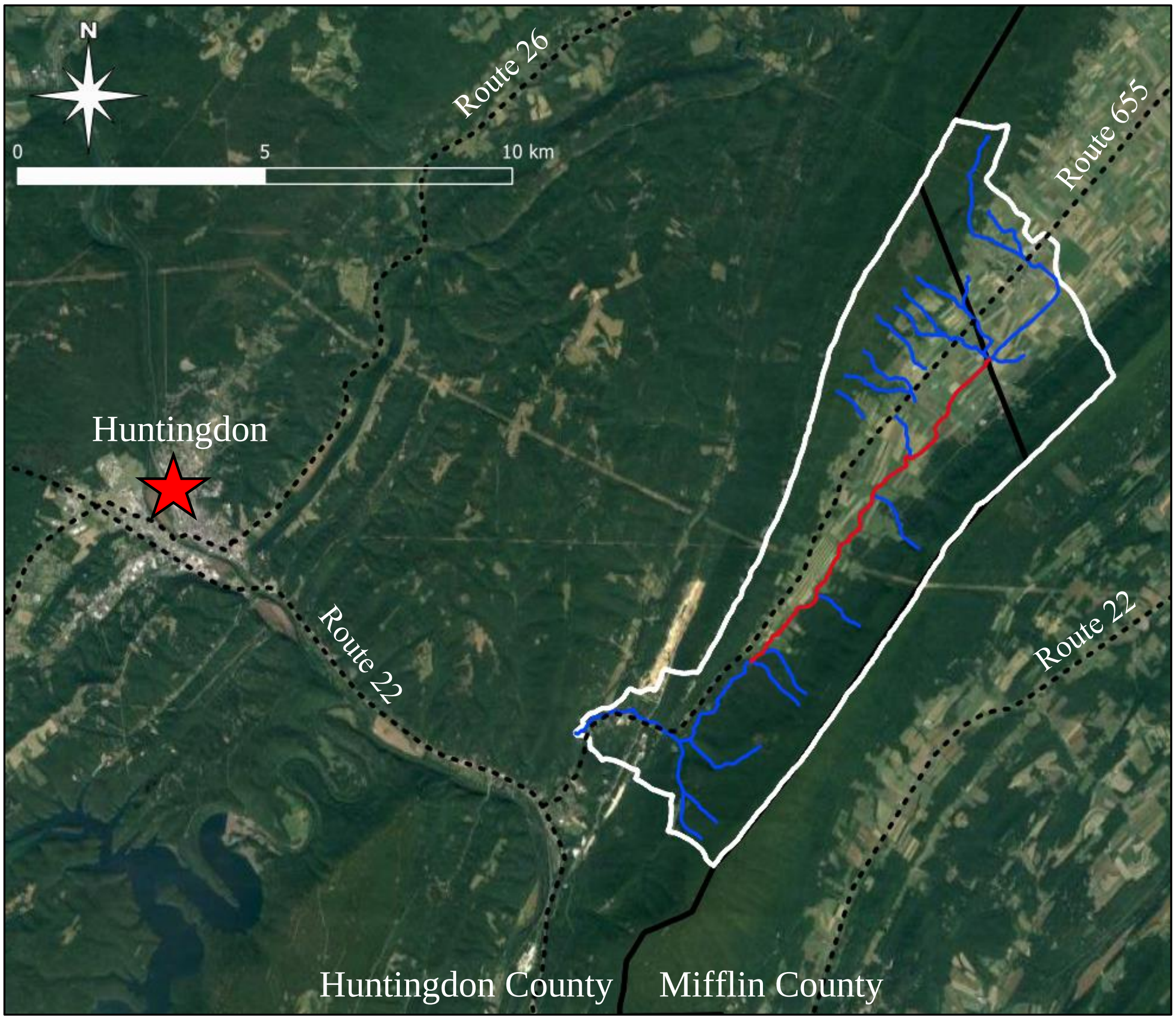
Water Quality Assessment Report

Saddler Creek

Huntingdon County, Pennsylvania



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Introduction

Purpose

In recent years, the Huntingdon County Conservation District (HCCD) and other partner agencies have collaborated with landowners within the Saddler Creek watershed to implement best management practices as well as other conservation activities. To monitor changes in water quality, the HCCD also conducts regular water quality assessments by examining stream characteristics such as water chemistry, habitat, and benthic macroinvertebrates. The following report summarizes the methods and results compiled from the HCCD's 2020 water quality assessment for the Saddler Creek watershed.

Photos 1-2. Student volunteers from Stone Valley Charter School (left) and Huntingdon Area High School (right) assisting with planting riparian buffers at restoration sites along Saddler Creek in 2019.

