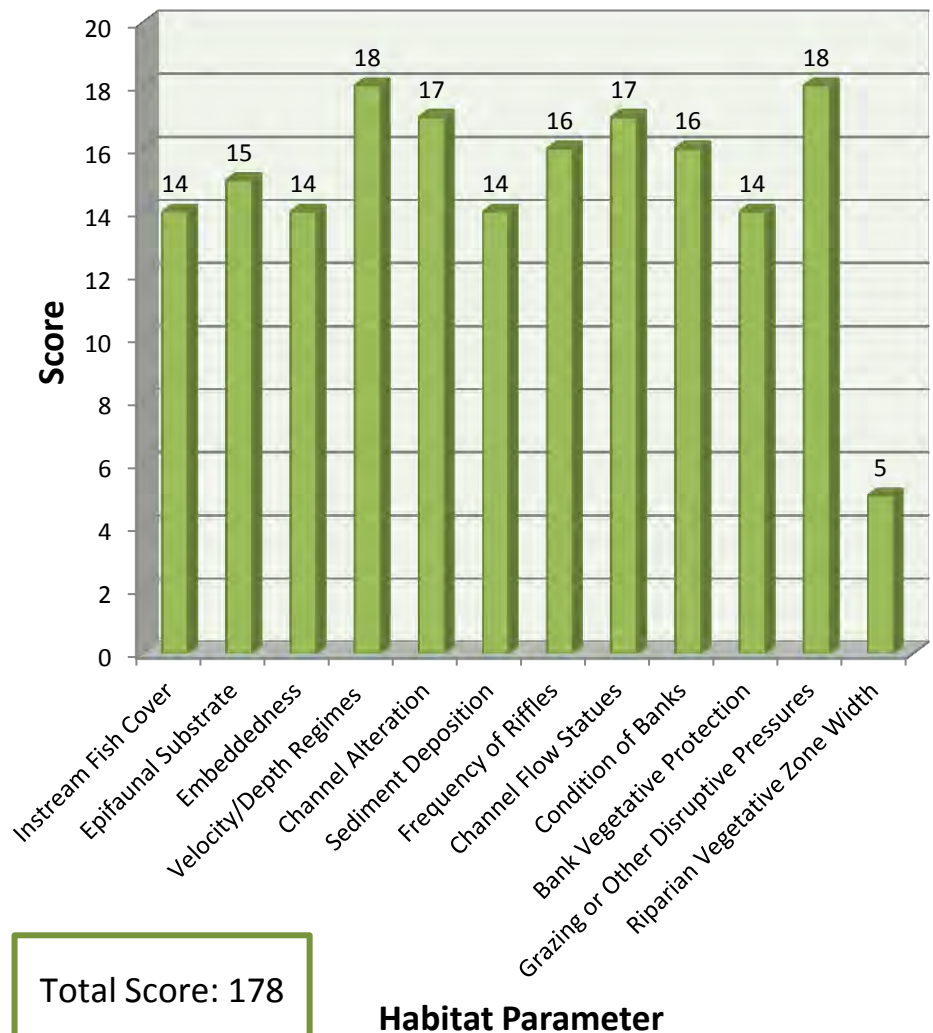
## Site # 14

Site ID	CRCRPA14	
Stream	Cranberry Creek (Paradise)	
Date	2/29/2015	
Time	08:33	
Lat/Long DD	41°07'15.1" N	75°15'43.1" W
Lat/Long DMS	41.12086111	-75.26197222
Municipality	Paradise Township	
Location	Approximately 25 yards U/S of Cranberry Creek Road	

### Field Measurements

Temp C°	8.83
pH	7.04
Press. inHg	28.84
D.O. %	99.1
D.O. mg/L	11.07
Conductivity [µS/cm]	139

### Habitat Assessment for CRCRPA02#14



## Lab Chemistry Analysis

Total Organic Carbon (TOC)	1.720	mg/L
Aluminum, Total	<0.0200	mg/L
Calcium, Total	6.57	mg/L
Iron, Total	<0.100	mg/L
Magnesium, Total	2.180	mg/L
Harness	25.4	mg CaCO <sub>3</sub> /L
Chloride	21.5	mg/L
pH	6.73	pH Units
Nitrogen, Total as N (Calc)	<0.500	mg/L
Ammonia as N	<0.0500	mg/L
Total Kjeldahl Nitrogen (TKN)	<0.500	mg/L
Nitrate-Nitrate as N	0.1830	mg/L
Alkalinity to pH 4.5	10.00	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	86.0	mg/L
Phosphorus - Total as P	<0.0500	mg/L
Biochemical Oxygen Demand	<3.00	mg/L

ORDER	
AMPHIPODA (shrimp)	
BIVALVIA (clams)	
COLEOPTERA (beetles)	21
DECAPODA (crayfish)	
DIPTERA (true flies)	40
EPHEMEROPTERA (mayflies)	78
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	3
ODONATA (dragon flies)	
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	11
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	50
<b>TOTAL</b>	<b>203</b>

METRICS	
Total Taxa Richness	35
Shannon Diversity Index	2.9
EPT Taxa Richness	24
Hilsenhoff Biotic Index	2.44
Percent Intolerant Individuals	74%
Modified Beck's Index	38
<b>Index of Biotic Integrity</b>	<b>96.8</b>

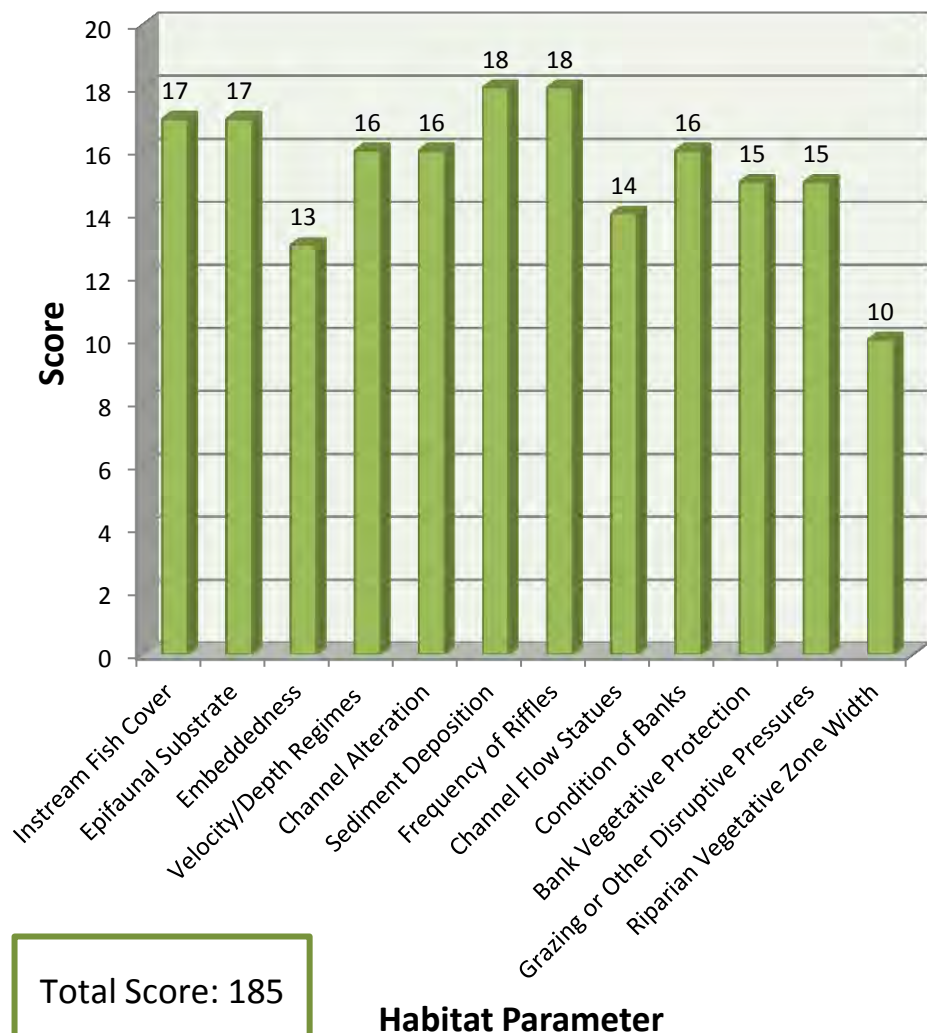
## Site # 15

Site ID	MARSCR03	
Stream	Marshalls Creek	
Date	5/7/2015	
Time	10:26	
Lat/Long DD	41°02'28.4" N	75°07'35.8" W
Lat/Long DMS	41.04122222	-75.12661111
Municipality	Smithfield Township	
Location	D/S of Route 209 at the discharge channel from the detention basin at the mall	

### Field Measurements

Temp C°	15.19
pH	7.28
Press. inHg	29.79
D.O. %	102.8
D.O. mg/L	10.27
Conductivity [μS/cm]	207

### HabitatAssessment for MARSCR03#15



## Lab Chemistry Analysis

Total Organic Carbon (TOC)	2.640	mg/L
Aluminum, Total	<0.0200	mg/L
Calcium, Total	17.3	mg/L
Iron, Total	0.186	mg/L
Magnesium, Total	2.630	mg/L
Harness	54.1	mg CaCO <sub>3</sub> /L
Chloride	30.6	mg/L
pH	6.93	pH Units
Nitrogen, Total as N (Calc)	<0.500	mg/L
Ammonia as N	<0.0500	mg/L
Total Kjeldahl Nitrogen (TKN)	<0.500	mg/L
Nitrate-Nitrate as N	0.1850	mg/L
Alkalinity to pH 4.5	24.50	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	25.0	mg/L
Phosphorus - Total as P	<0.0500	mg/L
Biochemical Oxygen Demand	<3.00	mg/L

ORDER	
AMPHIPODA (shrimp)	
BIVALVIA (clams)	6
COLEOPTERA (beetles)	41
DECAPODA (crayfish)	
DIPTERA (true flies)	28
EPHEMEROPTERA (mayflies)	79
GASTROPODA (snails)	2
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	
ODONATA (dragon flies)	2
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	5
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	46
TOTAL	209

METRICS	
Total Taxa Richness	35
Shannon Diversity Index	2.86
EPT Taxa Richness	21
Hilsenhoff Biotic Index	3.26
Percent Intolerant Individuals	48%
Modified Beck's Index	20
<b>Index of Biotic Integrity</b>	<b>82.1</b>

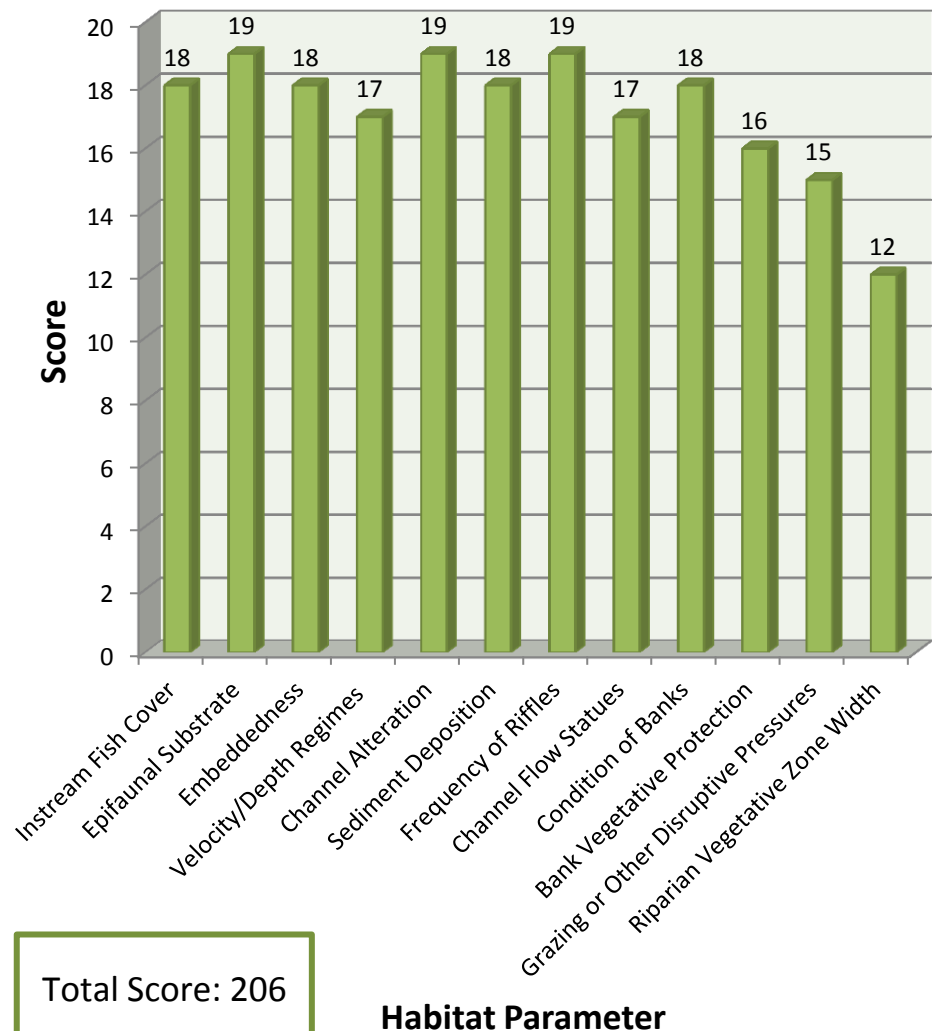
## Site # 16

Site ID	MARSCR11	
Stream	Marshalls Creek	
Date	5/7/2015	
Time	09:09	
Lat/Long DD	41°03'15.4" N	75°08'12.3" W
Lat/Long DMS	41.05427778	-75.13675000
Municipality	Middle Smithfield Township	
Location	Approximately 100 yards U/S of Newton Run and White Heron Lake	

### Field Measurements

Temp C°	11.99
pH	7.30
Press. inHg	29.54
D.O. %	106.1
D.O. mg/L	11.28
Conductivity [μS/cm]	127

### Habitat Assessment for MARSC11#16



## Lab Chemistry Analysis

Total Organic Carbon (TOC)	1.870	mg/L
Aluminum, Total	<0.0200	mg/L
Calcium, Total	9.15	mg/L
Iron, Total	<0.100	mg/L
Magnesium, Total	1.860	mg/L
Harness	30.5	mg CaCO <sub>3</sub> /L
Chloride	15.2	mg/L
pH	6.92	pH Units
Nitrogen, Total as N (Calc)	<0.500	mg/L
Ammonia as N	<0.0500	mg/L
Total Kjeldahl Nitrogen (TKN)	<0.500	mg/L
Nitrate-Nitrate as N	0.1800	mg/L
Alkalinity to pH 4.5	12.00	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	<20	mg/L
Phosphorus - Total as P	<0.0500	mg/L
Biochemical Oxygen Demand	<3.00	mg/L

ORDER	
AMPHIPODA (shrimp)	
BIVALVIA (clams)	
COLEOPTERA (beetles)	45
DECAPODA (crayfish)	
DIPTERA (true flies)	27
EPHEMEROPTERA (mayflies)	94
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	2
ODONATA (dragon flies)	3
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	27
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	27
TOTAL	225

METRICS	
Total Taxa Richness	32
Shannon Diversity Index	2.88
EPT Taxa Richness	24
Hilsenhoff Biotic Index	2.46
Percent Intolerant Individuals	71%
Modified Beck's Index	40
<b>Index of Biotic Integrity</b>	<b>95.7</b>



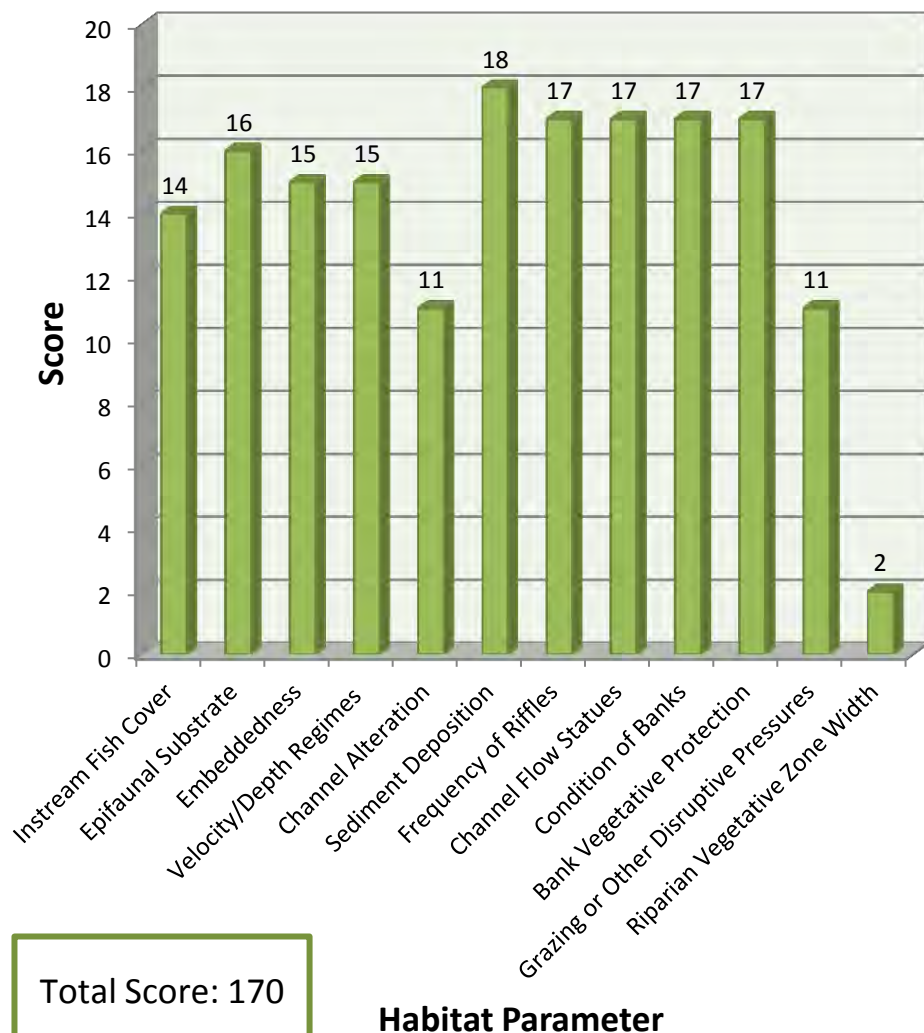
## Site # 17

<b>Site ID</b>	MARSCR12	
<b>Stream</b>	Marshalls Creek	
<b>Date</b>	5/7/2015	
<b>Time</b>	09:58	
<b>Lat/Long DD</b>	41°02'36.3" N	75°07'41.7" W
<b>Lat/Long DMS</b>	41.04341667	-75.12825000
<b>Municipality</b>	Middle Smithfield Township	
<b>Location</b>	Approximately 200 yards U/S of confluence with Pond Creek	

### Field Measurements

<b>Temp C°</b>	13.13
<b>pH</b>	7.56
<b>Press. inHg</b>	29.79
<b>D.O. %</b>	107.4
<b>D.O. mg/L</b>	11.22
<b>Conductivity [μS/cm]</b>	131

### Habitat Assessment for MARSC12#17





## Lab Chemistry Analysis

Total Organic Carbon (TOC)	1.950	mg/L
Aluminum, Total	<0.0200	mg/L
Calcium, Total	9.42	mg/L
Iron, Total	<0.100	mg/L
Magnesium, Total	1.890	mg/L
Harness	31.3	mg CaCO <sub>3</sub> /L
Chloride	15.9	mg/L
pH	7.00	pH Units
Nitrogen, Total as N (Calc)	<0.500	mg/L
Ammonia as N	<0.0500	mg/L
Total Kjeldahl Nitrogen (TKN)	<0.500	mg/L
Nitrate-Nitrate as N	0.1750	mg/L
Alkalinity to pH 4.5	13.00	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	131.0	mg/L
Phosphorus - Total as P	0.067	mg/L
Biochemical Oxygen Demand	<3.00	mg/L

ORDER	
AMPHIPODA (shrimp)	
BIVALVIA (clams)	
COLEOPTERA (beetles)	28
DECAPODA (crayfish)	
DIPTERA (true flies)	28
EPHEMEROPTERA (mayflies)	121
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	1
ODONATA (dragon flies)	2
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	20
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	33
<b>TOTAL</b>	<b>233</b>

METRICS	
Total Taxa Richness	32
Shannon Diversity Index	2.69
EPT Taxa Richness	21
Hilsenhoff Biotic Index	2.63
Percent Intolerant Individuals	61%
Modified Beck's Index	28
<b>Index of Biotic Integrity</b>	<b>88.0</b>

