

Pike County 2022 Surface Water Quality Report



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Pike County
Conservation District

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Introduction

Bioassessment is a standard today in the scientific community for monitoring the health and quality of streams. Streams are assessed by observing the macroinvertebrate and fish communities as they have been shown to exhibit changes in response to stressors, such as non-point source pollution. Bioassessment using macroinvertebrate and fish communities has been shown and accepted to be an effective tool in water quality monitoring practices nationwide. Since the late 1990s, Pike County Conservation District (PCCD or District) has been monitoring the surface waters of the county using biological, chemical, and habitat assessments.

Pike County contains over 1,800 miles of streams. These streams are almost all within the Pennsylvania Code, Title 25, Chapter 93, Water Quality Standards for either High-Quality (HQ) or Exceptional Value (EV). It is rare a county possesses surface water quality such as this and thus it is critical to monitor the conditions. Recreational activities focused on the surface water and the resources tied to it are also of vital importance to Pike County residents and the economy. It is critical the surface waters continue to be monitored for water quality changes. The information collected from monitoring is important for detecting significant disturbances as well as for long term planning within the county.

Methods

District staff sampled stream sites established at the inception of the program as baseline and non-point source sites by their proximity to areas of development and point-source discharge. The macroinvertebrate sites are sampled in the spring (April-May) with each site being sampled on a three-year rotational schedule. The fish sites were sampled in the fall (August-September) with each site being sampled on a five-year rotational schedule. Stream reaches are determined by choosing an area (100ft) that best represents all habitat conditions in the stream to get the most accurate sample. The District works with the Pennsylvania Fish and Boat Commission on the permitting required and the timing of the sampling. In addition, the District works closely with the landowners who have provided permission to access the stream sites through their properties over the past 20 years so the data is consistent in area and scope.

Habitat

Habitat assessments using the Pennsylvania Department of Environmental Protection (PADEP) Water Quality Network Habitat Assessment form are completed at each site. This form ranks twelve stream characteristics from 1 to 20 with 1 being poor and 20 being optimal. These characteristics include stream embeddedness, sediment deposition, condition of banks, and riffle frequency (Table 4).

Chemistry

Chemical measurements from the stream site as well as air temperature are recorded on the PA DEP Flowing Waterbody Field Data Form. The chemistry measurements are collected using a YSI ProQuatro Meter which is owned by the District and checked and calibrated as needed at the beginning of each sampling day to ensure accurate readings. The meter has several different probes and can measure pH, galvanic dissolved oxygen (DO), temperature (C), and conductivity. The meter also detects barometric pressure and can calculate the total dissolved solids (TDS), salinity, and specific conductance. Alkalinity is measured using a Hach alkalinity test kit. The air temperature is measured with a field thermometer (Table 5).

Macroinvertebrates

Macroinvertebrate community samples are obtained utilizing the protocol described by PADEP in the Water Quality Monitoring Protocols for Streams and Rivers 2021 document. In each stream reach, six separate one-minute kicks are done using a D-frame kick net with 500um mesh. Each kick lasts for one minute with the net directly downstream of the kick area. Kicks are done starting downstream and heading upstream and are spaced throughout the targeted stream area to get a composite sample. After each one-minute kick, the net is emptied into a sample jar for the site. All six kicks from each site are deposited in the same jar for a composite sample. The contents of each jar are then preserved with 90% isopropyl alcohol and sent to be identified and enumerated. In 2022, Don Baylor of Aquatic Resource Consulting (ARC) analyzed the macroinvertebrate samples for PCCD.

Several metrics are calculated using the information from macroinvertebrate sample analysis. ARC identified and enumerated the macroinvertebrate samples for each site using white pans marked with grids to delineate twenty-one 2 inch by 2 inch squares. Grids are then randomly selected, and organisms identified until the sample reaches 200 individuals. The individuals are identified to genus and species, if possible. PADEP has assigned tolerance values to each species of macroinvertebrate. The tolerance values and numbers of individuals at each value are then used to calculate several metrics.

Six separate metrics were calculated by Don Baylor of ARC which are used together to determine the Index of Biotic Integrity (IBI) for the site (Table 6). These six metrics are:

- Total Taxa Richness
- Ephemoptera + Plecoptera + Trichoptera Taxa Richness (EPT)
- Beck's Index
- Shannon Diversity Index
- Hilsenhoff Biotic Index
- Percent Sensitive Individuals

These are all standard metrics and are described further in the PADEP Assessment Book 2021. The IBI is calculated and is used as a way to standardize all of the above-mentioned metrics.

The maximum IBI score is 100. These values can be used to determine if the stream is considered attaining or impaired. Attaining means the water body is of good enough quality to meet the criteria and uses designated by Pennsylvania Code, Title 25, Chapter 93. Uses for water bodies as defined by Chapter 93 include special protections such as the High Quality (HQ) and Exceptional Value (EV) status of the streams in Pike County. They can also include uses such as Fishing, Potable Water Supply, Migratory Fishes, and so on. A water body is considered impaired when the data shows the waterway is no longer able to meet the designated use.

