
# 2013 COLDWATER HERITAGE PARTNERSHIP GRANT

## LACKAWANNA RIVER TRIBUTARIES STUDY/PLAN

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# TABLE OF CONTENTS

## I. Abstract

In 2011 Lackawanna County Conservation District (LCCD) requested the assistance of Trout Unlimited's Eastern Abandoned Mine Technical Assistance Program, in conducting a biological assessment of the Lackawanna River. The District partnered with DCNR, LRCA and the Lackawanna Valley Chapter of Trout Unlimited in this effort. Nine sites along the Lackawanna and three sites along Roaring Brook (a major tributary of the river) were assessed for habitat, fish (presence and absence) and macroinvertebrates. The habitat was surveyed using DEP's Water Quality Network Habitat Assessment Form. Benthic Macroinvertebrates were collected using DEP's Instream Comprehensive Evaluation (ICE) protocol. The Fishery Survey was conducted using a Smith-Root, Model LR-24 backpack electrofisher. The final report was issued in September of 2012.

The following is a list of the sites that were surveyed and their approximate locations:

| Site Number | Description | Latitude | Longitude |
|---|---|---|---|
| 1 | Forest City at American Water Plant | 41.659758 | 75.463561 |
| 2 | Carbondale Industrial Park | 41.586904 | 75.491003 |
| 3 | Behind LCCD | 41.547446 | 75.53044 |
| 4 | Jermyn at Powdermill Dam | 41.498087 | 75.539513 |
| 5 | Winton Street | 41.482127 | 75.550378 |
| 6 | Mellow Park, Peckville | 41.476439 | 75.581505 |
| 7 | Parker Street, near LRCA Office | 41.439376 | 75.640699 |
| 8 | Davis Street | 41.384866 | 75.703603 |
| 9 | Elm Street Bridge | 41.399228 | 75.676514 |
| 10 | Nay Aug Park on Roaring Brook | 41.406275 | 75.63805 |
| 11 | Roaring Brook at Chico's | 41.404925 | 75.572253 |
| 12 | Roaring Brook at Aberdeen Road | 41.340478 | 75.515347 |

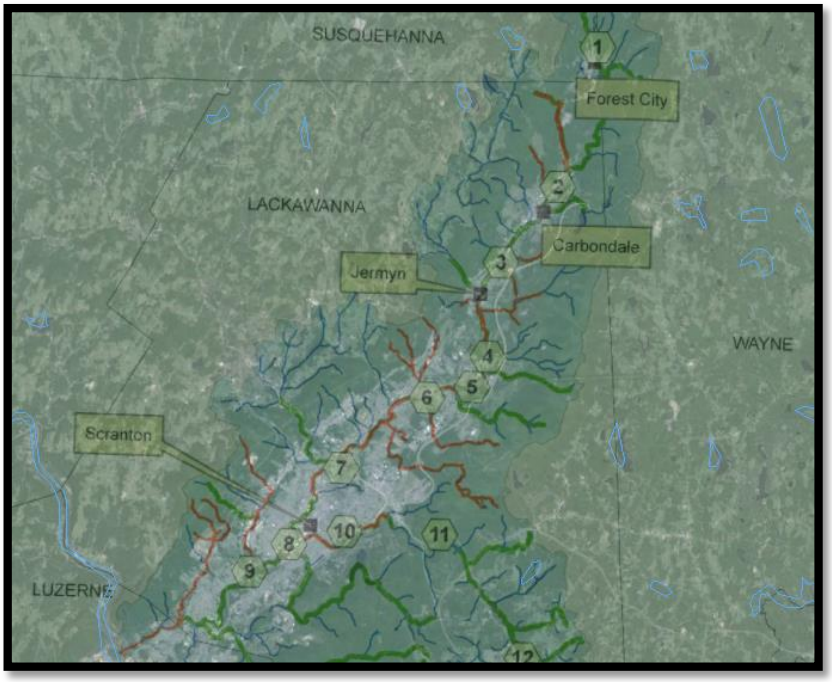



FIGURE 1. SITES FROM 2011 STUDY OF THE LACKAWANNA RIVER
Overlaid on Map of Land Use
(Gray area shows developed areas of study.)