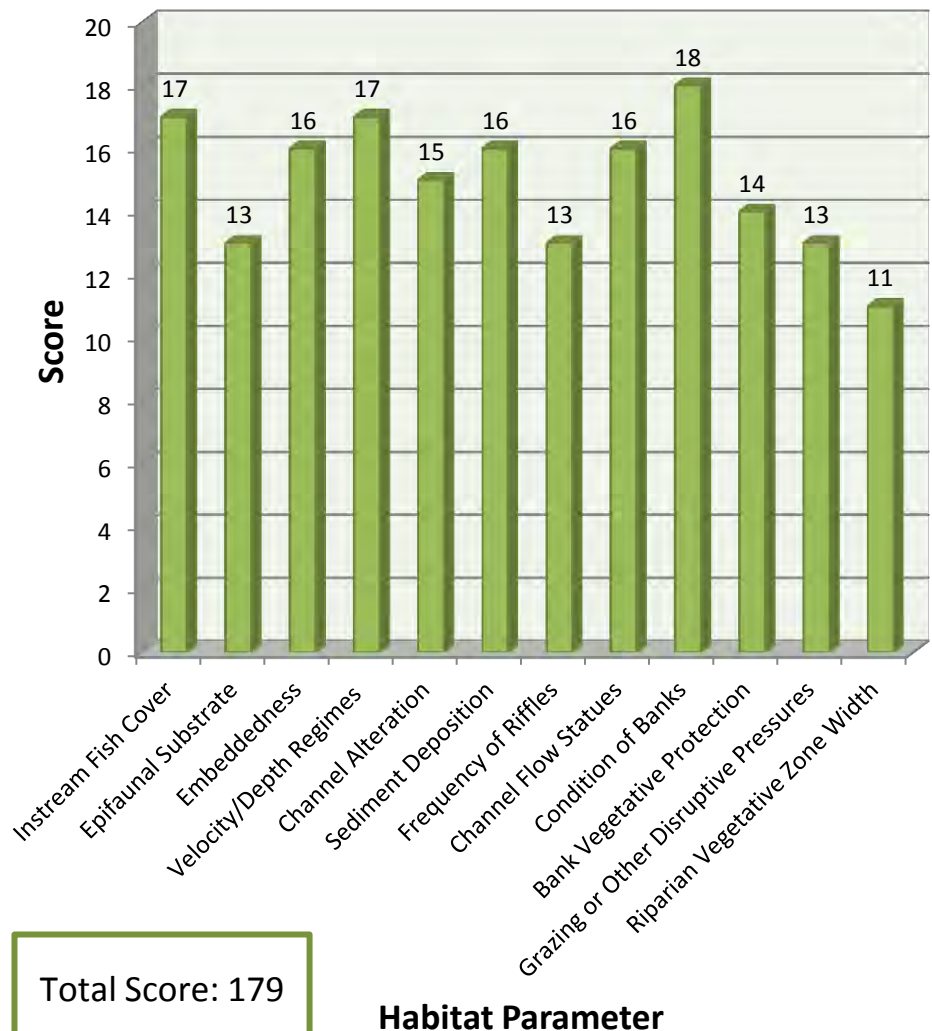
## Site # 18

<b>Site ID</b>	MARSCR13	
<b>Stream</b>	Marshalls Creek	
<b>Date</b>	5/6/2015	
<b>Time</b>	11:00	
<b>Lat/Long DD</b>	40°59'54.8" N	75°08'22.8" W
<b>Lat/Long DMS</b>	40.99855556	-75.13966667
<b>Municipality</b>	Smithfield Township	
<b>Location</b>	Behind Minisink Bar & Hotel at intersection of Post office Rd. & River Rd. U/S of stone bridge	

### Field Measurements

<b>Temp C°</b>	15.58
<b>pH</b>	7.62
<b>Press. inHg</b>	29.91
<b>D.O. %</b>	99.8
<b>D.O. mg/L</b>	9.92
<b>Conductivity [μS/cm]</b>	261

### Habitat Assessment for MARSC13#18



## Lab Chemistry Analysis

Total Organic Carbon (TOC)	2.280	mg/L
Aluminum, Total	<0.0200	mg/L
Calcium, Total	21.3	mg/L
Iron, Total	0.114	mg/L
Magnesium, Total	2.820	mg/L
Harness	64.7	mg CaCO <sub>3</sub> /L
Chloride	33.7	mg/L
pH	6.69	pH Units
Nitrogen, Total as N (Calc)	<0.500	mg/L
Ammonia as N	<0.0500	mg/L
Total Kjeldahl Nitrogen (TKN)	<0.500	mg/L
Nitrate-Nitrate as N	0.2240	mg/L
Alkalinity to pH 4.5	38.00	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	48.0	mg/L
Phosphorus - Total as P	<0.0500	mg/L
Biochemical Oxygen Demand	<3.00	mg/L

ORDER	
AMPHIPODA (shrimp)	1
BIVALVIA (clams)	
COLEOPTERA (beetles)	23
DECAPODA (crayfish)	
DIPTERA (true flies)	17
EPHEMEROPTERA (mayflies)	104
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	1
ODONATA (dragon flies)	4
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	19
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	24
<b>TOTAL</b>	<b>193</b>

METRICS	
Total Taxa Richness	30
Shannon Diversity Index	2.76
EPT Taxa Richness	19
Hilsenhoff Biotic Index	3.26
Percent Intolerant Individuals	51%
Modified Beck's Index	21
<b>Index of Biotic Integrity</b>	<b>81.0</b>

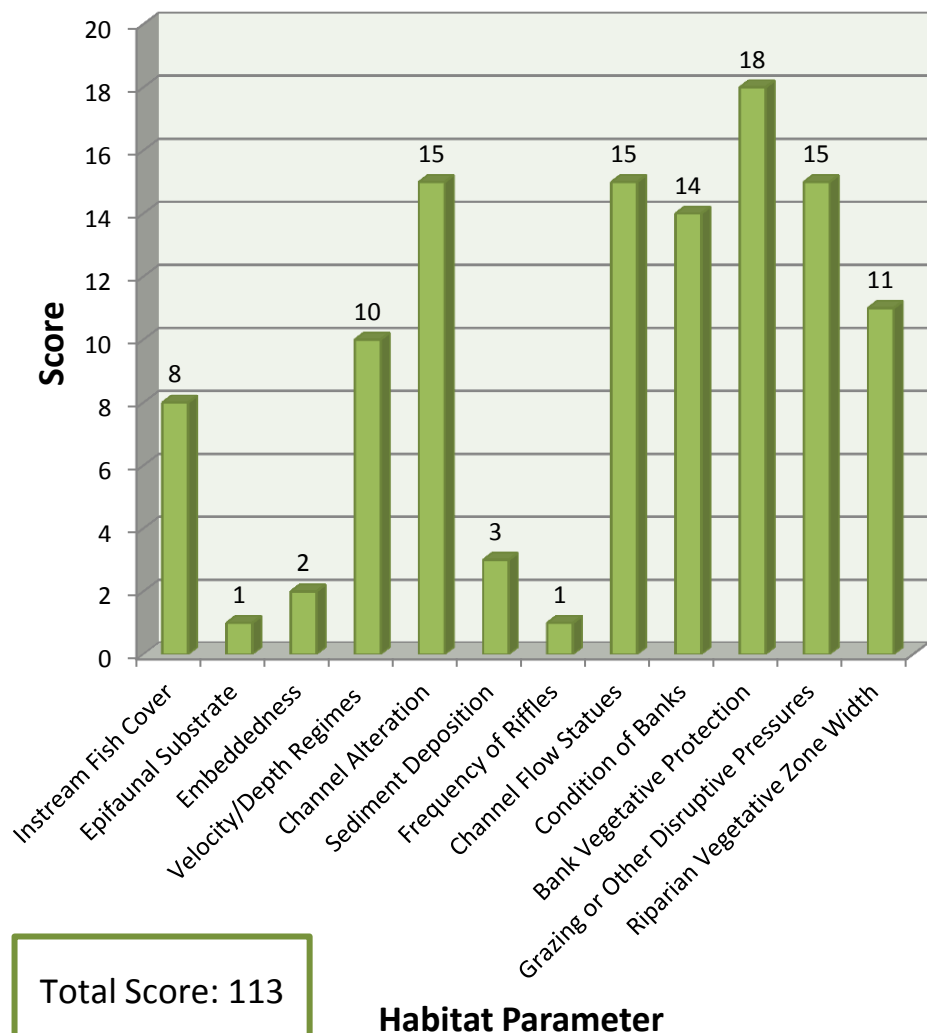
## Site # 19

Site ID	MCMICR20	
Stream	McMichael Creek	
Date	5/5/2015	
Time	08:42	
Lat/Long DD	40°58'45.3" N	75°11'52.7" W
Lat/Long DMS	40.97925000	-75.19797222
Municipality	Stroudsburg Borough	
Location	Approximately 30 yards U/S of its confluence with Pocono Creek (above long slow pool)	

### Field Measurements

Temp C°	15.41
pH	7.40
Press. inHg	29.95
D.O. %	95.97
D.O. mg/L	9.57
Conductivity [μS/cm]	193

### HabitatAssessment for MCMICR20#19



## Lab Chemistry Analysis

Total Organic Carbon (TOC)	1.580	mg/L
Aluminum, Total	<0.0200	mg/L
Calcium, Total	13.5	mg/L
Iron, Total	0.116	mg/L
Magnesium, Total	2.370	mg/L
Harness	43.5	mg CaCO <sub>3</sub> /L
Chloride	24.9	mg/L
pH	6.78	pH Units
Nitrogen, Total as N (Calc)	<0.500	mg/L
Ammonia as N	0.068	mg/L
Total Kjeldahl Nitrogen (TKN)	<0.500	mg/L
Nitrate-Nitrate as N	0.3810	mg/L
Alkalinity to pH 4.5	28.00	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	108.0	mg/L
Phosphorus - Total as P	<0.0500	mg/L
Biochemical Oxygen Demand	<3.00	mg/L

ORDER	
AMPHIPODA (shrimp)	32
BIVALVIA (clams)	
COLEOPTERA (beetles)	2
DECAPODA (crayfish)	
DIPTERA (true flies)	186
EPHEMEROPTERA (mayflies)	15
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	
ODONATA (dragon flies)	5
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	7
TOTAL	247

METRICS	
Total Taxa Richness	10
Shannon Diversity Index	0.93
EPT Taxa Richness	6
Hilsenhoff Biotic Index	5.65
Percent Intolerant Individuals	1%
Modified Beck's Index	2
<b>Index of Biotic Integrity</b>	<b>29.2</b>

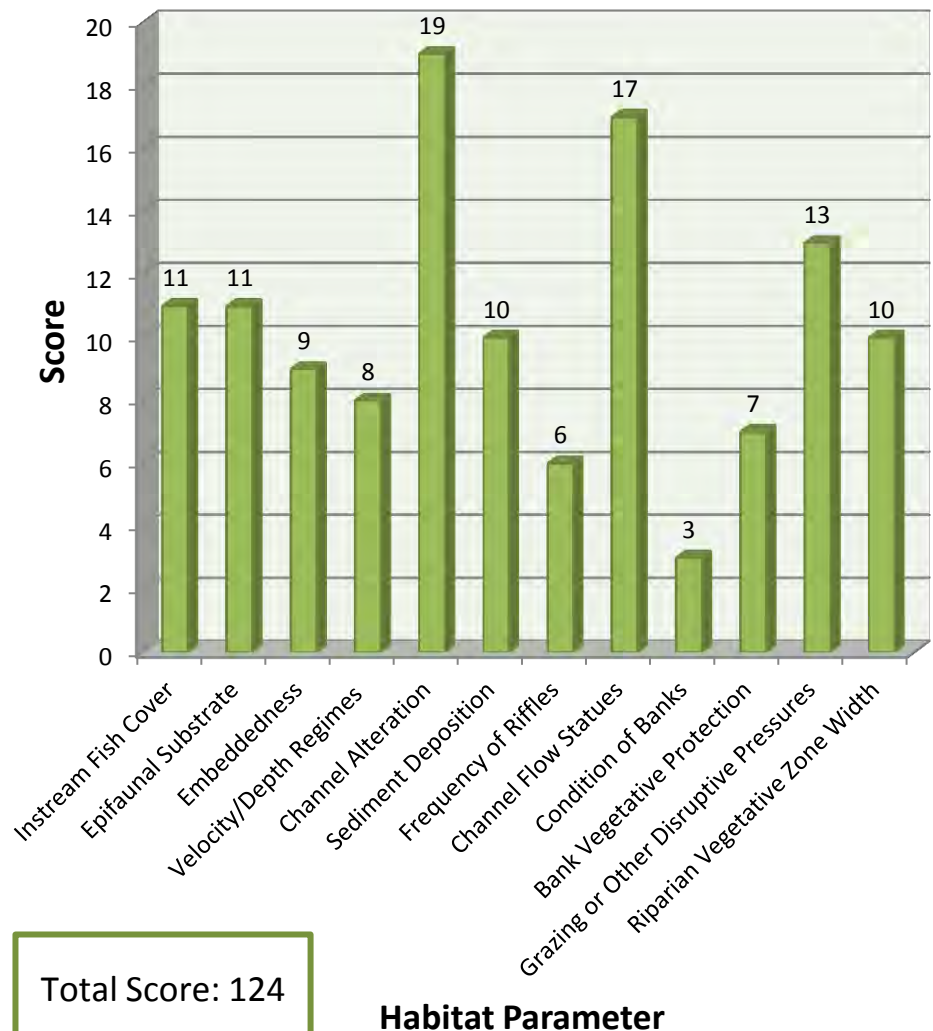
## Site # 20

Site ID	MCMICR35	
Stream	McMichael Creek	
Date	4/30/2015	
Time	08:12	
Lat/Long DD	40°58'08.8" N	75°12'46.6" W
Lat/Long DMS	40.96911111	-75.21295555
Municipality	Stroud Township	
Location	Near Norton Drive and Creekwood Drive	

### Field Measurements

Temp C°	11.72
pH	7.38
Press. inHg	29.18
D.O. %	98.2
D.O. mg/L	10.37
Conductivity [μS/cm]	189

### HabitatAssessment for MCMICR35#20



## Lab Chemistry Analysis

Total Organic Carbon (TOC)	N/A	mg/L
Aluminum, Total	N/A	mg/L
Calcium, Total	N/A	mg/L
Iron, Total	N/A	mg/L
Magnesium, Total	N/A	mg/L
Harness	N/A	mg CaCO <sub>3</sub> /L
Chloride	N/A	mg/L
pH	N/A	pH Units
Nitrogen, Total as N (Calc)	N/A	mg/L
Ammonia as N	N/A	mg/L
Total Kjeldahl Nitrogen (TKN)	N/A	mg/L
Nitrate-Nitrate as N	N/A	mg/L
Alkalinity to pH 4.5	N/A	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	N/A	mg/L
Phosphorus - Total as P	N/A	mg/L
Biochemical Oxygen Demand	N/A	mg/L

ORDER	
AMPHIPODA (shrimp)	4
BIVALVIA(clams)	
COLEOPTERA (beetles)	19
DECAPODA (crayfish)	
DIPTERA (true flies)	66
EPHEMEROPTERA (mayflies)	74
GASTROPODA (snails)	2
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	
ODONATA (dragon flies)	10
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	2
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	21
<b>TOTAL</b>	<b>198</b>

METRICS	
Total Taxa Richness	22
Shannon Diversity Index	2.38
EPT Taxa Richness	14
Hilsenhoff Biotic Index	4.87
Percent Intolerant Individuals	25%
Modified Beck's Index	8
<b>Index of Biotic Integrity</b>	<b>60.6</b>



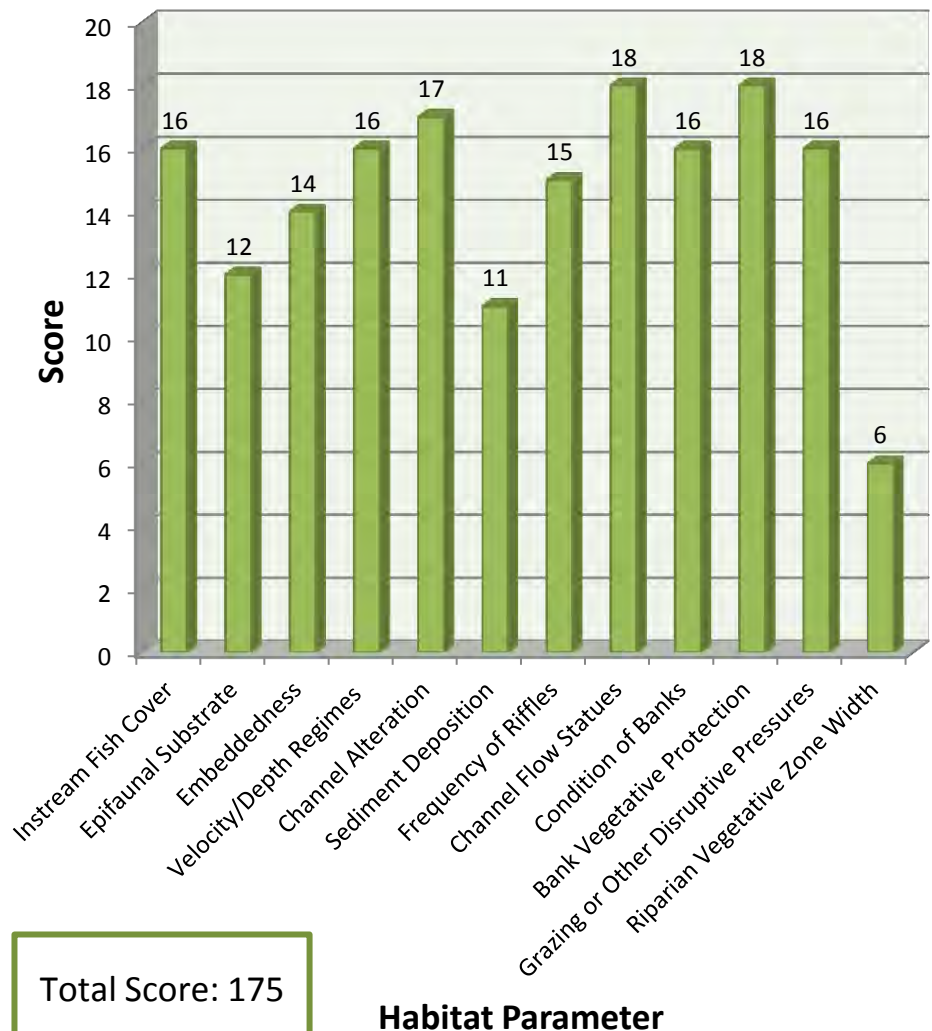
## Site # 21

Site ID	MCMICR37	
Stream	McMichael Creek	
Date	4/30/2015	
Time	07:14	
Lat/Long DD	40°57'44.1" N	75°14'17.5" W
Lat/Long DMS	40.96225000	-75.23819444
Municipality	Stroud Township	
Location	Hickory Valley Park, 50 yds. U/S of parking lot	

### Field Measurements

Temp C°	11.42
pH	7.26
Press. inHg	29.16
D.O. %	96.5
D.O. mg/L	10.26
Conductivity [μS/cm]	187

### HabitatAssessment for MCMICR37#21





## Lab Chemistry Analysis

Total Organic Carbon (TOC)	N/A	mg/L
Aluminum, Total	N/A	mg/L
Calcium, Total	N/A	mg/L
Iron, Total	N/A	mg/L
Magnesium, Total	N/A	mg/L
Harness	N/A	mg CaCO <sub>3</sub> /L
Chloride	N/A	mg/L
pH	N/A	pH Units
Nitrogen, Total as N (Calc)	N/A	mg/L
Ammonia as N	N/A	mg/L
Total Kjeldahl Nitrogen (TKN)	N/A	mg/L
Nitrate-Nitrate as N	N/A	mg/L
Alkalinity to pH 4.5	N/A	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	N/A	mg/L
Phosphorus - Total as P	N/A	mg/L
Biochemical Oxygen Demand	N/A	mg/L

ORDER	
AMPHIPODA (shrimp)	3
BIVALVIA (clams)	
COLEOPTERA (beetles)	11
DECAPODA (crayfish)	
DIPTERA (true flies)	13
EPHEMEROPTERA (mayflies)	108
GASTROPODA (snails)	1
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	2
ODONATA (dragon flies)	5
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	3
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	64
<b>TOTAL</b>	<b>210</b>

METRICS	
Total Taxa Richness	29
Shannon Diversity Index	2.57
EPT Taxa Richness	16
Hilsenhoff Biotic Index	3.25
Percent Intolerant Individuals	60%
Modified Beck's Index	20
<b>Index of Biotic Integrity</b>	<b>93.6</b>