Table 1. Example from PADEP Assessment Book 2021 of the metrics and calculation of the Index of Biotic Integrity (IBI).

Table 3. Index calculation process for Lycoming Creek.

Metric	Standardization Equation (using large-stream standardization values)	Observed Metric Value	Standardized Metric Score	Adjusted Standardized Metric Score Maximum = 100
Total Taxa Richness	(observed value / 31) * 100	33	106.5	100
EPT Taxa Richness	(observed value / 16) * 100	22	137.5	100
Beck's Index	(observed value / 22) * 100	40	181.8	100
Hilsenhoff Biotic Index	$[(10 - \text{observed value}) / (10 - 3.05)] * 100$	3.47	94.0	94.0
Shannon Diversity	(observed value / 2.86) * 100	2.67	93.4	93.4
Percent Sensitive Individuals	(observed value / 66.7) * 100	48.8	73.2	73.2
Average of standardized core metric scores = IBI Score =				93.4

Fish Communities

Fish communities are sampled using electrofishing procedures as outlined in the PADEP Water Quality Monitoring Protocols for Streams and Rivers 2021 document. Aquatic Resource Consulting operated their electrofishing equipment which includes a backpack with a battery, an anode staff, and a cathode to create a current. The voltage can be adjusted and varies by stream conditions such as conductivity. To sample as accurately as possible, ARC moved upstream in a zig-zag movement instead of straight ahead. Each site was sampled for 20 minutes. District staff and ARC staff netted fish stunned by the current and all fish caught during that time were stored in a live well. After the 20 minutes, the fish were identified and enumerated, then returned to the stream as quickly as possible to avoid accidental mortality. Individuals were also observed for any abnormalities such as growths or deformities.

An Index of Biotic Integrity (IBI) has historically been calculated by ARC for fish communities. This is done by assigning pollution tolerance values to each species and scoring each of ten metrics accordingly. These ten metrics include:

- Number of Intolerant Species (IS)
- Percent of Tolerant Individuals (TOL)
- Percent of Top Carnivore Individuals (CARN)
- Percent of Individuals that are Coolwater or Coldwater (STENO)
- Percent of Salmonid Individuals that are Brook Trout (ST)
- Percent of Individuals that are Insectivores (IS)
- Percent of Individuals that are Pioneering Species (P)
- Catch per 20 Minute Effort (CPE)
- Percent of individuals that are Lithophilic Spawners (L)
- Number of Young of Year (YOY) Trout Caught Per 20 Minute Effort (YOY)

All ten metrics are scored and the IBI is calculated through the combination of those scores. The maximum value for this is 50 with the minimum being 10 (Table 7).

The Pennsylvania Department of Environmental Protection (PADEP) has recently begun using a new metric, the Thermal Fish Index (TFI), to look at fish communities and stream health in place of the IBI. Both indices have been calculated for this report year (Table 8).

The Thermal Fish Index (TFI) is the new PADEP metric for observing fish communities and stream health. This metric is calculated as shown in the PADEP Assessment Methodology for Streams and Rivers 2021. Each fish species is given a thermal class by PADEP as described in the Technical Development of a Thermal Fish Index. These values range from 1 to 5 with 1 being cold and 5 being warm thermal classes. The percentage of individuals in each sample belonging to each of the five thermal classes is calculated and used to calculate a TFI value. The values range from 2 to 10 with scores closer to 2 being an assemblage of cold water and 10 being an assemblage of warm water. Values in the middle would be considered transitional. These indices can be used to determine if a waterway is attaining or impaired for its assessed use.