Results of the 2011 assessment suggest that sites 7, 8 and 9 represent the most degraded portion of the river. Through the Coldwater Conservation Planning Grant, LCCD has performed a focused assessment that sought to identify the source(s) of this measured degradation of the Lackawanna River. Building on the 2011 assessment, the District continued this effort by collecting chemistry data, benthic macroinvertebrate data and habitat information on the tributaries located within the most degraded portion of the Lackawanna River and used this information to identify the source(s) of any degradation and to create a plan to minimize or eliminate those sources. Our hypothesis was that urban runoff and AMD contributed to the degradation of the river. For example, Eddy Creek runs above abandoned mine pools and, during rain events, possibly carries highly acidic water to the river. Additionally, all of the streams (listed below) flow within very urbanized watersheds and are not diluted to any degree by cleaner mountain runoff, potentially adding to the contamination of the river.

The following tributaries and locations indicate where chemistry data was collected:

| Site Number | Description | Stream Type | *Latitude | *Longitude |
|---|---|---|---|---|
| 1 | West Branch Tinklepaugh Creek | Intermittent | 41.493069 | 75.591259 |
| 2 | Hulls Creek | Perennial | 41.492683 | 75.619283 |
| 3 | Eddy Creek | Ephemeral | 41.445380 | 75.605979 |
| 4 | Leggett's Creek | Perennial | 41.443691 | 75.646085 |
| 5 | Unnamed, Enterprise St. | Intermittent | 41.455330 | 75.621428 |
| 6 | Unnamed, Woodlawn St. | Intermittent | 41.452346 | 75.622909 |

*The latitudes and longitudes listed are the specific sites where chemistry was monitored under the CCP Grant. Some locations have changed from the originally proposed sites due to further scrutiny of access points and existing flow conditions.