Watershed Description

Saddler Creek is a small watershed located on the eastern edge of Huntingdon County, Pennsylvania along the Huntingdon and Mifflin County boundary (Figure 1). In total, this watershed encompasses 21 square-miles (13,440 acres) that is comprised of 67% forest, 28% agriculture (including cropland, pasture, and hay), and 5% developed space. In its entirety, this basin contains approximately 20.8 miles of streams, including 7.4 miles of first-order streams, 4.6 miles of second-order streams, and 8.8 miles of third-order streams (Stroud Water Research Center 2017).

According to the Pennsylvania Department of Environmental Protection (PADEP), all 20.8 miles of Saddler Creek have a Trout Stocking (TSF) designated use. A designated use is determined by Title 25 PA Code, Chapter 93 Water Quality Standards and are used to determine regulations and protection standards for a specific body of water. A TSF waterway is maintained to sustain a stocked trout fishery from February 15 to July 31, as well as additional species indigenous to warm water habitats for the remainder of the year (Title 25 PA Code Chapter 93).

In addition, PADEP also assigns an "attaining" (healthy) listing to bodies of water if their respective designated use water quality standards are observed. If a waterway fails to meet one or more of these standards, the water may be listed as an "impaired" (unhealthy) waterway (Clean Water Act Section 303d). In 1998, PADEP staff assessed Saddler Creek for Aquatic Life and determined that a 5.3 mile of stream was impaired from excess sedimentation and nutrients likely resulting from crop production and livestock grazing activity along riparian areas. (PADEP 2020).

Photos 3-4. An example of some of the in-stream restoration work completed at several properties along Saddler Creek.

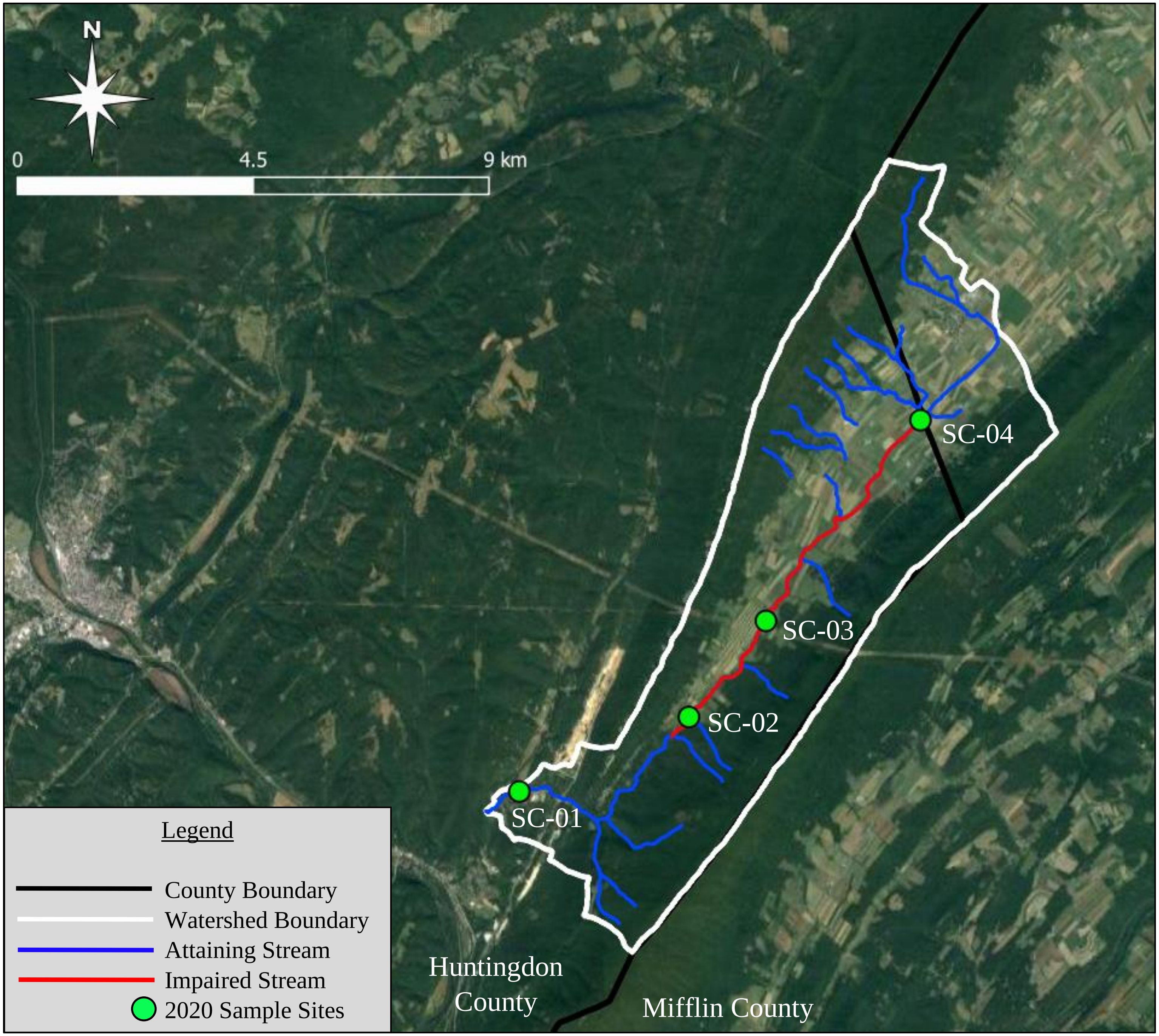

Figure 1. Map of 2020 sample sites in the Saddler Creek watershed.