Sampling Stations

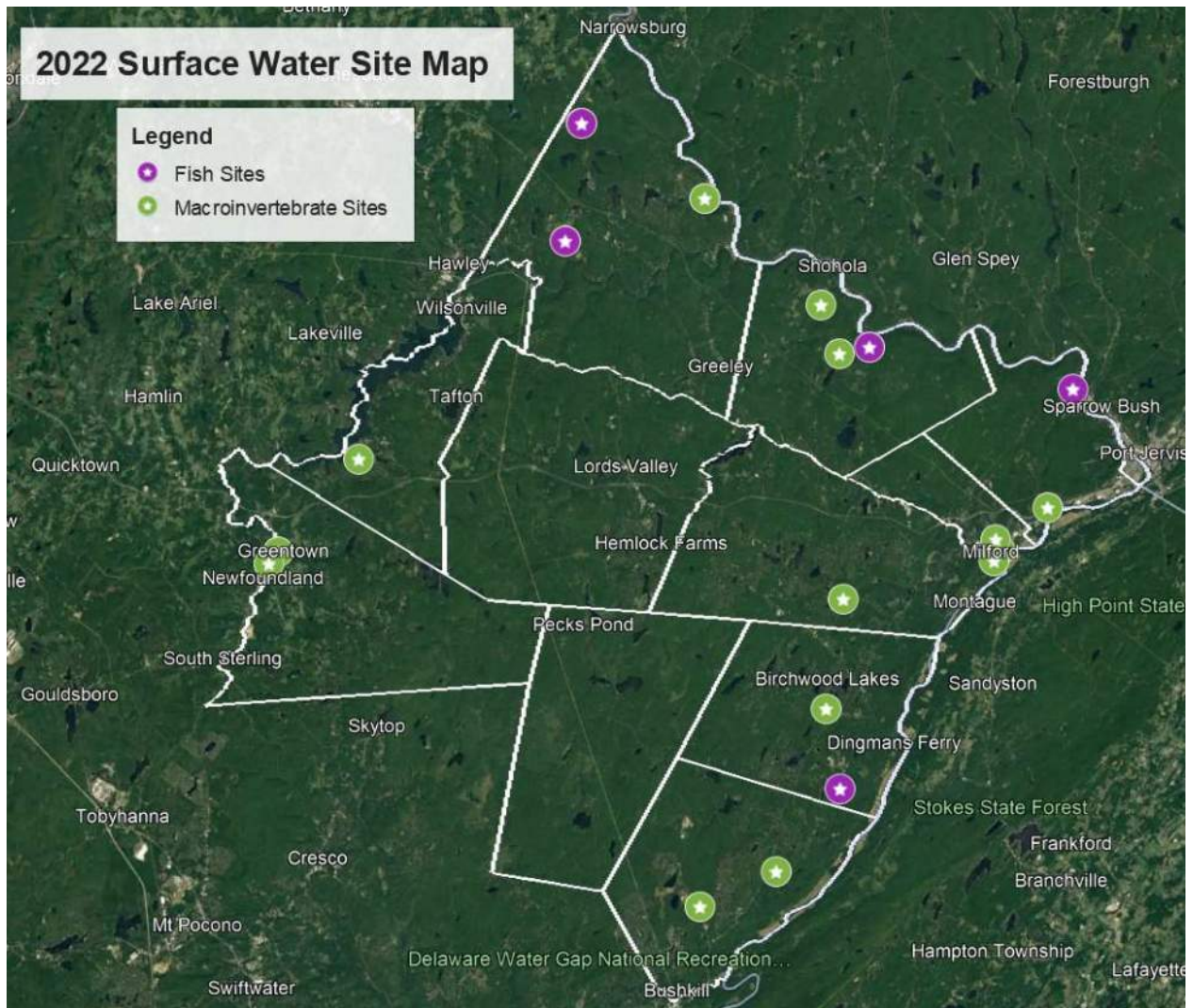


Figure 1. Site map of the surface water monitoring sites for the 2022 season.

Macroinvertebrates:

Table 2. The stream sites sampled for macroinvertebrates in spring 2022.

Site ID	Stream Name
04	Toms Creek
09	Sawkill Creek
10	Vandermark Creek
11	Cummins Creek
13	Twin Lakes Creek
14	Shohola Creek
17	Wallenpaupack Creek
18	E. Branch Wallenpaupack Creek
22N	Dingmans Creek
23N	Dwarfskill Creek
25N	Vandermark Creek
27N	Walker Lake Creek
28N	Westcolang Creek
29N	Teedyuskung Creek
30N	Kleinhans Creek
38N	Rattlesnake Creek
44N	Little Bushkill Creek

Fish:

Table 3. The stream sites sampled for fish in fall 2022.

Site ID	Stream Name
05	Hornbecks Creek
12	Bush Kill (Millrift) Creek
13	Twin Lakes Creek
28N	Westcolang Creek
29N	Teedyuskung Creek
38N	Rattlesnake Creek

Results

Habitat Assessments

Table 4. The data from the habitat assessment forms for each site using the PADEP Assessment Form.

Site	Toms Creek	Sawkill Creek	Vandermark Creek	Cummins Creek	Twin Lakes Creek	Shohola Creek
Site Number	4	9	10	11	13	14
Date Sampled	5/3/2022	5/3/2022	4/14/2022	4/14/2022	4/28/2022	5/12/2022
Instream Cover	20	20	15	19	20	15
Epifaunal Substrate	20	20	20	20	20	20
Embeddedness	16	20	20	20	20	20
Velocity/Depth Regimes	10	18	15	19	20	20
Channel Alteration	20	15	20	20	18	20
Sediment Deposition	17	19	20	20	19	20
Frequency of Riffles	20	20	20	20	20	20
Channel Flow Status	20	20	20	19	18	20
Banks Condition	20	19	11	13	19	19
Bank Vegetative Protection	20	20	18	18	20	20
Disruptive Pressure	20	20	20	20	20	18
Riparian Vegetative Zone Width	15	11	14	20	16	15
Total Habitat Score	218	222	213	228	230	227

Table 4. (continued)

Site	Wallenpaupack Creek	E. Branch Wallenpaupack Creek	Dingmans Creek	Dwarfskill Creek	Vandermark Creek	Walker Lake Creek
Site Number	17	18	22N	23N	25N	27N
Date Sampled	5/5/2022	5/5/2022	5/3/2022	4/26/2022	4/14/2022	5/12/2022
Instream Cover	10	16	17	14	12	20
Epifaunal Substrate	8	20	20	19	20	20
Embeddedness	20	18	20	20	20	19
Velocity/Depth Regimes	18	15	18	20	10	19
Channel Alteration	15	15	19	18	20	20
Sediment Deposition	20	19	20	20	20	20
Frequency of Riffles	5	20	20	20	20	20
Channel Flow Status	20	20	20	20	19	20
Banks Condition	16	20	20	20	13	19
Bank Vegetative Protection	20	20	20	15	5	20
Disruptive Pressure	20	20	20	18	11	20
Riparian Vegetative Zone Width	16	15	15	10	10	15
Total Habitat Score	188	218	229	214	180	232