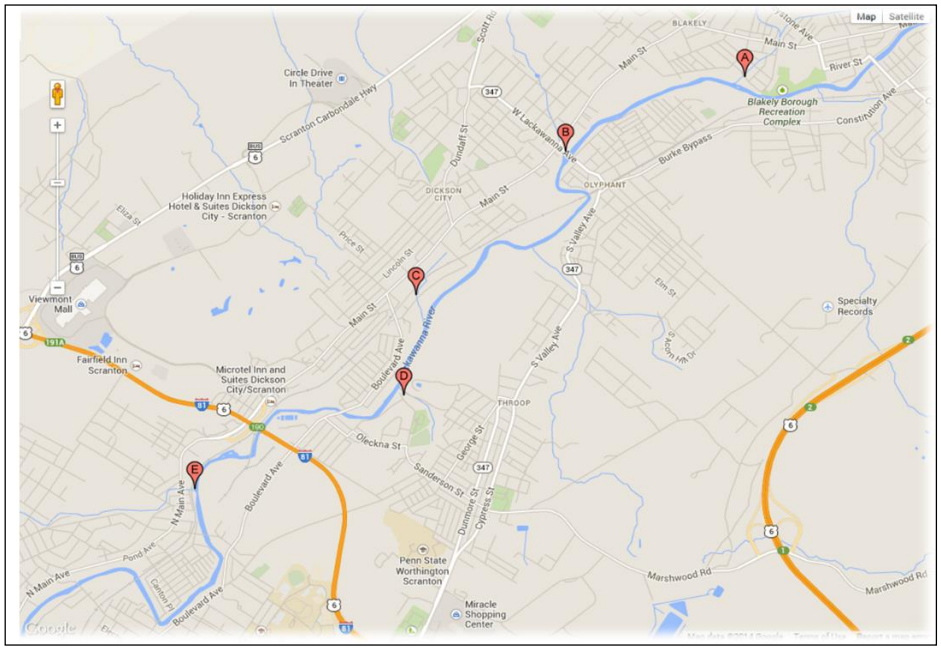



FIGURE 2. MAP OF MONITORING SITES

Tributaries 5 and 6 were only monitored through December of 2013. They are intermittent streams as was West Branch Tinklepaugh Creek. All three were dry for much of the summer. As expected these streams contributed very little, in volume of water, to the river during the study period. Eddy Creek was dry throughout the monitoring period and the single set of data was taken after a rain event. The sample was collected from standing water. Eddy Creek, an ephemeral stream, originates from Marshwood Reservoir in Olyphant, Lackawanna County. The PA DEP plans to excavate, backfill and grade abandoned mine lands featured on 25 acres, as well as restore 3.4 miles of Eddy Creek, lessening potential flooding hazards and thereby improving water quality in its watershed. Only Hulls and Leggetts continually ran during our monitoring period. West Branch Tinklepaugh Creek was dry from July through October of 2013 (See Appendix B). 2012 was an unusually dry year. Nearing the end of the summer months, the monitoring region was down 11 inches of precipitation from the average year's precipitation.

Of the tributaries in the study, Leggetts Creek contributed by far, the highest volume of water to the Lackawanna River at approximately 64%, considering the contribution of volume of water and chemistry results, we concluded that Leggetts Creek was contributing most of the degradation to the studied portion of the river. Therefore, we began focusing our attention on Leggetts Creek and will continue, as part of this plan.

In 2012, the South Abington Sewer Authority began state and federally mandated upgrades to the sewage treatment facility, including the sewer lines, located along Leggetts Creek. The project includes increasing the plant's hydraulic capacity to avoid system overloads that have led to untreated wastewater and harmful nutrients being discharged into Leggett's Creek and installing new sewer lines that run parallel to and cross under the creek several times (This portion of the improvement project is complete.). All of the improvements are due to be completed by the end of 2014. In addition, all of the developed land and impervious surfaces surrounding the creek from Clarks Green, through Clarks Summit, South Abington and Dickson City; including the PA Turnpike to the north and Routes 81 and 6/11 which run parallel to the stream, make the potential for contamination from urban runoff extremely high.

Our results show that Leggetts Creek has elevated levels of Total Dissolved Solids (TDS), Electrical Conductivity (EC) and pH. (TDS measures the dissolved solid in the water and EC measures the amount of electrical conductivity in the water or metals that will conduct electricity.) Although the average salinity was well within acceptable limits of < 1000 ppm (parts per million), actual results averaged 345 ppm. The maximum reading was 435 ppm; it would be beneficial to take steps to reduce salinity levels.

Therefore our plan is to continue to monitor Leggetts Creek until well after the completion of the upgrades to the treatment plant in order to verify what is expected to be a considerable improvement in water quality. We began testing for TDS, EC and salinity above and below the treatment plant in April 2014. If improvements aren't observed to an acceptable level, the District will then begin testing for more specific contaminants (e.g. aluminum, magnesium, lead, nitrates and phosphates etc.). However, we expect that we will see improvements.

## II. Methodology

The District collected chemistry data and conducted habitat assessments (using ***PA DEP's Water Quality Network Habitat Assessment Form***) along the six main tributaries that feed a portion of the Lackawanna River. Benthic macroinvertebrate surveys (using ***DEP's Instream Comprehensive Evaluation (ICE)*** protocol) were conducted on Leggetts Creek, Hulls Creek and two locations along the river within the monitoring area. Leggetts and Hulls were the only two streams capable of supporting aquatic life. Chemistry data was collected approximately once per month, for a period of one year and habitat assessments and benthic macroinvertebrate surveys were conducted once during this one year period. The habitat assessments were conducted in the spring of 2013 and the macro collection was conducted in November of 2013.

As shown in the map above, Site #7 is centrally located in the portion of the river that is most developed. Runoff from these developed areas is believed to be the major cause of degradation in the Lackawanna River.