Methods

Study Sites

To accurately provide a snapshot analysis of the entire watershed's current health, a total of four sites were selected throughout the Saddler Creek watershed (Figure 1). Specifically, one site was selected on the downstream "attaining" reach while the other three sites were sampled along the "impaired" reach of Saddler Creek. Water chemistry, physical habitat, and benthic macroinvertebrates were all measured at each study site.

Table 1. Summary of 2021 sample sites. *Indicates upstream reference site.

Stream Name	HCCD Code	Site ID	Latitude	Longitude
Saddler Creek	20200309-1100-LRS	SC-01	40.453494	-77.916967
Saddler Creek	20200309-1145-LRS	SC-02	40.466067	-77.878857
Saddler Creek	20200309-1300-LRS	SC-03	40.482447	-77.861166
Saddler Creek	20200309-1340-LRS	SC-04	40.516921	-77.826539

Water Chemistry

Comprehensive water chemistry measurements were taken with a Yellow Springs Instrument (YSI) Professional Plus meter (Serial Number: 17A103194) for temperature (C°), pH (standard units), dissolved oxygen (mg/L), and specific conductance (uS/cm), and total dissolved solids (g/L). Meter calibration and data collection was completed in accordance with PADEP protocols described in Shull and Lookenbill (2018).

While this method of measuring chemical parameters at a single point in time, known as "in-situ" collection, provides valuable insight towards water quality, our interpretation of these results is limited. Chemical parameters, especially temperature and dissolved oxygen, can be highly variable and influenced by factors such as time of collection, season, flow, and more.

Therefore, our results provide a short-term "snapshot" of the watershed's chemical parameters rather than a long-term analysis. To draw more detailed conclusions from water chemistry, continuous water chemistry data would need be collected either through regular monitoring activities or the installation of permanent data loggers.

Physical Habitat

A physical habitat assessment was completed at each sample site in accordance with PADEP protocols for high gradient, riffle-run, wadable streams (Shull and Lookenbill 2018). This process involves ranking 12 parameters over a 100-meter reach that represent potential limitations to the quality and quantity of instream habitat. The observer classifies each parameter as optimal, suboptimal, marginal, and poor by assigning each parameter a value ranging from 1-20. Parameters evaluated include instream cover, epifaunal substrate, embeddedness, velocity/depth regimes, channel alterations, sediment deposition, frequency of riffles, channel flow status, condition of banks, bank vegetative protection, grazing or other disruptive pressure, and riparian vegetative zone width (Appendix I). After all parameters are evaluated, the scores are combined to calculate a Total Habitat Score and rated as follows: optimal (240-181); suboptimal (180-121); marginal (120-61); and poor (60-0).

To further assess the quality of a stream's physical habitat, scores are compared to multiple PADEP impairment thresholds (Shull and Pulket 2018). The first impairment threshold for high gradient, riffle-run, wadable streams includes a Total Habitat Score ≤ 140. In addition, certain habitat parameters are exceptionally strong indicators of habitat degradation. Therefore, two additional impairment thresholds for 1) Embeddedness + Sediment Deposition and 2) Condition of Banks + Bank Vegetative Protection were calculated and compared across all sample sites. The impairment threshold for either parameter combination is a total score of ≤ 24.

Benthic Macroinvertebrate Sample Collection

Benthic macroinvertebrates are small, aquatic organisms such as aquatic insects (mayflies, stoneflies, "hellgrammites", etc.), crayfish, snails, mussels, and more that inhabit the stream bottom. Different species of benthic macroinvertebrates are sensitive to different levels of pollution, making them excellent bioindicators of stream health. By examining a stream's benthic macroinvertebrate community to determine the abundance of "pollution-intolerant" (healthy) and "pollution-tolerant" (unhealthy) species, biologists can accurately assess water quality.

Photo 5. HCCD Watershed Specialist collecting a benthic macroinvertebrate sample.

Benthic macroinvertebrate samples were collected at each sample site following PADEP methodology for wadeable, freestone, riffle-run streams (Shull and Lookenbill 2018). Collection begins by delineating a 100-meter reach along the stream of interest. A six-kick composite sample is collected from the reach using a 12-inch wide x 10-inch high D-frame net with 500-micron mesh. For each kick, the collector places the net against the stream bottom and disturbs a one square meter area immediately upstream of the net for approximately one minute. The collector attempts to distribute the kicks among a variety of riffle habitats (e.g., slow-flowing, shallow riffles and fast-flowing, deeper riffles). Kicks were also conducted throughout the width of the stream to include the left, middle, and right areas. This is done to ensure the composited sample provides an accurate representation of the macroinvertebrate community throughout the stream reach.