Table 4. (continued)

Site	Westcolang Creek	Teedyuskung Creek	Kleinhans Creek	Rattlesnake Creek	Little Bushkill Creek	Hornbecks Creek
Site Number	28N	29N	30N	38N	44N	5
Date Sampled	4/26/2022	4/26/2022	5/5/2022	4/26/2022	5/3/2022	9/29/2022
Instream Cover	20	20	20	16	20	5
Epifaunal Substrate	20	20	20	20	20	13
Embeddedness	20	5	16	20	20	16
Velocity/Depth Regimes	15	15	15	20	20	15
Channel Alteration	15	15	19	20	20	20
Sediment Deposition	20	11	17	20	19	20
Frequency of Riffles	20	20	20	20	20	16
Channel Flow Status	20	10	20	19	19	20
Banks Condition	19	5	19	20	19	20
Bank Vegetative Protection	19	19	20	10	20	20
Disruptive Pressure	20	19	20	20	20	20
Riparian Vegetative Zone Width	13	20	18	20	18	20
Total Habitat Score	221	179	224	225	235	205

Table 4. (continued)

Site	Bushkill (Millrift) Creek	Twin Lakes Creek	Westcolang Creek	Teedyuskung Creek	Rattlesnake Creek
Site Number	12	13	28N	29N	38N
Date Sampled	9/29/2022	9/29/2022	9/27/2022	9/27/2022	9/27/2022
Instream Cover	20	18	15	19	15
Epifaunal Substrate	20	20	19	20	15
Embeddedness	20	20	20	19	18
Velocity/Depth Regimes	16	20	15	15	15
Channel Alteration	15	19	16	18	20
Sediment Deposition	20	18	20	18	19
Frequency of Riffles	20	20	18	18	16
Channel Flow Status	20	20	20	20	20
Banks Condition	18	20	19	13	19
Bank Vegetative Protection	20	20	20	16	20
Disruptive Pressure	18	20	20	20	20
Riparian Vegetative Zone Width	10	15	15	15	20
Total Habitat Score	217	230	217	211	217

Site Chemistry

Table 5. Chemical data collected at each site with the YSI ProQuatro meter and Hach alkalinity kit. Total dissolved solids (TDS) and Salinity are blank for some sites because we had not yet started sampling for those parameters at the time of the field visit for that site.

	Toms Creek	Sawkill Creek	Vandermark Creek	Cummins Creek	Twin Lakes Creek	Shohola Creek
Site Number	4	9	10	11	13	14
Date Sampled	5/3/2022	5/3/2022	4/14/2022	4/14/2022	4/28/2022	5/12/2022
Water Temp °C	11	12.4	10.9	11.8	6.8	14.7
Dissolved Oxygen (mg/L)	10.71	10.9	10.91	10.62	11.3	9.51
pH	7.47	7.53	7.07	6.93	7.22	7.18
Conductivity (uS/cm)	84.7	78.2	74.2	40.4	42	48
Specific Conductance (uS/cm)	115.6	102.9	101.6	54.1	64.3	59.8
Alkalinity (mg/L CaCO₃)	20	15	20	15	10	15
TDS (g/L)	0.0752	0.0669	-	-	-	0.0389
Salinity (ppt)	0.06	0.05	-	-	-	0.03

Table 5. (continued)

	Wallenpaupack Creek	E. Branch Wallenpaupack Creek	Dingmans Creek	Dwarfskill Creek	Vandermark Creek	Walker Lake Creek
Site Number	17	18	22N	23N	25N	27N
Date Sampled	5/5/2022	5/5/2022	5/3/2022	4/26/2022	4/14/2022	5/12/2022
Water Temp °C	14.4	14.4	13.6	12	11	17.2
Dissolved Oxygen (mg/L)	10.08	10.26	10.09	10.33	10.56	8.84
pH	7.37	7.54	7.27	7.03	6.72	6.76
Conductivity (uS/cm)	53.6	28.7	44.8	113.4	58	45.8
Specific Conductance (uS/cm)	67.2	36	57.3	150.7	79.1	53.8
Alkalinity (mg/L CaCO₃)	20	15	15	15	20	15
TDS (g/L)	0.0436	0.0234	0.0373	-	-	0.035
Salinity (ppt)	0.03	0.02	0.03	-	-	0.03

Table 5. (continued)