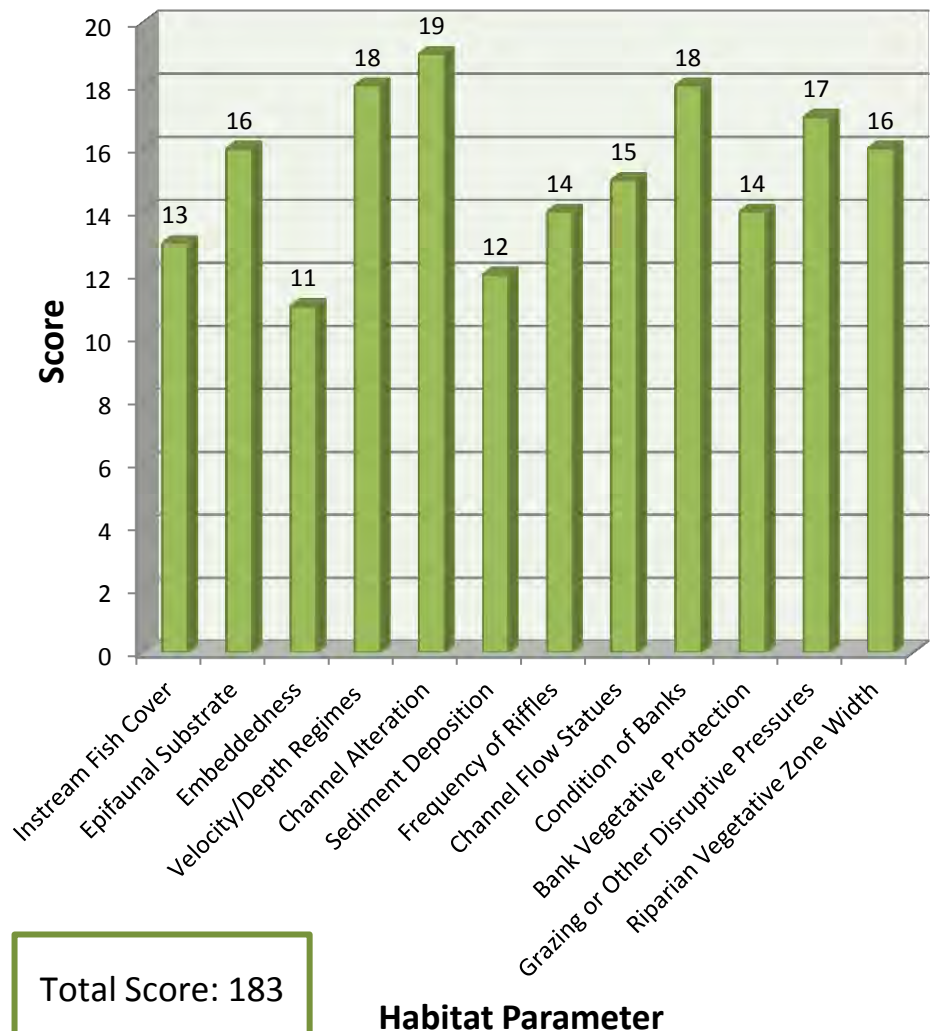
## Site # 22

Site ID	POCOCR14	
Stream	Pocono Creek	
Date	5/5/2015	
Time	08:03	
Lat/Long DD	40°58'48.9" N	75°11'46.2" W
Lat/Long DMS	40.98025000	-75.19616667
Municipality	Stroudsburg Borough	
Location	(MOUTH) Above McMichael confluence	

### Field Measurements

Temp C°	14.61
pH	7.53
Press. inHg	29.84
D.O. %	106.6
D.O. mg/L	10.79
Conductivity [μS/cm]	373

### Habitat Assessment for POCOCR14#22



## Lab Chemistry Analysis

Total Organic Carbon (TOC)	1.920	mg/L
Aluminum, Total	<0.0200	mg/L
Calcium, Total	18.1	mg/L
Iron, Total	0.169	mg/L
Magnesium, Total	3.660	mg/L
Harness	60.2	mg CaCO <sub>3</sub> /L
Chloride	68.6	mg/L
pH	6.76	pH Units
Nitrogen, Total as N (Calc)	<0.500	mg/L
Ammonia as N	<0.0500	mg/L
Total Kjeldahl Nitrogen (TKN)	<0.500	mg/L
Nitrate-Nitrate as N	0.3480	mg/L
Alkalinity to pH 4.5	30.00	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	190.0	mg/L
Phosphorus - Total as P	<0.0500	mg/L
Biochemical Oxygen Demand	<3.00	mg/L

ORDER	
AMPHIPODA (shrimp)	
BIVALVIA (clams)	
COLEOPTERA (beetles)	27
DECAPODA (crayfish)	
DIPTERA (true flies)	11
EPHEMEROPTERA (mayflies)	131
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	
ODONATA (dragon flies)	2
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	2
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	37
TOTAL	210

METRICS	
Total Taxa Richness	22
Shannon Diversity Index	2.31
EPT Taxa Richness	15
Hilsenhoff Biotic Index	4.32
Percent Intolerant Individuals	32%
Modified Beck's Index	15
<b>Index of Biotic Integrity</b>	<b>62.3</b>

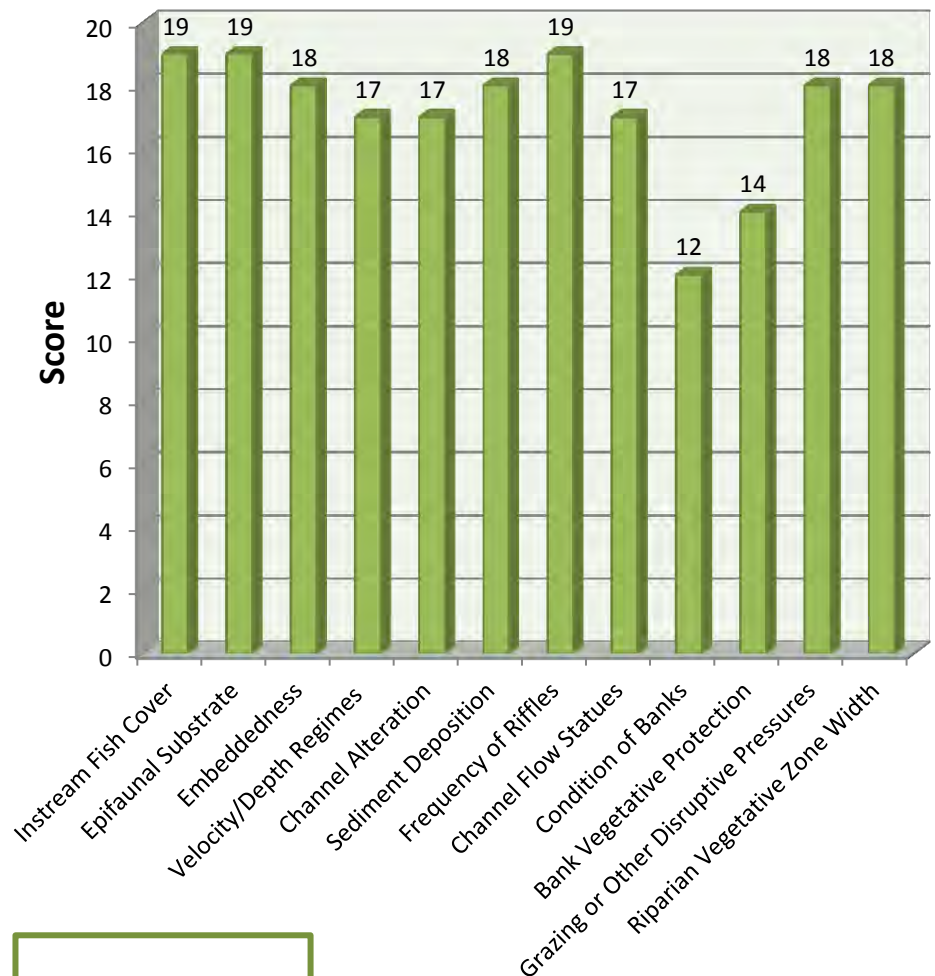
## Site # 23

Site ID	POCOCR18	
Stream	Pocono Creek	
Date	4/30/2015	
Time	10:24	
Lat/Long DD	40°59'27.3" N	75°15'16.4" W
Lat/Long DMS	40.99091667	-75.25455556
Municipality	Stroud Township	
Location	Schaeffer Schoolhouse Road (above Wigwam Run)	

### Field Measurements

Temp C°	11.53
pH	7.90
Press. inHg	29.15
D.O. %	105.4
D.O. mg/L	11.17
Conductivity [μS/cm]	313

### Habitat Assessment for POCOCR18#23



Total Score: 206

Habitat Parameter

## Lab Chemistry Analysis

Total Organic Carbon (TOC)	1.910	mg/L
Aluminum, Total	<0.0200	mg/L
Calcium, Total	14	mg/L
Iron, Total	<0.100	mg/L
Magnesium, Total	3.270	mg/L
Harness	48.4	mg CaCO <sub>3</sub> /L
Chloride	61	mg/L
pH	6.77	pH Units
Nitrogen, Total as N (Calc)	<0.500	mg/L
Ammonia as N	0.058	mg/L
Total Kjeldahl Nitrogen (TKN)	<0.500	mg/L
Nitrate-Nitrate as N	0.3070	mg/L
Alkalinity to pH 4.5	22.00	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	166.0	mg/L
Phosphorus - Total as P	<0.0500	mg/L
Biochemical Oxygen Demand	<3.00	mg/L

ORDER	
AMPHIPODA (shrimp)	1
BIVALVIA(clams)	
COLEOPTERA (beetles)	19
DECAPODA (crayfish)	
DIPTERA (true flies)	50
EPHEMEROPTERA (mayflies)	1
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	2
ODONATA (dragon flies)	9
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	11
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	47
<b>TOTAL</b>	<b>140</b>

METRICS	
Total Taxa Richness	25
Shannon Diversity Index	2.55
EPT Taxa Richness	12
Hilsenhoff Biotic Index	4.59
Percent Intolerant Individuals	27%
Modified Beck's Index	17
<b>Index of Biotic Integrity</b>	<b>61.9</b>

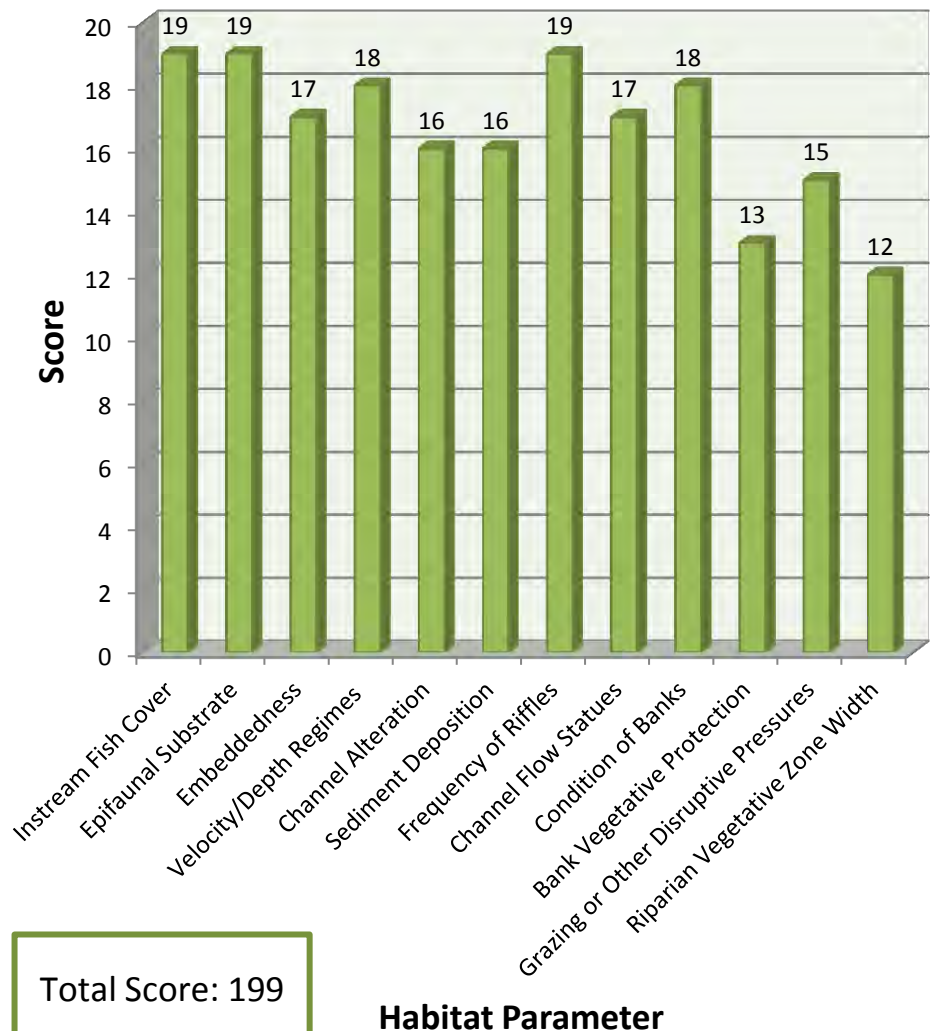
## Site # 24

Site ID	POCOCR23	
Stream	Pocono Creek	
Date	4/28/2015	
Time	11:08	
Lat/Long DD	41°03'07.0" N	75°20'16.7" W
Lat/Long DMS	41.05194444	-75.33797222
Municipality	Pocono Township	
Location	50 yards downstream of confluence with the Coolmoor	

### Field Measurements

Temp C°	9.57
pH	7.27
Press. inHg	28.49
D.O. %	108.9
D.O. mg/L	11.80
Conductivity [μS/cm]	228

### Habitat Assessment for POCOCR23#24



## Lab Chemistry Analysis

Total Organic Carbon (TOC)	1.320	mg/L
Aluminum, Total	0.0305	mg/L
Calcium, Total	7.52	mg/L
Iron, Total	<0.100	mg/L
Magnesium, Total	1.860	mg/L
Harness	26.4	mg CaCO <sub>3</sub> /L
Chloride	46.4	mg/L
pH	6.53	pH Units
Nitrogen, Total as N (Calc)	<0.500	mg/L
Ammonia as N	<0.0500	mg/L
Total Kjeldahl Nitrogen (TKN)	<0.500	mg/L
Nitrate-Nitrate as N	0.2090	mg/L
Alkalinity to pH 4.5	8.50	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	116.0	mg/L
Phosphorus - Total as P	<0.0500	mg/L
Biochemical Oxygen Demand	1.16	mg/L

ORDER	
AMPHIPODA (shrimp)	
BIVALVIA (clams)	
COLEOPTERA (beetles)	
DECAPODA (crayfish)	
DIPTERA (true flies)	19
EPHEMEROPTERA (mayflies)	113
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	
ODONATA (dragon flies)	
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	35
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	39
<b>TOTAL</b>	<b>206</b>

METRICS	
Total Taxa Richness	18
Shannon Diversity Index	1.98
EPT Taxa Richness	13
Hilsenhoff Biotic Index	2.82
Percent Intolerant Individuals	61%
Modified Beck's Index	21
<b>Index of Biotic Integrity</b>	<b>68.0</b>



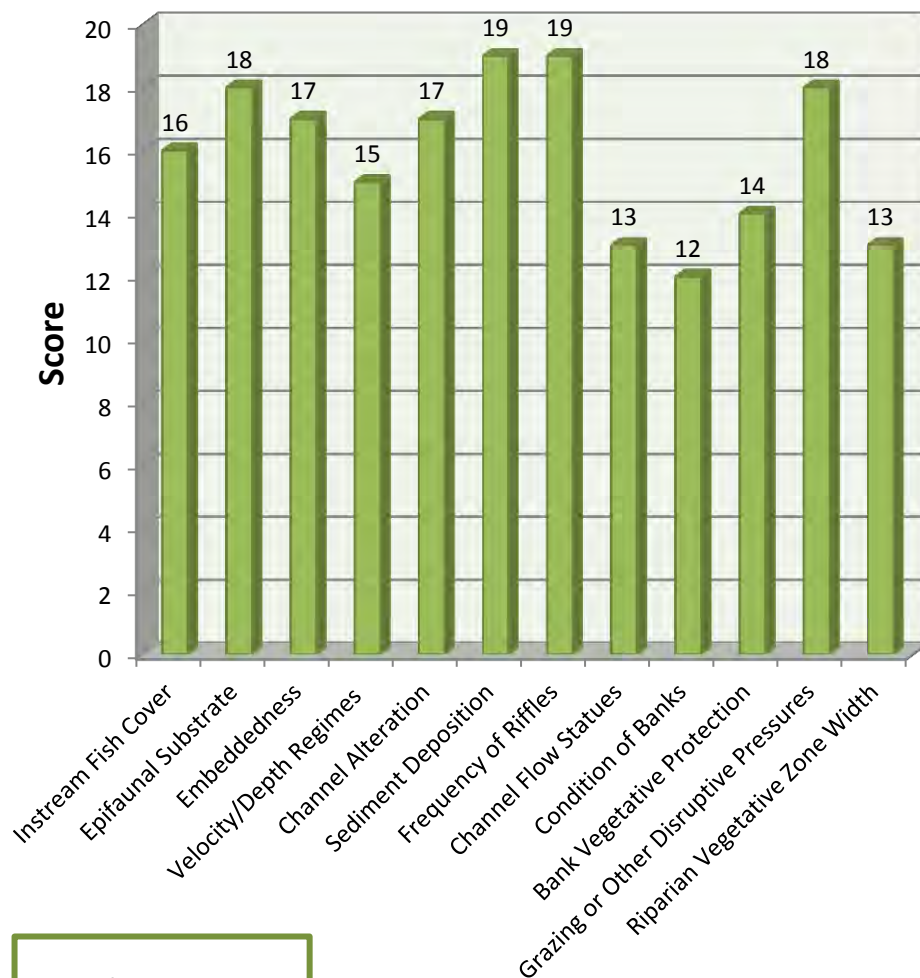
## Site # 25

Site ID	POCOCR24	
Stream	Pocono Creek	
Date	5/5/2015	
Time	10:06	
Lat/Long DD	40°59'13.3" N	75°12'29.6" W
Lat/Long DMS	40.98702778	-75.20822222
Municipality	Stroudsburg Borough	
Location	50 yds above Big Meadow Run	

### Field Measurements

Temp C°	15.83
pH	7.69
Press. inHg	29.93
D.O. %	107.5
D.O. mg/L	10.63
Conductivity [μS/cm]	364

### Habitat Assessment for POCOCR24#25



Total Score: 191

Habitat Parameter



## Lab Chemistry Analysis

Total Organic Carbon (TOC)	1.930	mg/L
Aluminum, Total	<0.0200	mg/L
Calcium, Total	18.9	mg/L
Iron, Total	<0.100	mg/L
Magnesium, Total	3.880	mg/L
Harness	63.2	mg CaCO <sub>3</sub> /L
Chloride	70.7	mg/L
pH	6.73	pH Units
Nitrogen, Total as N (Calc)	<0.500	mg/L
Ammonia as N	<0.0500	mg/L
Total Kjeldahl Nitrogen (TKN)	<0.500	mg/L
Nitrate-Nitrate as N	0.3530	mg/L
Alkalinity to pH 4.5	26.00	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	186.0	mg/L
Phosphorus - Total as P	<0.0500	mg/L
Biochemical Oxygen Demand	<3.00	mg/L

ORDER	
AMPHIPODA (shrimp)	
BIVALVIA (clams)	
COLEOPTERA (beetles)	24
DECAPODA (crayfish)	
DIPTERA (true flies)	35
EPHEMEROPTERA (mayflies)	64
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	
ODONATA (dragon flies)	4
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	4
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	31
<b>TOTAL</b>	<b>162</b>

METRICS	
Total Taxa Richness	23
Shannon Diversity Index	2.51
EPT Taxa Richness	16
Hilsenhoff Biotic Index	4.25
Percent Intolerant Individuals	21%
Modified Beck's Index	16
<b>Index of Biotic Integrity</b>	<b>63.3</b>