## III. Results

### *A. Chemistry*

#### *1.* Equipment

Meters were chosen over titration methods in the interest of time constraints and maximizing accuracy of the data. If meters weren't operating, titration methods were used. The following is a list of the meters used:

1. *LaMotte Tracer Pocketester, Code 1749, Salt, TDS, EC, Temp. – Removed from service in July. Replaced by #3.
2. **Extech Instruments, Dissolved Oxygen, DO600, ExStik II- Removed from service
3. Hanna Waterproof Combo Tester for pH, EC, TDS, Temp.
4. *Oakton Waterproof pHTestr 30-Replaced by #3 in July

***Due to multiple failures of the monitoring equipment, replacements had to be introduced during the 12 month monitoring period. All precautions were taken to ensure continued accuracy.***

****Due to inconsistent performance and eventual failure of D.O. meter it was removed from service in February 2013. Please consider this while reviewing the data.***

#### *2.* Results Summary

The following tables show summaries of the chemistry data collected from March 2013-March 2014 (for complete data see Appendix B):

| West Branch Tinklepaugh Creek (Intermittent)-Site 1-Chemistry Data_41.493069, -75.591259; Elevation: 310 MASL | | | | |
|---|---|---|---|---|
| | Avg. | Min | Max | STDEV |
| EC (µS/cm) | 28.69 | 14.00 | 49.50 | 11.64 |
| TDS (mg/L) | 13.86 | 7.00 | 20.00 | 5.84 |
| pH | 7.25 | 6.38 | 7.95 | 0.50 |
| DO (%) | 133.70 | 83.06 | 172.40 | 37.82 |
| Temp. (°C) | 8.75 | 3.28 | 18.08 | 5.24 |
| Salinity (ppm) | 10.00 | 10.00 | 10.00 | 0.00 |
| Surrogate St. Flow ($ft^2$) | 1.22 | 0.00 | 2.64 | 1.09 |

Table 1- WBTC Chemistry Data

| Hulls Creek (Perennial)-Site 2-Chemistry Data_41.492683, 75.619283; Elevation: 415 MASL | | | | |
|---|---|---|---|---|
| | Avg. | Min | Max | STDEV |
| EC (µS/cm) | 283.45 | 179.50 | 679.00 | 133.21 |
| TDS (mg/L) | 167.81 | 50.00 | 490.00 | 110.87 |
| pH | 7.60 | 6.82 | 8.07 | 0.34 |
| DO (%) | 115.69 | 30.80 | 249.02 | 59.11 |
| Temp. (°C) | 11.34 | 2.17 | 21.64 | 6.96 |
| Salinity (ppm) | 136.37 | 70.95 | 310.00 | 76.54 |
| Surrogate St. Flow ($ft^2$) | 2.75 | 1.07 | 6.38 | 1.55 |

Table 2- Hulls Ck. Chemistry Data

| Eddy Creek (Ephemeral)-Site 3-Chemistry Data_41.445380, -75.605979; Elevation: 271 MASL | | | | |
|---|---|---|---|---|
| | Avg. | Min | Max | STDEV |
| EC (µS/cm) | 203.50 | 203.50 | 203.50 | N/A |
| TDS (mg/L) | 140.00 | 140.00 | 140.00 | N/A |
| pH | 6.99 | 6.99 | 6.99 | N/A |
| DO (%) | 66.50 | 66.50 | 66.50 | N/A |
| Temp. (°C) | 23.42 | 23.42 | 23.42 | N/A |
| Salinity (ppm) | 100.00 | 100.00 | 100.00 | N/A |
| Surrogate St. Flow ($ft^2$) | N/A | N/A | N/A | N/A |

Table 3- Eddy Ck. Chemistry Data

| Legget's Creek (Perennial)-Site 4-Chemistry Data_41.443691, -75.646085; Elevation: 221 MASL | | | | |
|---|---|---|---|---|
| | Avg. | Min | Max | STDEV |
| EC (µS/cm) | 677.54 | 538.00 | 979.50 | 141.13 |
| TDS (mg/L) | 411.96 | 50.00 | 680.00 | 168.92 |
| pH | 8.20 | 7.64 | 9.23 | 0.49 |
| DO (%) | 119.38 | 28.95 | 236.75 | 61.33 |
| Temp. (°C) | 11.62 | 0.97 | 22.64 | 7.27 |
| Salinity (ppm) | 345.00 | 280.00 | 435.00 | 66.14 |
| Nitrates (mg/L) | 2.50 | 2.50 | 2.50 | N/A |
| Phosphates (mg/L) | 1.58 | 1.58 | 1.58 | N/A |
| Surrogate St. Flow ($ft^2$) | 15.38 | 4.69 | 41.25 | 8.66 |