The composited sample is placed into a jar and preserved with 95% ethanol. Jars are labelled inside and outside with the date, time, collector, and location. Upon completion of the six collection kicks, the net is thoroughly examined for any attached organisms, which are added back into the sample jar. The net is then rinsed to prevent contamination at succeeding sample sites.

Benthic Macroinvertebrate Subsampling

In the laboratory, benthic macroinvertebrate samples were sorted and processed following PADEP methodology for macroinvertebrate samples collected from freestone streams (Shull and Lookenbill 2018). Prior to subsampling, the composited sample is removed from the collection container and placed in a 500-micron sieve. The sample is gently rinsed under running water to remove ethanol and minimize damage to the macroinvertebrates. The sample is then placed in an 18-inch x 12-inch x 3½-inch pan, marked off into (28) 2-inch x 2-inch grids. Water is added to the pan before sample placement to ensure the macroinvertebrates are evenly distributed throughout the pan, and to prevent the contents of the sample from drying out during the subsampling process. Once the contents of the sample are placed in the pan, four 2-inch x 2-inch grids are randomly selected.

The materials and organisms from the selected grids are removed from within four-square inch circular "cookie cutters" placed in the randomly selected grids and removed using spoons, turkey basters, tweezers, and other implements as needed. The extracted contents are then placed into a second pan with water. Identifiable organisms are then picked and counted from the second pan.

If less than 180 identifiable organisms are picked from the second pan, an additional grid is randomly selected and extracted from the first pan. The materials and organisms from this additional grid are moved to the second pan, and the organisms are picked. This process goes on until a subsample target number of 200 ± 20 organisms is reached.

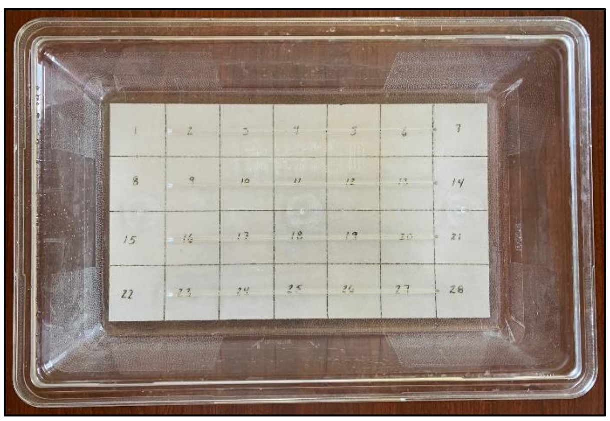

Photo 6. Example of gridded subsampling pan.

Photo 7. Subsampling pan with sample contents and one "cookie cutter" grid selected.

If more than 220 identifiable organisms are picked from the initial four grids, then those organisms are all placed and evenly distributed into another pan with the same dimensions and gridding as the first pan. A grid is then randomly selected, and the organisms are picked from the selected grid. This process continues until the subsample target number of 200 ± 20 organisms is reached.



Photos 8-10. Contents of the subsampling grid are removed using spoons, turkey basters, etc.

Each grid selected during the subsampling process is picked in its entirety. The total number of grids selected from each pan and the count of organisms picked from each grid is recorded. Once the subsampling is complete and the target number of organisms is achieved, all organisms are placed in a clean, 125mL container with 70% - 80% ethanol. The container is labelled both inside and outside with date, time, collector, and location. The container is then stored for later identification.

Benthic Macroinvertebrate Identification

The HCCD Watershed Specialist served as the macroinvertebrate taxonomist for this study and is certified by the Society for Freshwater Science (SFS) for those tests that covered the identifications performed (Ephemeroptera, Plecoptera, & Trichoptera East and General Arthropods East). To begin identification, organisms are removed from the subsample vial and placed under a microscope for identification and enumeration. All macroinvertebrates are identified to the genus level, except for those taxonomic groups listed in Table 2. Once identification is complete, all organisms are returned to the labelled vial with 70% - 80% ethanol.

Table 2. Taxonomic groups that are identified to a higher taxonomic level than genus (Shull and Lookenbill 2018).