	Westcolang Creek	Teedyuskung Creek	Kleinhans Creek	Rattlesnake Creek	Little Bushkill Creek
Site Number	28N	29N	30N	38N	44N
Date Sampled	4/26/2022	4/26/2022	5/5/2022	4/26/2022	5/3/2022
Water Temp °C	11.7	10	13	10.8	12.1
Dissolved Oxygen (mg/L)	11.18	11.61	10.19	11.04	10.8
pH	7.29	7.48	7.51	7.11	6.94
Conductivity (uS/cm)	93	117.5	83.3	23.7	28.6
Specific Conductance (uS/cm)	126	164.7	108.1	32.4	38
Alkalinity (mg/L CaCO₃)	15	25	20	15	15
TDS (g/L)	-	-	0.0702		0.0247
Salinity (ppt)	-	-	0.05		0.02

Table 5. (continued)

	Hornbeck's Creek	Bush Kill (Millrift) Creek	Twin Lakes Creek	Westcolang Creek	Teedyuskung Creek	Rattlesnake Creek
Site Number	5	12	13	28N	29N	38N
Date Sampled	9/29/2022	9/29/2022	9/29/2022	9/27/2022	9/27/2022	9/7/2022
Water Temp ©	14.4	13	11	13.5	12	12.9
Dissolved Oxygen (mg/L)	10.1	9.78	10.65	9.05	10.17	9.34
pH	7.16	7.38	7.6	7.29	7.82	7.34
Conductivity (uS/cm)	151.7	57.4	57.5	112.2	152.7	37.6
Specific Conductance (uS/cm)	190.3	74.6	78.6	143.9	203.1	49
Alkalinity (mg/L CaCO3)	20	15	20	15	30	20
TDS (g/L)	0.1237	0.0484	0.0511	0.0935	0.132	0.0318
Salinity (ppt)	0.09	0.04	0.04	0.07	0.1	0.03

Macroinvertebrates

Table 6. Index of Biotic Integrity calculations for the macroinvertebrate sites sampled in spring 2022.

Site	Toms Creek	Sawkill Creek	Vandermark Creek	Cummins Creek	Twin Lakes Creek	Shohola Creek
Site Number	4	9	10	11	13	14
Total Taxa Richness	29	24	23	21	21	23
EPT Taxa Richness	18	16	16	13	13	16
Modified Beck's Index	40	32	42	33	35	26
Shannon Diversity Index	2.73	2.33	2.18	2.38	2.19	2.57
Hilsenhoff Biotic Index	1.56	2.88	1.3	1.77	1.3	2.85
Percent Sensitive Individuals	82.33	46.27	84.11	77.38	83.25	61.5
INDEX OF BIOTIC INTEGRITY	95.9	78.4	88.3	82.3	83.2	92.7

Site	Wallenpaupack Creek	E. Branch Wallenpaupack Creek	Dingmans Creek	Dwarfskill Creek	Vandermark Creek	Walker Lake Creek
Site Number	17	18	22N	23N	25N	27N
Total Taxa Richness	22	28	19	26	20	14
EPT Taxa Richness	12	16	11	14	12	7
Modified Beck's Index	21	25	16	22	26	11
Shannon Diversity Index	2.12	2.43	2.4	2.32	1.94	1.85
Hilsenhoff Biotic Index	2.62	2.5	4	2.29	1.11	4.12
Percent Sensitive Individuals	64.65	70.67	44.62	74.16	89.27	42.78
INDEX OF BIOTIC INTEGRITY	71.1	82.7	61.4	79.1	76.7	49.3

Table 6. (continued)

Site	Westcolang Creek	Teedyuskung Creek	Kleinhans Creek	Rattlesnake Creek	Little Bushkill Creek
Site Number	28N	29N	30N	38N	44N
Total Taxa Richness	19	19	26	30	27
EPT Taxa Richness	15	12	16	16	15
Modified Beck's Index	32	21	39	26	27
Shannon Diversity Index	2.16	2.22	2.45	2.54	2.72
Hilsenhoff Biotic Index	1.66	3.49	1.79	2.81	2.78
Percent Sensitive Individuals	79.5	51.89	74.5	58.9	60.34
INDEX OF BIOTIC INTEGRITY	81.7	65.9	89.5	82	81.2

Fish Communities

Table 7. Index of Biotic Integrity (IBI) calculations for the 6 sites samples for fish species in fall of 2022. The IBI metrics in the table below are as listed on pages 5 and 6 of the report under Fish Communities.

Hornbecks Creek - 05		
IBI Metrics	Metric Value	Test Score
IS	0	1
TOL	100	1
CARN	0	1
STENO	0	1
ST	0	1
IS	73.5	5
P	23.53	3
CPE	68	1
L	72.06	3
YOY	0	1
IBI Score		18

Bush Kill (Millrift) - 12		
IBI Metrics	Metric Value	Test Score
IS	0	1
TOL	100	1
CARN	28.3	5
STENO	28.3	1
ST	0	1
IS	52.8	3
P	54.72	3
CPE	53	1
L	86.79	3
YOY	4	3
IBI Score		22

Twin Lakes Creek - 13		
IBI Metrics	Metric Value	Test Score
IS	3	5
TOL	84.6	1
CARN	92.3	5
STENO	92.3	5
ST	13	5
IS	96.15	5
P	7.69	5
CPE	26	1
L	92.31	5
YOY	14	5
IBI Score		42