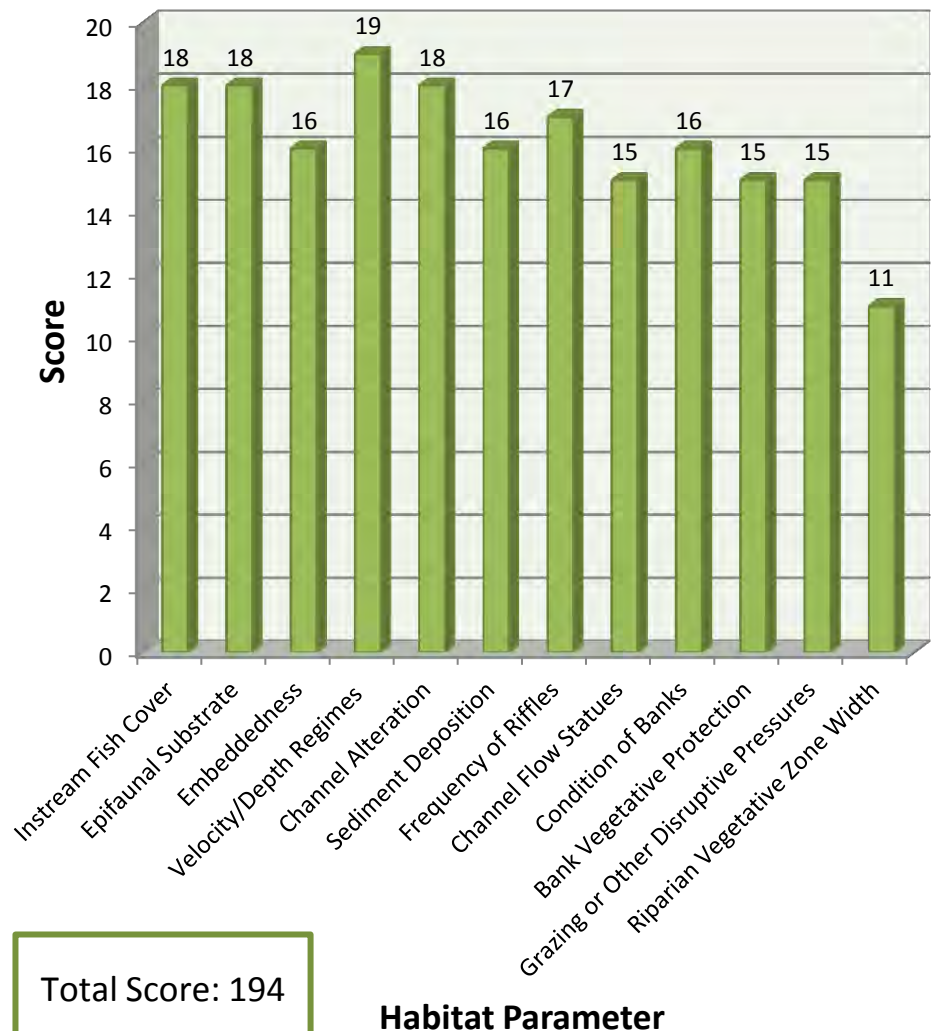
## Site # 26

Site ID	POCOCR25	
Stream	Pocono Creek	
Date	5/5/2015	
Time	10:40	
Lat/Long DD	40°59'11.9" N	75°12'25.0" W
Lat/Long DMS	40.98663889	-75.20694444
Municipality	Stroudsburg Borough	
Location	50 yds below Big Meadow Run	

### Field Measurements

Temp C°	16.17
pH	7.72
Press. inHg	29.98
D.O. %	108.4
D.O. mg/L	10.66
Conductivity [μS/cm]	366

### Habitat Assessment for POCOCR25#26



## Lab Chemistry Analysis

Total Organic Carbon (TOC)	1.990	mg/L
Aluminum, Total	<0.0200	mg/L
Calcium, Total	19	mg/L
Iron, Total	<0.100	mg/L
Magnesium, Total	3.910	mg/L
Harness	63.5	mg CaCO <sub>3</sub> /L
Chloride	70	mg/L
pH	6.88	pH Units
Nitrogen, Total as N (Calc)	0.865	mg/L
Ammonia as N	0.056	mg/L
Total Kjeldahl Nitrogen (TKN)	0.517	mg/L
Nitrate-Nitrate as N	0.3480	mg/L
Alkalinity to pH 4.5	26.00	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	191.0	mg/L
Phosphorus - Total as P	<0.0500	mg/L
Biochemical Oxygen Demand	<3.00	mg/L

ORDER	
AMPHIPODA (shrimp)	
BIVALVIA (clams)	
COLEOPTERA (beetles)	20
DECAPODA (crayfish)	
DIPTERA (true flies)	66
EPHEMEROPTERA (mayflies)	87
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	
ODONATA (dragon flies)	2
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	5
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	29
<b>TOTAL</b>	<b>209</b>

METRICS	
Total Taxa Richness	27
Shannon Diversity Index	2.50
EPT Taxa Richness	19
Hilsenhoff Biotic Index	4.15
Percent Intolerant Individuals	26%
Modified Beck's Index	21
<b>Index of Biotic Integrity</b>	<b>71.2</b>

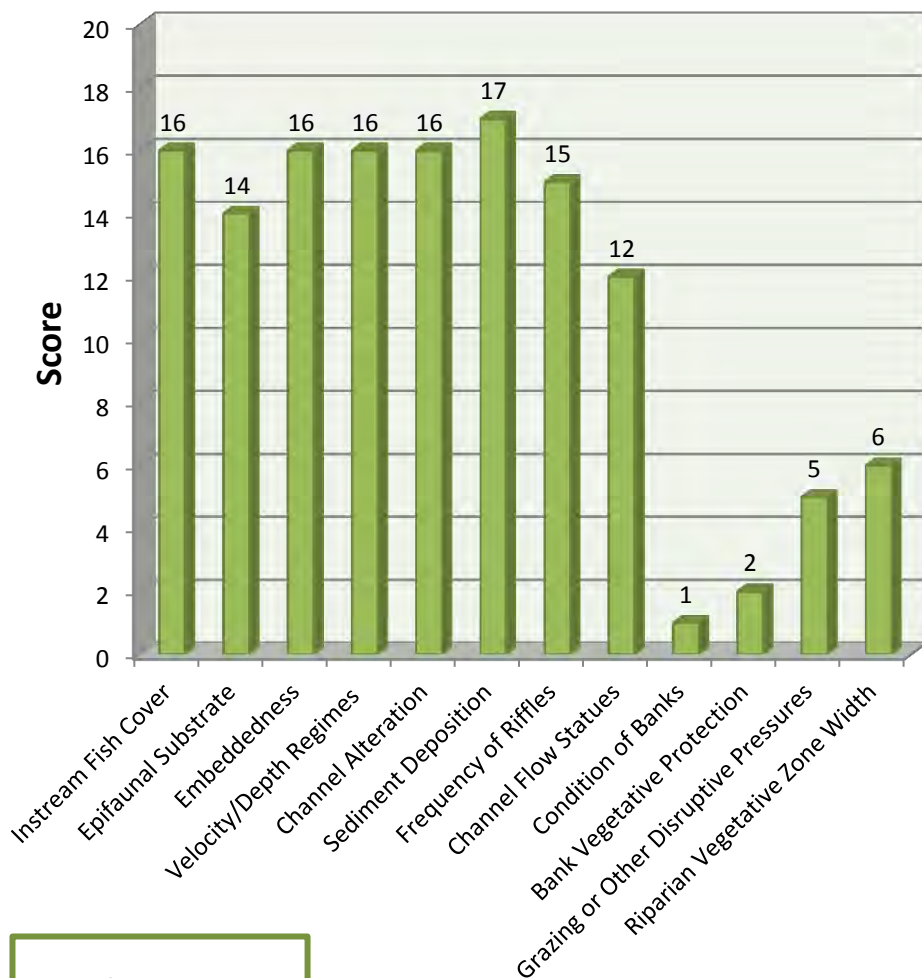
## Site # 27

Site ID	POCOCR26	
Stream	Pocono Creek	
Date	5/5/2015	
Time	11:06	
Lat/Long DD	40°59'10.8" N	75°12'14.9" W
Lat/Long DMS	40.98633333	-75.20413889
Municipality	Stroudsburg Borough	
Location	Below pipes that come in across from Stroudsburg High School	

### Field Measurements

Temp C°	16.52
pH	8.12
Press. inHg	30.03
D.O. %	107.7
D.O. mg/L	10.54
Conductivity [μS/cm]	367

### Habitat Assessment for POCOCR26#27



Total Score: 136

Habitat Parameter

## Lab Chemistry Analysis

Total Organic Carbon (TOC)	N/A	mg/L
Aluminum, Total	N/A	mg/L
Calcium, Total	N/A	mg/L
Iron, Total	N/A	mg/L
Magnesium, Total	N/A	mg/L
Harness	N/A	mg CaCO <sub>3</sub> /L
Chloride	N/A	mg/L
pH	N/A	pH Units
Nitrogen, Total as N (Calc)	N/A	mg/L
Ammonia as N	N/A	mg/L
Total Kjeldahl Nitrogen (TKN)	N/A	mg/L
Nitrate-Nitrate as N	N/A	mg/L
Alkalinity to pH 4.5	N/A	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	N/A	mg/L
Phosphorus - Total as P	N/A	mg/L
Biochemical Oxygen Demand	N/A	mg/L

ORDER	
AMPHIPODA (shrimp)	
BIVALVIA (clams)	
COLEOPTERA (beetles)	67
DECAPODA (crayfish)	
DIPTERA (true flies)	43
EPHEMEROPTERA (mayflies)	68
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	
ODONATA (dragon flies)	
OLIGOCHAETA (worms)	1
PLECOPTERA (stoneflies)	4
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	31
<b>TOTAL</b>	<b>214</b>

METRICS	
Total Taxa Richness	26
Shannon Diversity Index	2.4
EPT Taxa Richness	15
Hilsenhoff Biotic Index	4.07
Percent Intolerant Individuals	21%
Modified Beck's Index	22
<b>Index of Biotic Integrity</b>	<b>66.1</b>

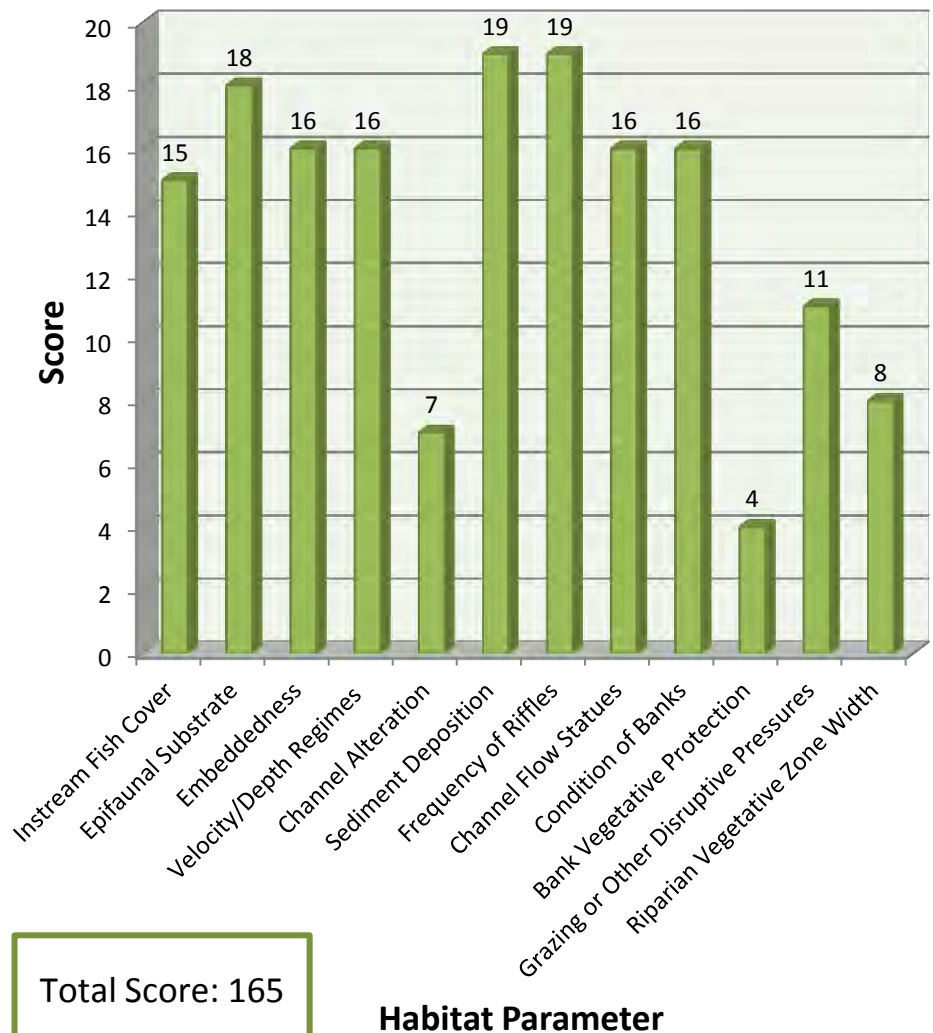
## Site # 28

Site ID	POCOCR27	
Stream	Pocono Creek	
Date	4/28/2015	
Time	12:20	
Lat/Long DD	41°03'06.9" N	75°20'20.2" W
Lat/Long DMS	41.05191667	-75.33894444
Municipality	Pocono Township	
Location	Just above confluence with Coolmoor Creek	

### Field Measurements

Temp C°	10.62
pH	7.17
Press. inHg	28.68
D.O. %	106.4
D.O. mg/L	11.33
Conductivity [μS/cm]	223

### Habitat Assessment for POCOCR27#28



## Lab Chemistry Analysis

Total Organic Carbon (TOC)	1.630	mg/L
Aluminum, Total	0.0279	mg/L
Calcium, Total	7.65	mg/L
Iron, Total	<0.100	mg/L
Magnesium, Total	1.870	mg/L
Harness	26.8	mg CaCO <sub>3</sub> /L
Chloride	44.7	mg/L
pH	6.67	pH Units
Nitrogen, Total as N (Calc)	1.240	mg/L
Ammonia as N	<0.0500	mg/L
Total Kjeldahl Nitrogen (TKN)	<0.500	mg/L
Nitrate-Nitrate as N	1.2400	mg/L
Alkalinity to pH 4.5	10.50	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	124.0	mg/L
Phosphorus - Total as P	0.106	mg/L
Biochemical Oxygen Demand	<3.00	mg/L

ORDER	
AMPHIPODA (shrimp)	
BIVALVIA (clams)	
COLEOPTERA (beetles)	
DECAPODA (crayfish)	
DIPTERA (true flies)	38
EPHEMEROPTERA (mayflies)	95
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	2
ODONATA (dragon flies)	
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	42
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	34
<b>TOTAL</b>	<b>211</b>

METRICS	
Total Taxa Richness	19
Shannon Diversity Index	2.16
EPT Taxa Richness	15
Hilsenhoff Biotic Index	2.74
Percent Intolerant Individuals	65%
Modified Beck's Index	25
<b>Index of Biotic Integrity</b>	<b>74.0</b>



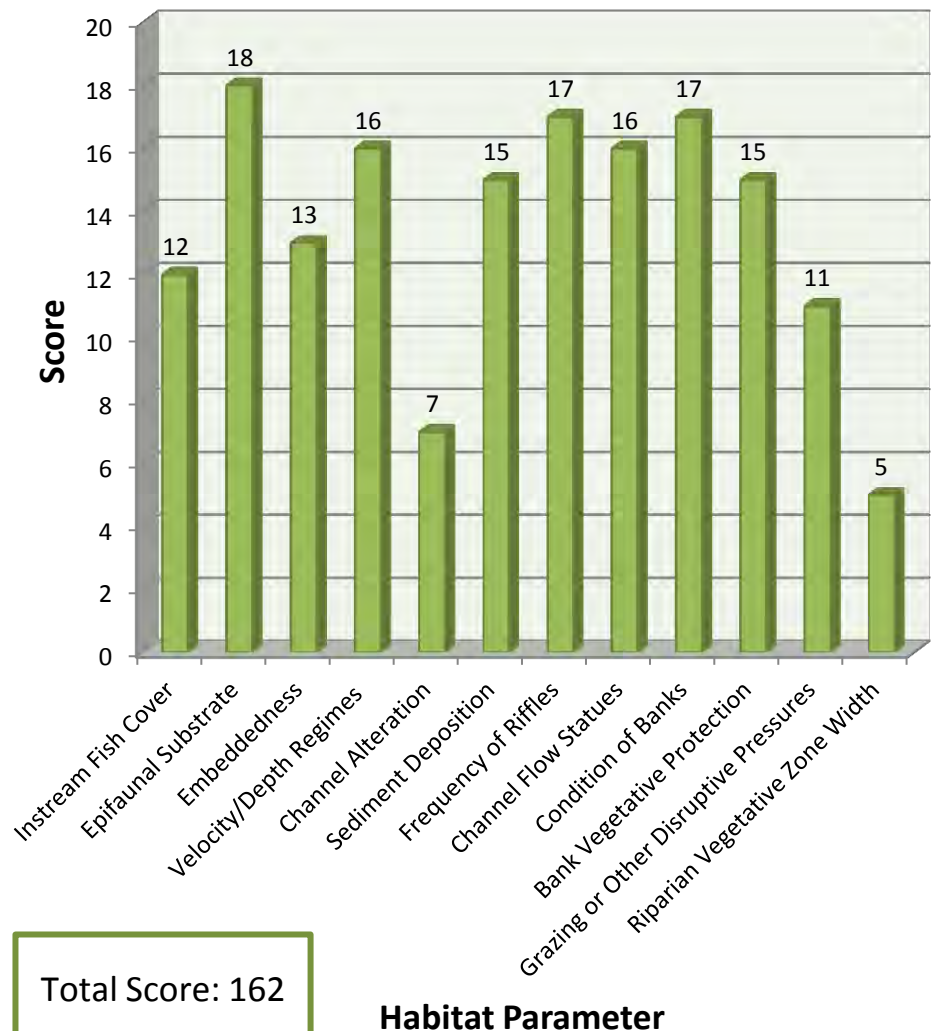
## Site # 29

Site ID	POHOCR02	
Stream	Pohopoco Creek	
Date	5/4/2015	
Time	12:19	
Lat/Long DD	40°54'56.9" N	75°26'05.9" W
Lat/Long DMS	40.91580556	-75.43497222
Municipality	Polk Township	
Location	50 yards U/S of US 209 near Beechwood Café	

### Field Measurements

Temp C°	15.78
pH	8.83
Press. inHg	29.55
D.O. %	116.9
D.O. mg/L	11.43
Conductivity [μS/cm]	166

### HabitatAssessment for POHOCR02#29





## Lab Chemistry Analysis

Total Organic Carbon (TOC)	N/A	mg/L
Aluminum, Total	N/A	mg/L
Calcium, Total	N/A	mg/L
Iron, Total	N/A	mg/L
Magnesium, Total	N/A	mg/L
Harness	N/A	mg CaCO <sub>3</sub> /L
Chloride	N/A	mg/L
pH	N/A	pH Units
Nitrogen, Total as N (Calc)	N/A	mg/L
Ammonia as N	N/A	mg/L
Total Kjeldahl Nitrogen (TKN)	N/A	mg/L
Nitrate-Nitrate as N	N/A	mg/L
Alkalinity to pH 4.5	N/A	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	N/A	mg/L
Phosphorus - Total as P	N/A	mg/L
Biochemical Oxygen Demand	N/A	mg/L

ORDER	
AMPHIPODA (shrimp)	
BIVALVIA (clams)	
COLEOPTERA (beetles)	32
DECAPODA (crayfish)	
DIPTERA (true flies)	49
EPHEMEROPTERA (mayflies)	58
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	
ODONATA (dragon flies)	
OLIGOCHAETA (worms)	9
PLECOPTERA (stoneflies)	8
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	61
<b>TOTAL</b>	<b>217</b>

METRICS	
Total Taxa Richness	24
Shannon Diversity Index	2.76
EPT Taxa Richness	16
Hilsenhoff Biotic Index	4.39
Percent Intolerant Individuals	27%
Modified Beck's Index	15
<b>Index of Biotic Integrity</b>	<b>65.7</b>