Table 4- Leggetts Ck. Chemistry Data

| Un-Named Trib (Intermittent)-Site 5-Chemistry Data_41.45533, -75.621428; Elevation: 227 MASL | | | | |
|---|---|---|---|---|
| | Avg. | Min | Max | STDEV |
| EC (µS/cm) | 171.60 | 115.00 | 235.00 | 45.98 |
| TDS (mg/L) | 111.60 | 58.00 | 160.00 | 39.02 |
| pH | 7.68 | 7.21 | 8.27 | 0.39 |
| DO (%) | 107.20 | 74.28 | 157.10 | 40.05 |
| Temp. (°C) | 14.08 | 7.30 | 19.81 | 4.51 |
| Salinity (ppm) | 87.50 | 70.00 | 110.00 | 17.08 |
| Surrogate St. Flow ($ft^2$) | 1.29 | 0.00 | 4.46 | 1.59 |

Table 5- Un-named Trib. #5 Chemistry Data

| Un-Named Trib (Intermittent)-Site 6-Chemistry Data_41.452346, -75.622909; Elevation: 225 MASL | | | | |
|---|---|---|---|---|
| | Avg. | Min | Max | STDEV |
| EC (µS/cm) | 167.07 | 116.00 | 198.40 | 27.21 |
| TDS (mg/L) | 104.63 | 57.00 | 134.00 | 24.52 |
| pH | 7.43 | 6.20 | 8.75 | 0.80 |
| DO (mg/L) | 104.63 | 43.45 | 139.00 | 35.18 |
| Temp. (°C) | 18.23 | 7.60 | 25.06 | 5.52 |
| Salinity (ppm) | 87.50 | 80.00 | 100.00 | 9.57 |
| Surrogate St. Flow ($ft^2$) | 2.65 | 0.00 | 6.62 | 2.47 |

Table 6- Un-named Trib. #6 Chemistry Data

The following parameters were used to determine acceptable levels of chemistry. These parameters were taken from the *PA Fish and Boat Commission's Pond and Stream Guide:*

| Parameter | *Normal Values |
|---|---|
| EC (Conductivity) | 150 to 500 µS/cm (microsiemens per centimeter) |
| TDS | 50 to 250 mg/L |
| pH | 6.5-8 |
| DO | 125% and greater- Too High |
| | 80-124%-Excellent |
| | 60-79%-Ok |
| | Below 60%-Poor |
| Temperature | Optimum for spawning trout 48 oF (8.8 °C) |
| | 52-61 °F (11-16 °C) - Good |
| Salinity | <1000 ppm |
| Nitrates | <1 mg/L-good (naturally occurs) |
| | <0.06 mg/L-ideal |
| Phosphates | <0.01 mg/L-ideal for small streams |

Table 7- Acceptable Chemistry

## *B. Benthic Macroinvertebrates*

The Index of Biological Integrity, or IBI, is a scoring system used to measure strong responses to human disturbance, or pollution, in streams. PA DEP's Index of Biological Integrity (IBI) uses Beck's Index, EPT Taxa Richness, Total Taxa Richness, Percent Intolerance Index, Shannon Diversity and Hilsenhoff Biotic Index. These indexes are calculated in a standard formula to come up with the IBI. (See Appendix B for more on these indexes.)