Westcolang Creek - 28N		
IBI Metrics	Metric Value	Test Score
IS	0	1
TOL	100	1
CARN	3.28	1
STENO	3.27	1
ST	0	1
IS	6.56	1
P	93.44	1
CPE	61	1
L	96.72	5
YOY	1	3
IBI Score		16

Teedyuskung Creek - 29N		
IBI Metrics	Metric Value	Test Score
IS	1	3
TOL	94.2	1
CARN	5.79	1
STENO	5.79	1
ST	100	5
IS	7.44	1
P	92.56	1
CPE	121	3
L	98.35	5
YOY	0	1
IBI Score		22

Rattlesnake Creek - 38N		
IBI Metrics	Metric Value	Test Score
IS	2	3
TOL	84.9	1
CARN	5.66	1
STENO	7.55	1
ST	0	1
IS	35.85	1
P	32.08	3
CPE	53	1
L	83.02	3
YOY	0	1
IBI Score		16

Table 8. The Thermal Fish Index (TFI) calculations for the 6 sites sampled for fish species in fall of 2022.

Hornbecks Creek - 5		
Thermal Class	P Values	
1	0.00	0.00
2	0.00	0.00
3	0.26	0.79
4	0.68	2.71
5	0.06	0.29
	TFI	7.59

Bush Kill (Millrift) Creek - 12		
Thermal Class	P Values	
1	0.00	0.00
2	0.17	0.34
3	0.77	2.32
4	0.06	0.23
5	0.00	0.00
	TFI	5.77

Twin Lakes Creek - 13		
Thermal Class	P Values	
1	0.12	0.12
2	0.77	1.54
3	0.08	0.23
4	0.04	0.15
5	0.00	0.00
	TFI	4.08

Westcolang Creek - 28N		
Thermal Class	P Values	
1	0.02	0.02
2	0.02	0.03
3	0.93	2.80
4	0.03	0.13
5	0.00	0.00
	TFI	5.97

Teedyuskung Creek - 29N		
Thermal Class	P Values	
1	0.06	0.06
2	0.00	0.00
3	0.93	2.78
4	0.02	0.07
5	0.00	0.00
	TFI	5.80

Rattlesnake Creek- 38N		
Thermal Class	P Values	
1	0.00	0.00
2	0.02	0.04
3	0.72	2.15
4	0.26	1.06
5	0.00	0.00
	TFI	6.49

Conclusions

In 2022, the majority of the 17 sites sampled for macroinvertebrates were considered attaining and not impaired. Five of the sites (Sawkill Creek (9), Cummins Creek (11), Dingmans Creek (22N), Walker Lake Creek (27N), and Teedyuskung Creek (29N)) were out of the appropriate range or below the baseline values for the index of biotic integrity (IBI) as shown in Table 9.

Table 9. Index of Biotic Integrity baseline scores from Pike County Conservation District historical data compared to the 2022 scores for the five sites that scored lower than expected.

Site	Sawkill Creek	Cummins Creek	Dingmans Creek	Walker Lake Creek	Teedyuskung Creek
Site Number	9	11	22N	27N	29N
Baseline IBI	90.8	94.4	55.1	85.1	81.6
2022 IBI	78.4	82.3	61.4	49.3	65.9

According to the PA DEP Assessment Methodology, High-Quality (HQ) and Exceptional Value (EV) streams should have an IBI score of 63 or higher. Sites Dingmans Creek (22N) and Walker Lake Creek (27N) have been identified in the table above because their IBI scores are below 63. The Methodology also states that, for HQ and EV streams, IBI values lower than the baseline value by 11 or more points would be a cause for further investigation. Sites Sawkill Creek (9), Cummins Creek (11), and Walker Lake Creek (27N) are identified in the table above because the 2022 value is lower than expected, based on past year's data. These numerical discrepancies could be due to human error during sampling. The conditions of the stream could also have impacted the results if they were not ideal at the time of sampling. The District will monitor these streams closely in the future to determine if the 2022 values are outliers or if they truly represent the stream status.

Of the six fish sites sampled in 2022, only half (3) had an IBI score that would be considered good (≥ 21). Bush Kill (Millrift 12), Twin Lakes Creek (13), and Teedyuskung Creek (29N) all earned a "good" ranking, showing they are healthy, but there's still room for improvement (Table 7, pg.19). The three other sites (in Table 7, pg.19) were only a few points below the "good" threshold (≥ 21), inconsistent with historic data from these sites. This year's irregularity can be attributed to sampling being done very late in the season due to equipment issues beyond District control. Many fish could have migrated elsewhere by that point which could account for low catches and low values. The District will be sampling earlier in the season in the future to avoid the inconsistencies that may have occurred this year because of late sampling.

In terms of the new thermal fish index (TFI), the values were spread out, but Twin Lakes Creek was at an ideal value. Values closer to 2 are more ideal and indicative of a colder water environment while values closer to 10 are potentially indicative of impairment and warm water

conditions. Two sites (Hornbecks Creek (5) and Rattlesnake Creek (38N)) were a little higher than anticipated (Table 8). Again, this could have been due to the time of the sampling.