Taxonomic Group	**Identification Level**
Midges	Family
Snails	Family
Mussels & Clams	Family

Aquatic Earthworms & Tubificid Worms	Class (Oligochaeta)
Leeches	Class (Hirudinea)
Flatworms	Phylum (Turbellaria)
Proboscis Worms	Phylum (Nemertea)
Roundworms	Phylum (Nematoda)
Moss Animalcules	Phylum (Bryozoa)
Water Mites	Hydracarina (artificial grouping of several water mite superfamilies)

Index of Biological Integrity Metric Calculation

The index of biological integrity (IBI) is a method used to quantify stream health through benthic macroinvertebrates. By examining the diversity and abundance of the different benthic macroinvertebrates present in a stream community, we can calculate multiple metrics that exhibit a strong ability to discern between streams considered relatively pristine and heavily degraded (Shull and Pulket 2018). The following six metric calculations were included in the IBI analysis for each sampling site: Total Taxa Richness, Ephemeroptera + Trichoptera + Plecoptera (EPT) Richness (Pollution Tolerance Values 0-4 only), Becks Index (version 3), Shannon Diversity, Hilsenhoff Biotic Index, and Percent Sensitive Individuals (Pollution Tolerance Values 0-3 only). To compare biological conditions between each sample site, each metric is standardized to a value of 0-100. Higher scores are associated with unimpacted, “natural” environments, while lower scores are associated with anthropogenically degraded environments. The six standardized metrics are then averaged to produce a final total IBI score. A description of each metric and standardization process is given in detail by Shull and Pulket (2018).

Results and Discussion

Water Chemistry

In total, five water chemistry parameters were measured at each sample site, including temperature, dissolved oxygen, pH, specific conductance, and total dissolved solids (Table 3).

Table 3. Summary of 2020 water chemistry measurements

Saddler Creek - Spring 2020 water Chemistry Results				
Sample Site	**SC-01**	**SC-02**	**SC-03**	**SC-04**
Date of Collection	**3/9/2020**	**3/9/2020**	**3/9/2020**	**3/9/2020**
Temperature (C°)	6.1	7.4	9.3	13.4
Dissolved Oxygen (mg/L)	15.78	15.82	14.63	12.48
pH	8.48	8.39	8.46	8.76
Specific Conductivity (uS/cm)	223.8	252.9	270.2	234.8
Total Dissolved Solids (g/L)	0.1456	0.1644	0.1755	0.1528

According to Title 25 PA Code Chapter 93, all four study sites recorded temperatures above the 7.8 C° maximum standard for TSF streams measured between March 1-31. However, pH levels were all recorded within Chapter 93's criteria of 6.0 to 9.0. Chapter 93 does not list criteria for in-situ dissolved oxygen measurements but instead requires a 7-day continuous average. For TSF streams sampled between February 15 to July 31, this 7-day continuous average is equal to 6.0 mg/L, with a minimum reading of 5.0 mg/L. All four sites recorded DO measurements above this threshold.

In addition, Chapter 93 does not list specific water quality criteria for specific conductivity. Since specific conductivity is a measure of dissolved ions such as metals, salts, and other conductive materials, it can be greatly influenced by elevation and geology, and therefore difficult to set "normal" thresholds. Typically, headwater streams tend to have lower conductivity values that gradually increase as surface water flows downstream and begins accumulating more conductive materials from the surrounding landscape. In addition, streams receiving water that flows through limestone geology tend to have higher concentrations of dissolved calcium carbonate ($CaCO3$), and thus have naturally higher conductivity values than normal freestone streams. However, conductivity can also be greatly impacted by human activity, and streams receiving abandoned mine, urban stormwater, or agricultural runoff tend to have unnaturally high conductivity measurements due to increased levels of dissolved heavy metals, road salt, nitrates, phosphates, and more.

Given their position in the watershed, all four sites appear have slightly higher than expected SPC measurements. However, while this could indicate some degree of anthropogenic influence to the waterbody, these readings could also be the result of limestone influence to Saddler Creek. The HCCD suggests that during future monitoring events, an effort should be made to measure and obtain alkalinity measurement to confirm whether there is significant limestone influence in Saddler Creek.

Physical Habitat

Twelve habitat parameters were assessed and combined to determine a total habitat score for each sample site (Table 4). During this assessment, two sites received scores in the suboptimal range (180-121), one site scored in the marginal range (120-61), and one site scored in the poor range (60-0).

Table 4. Summary of 2020 physical habitat assessment results.

Saddler Creek - 2020 Habitat Assessment Results				
Sample Site	**SC-01**	**SC-02**	**SC-03**	**SC-04**
Instream Cover	16	8	10	3
Epifaunal Substrate	18	11	13	3
Embeddedness	12	7	9	5
Velocity/Depth Regimes	17	7	16	8
Channel Alteration	11	15	12	7
Sediment Deposition	11	8	11	3
Riffle Frequency	16	5	16	3
Channel Flow Status	15	16	14	10
Condition of Banks	10	10	9	3
Bank Vegetative Protection	9	5	4	4
Grazing or Other Disruptive Pressure	11	9	13	3
Riparian Vegetative Zone	14	13	13	3
Total Score =	**160**	**114**	**140**	**55**

In addition, further analyses show that all four sites received scores below the impairment threshold (≤ 24) for Embeddedness + Sediment Deposition and Condition of Banks + Bank Vegetative Protection (Table 5). In addition, only two sites scored below the impairment threshold for Total Habitat Score (<140). It should be noted that sample site SC-03 received a Total Habitat Score of 140, the absolute minimum score needed to not be listed as impaired for habitat degradation.