The following table shows the locations of the benthic macroinvertebrate collection sites:

| Macro Collection Site Locations | Latitude | Longitude |
|---|---|---|
| Hulls A1 | 41.486220 | -75.614279 |
| Hulls B1 | 41.500988 | -75.625081 |
| Hulls C1 | 41.506456 | -75.624096 |
| Leggetts A1 | 41.443627 | -75.646198 |
| Leggetts A2 | 41.496013 | -75.665720 |
| Leggetts D1 | 41.449629 | -75.675704 |
| Lackawanna D1 | 41.437920 | -75.641142 |
| Lackawanna E2 | 41.399230 | -75.676514 |

Table 8-Macro Collection Sites

The follow tables show the results of the benthic macroinvertebrate survey. Three sites were surveyed on both Hulls Creek and Leggetts Creek. Two sites were surveyed on the Lackawanna River.

| *Hulls Creek* | *Site A1* | *Site B1* | *Site C1* |
|---|---|---|---|
| Beck's Index | 26.00 | 14.00 | 10.00 |
| EPT Taxa Richness | 16.00 | 4.00 | 9.00 |
| Total Taxa Richness | 24.00 | 7.00 | 14.00 |
| Percent Intolerance Index | 53% | 2.5% | 18.8% |
| Shannon Diversity | 2.05 | 1.45 | 1.54 |
| Hilsenhoff Biotic Index | 2.70 | 0.28 | 2.50 |
| *IBI Score* | *74.96* | *38.79* | *47.45* |

Table 9- Macro Results-Hulls Ck.

| *Leggetts Creek* | *Site A1* | *Site A2* | *Site D1* |
|---|---|---|---|
| Beck's Index | 2.00 | 3.00 | 6.00 |
| EPT Taxa Richness | 6.00 | 4.00 | 6.00 |
| Total Taxa Richness | 11.00 | 10.00 | 11.00 |
| Percent Intolerance Index | 7.1% | 4.2% | 7.9% |
| Shannon Diversity | 0.91 | 0.70 | 2.01 |
| Hilsenhoff Biotic Index | 2.85 | 1.24 | 1.56 |
| *IBI Score* | *33.09* | *31.45* | *43.39* |

Table 10- Macro Results-Leggetts Ck.

| *Lackawanna River* | *Site D2* | *Site E2* |
|---|---|---|
| Beck's Index | 2.00 | 2.00 |
| EPT Taxa Richness | 6.00 | 8.00 |
| Total Taxa Richness | 18.00 | 22.00 |
| Percent Intolerance Index | 32.1% | 19.2% |
| Shannon Diversity | 1.90 | 1.86 |
| Hilsenhoff Biotic Index | 4.86 | 5.78 |
| *IBI Score* | *43.20* | *42.30* |

Table 11- Macro Results-Lackawanna River

Biological indexes were calculated for each sample site. IBI scores highlighted in green indicate that the site meets the benchmark for aquatic life use. Red highlights indicate sites that do not meet the benchmark for aquatic life use and that fewer than 160 individual benthic macroinvertebrates were present in the sample at the site, therefore IBI scores should be interpreted cautiously. Sites highlighted in grey also do not meet the benchmark for attaining life use however, do have more than 160 individuals.