The District will continue to monitor the sites noted in the future to determine whether or not the numbers are outliers and not representative of the actual stream conditions.

In 2023, the PCCD will be monitoring ten macroinvertebrate site and seven fish sites. The District is hoping to get back on track after an interruption of the normal rotational schedule due to COVID-19. PCCD will continue to monitor on the same rotational basis as has been done historically. The thermal fish index will be the new calculated metric for future fish sampling efforts. The District will also be working on updating protocol as more information becomes available from PA DEP.

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Appendix A

Macro Species Table

Pike County macroinvertebrate samples 2022												
TAXON			POL. TOL									
Order												
Genus/Species				04 Toms	09 Sawkill	10 Vander	11 Cummir	13 Twin Lk	14 Shoho	17 Wallen	18E.B Wal	22N Ding
AMPHIPODA (shrimp)												
Gammarus spp.												
COLEOPTERA (beetles)												
Psephenus spp.			4	15		1				8	2	
Microcylloepus spp.			2	2								
Oulimnius spp.			5				4					
Stenelmis spp.			5						4			2
Ancyronyx spp.			2						1			
Macronychus spp.			2									
Promoresia spp.			2								2	
DIPTERA (true flies)												
Chironomidae			6	7	10	4	6	17	36	6	29	25
Antocha spp.			3	1				1			3	
Atheryx spp.			2	1				2			1	
Tipula spp.			4							2		
Blepharicae adie			0	1	3	3		12				
Emphididae spp.			6		2							
Hexatoma spp.			2				1	1				
Simulium spp.			6		1				3	1	2	29
Prosimulium spp.			2			2	2	3				42
EPHEMEROPTERA (mayflies)												
Epeorus spp.			0	33	28	77	59	88	10	23	9	2
Rhythrogena spp.			0		2							
Ephemerella spp.			1	21	20	21	11	20	43	70	72	5
Seratella spp.			2	12	2				9		6	
Drunella spp.			1		5		17		12	4	23	
Eurylophella spp.			4							1	8	
Panelomis spp.			1						1			
Ameletus spp.			0	1		2	5			2		
Isonychia spp.			3	2	1			3	4		2	9
Paraleptophlebia spp.			1	41	9	5	11	3		24	3	
Cinygmula spp.			1	15		37	38	5		6		
Maccaffertium spp.			3	1	1				6		9	1

Leucrocuta spp.		1	9			4					
Diphetor spp.		6	3			3			1		
Acerpenna spp.		6									
Acentrella spp.		4						2	2	8	7
Baetis spp.		6	9	71	24	33	16		49	1	15
ISOPODA (sowbugs)											
Caecidotea spp.		6								1	
MEGALOPTERA (helgrammites)											
Corydalus spp.		4						4			
Nigronia spp.		2									
Sialis spp.		6									
ODONATA (dragonflies)											
Lanthus spp.		5	2						2	2	1
Aeshna spp.		5									
Argia spp.		6									
OLIGOCHAETA (worms)											
PLECOPTERA (stoneflies)											
Pteronarcys spp.		0					4				
Tallaperla spp.		0	2		1	1	3	1			
Acroneuria spp.		0	7	7	2		4	6			6
Paragnetina spp.		1	2	2	1		1	1	1	3	1
Agnetina spp.					1				1		
Sweltsa spp.		0	7	5	5	7	5		1	1	
Leuctra spp.		0	2			1					
Isoperla spp.		2	1		1	4	3	12	7	7	
Amphinemura spp.		3	2	2						3	14
Paracapnia spp.		1			2						
Malirekus spp.		2									
Beloneuria spp.		3									
TRICHOPTERA (caddisflies)											
Rhyacophila spp.		1	2	1	8	3	4	1		1	2
Dolophilodes spp.		0		1	2			6			1
Chimarra spp.		4						3			10
Wormaldia spp.		0			1						
Diplectrona spp.		0	12	3	9	8	12			1	

Ceratopsyche spp.		5	1	12	4	3	2	13	2	5	1
Hydropsyche spp.		5									
Cheumatopsyche spp.		6		11	1	1		7	3	2	13
Polycentropus spp.		6	1	1							
Neophylax spp.											
Pycnopsyche spp.		4								1	
Micrasema spp.								2			
Lepidostoma spp.		1		1							
Psilotrets spp.		0								1	
METRICS			04 Toms	09 Sawkill	10 Vander	11 Cummin	13 Twin Lk	14 Shoho	17 Wallen	18E.B Wal	22N Dingm
Total Taxa Richness			29	24	23	21	21	23	22	28	19
EPT Taxa Richness			18	16	16	13	13	16	12	16	11
Modified Beck's Index			40	32	42	33	35	26	21	25	16
Shannon Diversity Index			2.73	2.33	2.18	2.38	2.19	2.57	2.12	2.43	2.4
Hilsenhoff Biotic Index			1.56	2.88	1.3	1.77	1.3	2.85	2.62	2.5	4
Percent Sensitive Individuals			82.33	46.27	84.11	77.38	83.25	61.5	64.65	70.67	44.62