Table 5. Summary of physical habitat impairment results. *Note impaired scores in red.

Saddler Creek - 2020 Physical Habitat Impairment Results				
Sample Site	**SC-01**	**SC-02**	**SC-03**	**SC-04**
Embeddedness + Sediment Deposition	23	15	20	8
Condition of Banks + Bank Vegetative Protection	19	15	13	7
Total Habitat Score	160	114	140	55

Benthic Macroinvertebrate Analysis

To develop an inventory of the benthic macroinvertebrates identified and recorded in the Saddler Creek watershed, the 2020 taxonomic data was compiled and made available in Appendix III. In total, 34 distinct taxa were identified across the 4 sites during the HCCD’s spring 2020 assessment (Appendix II). Benthic macroinvertebrate samples from 2020 passed quality assurance audits by PADEP (Appendix III).

A summary of index of biological integrity (IBI) metrics for each study site is provided in Table 6. In Pennsylvania, PADEP utilizes IBI assessments to determine whether a stream is “attaining” (meets water quality standards) or “impaired” (fails to meet water quality standards). For TSF streams, the PADEP impairment threshold is an IBI score less than 50 for samples collected between November-May (Shull and Pulket 2018). In 2020, all three sites along the impaired reach scored below this threshold, while the downstream site on the attaining section scored above this impairment threshold. The 2020 biological assessments followed wadeable, freestone riffle-run stream assessment methods.

Table 6. Summary of 2020 index of biological integrity metrics.

	Saddler Creek - 2020 IBI Results			
	Red text indicates impaired scores			
Metrics	SC-01	SC-02	SC-03	SC-04
Total Taxa Richness	21	16	14	13
EPT Richness	10	5	3	1
Beck's Index	17	3	4	3
Hilsenhoff-Biotic Index	2.7	4.87	5.22	5.9
Shannon Diversity	1.78	1.97	1.85	1.21
% Sensitive Individuals	60.8	12.8	3.9	1.5
Total IBI Score	**64.2**	**38.3**	**32.8**	**24.6**