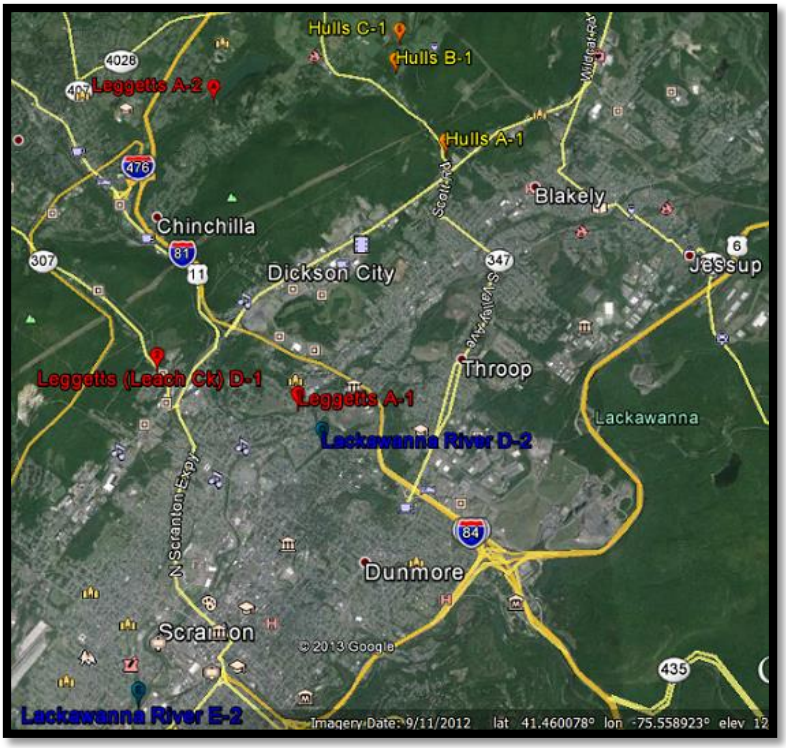



FIGURE 3. MACRO COLLECTION SITE LOCATIONS

This map shows all taxa collection locations in relation to urbanized development and impervious surfaces.

## *C. Fish Population – Leggetts Creek*

*(see Appendix A for complete report)*

A fish population survey was conducted on Leggetts Creek by PA Trout Unlimited AMD Technical Assistance Program on November 15, 2013. (This survey was not part of the original proposal however, it was added during the study period.)

A total of nine (9) brown trout were collected during the fishery survey. Brown trout ranged in total length from 84 to 316 mm with a mean of 139 mm. Mean stream width was 5.45 meters. Density of brown trout was 164 trout per hectare. Figure 2 of Appendix A shows the size class distribution of brown trout captured within the survey reach. Other fish species were present, their relative abundance are shown in Table 1 of Appendix A. The results of the fishery survey have been sent to the Pennsylvania Fish and Boat Commission and may lead to the addition of Leggetts Creek to the "wild trout list". This designation would include an upgrade of all of the associated wetlands to Exceptional Value by the DEP and offer the stream additional protections. Although, as of the writing of this report, we have received no notification of this upgrade.

## *D. Habitat Assessment (see Appendix B for complete assessment)*

Habitat Assessments were conducted on August 7, 2013 when vegetation was at its peak and where chemistry monitoring took place. Therefore, these assessments are not representative of the entire stream length. Refer to coordinates in Section I, Abstract for exact locations. See Section IX, Appendix C for Habitat Assessment Field Data Sheets.

*Habitat Assessment Scores:*

| Stream Number | Stream Name | Instream Cover | Epifaunal Substrate | Embedded | Velocity/Depth Regimes | Channel Alteration | Sediment Deposit | Frequency of Riffle | Channel Flow Status | Condition of Banks | Bank Vegetative Protection | Grazing or Other Disruptive Pressure | Riparian Vegetative Zone Width | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | *WBTC | 19 | 19 | 12 | 19 | 16 | 11 | 18 | 8 | 13 | 18 | 20 | 19 | 192 |
| 2 | Hulls Ck | 13 | 9 | 18 | 5 | 13 | 19 | 18 | 8 | 13 | 13 | 20 | 10 | 159 |
| 3 | Eddy's Ck | 1 | 0 | 1 | 0 | 19 | 1 | 2 | 2 | 18 | 18 | 19 | 19 | 100 |
| 4 | Leggetts Ck | 16 | 18 | 18 | 17 | 18 | 19 | 17 | 10 | 19 | 14 | 17 | 10 | 193 |
| 5 | #5 **UT | 8 | 6 | 8 | 2 | 11 | 6 | 4 | 15 | 18 | 19 | 13 | 8 | 118 |
| 6 | #6 **UT | 7 | 11 | 5 | 3 | 17 | 11 | 8 | 8 | 14 | 19 | 19 | 7 | 129 |