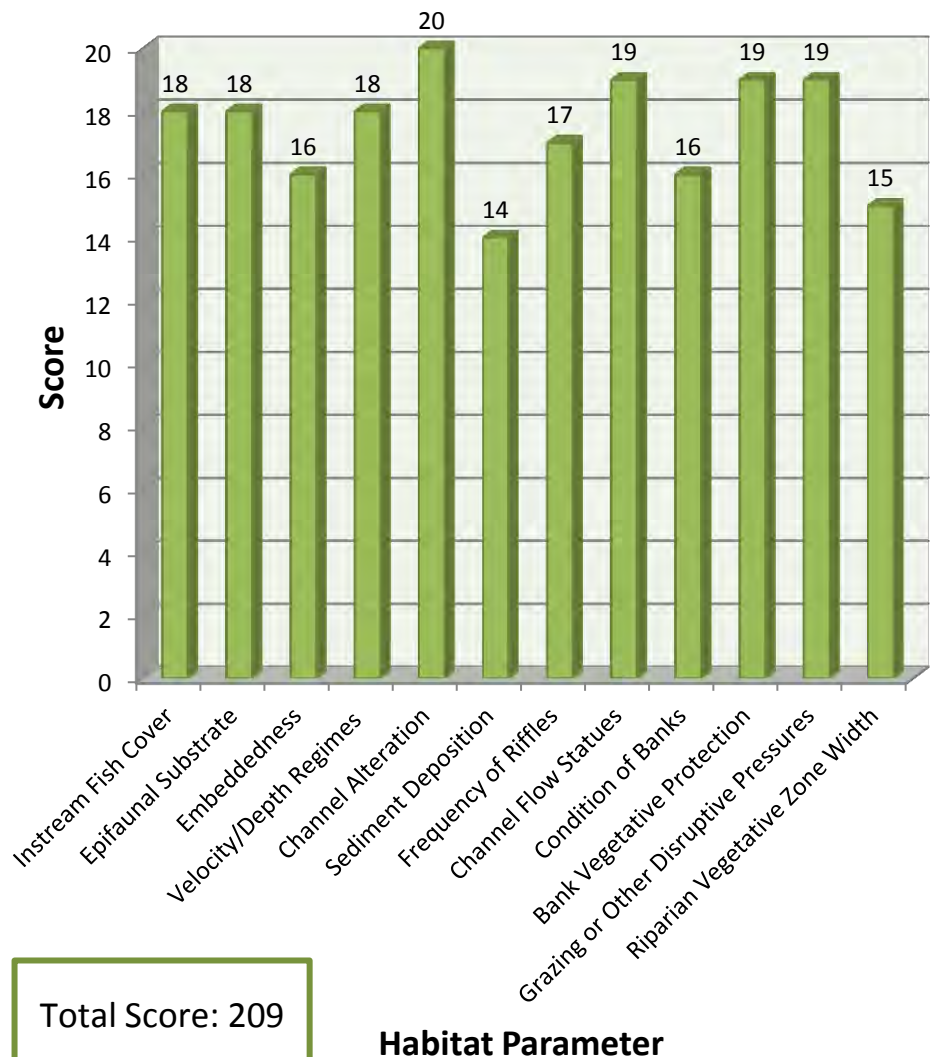
## Site # 30

Site ID	POHOCR06	
Stream	Pohopoco Creek	
Date	5/4/2015	
Time	08:04	
Lat/Long DD	40°53'58.8" N	75°30'23.4" W
Lat/Long DMS	40.89966667	-75.50650000
Municipality	Polk Township	
Location	Whitey B. Drive where stream bends to west and parallels road	

### Field Measurements

Temp C°	11.80
pH	6.96
Press. inHg	29.48
D.O. %	100.2
D.O. mg/L	10.68
Conductivity [μS/cm]	144

### HabitatAssessment for POHOCR06#30



## Lab Chemistry Analysis

Total Organic Carbon (TOC)	N/A	mg/L
Aluminum, Total	N/A	mg/L
Calcium, Total	N/A	mg/L
Iron, Total	N/A	mg/L
Magnesium, Total	N/A	mg/L
Harness	N/A	mg CaCO <sub>3</sub> /L
Chloride	N/A	mg/L
pH	N/A	pH Units
Nitrogen, Total as N (Calc)	N/A	mg/L
Ammonia as N	N/A	mg/L
Total Kjeldahl Nitrogen (TKN)	N/A	mg/L
Nitrate-Nitrate as N	N/A	mg/L
Alkalinity to pH 4.5	N/A	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	N/A	mg/L
Phosphorus - Total as P	N/A	mg/L
Biochemical Oxygen Demand	N/A	mg/L

ORDER	
AMPHIPODA (shrimp)	1
BIVALVIA(clams)	
COLEOPTERA (beetles)	32
DECAPODA (crayfish)	1
DIPTERA (true flies)	40
EPHEMEROPTERA (mayflies)	85
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	1
MEGALOPTERA (hellgramites)	
ODONATA (dragon flies)	
OLIGOCHAETA (worms)	6
PLECOPTERA (stoneflies)	6
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	35
<b>TOTAL</b>	<b>207</b>

METRICS	
Total Taxa Richness	32
Shannon Diversity Index	2.65
EPT Taxa Richness	19
Hilsenhoff Biotic Index	3.50
Percent Intolerant Individuals	53%
Modified Beck's Index	19
<b>Index of Biotic Integrity</b>	<b>80.4</b>

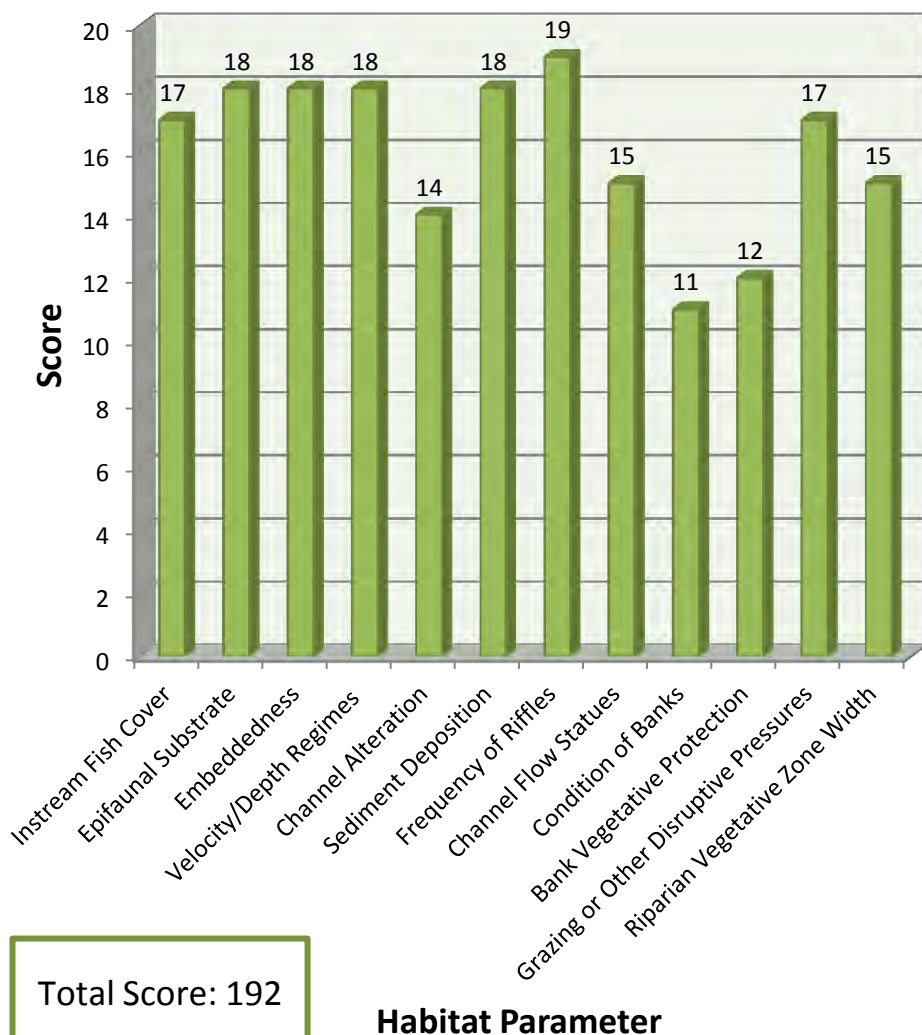
## Site # 31

Site ID	SWIFCR09	
Stream	Swiftwater Creek	
Date	4/28/2015	
Time	08:27	
Lat/Long DD	41°05'44.1" N	75°23'44.3" W
Lat/Long DMS	41.09558333	-75.39563889
Municipality	Tobyhanna Township	
Location	Just below culvert pipes under 380 upstream of Kalahari	

### Field Measurements

Temp C°	7.38
pH	6.86
Press. inHg	27.74
D.O. %	105.9
D.O. mg/L	11.77
Conductivity [μS/cm]	532

### Habitat Assessment for SWIFCR09#31



## Lab Chemistry Analysis

Total Organic Carbon (TOC)	1.770	mg/L
Aluminum, Total	0.1160	mg/L
Calcium, Total	9.87	mg/L
Iron, Total	<0.0500	mg/L
Magnesium, Total	2.380	mg/L
Harness	34.5	mg CaCO <sub>3</sub> /L
Chloride	133	mg/L
pH	6.75	pH Units
Nitrogen, Total as N (Calc)	0.709	mg/L
Ammonia as N	<0.0500	mg/L
Total Kjeldahl Nitrogen (TKN)	<0.500	mg/L
Nitrate-Nitrate as N	0.7090	mg/L
Alkalinity to pH 4.5	5.00	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	259.0	mg/L
Phosphorus - Total as P	<0.0500	mg/L
Biochemical Oxygen Demand	<3.00	mg/L

ORDER	
AMPHIPODA (shrimp)	
BIVALVIA (clams)	
COLEOPTERA (beetles)	2
DECAPODA (crayfish)	
DIPTERA (true flies)	17
EPHEMEROPTERA (mayflies)	8
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	1
ODONATA (dragon flies)	1
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	24
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	27
TOTAL	80

METRICS	
Total Taxa Richness	18
Shannon Diversity Index	2.49
EPT Taxa Richness	11
Hilsenhoff Biotic Index	2.53
Percent Intolerant Individuals	64%
Modified Beck's Index	16
<b>Index of Biotic Integrity</b>	<b>68.2</b>

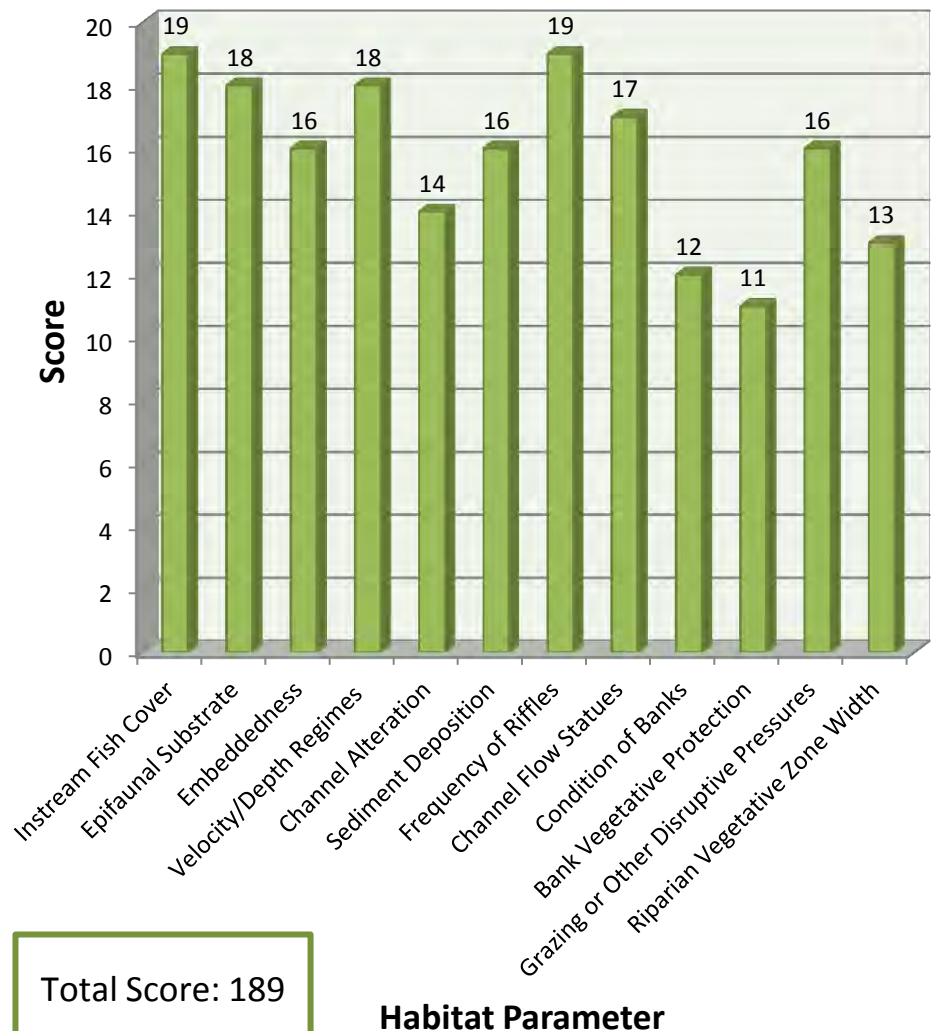
## Site # 32

Site ID	SWIFTCR10	
Stream	Swiftwater Creek	
Date	4/28/2015	
Time	9:57	
Lat/Long DD	41°06'03.4" N	75°20'46.6" W
Lat/Long DMS	41.10094444	-75.34627778
Municipality	Pocono Township	
Location	Immediately D/S of Route 314, west of Route 611	

### Field Measurements

Temp C°	8.00
pH	7.13
Press. inHg	28.27
D.O. %	108.9
D.O. mg/L	12.17
Conductivity [μS/cm]	176

### Habitat Assessment for SWIFCR10#32



## Lab Chemistry Analysis

Total Organic Carbon (TOC)	0.776	mg/L
Aluminum, Total	0.0231	mg/L
Calcium, Total	5.23	mg/L
Iron, Total	<0.100	mg/L
Magnesium, Total	1.560	mg/L
Harness	19.5	mg CaCO <sub>3</sub> /L
Chloride	34.8	mg/L
pH	6.60	pH Units
Nitrogen, Total as N (Calc)	<0.500	mg/L
Ammonia as N	<0.0500	mg/L
Total Kjeldahl Nitrogen (TKN)	<0.500	mg/L
Nitrate-Nitrate as N	0.4550	mg/L
Alkalinity to pH 4.5	6.75	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	91.0	mg/L
Phosphorus - Total as P	<0.0500	mg/L
Biochemical Oxygen Demand	0.900	mg/L

ORDER	
AMPHIPODA (shrimp)	
BIVALVIA (clams)	
COLEOPTERA (beetles)	5
DECAPODA (crayfish)	
DIPTERA (true flies)	54
EPHEMEROPTERA (mayflies)	71
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	
ODONATA (dragon flies)	
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	13
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	62
<b>TOTAL</b>	<b>205</b>

METRICS	
Total Taxa Richness	24
Shannon Diversity Index	2.33
EPT Taxa Richness	17
Hilsenhoff Biotic Index	3.44
Percent Intolerant Individuals	48%
Modified Beck's Index	28
<b>Index of Biotic Integrity</b>	<b>75.8</b>



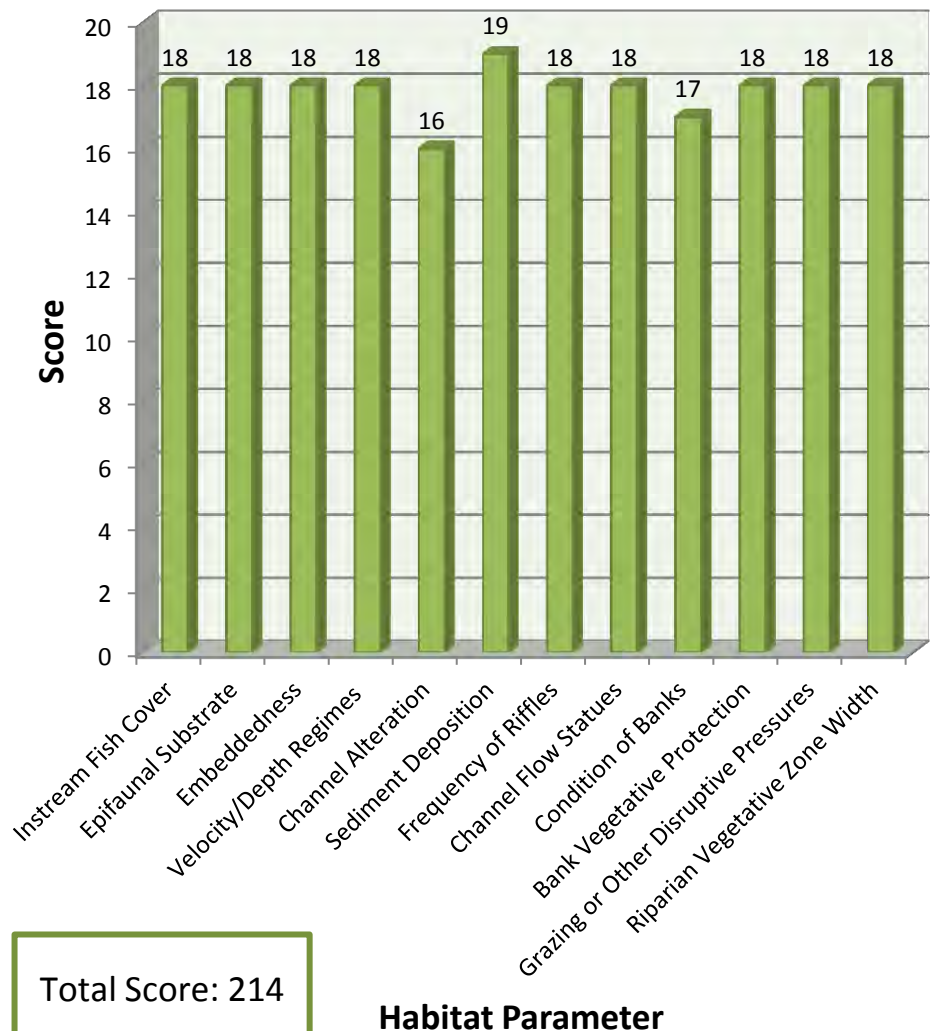
## Site # 33

Site ID	TOBYCR01	
Stream	Tobyhanna Creek	
Date	4/27/2015	
Time	12:37	
Lat/Long DD	41°09'44.8" N	75°27'22.3" W
Lat/Long DMS	41.16244444	-75.45619444
Municipality	Coolbaugh Township	
Location	Approximately 75 yards D/S of Rt 423 bridge at east boundary of Warnertown and SGL 127	

### Field Measurements

Temp C°	9.42
pH	7.04
Press. inHg	27.60
D.O. %	103.4
D.O. mg/L	10.90
Conductivity [μS/cm]	164

### Habitat Assessment for TOBYCR01#33





## Lab Chemistry Analysis

Total Organic Carbon (TOC)	N/A	mg/L
Aluminum, Total	N/A	mg/L
Calcium, Total	N/A	mg/L
Iron, Total	N/A	mg/L
Magnesium, Total	N/A	mg/L
Harness	N/A	mg CaCO <sub>3</sub> /L
Chloride	N/A	mg/L
pH	N/A	pH Units
Nitrogen, Total as N (Calc)	N/A	mg/L
Ammonia as N	N/A	mg/L
Total Kjeldahl Nitrogen (TKN)	N/A	mg/L
Nitrate-Nitrate as N	N/A	mg/L
Alkalinity to pH 4.5	N/A	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	N/A	mg/L
Phosphorus - Total as P	N/A	mg/L
Biochemical Oxygen Demand	N/A	mg/L

ORDER	
AMPHIPODA (shrimp)	
BIVALVIA (clams)	
COLEOPTERA (beetles)	12
DECAPODA (crayfish)	
DIPTERA (true flies)	40
EPHEMEROPTERA (mayflies)	52
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	2
MEGALOPTERA (hellgramites)	
ODONATA (dragon flies)	12
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	6
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	29
TOTAL	153

METRICS	
Total Taxa Richness	27
Shannon Diversity Index	2.70
EPT Taxa Richness	14
Hilsenhoff Biotic Index	3.74
Percent Intolerant Individuals	46%
Modified Beck's Index	18
Index of Biotic Integrity	85.6