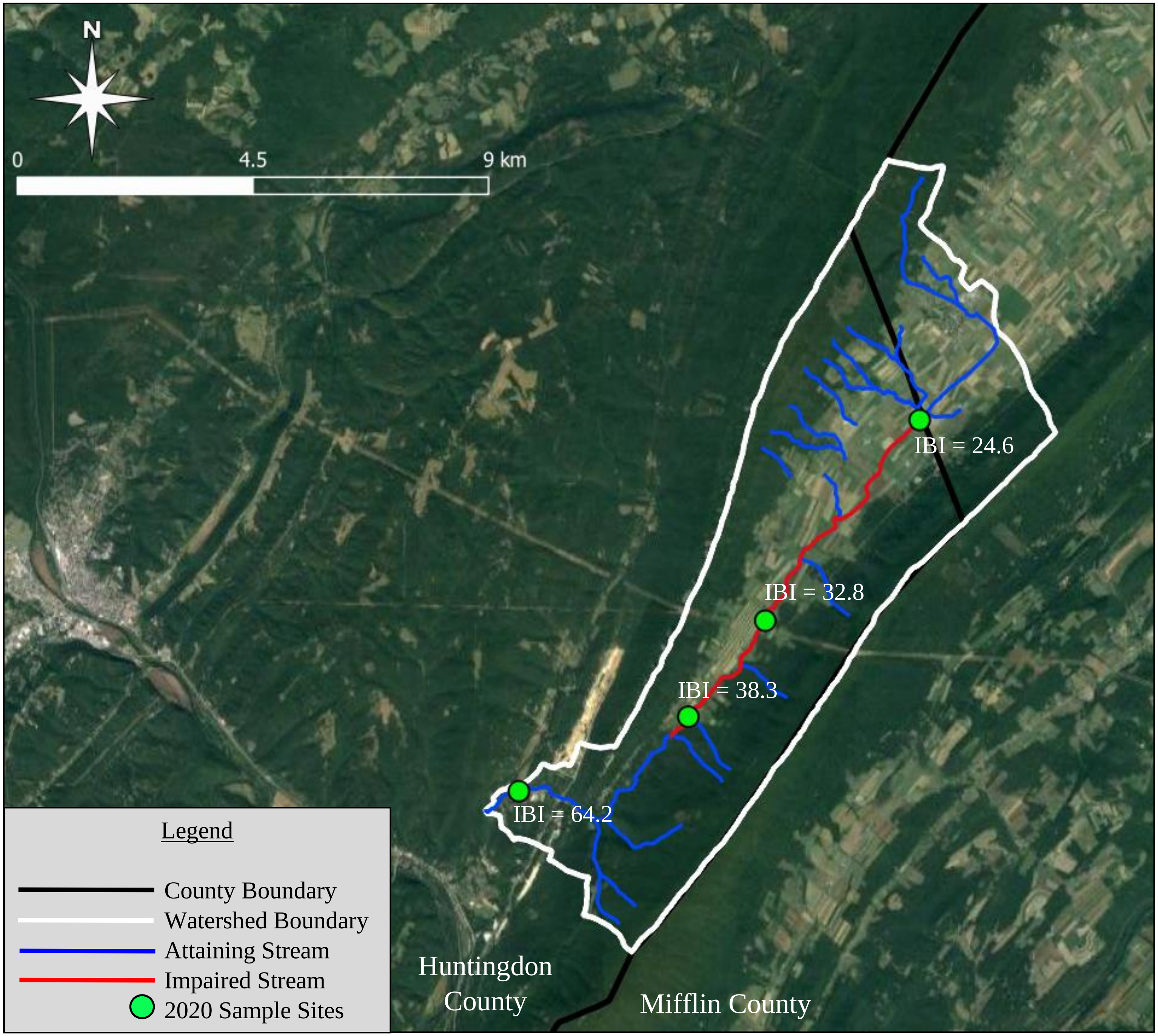

Figure 2. Map of sample sites with corresponding IBI metric scores.

Conclusions

In March 2020, four sites along Saddler Creek, an impaired tributary to the Juniata River in Huntingdon County, Pennsylvania, were sampled for water chemistry, physical habitat, and benthic macroinvertebrates by the HCCD.

Temperature appears to be the most concerning chemical parameter within this watershed. Water temperatures across all four sample sites exceeded Title 25 PA Code Chapter 93 specific water quality criteria for TSF streams for measurements taken between March 1-31.

All four sites qualify for impairment based on the physical habitat assessments. All four sites scored below the impairment thresholds for Embeddedness + Sediment Deposition and Condition of Banks + Bank Vegetative Protection, while only two sites scored below the impairment threshold for Total Habitat Score.

There was a noticeable lack in abundance of pollution-intolerant taxa, such as mayflies, stoneflies, and caddisflies, and a noticeable abundance of “pollution-tolerant” taxa, such as midges and beetles, as we moved upstream from the attaining to the impaired stream sections. IBI metrics for the three sites along the impaired reach fell below the impairment threshold for TSF streams, while the downstream site along the attaining reach scored above the impairment threshold.

The results of this study support the evidence that in order to de-list this stream as a 303(d) impaired waterbody there needs to be an emphasis on better conservation practices in this watershed. To achieve the goal of de-listing, the HCCD intends to continue working with local landowners and partner organizations to design, fund, and implement best management practices (BMPs) and other conservation activities. BMPs include many different methods landowners can use to manage their land while reducing pollution and conserving natural resources. Specifically, the HCCD will aim to implement BMPs associated with improving water quality. Some popular examples of stream BMPs include cover cropping, installing fence to exclude livestock from a stream, constructing in-stream erosion control and fish habitat structures, and planting riparian forest buffers. The HCCD has implemented such strategies in several watersheds throughout Huntingdon County which has improved water quality in those areas. Typically, these projects incorporate multiple BMPs to ensure the stream receives the best environmental improvements possible. It is expected that the implementation of such projects would likely bring the IBI scores closer to an attaining value of >50 and would allow the HCCD to propose this stream for impairment de-listing.

References

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Stroud Water Research Center. (2017). Model My Watershed [Software]. Available from https://wikiwatershed.org

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Appendix I: Habitat evaluation form (Shull and Lookenbill 2018)

Physical Habitat Evaluation Form for Riffle/Run Prevalence				
Waterbody Name:		GIS Key (YYYYMMDD-hhmm-User):		
Location:				
Investigators:			Completed By:	
Parameter	**Optimal**	**Suboptimal**	**Marginal**	**Poor**
1. Instream Cover (Fish)	Greater than 50% mix of boulder, cobble, submerged logs, undercut banks, or other stable habitat.	30-50% mix of boulder, cobble, or other stable habitat; adequate habitat.	10-30% mix of boulder, cobble, or other stable habitat; habitat availability less than desirable.	Less than 10% mix of boulder, cobble, or other stable habitat; lack of habitat is obvious.
________	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
2. Epifaunal Substrate	Well-developed riffle and run; riffle is as wide as stream and length extends two times the width of stream; abundance of cobble.	Riffle is as wide as stream but length is less than two times width; abundance of cobble; boulders and gravel common.	Run area may be lacking; riffle not as wide as stream and its length is less than 2 times the stream width; gravel or large boulders and bedrock prevalent; some cobble present.	Riffles or run virtually nonexistent; large boulders and bedrock prevalent; cobble lacking.
________	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
3. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
4. Velocity/Depth Regimes	All four velocity/depth regimes present (slow-deep, slow shallow, fast-deep, fast shallow)	Only 3 of the 4 regimes present if fast-shallow is missing, score lower than if missing other regimes.)	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score lower than if missing other regimes).	Dominated by 1 velocity/depth regime (usually slow-deep).
______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
5. Channel Alteration	No channelization or dredging present.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging (greater than 20 yr.) may be present, but recent channelization is not present.	New embankments present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement over 80% of the stream reach channelized and disrupted.
______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
6. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar information, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel coarse sand on old and new bars; 30-50% of the bottom affected; sediment deposits at obstruction, construction and bends, moderate depositions of pools prevalent.	Heavy deposits of fine material increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
________	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

Appendix I cont.