TAXON										
Order										
Genus/Species		23N Dwarf	25N Vand	27N Walk	28N Wesc	29N Teedy	30N Klein	38N Rattle	44N L Busr	
AMPHIPODA (shrimp)										
Gammarus spp.										
COLEOPTERA (beetles)										
Psephenus spp.		4							3	
Microcyloepus spp.		2								
Oulimnius spp.										
Stenelmis spp.							2		6	
Ancyronyx spp.								6		
Macronychus spp.		2						1		
Promoresia spp.		8						7	2	
DIPTERA (true flies)										
Chironomidae		12	4	33	23	16	18	12	28	
Antocha spp.		1				1	1			
Atheryx spp.			1			1		1		
Tipula spp.							4			
Blepharicacidae							2			
Emphididae spp.										
Hexatoma spp.			1				5			
Simulium spp.		1	1		5			19	2	
Prosimulium spp.		1		1	1	14		5	5	
EPHEMEROPTERA (mayflies)										
Epeorus spp.			86		54	18	69		8	
Rhythrogena spp.										
Ephemerella spp.		76	18	47	54	5	21	60	30	
Seratella spp.								1		
Drunella spp.									11	
Eurylophella spp.		1				1		2		
Panelomis spp.								1		
Ameletus spp.					10	12	1			
Isonychia spp.		5			1			1		
Paraleptophlebia spp.			9					1		
Cinygmula spp.			42		3					
Maccaffertium spp.		5	1	9	2	5		1	1	

Leucrocuta spp.			1						
Dipheter spp.			1			3	7		
Acerpenna spp.				8				12	
Acentrella spp.		11						20	1
Baetis spp.			15		14	82	19		1
ISOPODA (sowbugs)									
Caecidotea spp.									
MEGALOPTERA (helgrammites)									
Corydalis spp.		1							
Nigronia spp.			1	5				1	
Sialis spp.									1
ODONATA (dragonflies)									
Lanthus spp.								4	
Aeshna spp.								1	
Argia spp.									1
OLIGOCHAETA (worms)									
				3					2
PLECOPTERA (stoneflies)									
Pteronarcys spp.					3		5	2	1
Tallaperla spp.		1			3		3	1	
Acroneuria spp.		5		1	11	1	5	3	4
Paragnetina spp.		1					1	1	2
Agnetina spp.									
Sweltsa spp.			7		5	14	2		
Leuctra spp.									
Isoperla spp.		10	6	2	1	16	5		21
Amphinemura spp.		8		14	3	2	1	33	
Paracapnia spp.									
Malirekus spp.							1		
Beloneuria spp.								1	
TRICHOPTERA (caddisflies)									
Rhyacophila spp.		2	2	1	1	2	5	2	6
Dolophilodes spp.		1	2		6		8		13
Chimarra spp.		3						1	12
Wormaldia spp.							1		
Diplectrona spp.		4	5		1	8	14		1

Ceratopsyche spp.		10					1	13	12
Hydropsyche spp.				1		2			2
Cheumatopsyche spp.		2	1	66				5	
Polycentropus spp.		1					2	1	
Neophylax spp.			1			9			1
Pycnopsyche spp.							1		
Micrasema spp.				3					2
Lepidostoma spp.									
Psilotrets spp.									
METRICS		23N West	25N Vand	27N Walk	28N Wesc	29N Teedy	30N Klein	38N Rattle	44N L Bush
Total Taxa Richness		26	20	14	19	19	26	30	27
EPT Taxa Richness		14	12	7	15	12	16	16	15
Modified Beck's Index		22	26	11	32	21	39	26	27
Shannon Diversity Index		2.32	1.94	1.85	2.16	2.22	2.45	2.54	2.72
Hilsenhoff Biotic Index		2.29	1.11	4.12	1.66	3.49	1.79	2.81	2.78
Percent Sensitive Individuals		74.16	89.27	42.78	79.5	51.89	74.5	58.9	60.34

Appendix B

Fish Species Table

	Hornbeck's Creek	Bush Kill (Millrift) Creek	Twin Lakes Creek	Westcolang Creek	Teedyuskung Creek	Rattlesnake Creek
	5	12	13	28N	29N	38N
Species	9/29/2022	9/29/2022	9/29/2022	9/27/2022	9/27/2022	9/27/2022
Bluegill	4					
BlacknoseDace	16	23	1	57	112	12
Redbreast Sunfish	13					3
Fallfish	31	2				9
Grass Pickerel	2					
Longnose Dace	2	11				
Brown Trout		5	7			1
Brown Trout YOY		4	13	1		
Smallmouth Bass		1				
American Eel		6	1			2
White Sucker		1				13
Brook Trout			2		7	
Brook Trout YOY			1			
Margined Madtom			1			1
Pumpkinseed				2	2	
Rainbow Trout				1		
Tesselated Darter						2
Creek Chub						1
Cutlips Minnow						7
Common Shiner						1
Lamprey YOY						1
TOTAL	68	53	26	61	121	53