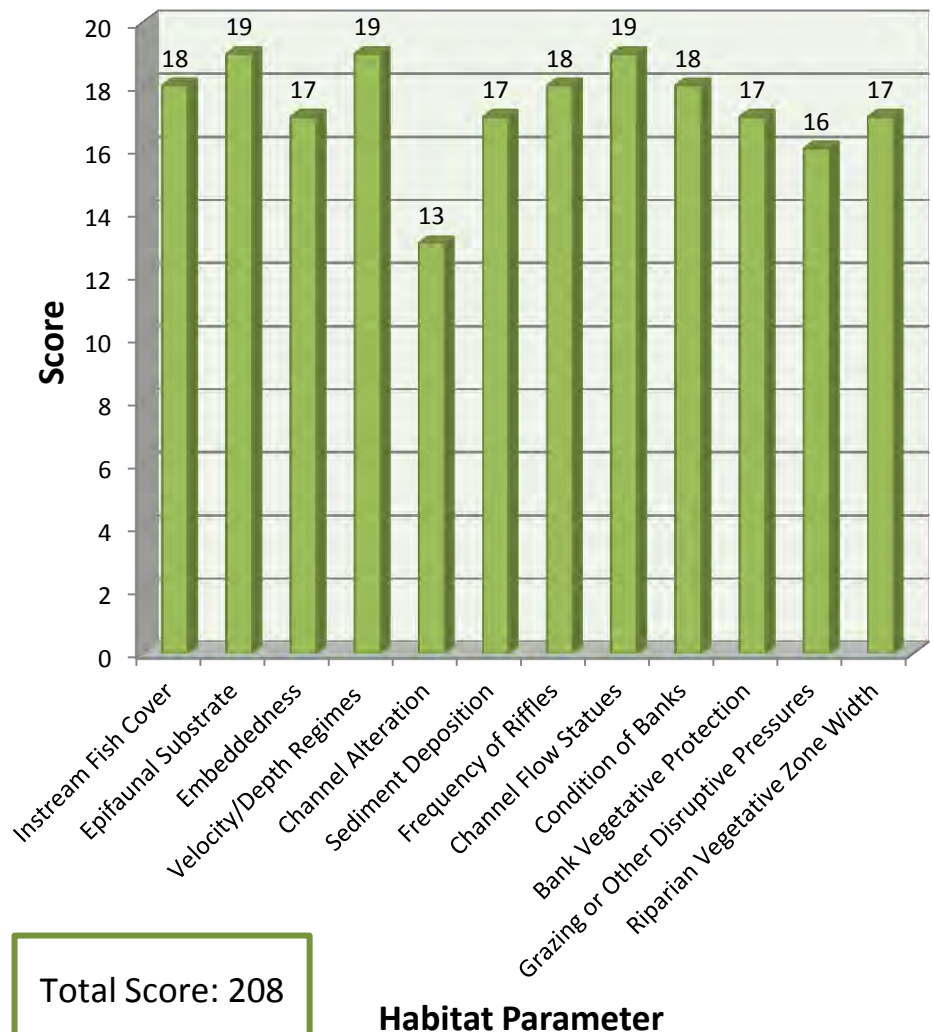
## Site # 34

Site ID	TOBYCR14	
Stream	Tobyhanna Creek	
Date	4/27/2015	
Time	10:08	
Lat/Long DD	41°04'58.9" N	75°35'00.2" W
Lat/Long DMS	41.08302778	-75.58338889
Municipality	Tobyhanna Township	
Location	Immediately U/S of the Route 115 bridge, downstream of the STP	

### Field Measurements

Temp C°	9.46
pH	6.63
Press. inHg	27.81
D.O. %	107.5
D.O. mg/L	11.40
Conductivity [μS/cm]	165

### Habitat Assessment for TOBYCR14#34



## Lab Chemistry Analysis

Total Organic Carbon (TOC)	5.320	mg/L
Aluminum, Total	0.1080	mg/L
Calcium, Total	N/A	mg/L
Iron, Total	<0.100	mg/L
Magnesium, Total	N/A	mg/L
Harness	N/A	mg CaCO <sub>3</sub> /L
Chloride	33.9	mg/L
pH	6.93	pH Units
Nitrogen, Total as N (Calc)	<0.500	mg/L
Ammonia as N	<0.0500	mg/L
Total Kjeldahl Nitrogen (TKN)	<0.500	mg/L
Nitrate-Nitrate as N	0.1110	mg/L
Alkalinity to pH 4.5	4.75	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	75.0	mg/L
Phosphorus - Total as P	<0.0500	mg/L
Biochemical Oxygen Demand	<2.00	mg/L

ORDER	
AMPHIPODA (shrimp)	
BIVALVIA (clams)	
COLEOPTERA (beetles)	1
DECAPODA (crayfish)	
DIPTERA (true flies)	94
EPHEMEROPTERA (mayflies)	69
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	1
ODONATA (dragon flies)	1
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	10
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	21
<b>TOTAL</b>	<b>197</b>

METRICS	
Total Taxa Richness	22
Shannon Diversity Index	2.14
EPT Taxa Richness	17
Hilsenhoff Biotic Index	3.11
Percent Intolerant Individuals	62%
Modified Beck's Index	4
<b>Index of Biotic Integrity</b>	<b>76.0</b>

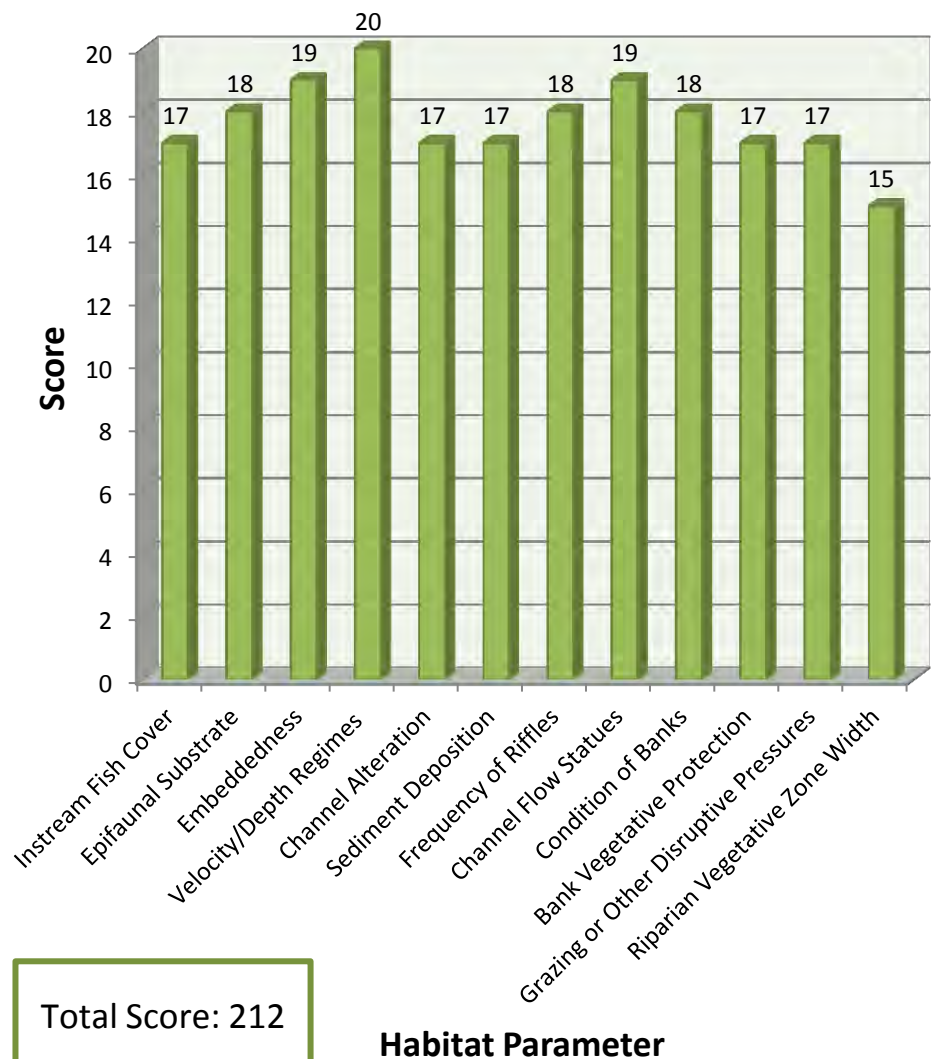
## Site # 35

Site ID	TUNKCR03	
Stream	Tunkhannock Creek	
Date	4/27/2015	
Time	09:23	
Lat/Long DD	41°03'31.7" N	75°33'11.2" W
Lat/Long DMS	41.05880556	-75.55311111
Municipality	Tunkhannock Township	
Location	100 yards U/S Rt. 115 near intersection with Rt. 903	

### Field Measurements

Temp C°	7.71
pH	5.35
Press. inHg	27.55
D.O. %	104.6
D.O. mg/L	11.47
Conductivity [μS/cm]	77

### Habitat Assessment for TUNKCR03#35



## Lab Chemistry Analysis

Total Organic Carbon (TOC)	N/A	mg/L
Aluminum, Total	N/A	mg/L
Calcium, Total	N/A	mg/L
Iron, Total	N/A	mg/L
Magnesium, Total	N/A	mg/L
Harness	N/A	mg CaCO <sub>3</sub> /L
Chloride	N/A	mg/L
pH	N/A	pH Units
Nitrogen, Total as N (Calc)	N/A	mg/L
Ammonia as N	N/A	mg/L
Total Kjeldahl Nitrogen (TKN)	N/A	mg/L
Nitrate-Nitrate as N	N/A	mg/L
Alkalinity to pH 4.5	N/A	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	N/A	mg/L
Phosphorus - Total as P	N/A	mg/L
Biochemical Oxygen Demand	N/A	mg/L

ORDER	
AMPHIPODA (shrimp)	
BIVALVIA (clams)	
COLEOPTERA (beetles)	10
DECAPODA (crayfish)	
DIPTERA (true flies)	101
EPHEMEROPTERA (mayflies)	35
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	7
ODONATA (dragon flies)	7
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	26
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	23
<b>TOTAL</b>	<b>209</b>

METRICS	
Total Taxa Richness	35
Shannon Diversity Index	2.36
EPT Taxa Richness	20
Hilsenhoff Biotic Index	4.06
Percent Intolerant Individuals	39%
Modified Beck's Index	33
<b>Index of Biotic Integrity</b>	<b>81.5</b>

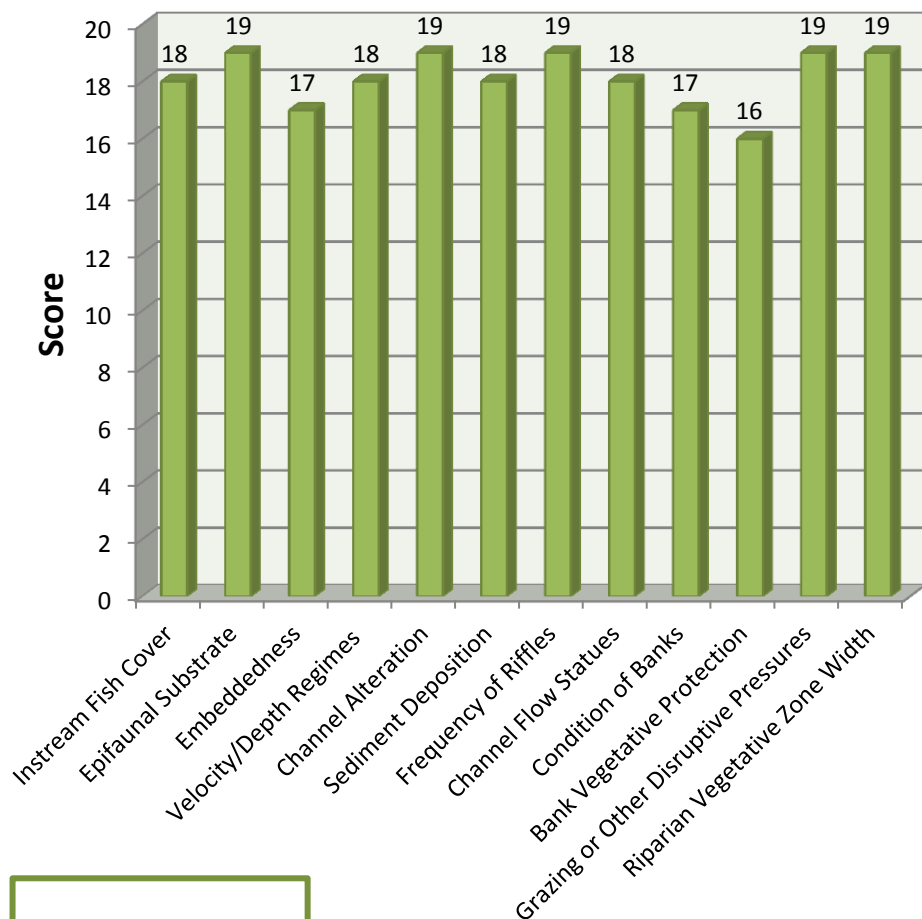
## Site # 36

Site ID	KEIPRN01	
Stream	Keiper Run	
Date	4/27/2015	
Time	08:02	
Lat/Long DD	41°03'01.9" N	75°31'57.0" W
Lat/Long DMS	41.05052778	-75.53250000
Municipality	Tunkhannock Township	
Location	Just U/S culvert pipes on Schochs Mill Rd. across 903 from Pocono Raceway in SGL	

### Field Measurements

Temp C°	6.05
pH	6.03
Press. inHg	27.48
D.O. %	129
D.O. mg/L	10.53
Conductivity [μS/cm]	129

### Habitat Assessment for KEIPRN01#36 Tunkhannock Creek Tributary



Total Score: 217

Habitat Parameter

## Lab Chemistry Analysis

Total Organic Carbon (TOC)	1.720	mg/L
Aluminum, Total	0.1090	mg/L
Calcium, Total	N/A	mg/L
Iron, Total	<0.100	mg/L
Magnesium, Total	N/A	mg/L
Harness	N/A	mg CaCO <sub>3</sub> /L
Chloride	23.7	mg/L
pH	6.94	pH Units
Nitrogen, Total as N (Calc)	<0.500	mg/L
Ammonia as N	<0.0500	mg/L
Total Kjeldahl Nitrogen (TKN)	<0.500	mg/L
Nitrate-Nitrate as N	0.2530	mg/L
Alkalinity to pH 4.5	<2.00	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	58.0	mg/L
Phosphorus - Total as P	<0.0500	mg/L
Biochemical Oxygen Demand	<2.00	mg/L

ORDER	
AMPHIPODA (shrimp)	
BIVALVIA (clams)	
COLEOPTERA (beetles)	3
DECAPODA (crayfish)	
DIPTERA (true flies)	67
EPHEMEROPTERA (mayflies)	75
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	
MEGALOPTERA (hellgramites)	
ODONATA (dragon flies)	
OLIGOCHAETA (worms)	
PLECOPTERA (stoneflies)	12
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	76
<b>TOTAL</b>	<b>233</b>

METRICS	
Total Taxa Richness	23
Shannon Diversity Index	2.23
EPT Taxa Richness	16
Hilsenhoff Biotic Index	1.81
Percent Intolerant Individuals	82%
Modified Beck's Index	29
<b>Index of Biotic Integrity</b>	<b>84.2</b>



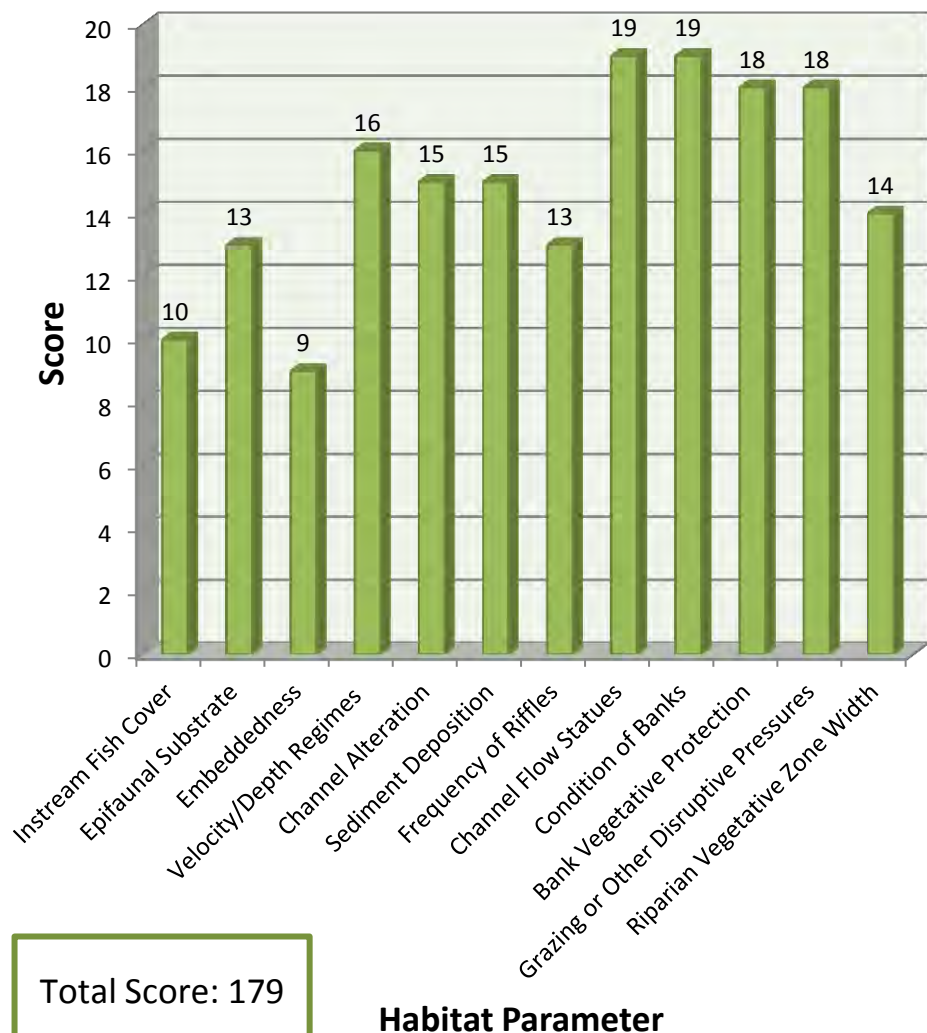
## Site # 37

Site ID	WEIRCR01	
Stream	Weir Creek	
Date	5/4/2015	
Time	11:27	
Lat/Long DD	40°54'28.6" N	75°25'51.1" W
Lat/Long DMS	40.90794444	-75.43086111
Municipality	Polk Township	
Location	Just D/S of County Park Rd.	