Parameter	Optimal	Suboptimal	Marginal	Poor
7. Riffle Frequency	Occurrence of riffles relatively frequent;; distance between riffles divided by the width of the stream equals 5 to 7; variety of habitat.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream equals 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is >25.
_______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
8. Channel Flow Status	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
_______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
9. Condition of Banks	Banks stable; no evidence of erosion or bank failure.	Moderately stable; infrequent, small areas of erosion mostly healed over.	Moderately unstable; up to 60% of banks in reach have areas of erosion.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; on side slopes, 60-100% of bank has erosional scars.
_______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
10. Bank Vegetative Protection	More than 90% of the stream bank surfaces covered by vegetation.	70-90% of the stream bank surfaces covered by vegetation.	50-70% of the stream bank surfaces covered by vegetation.	Less than 50% of the stream bank surfaces covered by vegetation.
_______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
11. Grazing or Other Disruptive Pressure	Vegetative disruption through grazing or mowing is minimal or not evident; almost all plants allowed to grow naturally.	Disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	Disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Disruption of stream bank vegetation is very high; vegetation has been removed to 2 inches or less in average stubble height.
_______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
12. Riparian Vegetative Zone	Width or riparian zone >18 meters; human activities (i.e. parking lots, roadbeds, clear-cuts, lawns or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.
_______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

TOTAL _______

Appendix II: Benthic Macroinvertebrate Inventory

Saddler Creek - Spring 2020 Benthic Macroinvertebrate Inventory							
				Site: SC-01	Site: SC-02	Site: SC-03	Site: SC-04
				3/9/2020	3/9/2020	3/9/2020	3/9/2020
Taxa							
Order	**Family**	**Genus**	**PTV**	**Count**	**Count**	**Count**	**Count**
Ephemeroptera (Mayflies)	Baetidae	Baetis	6	4	0	1	0
		Acentrella	4	1	0	0	0
	Ephemerellidae	Ephemerella	1	102	18	2	1
		Eurylophella	4	0	0	1	0
	Ephemeridae	Ephemera	2	0	0	1	0
	Heptageniidae	Stenonema	3	2	4	0	0
		Epeorus	0	2	0	0	0
	Leptophlebiidae	Paraleptophlebia	1	2	0	0	0
Plecoptera (Stoneflies)	Perlidae	Acroneuria	0	1	0	0	0
	Perlodidae	Cultus	2	1	0	0	0
Tricoptera (Caddisflies)	Helicopsychidae	Helicopsyche	3	0	1	0	0
	Hydropsychidae	Hydropsyche	5	3	8	32	3
		Cheumatopsyche	6	1	11	14	9
	Philopotamidae	Chimarra	4	2	2	0	0
		Dolophilodes	0	1	0	0	0
	Rhyacophilidae	Rhyacophila	1	5	0	0	0
	Thremmatidae	Neophylax	3	0	1	0	0
Diptera (Flies)	Ceratopogonidae	Bezzia	6	0	0	1	0
	Chironomidae		6	39	73	83	132
	Psychodidae	Pericoma	4	0	0	0	1
	Limoniidae	Antocha	3	2	1	3	1
	Simuliidae	Prosimulium	2	3	0	2	1
		Simulium	6	0	7	14	0
Coleoptera (Beetles)	Dryopidae	Helichus	5	1	0	0	0
	Elmidae	Dubiraphia	6	0	5	0	37
		Optioservus	4	9	29	16	6
		Stenelmis	5	5	39	5	7
	Psephenidae	Psephenus	4	12	1	0	0
Megaloptera (Hellgrammites/Fishflies)	Corydalidae	Corydalus	4	1	0	0	0
		Nigronia	2	0	1	0	0
Amphipoda (Scuds)	Gammaridae	Gammarus	4	0	2	29	0
Isopoda (Isopods)	Asellidae	Caecidotea	6	0	0	0	1
Gastropoda (Snails & Slugs)	Physidae		8	0	0	0	1
Annelida (Segmented Worms)	Oligochaeta		10	0	0	0	2
Total #		**34 taxa**		**199**	**203**	**204**	**202**

*PTV = Pollution Tolerance Value. This value is assigned to individual organisms based on their tolerance to pollution levels. Scores range from 0-10 with lower scores associated with “pollution-intolerant” taxa, while higher scores are associated with “pollution-tolerant” taxa.