### Field Measurements

Temp C°	16.01
pH	6.33
Press. inHg	29.62
D.O. %	123.5
D.O. mg/L	12.05
Conductivity [μS/cm]	228

### HabitatAssessment for WEIRCR01 #37





## Lab Chemistry Analysis

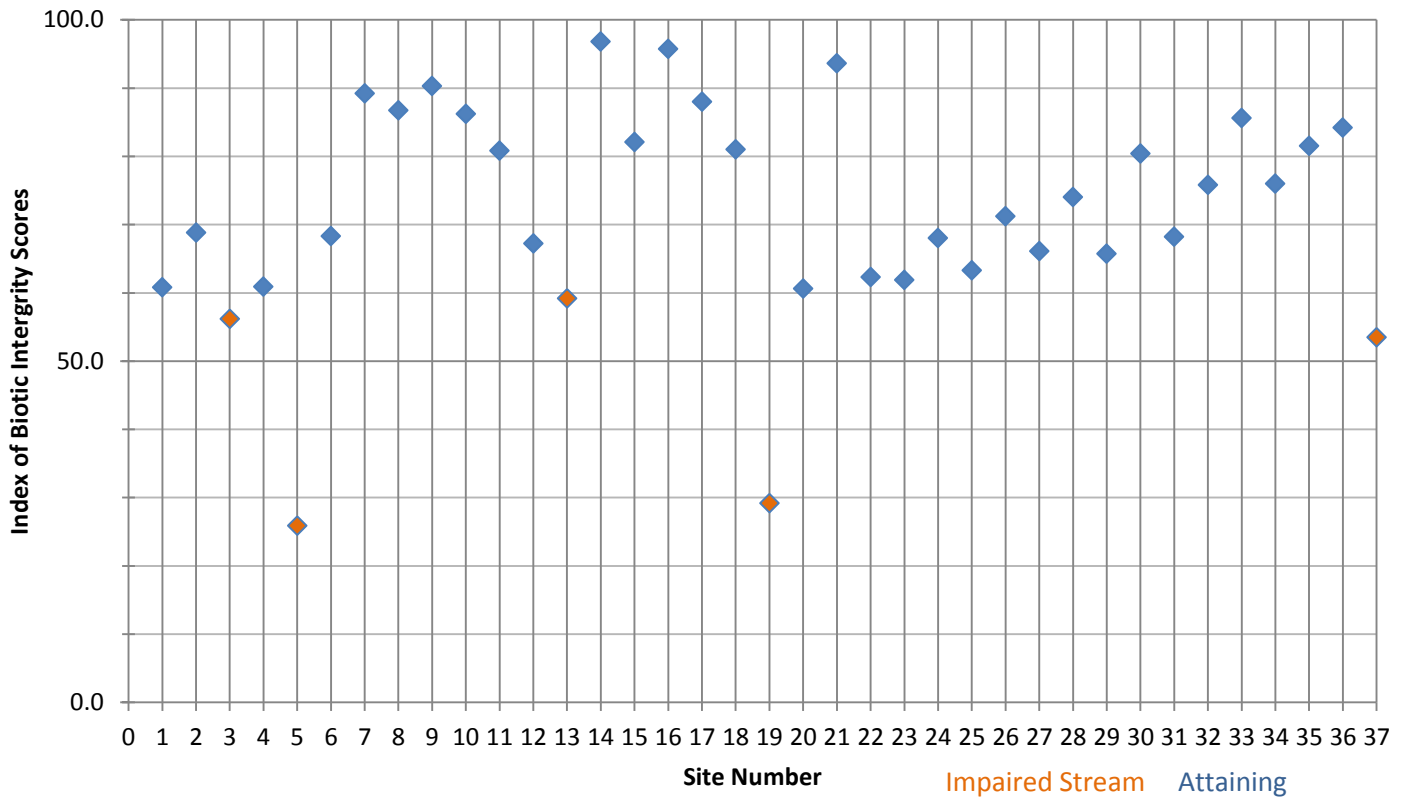
Total Organic Carbon (TOC)	N/A	mg/L
Aluminum, Total	N/A	mg/L
Calcium, Total	N/A	mg/L
Iron, Total	N/A	mg/L
Magnesium, Total	N/A	mg/L
Harness	N/A	mg CaCO <sub>3</sub> /L
Chloride	N/A	mg/L
pH	N/A	pH Units
Nitrogen, Total as N (Calc)	N/A	mg/L
Ammonia as N	N/A	mg/L
Total Kjeldahl Nitrogen (TKN)	N/A	mg/L
Nitrate-Nitrate as N	N/A	mg/L
Alkalinity to pH 4.5	N/A	mg CaCO <sub>3</sub> /L
Total Dissolved Solids (TDS)	N/A	mg/L
Phosphorus - Total as P	N/A	mg/L
Biochemical Oxygen Demand	N/A	mg/L

ORDER	
AMPHIPODA (shrimp)	3
BIVALVIA (clams)	
COLEOPTERA (beetles)	38
DECAPODA (crayfish)	
DIPTERA (true flies)	40
EPHEMEROPTERA (mayflies)	85
GASTROPODA (snails)	
HEMIPTERA (true bugs)	
HIRUDINEA (leeches)	
ISOPODA (scuds)	28
MEGALOPTERA (hellgramites)	2
ODONATA (dragon flies)	
OLIGOCHAETA (worms)	3
PLECOPTERA (stoneflies)	1
TURBELLARIA (flatworms)	
TRICHOPTERA (caddisflies)	16
<b>TOTAL</b>	<b>216</b>

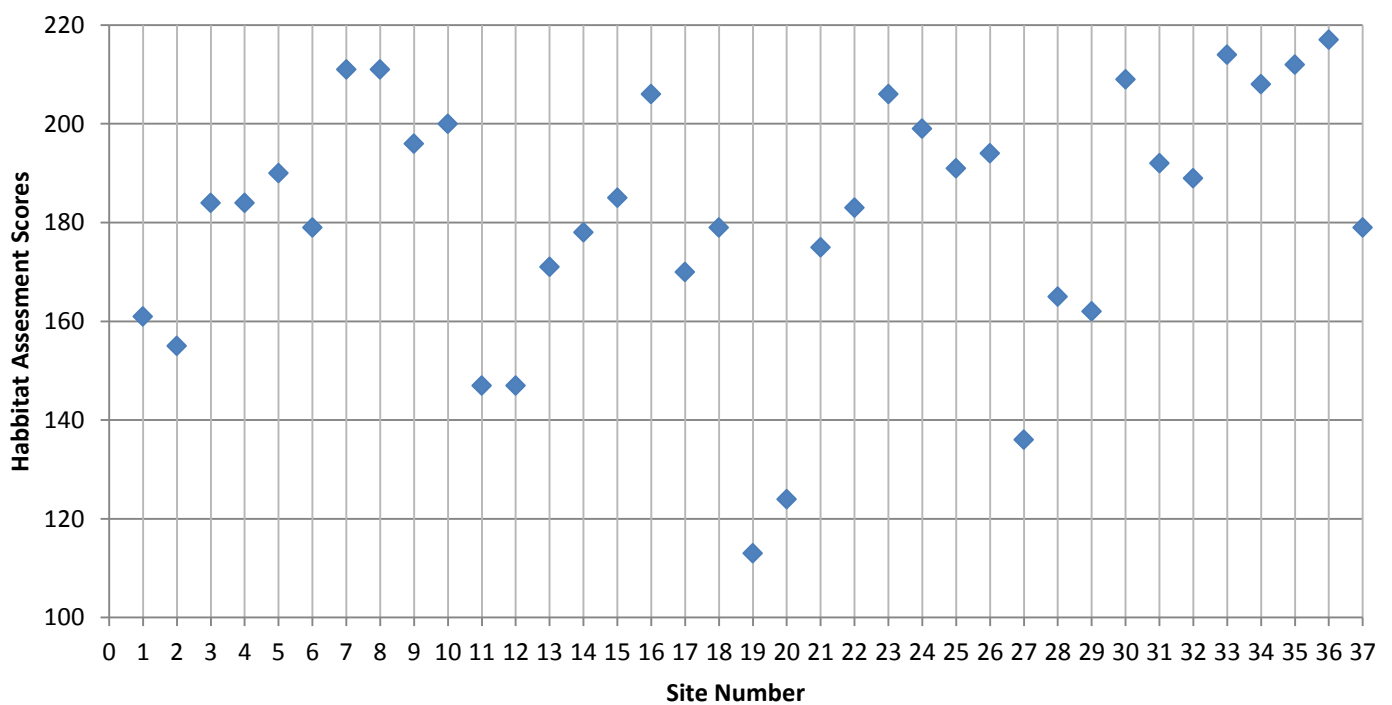
METRICS	
Total Taxa Richness	22
Shannon Diversity Index	2.40
EPT Taxa Richness	13
Hilsenhoff Biotic Index	4.44
Percent Intolerant Individuals	15%
Modified Beck's Index	6
<b>Index of Biotic Integrity</b>	<b>53.5</b>

# Data Graphs

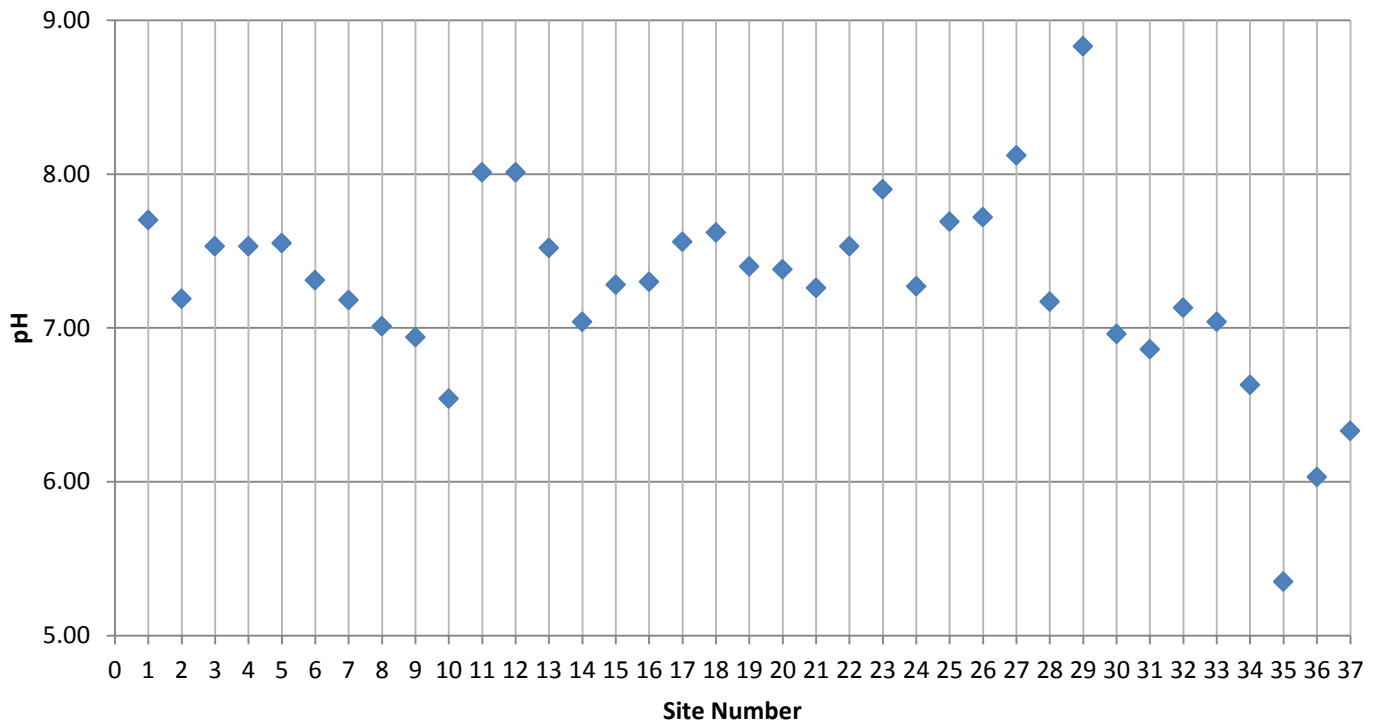
## Macroinvertebrate IBI Scores



## Habitat Assessment Scores

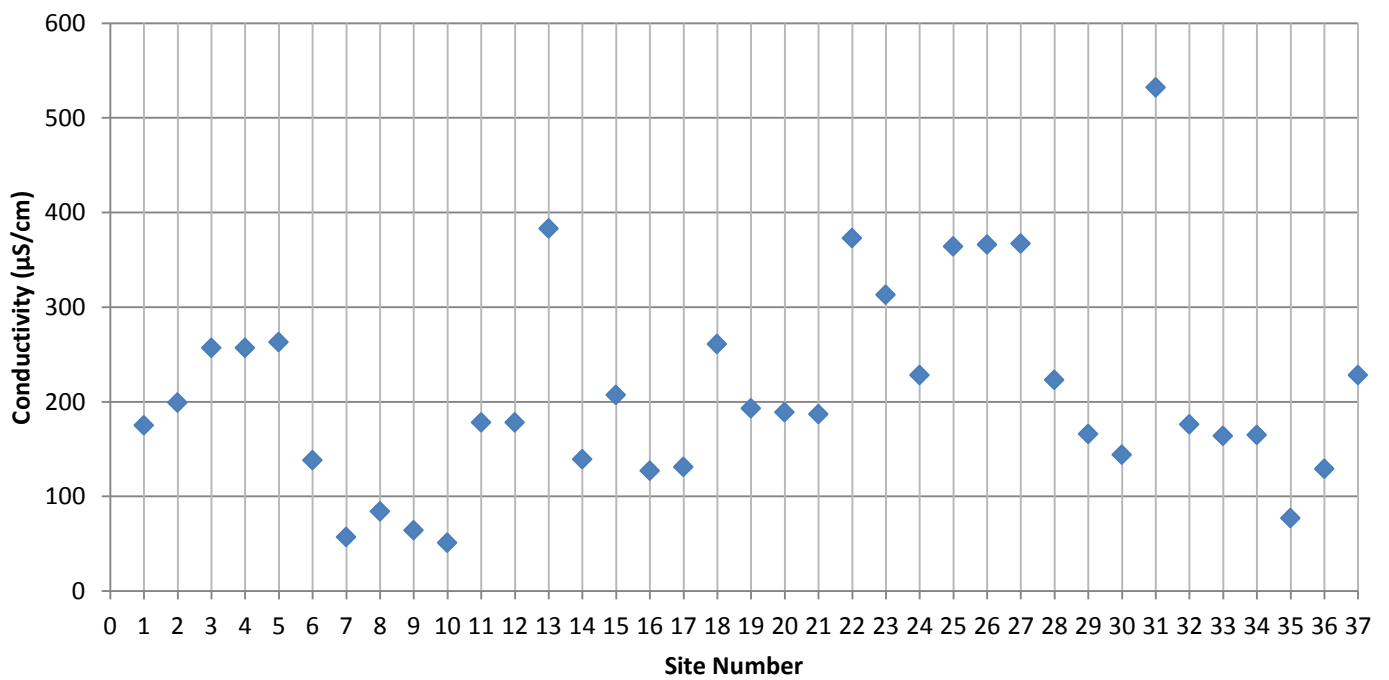


## pH

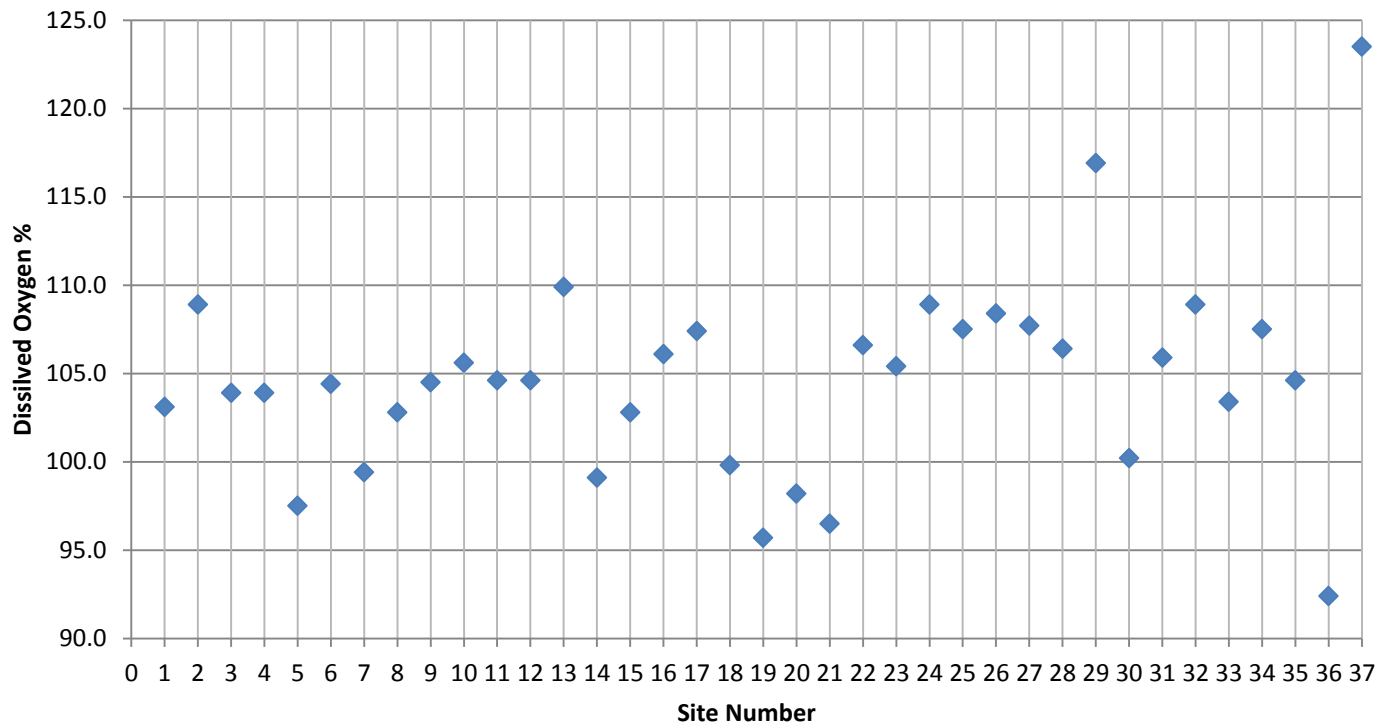


## Conductivity

Healthy streams measure below 500  $\mu\text{S}/\text{cm}$

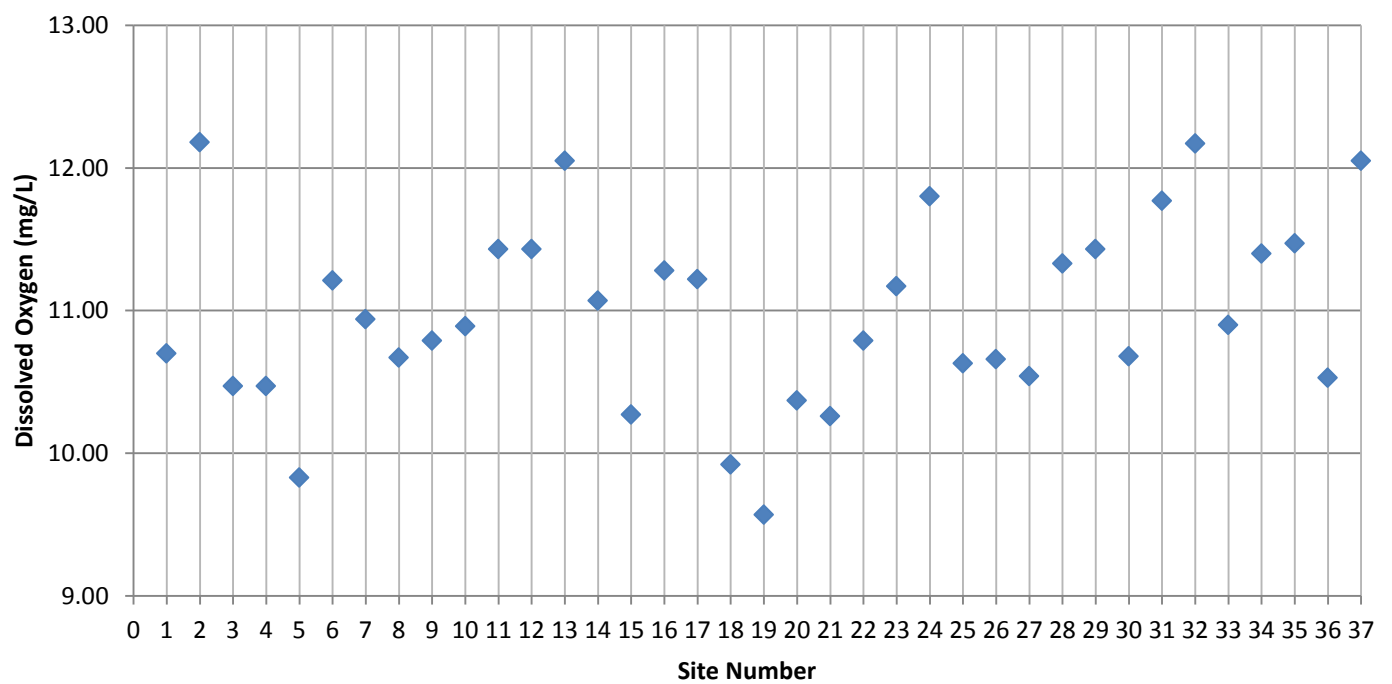


## Dissolved Oxygen %



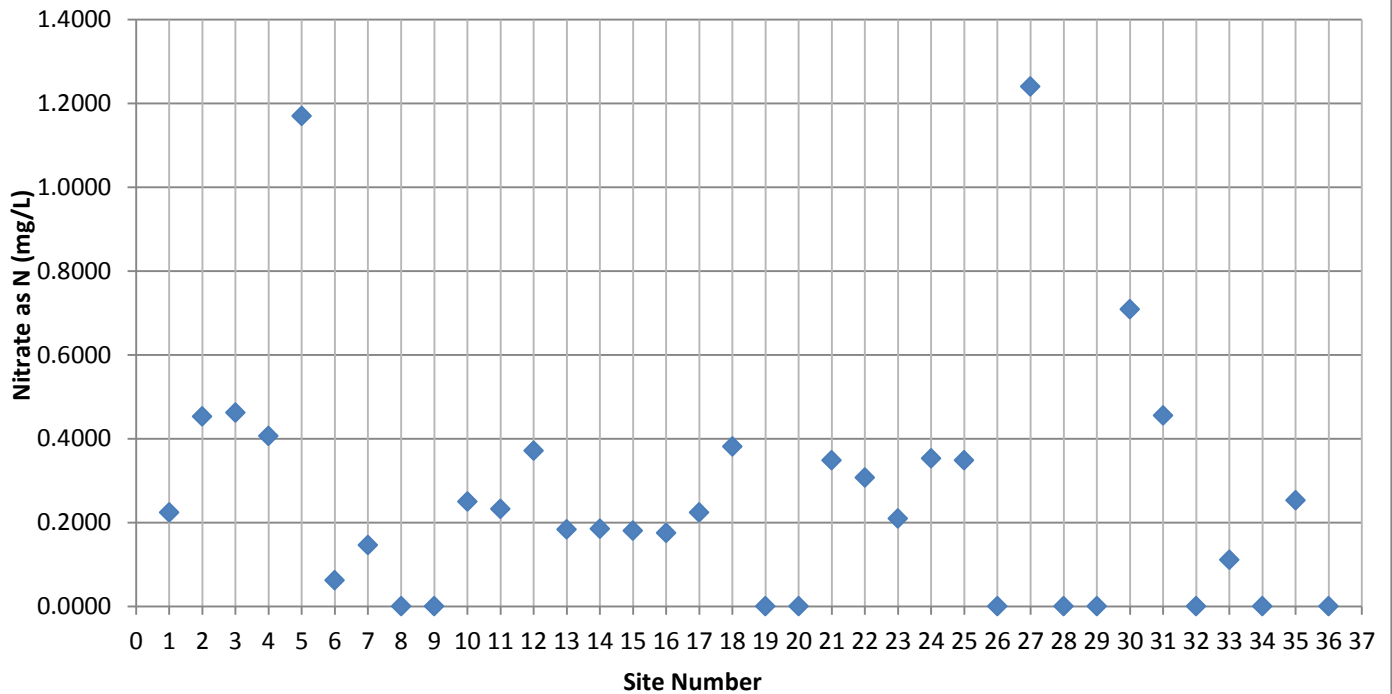
## Dissolved Oxygen mg/L

Greater than 5 mg/L is recommended for healthy streams

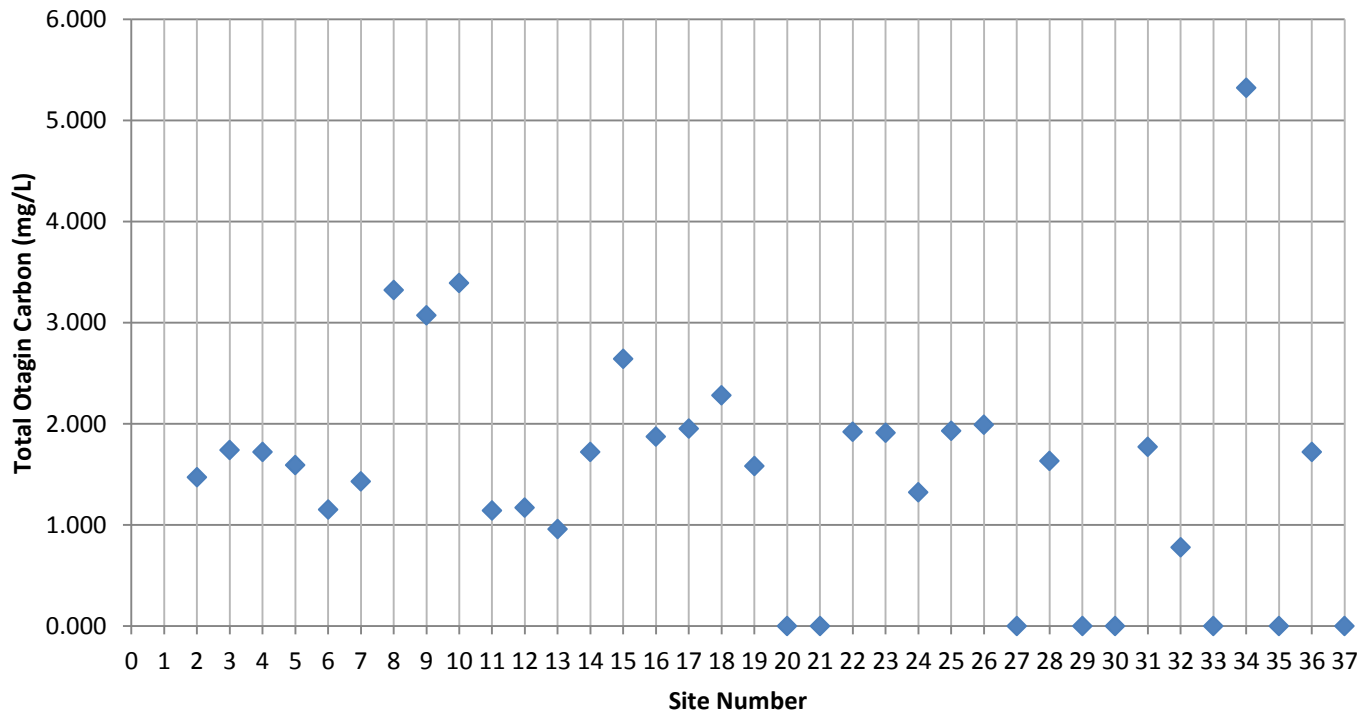


## Nitrate as N

Nitrate levels in freshwater are usually between 0.1 and 4mg/L

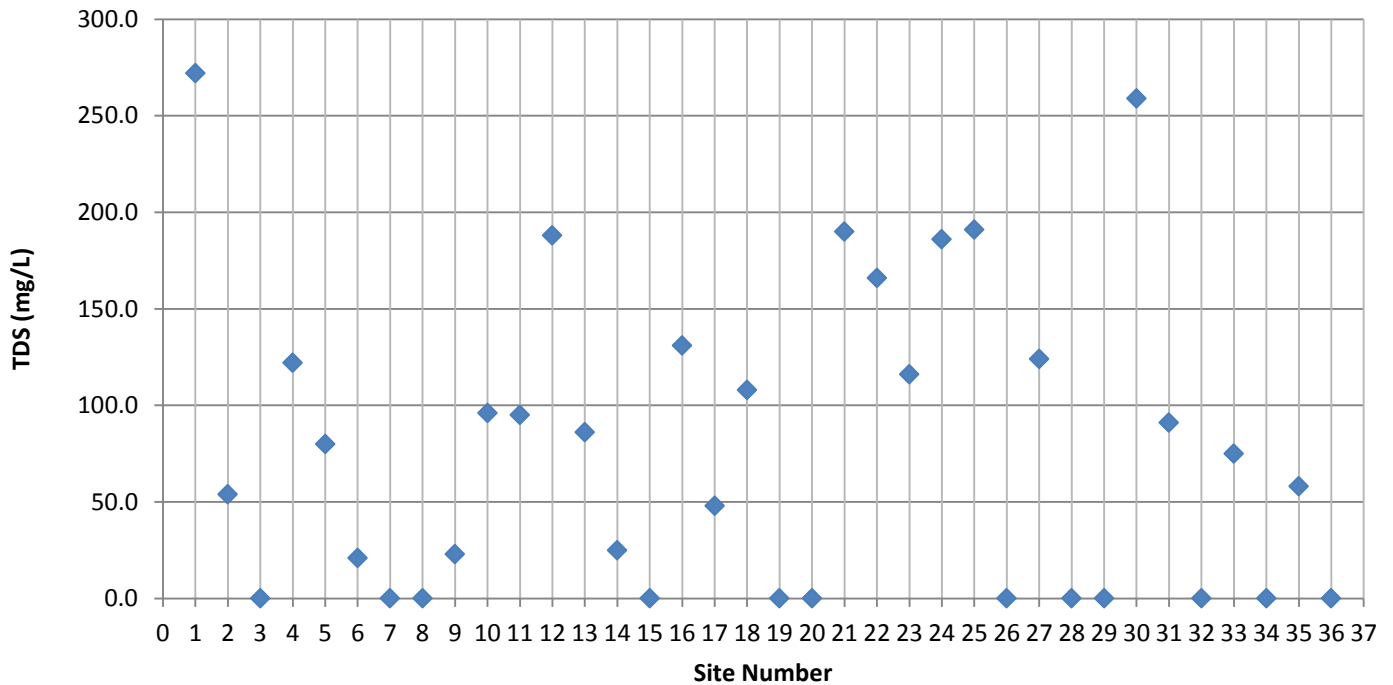


## Total Organic Carbon



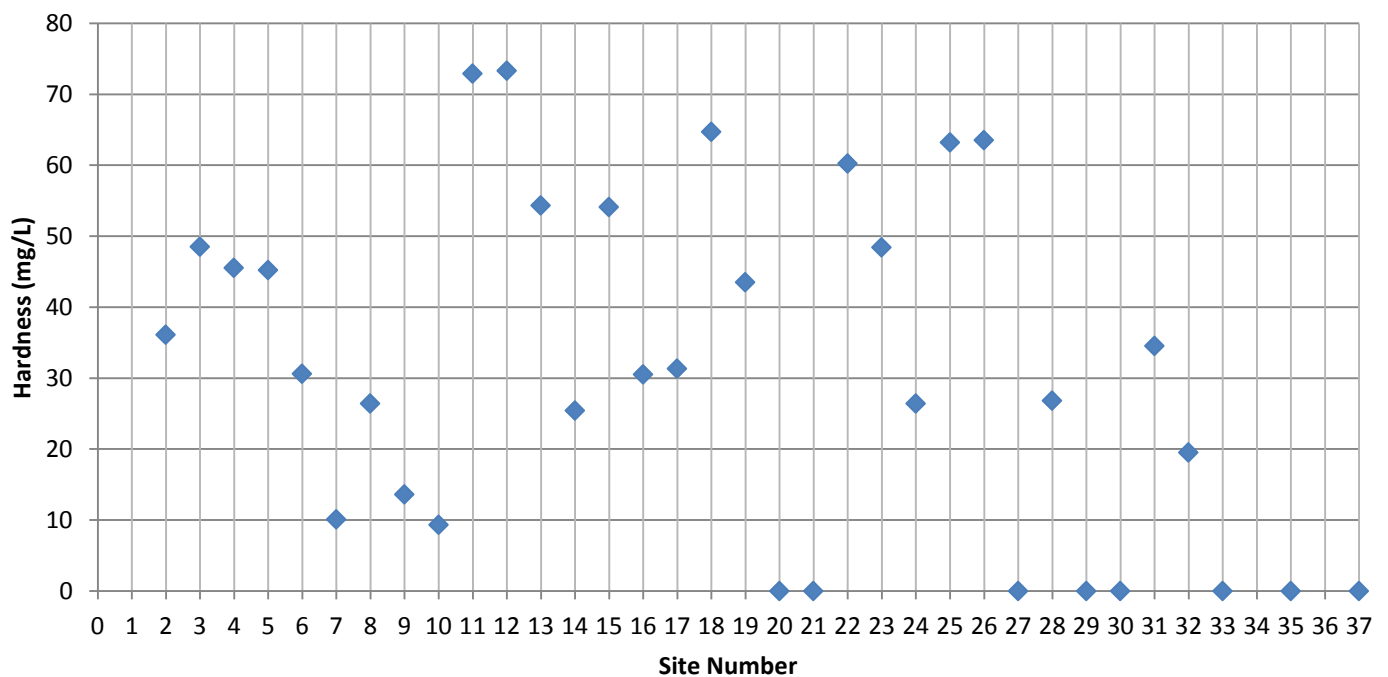
## Total Dissolved Solids

Less than 500mg/L is recommended for public drinking water

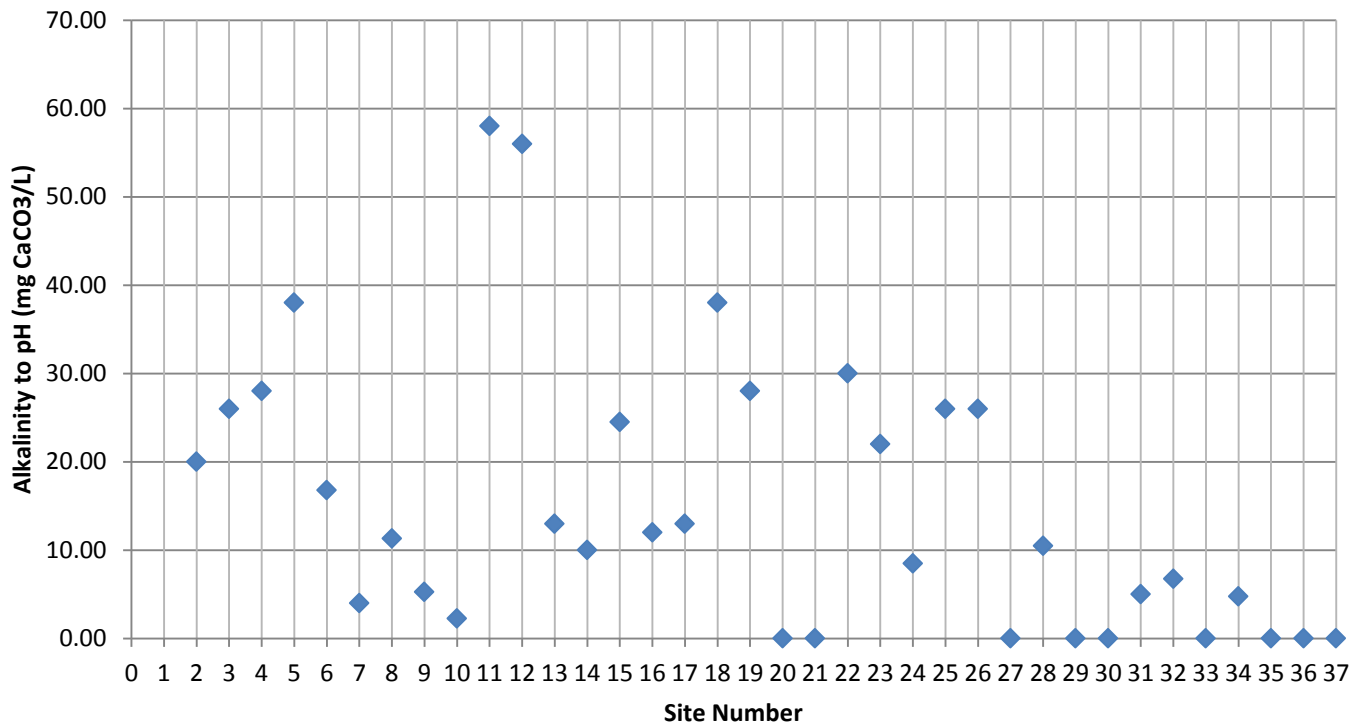


## Hardness

Soft water ranges between 0 and 60 mg/L

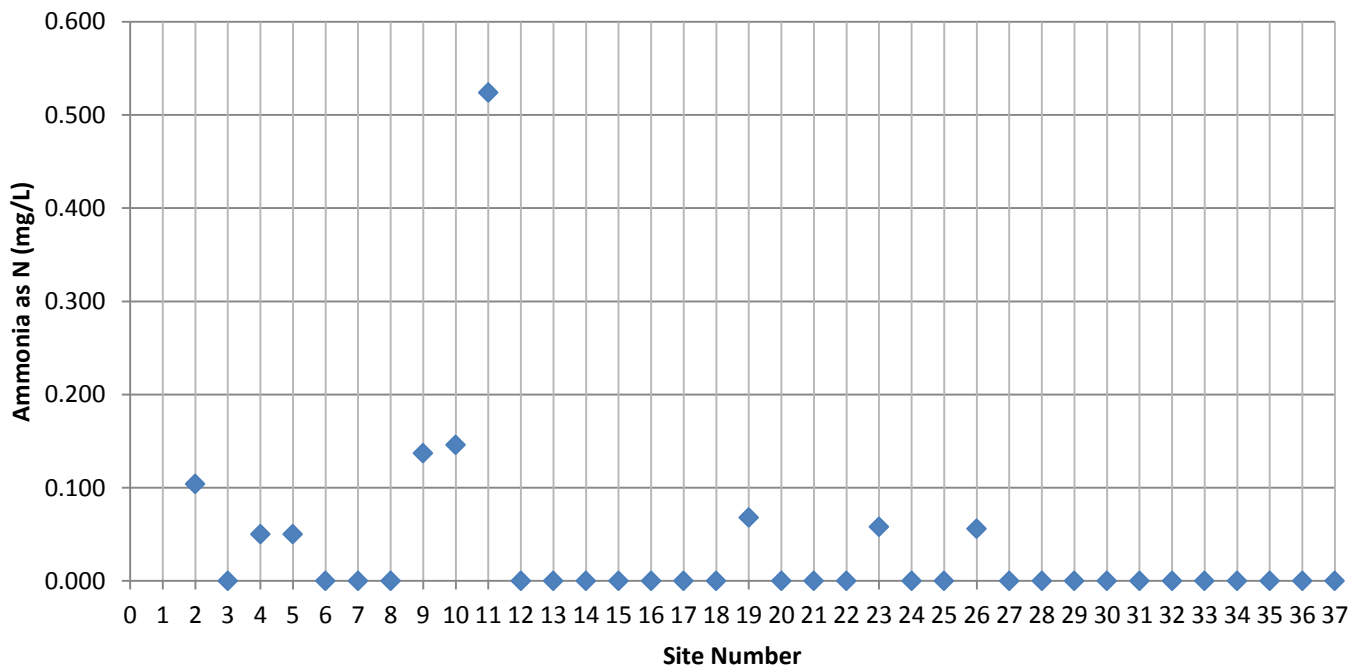


## Alkalinity



## Ammonia as N

Safe ammonia levels are below 0.05mg/L



# Conclusions and Recommendations

## *Macroinvertebrates*

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The potentially impaired sites are indicated below.

IBI Scores did not reach the recommended Aquatic Life Use Attainment Benchmarks

### **Site 3 (BRODCR19)** IBI Score 56.2 and 60.9

**Brodhead Creek** – Below RockTenn, Below Marshals Creek Confluence

This site was a replicate site for quality control. One of the IBI scores at this location revealed the stream to be impaired. This site is near the mouth of the Brodhead where it drains into the Delaware River. The stream reach has a wide and shallow wetted perimeter. The lower IBI score may be caused by urbanized areas located upstream.

### **Site 5 (BRODCR24)** IBI Score 25.9

**Brodhead Creek** – Above RockTenn, below East Stroudsburg STP at Glenn Park

This site is believed to have a low IBI score due to the habitat of the sample area. The sample area contained large boulders which were too large to dislodge in order to collect a thorough sample. The samples were collected in the best habitats and flow regimes available; future collection sites in this segment will need an alternative location in order to collect better macroinvertebrate samples.

### **Site 13 (COOLCR01)** IBI Score 59.2

**Coolmoor Creek** - Just above confluence with Pocono Creek

This stream showed a low IBI score most likely due to its size. It is a relatively small stream in length and width with limited headwaters. The water that flows through Coolmoor Creek comes from a small dam which collects meltwater off of Camelback ski area.

### **Site 19 (MCMICR20)** IBI Score 29.2

**McMichael Creek** – Approximately 75 yards up stream of its confluence with Pocono Creek

This site showed a low IBI score as well as a low habitat assessment score. The stream reach at this site was a long, slow pool with a large abundance of silt and organics. A large portion of this silt is believed to have eroded from upstream banks. These banks may be eroding at an accelerated rate, due to stream bank lawns and lack of larger vegetation, including trees and shrubs.

### **Site 37 (WEIRCR01)** IBI Score 53.5

**Weir Creek** – Just downstream of County Park Road

This stream reach had a large abundance of aquatic vegetation and resembled a spring creek. The low IBI score found could be influenced by Weir Lake, which is a eutrophic lake upstream of the study site. This lake has multiple homes around it and experiences algal blooms during the summer months.



## *Chemistry Analysis*

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The following information refers to the notable laboratory and field chemistry results.

### **Site 31 (SWIFCR09)**

Swiftwater Creek - Just below culvert pipes, under I-380, and upstream of Kalahari Resort

Above average values were found for both conductivity and chlorides. The conductivity value for this site was 532  $\mu\text{S}/\text{cm}$  (the next highest value was 383  $\mu\text{S}/\text{cm}$ ). The chloride values at the site were 133 mg/L (the next highest value was 83.7 mg/L). These findings could be the result of annual road salt used on I-380. This location will should continue to be monitored during future studies.

### **Site 34 (TOBYCR14)**

Tobyhanna Creek – Immediately upstream of the Route 115 Bridge, downstream of the STP

This location measured high total organic carbon (TOC) when compared with the rest of the study sites. This score may be higher due to upstream lakes and dams which Tobyhanna Creek flows through. This location will should continue to be monitored during future studies.

### **Low Alkalinity throughout Monroe County**

Most of the sites showed low alkalinity scores. Low alkalinity is not harmful to a stream, however, low alkalinity decreases the water's ability to buffer acids and protect aquatic life against sudden changes in pH. These values are normal when considering the geology of Monroe County. Most of the streams that were studied in this report flow within areas of silica rich sandstone and quartzite conglomerates, as well as red and grey sandstone and shales. These rocks generally have low carbonate values which would be responsible for low surface and ground water alkalinity values. Cherry Creek, the lower half of Marshalls Creek, and the mouth of Brodhead Creek flows through carbonate rich shales and siltstones which may be the reason for higher alkalinity values when compared to the rest of the county.

## *Recommendations*

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After reviewing the data from the 2015 Water Quality Study, the lead and cooperating agencies recommend the following:

- All of the sites listed as impaired should be retested the following year to continue with data trend collection.
- Site number 31 should also be retested at the same location, as well as upstream to monitor the chloride and conductivity levels of Swiftwater Creek near I-380.
- 32 of 37 sites in the county are healthy attaining streams.
- Overall, much of the data that was collected during the study represents many miles of quality streams.
- Continued monitoring and increased trend data are essential tools to stream quality protection.

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