Table 12- Habitat Assessment Results

*West Branch Tinklepaugh Creek
**Unnamed Tributary

*Habitat Assessment Categories are as follows:*

Poor: 0-55, Marginal: 56-105, Sub-Optimal: 106-155, Optimal: 156-200

*Stream Habitat Assessment Rankings:*

| Stream # | Stream Name | Score | Habitat Assessment Ranking |
|---|---|---|---|
| 1 | West Branch Tinklepaugh Creek | 192 | Optimal |
| 2 | Hulls Creek | 159 | Optimal |
| 3 | Eddy's Creek | 100 | Marginal |
| 4 | Leggetts Creek | 193 | Optimal |
| 5 | Unnamed Tributary | 118 | Sub-Optimal |
| 6 | Unnamed Tributary | 129 | Sub-Optimal |

Table 13-Habitat Assessment Ranking

## IV. Conclusion

Leggetts Creek was found to be a major contributor to the degraded portion of the Lackawanna River as evidenced by the TDS/EC and salinity data and will require more intensive studies to determine if the waste water treatment plant improvements will, in time, reverse any contamination the sub-adequate treatment may have caused.

Additionally as expected, urbanization contributes to the degradation of the river and Leggetts Creek and to some degree all tributaries in this study. These streams are not diluted to any degree by cleaner mountain runoff. However, AMD did not seem to have much of an effect on water quality, as originally expected, as evidenced by the pH data, contained in this report.

Therefore at this time, there is no tangible evidence that would justify upgrading any of these tributaries or the affected portion of the Lackawanna River in order to provide them with increased protection.

## V. Plan

***Description of Leggetts Creek***

Leggetts Creek is a third order stream that enters the Lackawanna River at RM 14.5, in the city of Scranton. The main stem of Leggetts Creek begins at Griffin Reservoir at 1360 feet in South Abington Township. Tributaries above the reservoir drain wetlands in South Abington and Scott Twps. From these wetland sources, the stream flows for 8.0 miles, draining an 18.46 mi2 watershed and entering the river at 730 feet. Leggetts Creek has the third largest watershed of the Lackawanna River's tributary streams. Most of the stream's watershed is developed with only a few reaches of the stream still remaining in natural conditions. Leggetts Creek has twelve tributary streams which include:
Leach Creek, Summit Lake Creek, Landsdowne Creek, and small first order tributaries with local names. Like Leggetts Creek, most of these streams flow through developed areas, with generally only their upper reaches remaining in undisturbed land.
Headwater wetland and stream reaches to Leggetts Creek are generally surrounded by residential development. Though the wetlands themselves are relatively un-impacted, streams flowing from them intersect roadways and subdivisions, restricting their riparian corridor. As development in South Abington and Scott Twps. continues, the wetlands are being crowded as well. Conditions at Griffin Reservoir, the source of Leggetts Creek's main stem, are relatively undisturbed. The reservoir is the source of drinking water for residents in the stream's watershed, so access and use are restricted. A native cover of trees and understory surround the reservoir and all development is well off its banks.
A pipe discharge at the dam on Griffin Reservoir conveys flow downstream into Leggetts Creek. From the dam downstream 0.75 miles to a water supply intake pond, near I-81, the stream and its corridor remain in natural condition. The riparian zone consists mainly of old growth forest.

Just upstream of I-81, Leggetts Creek flows into a small pond, from which an intake pipe conveys water downstream to a wastewater treatment plant in Chinchilla. The stream then crosses under


I-81 and an entrance ramp to the North East Extension of the PA Turnpike, before flowing through South Abington Park (left). A riparian zone of native trees and understory flank the north bank. A walking trail has been developed through the park along the north bank. It extends about 0.4 miles downstream of the park to Layton Road and receives regular use. The park, an elementary school, and PA Rtes. 6 & 11 lie off the south bank, restricting the riparian corridor.

Two second-order and one first-order tributary streams enter Leggetts Creek in the park area. The first order tributary stream originates in Scott Twp. and flows along developed areas of the township and Chinchilla Borough. Its south bank is flanked primarily by undeveloped forest, however, residential development off its north bank has encroached into its corridor. A second order tributary, Landsdowne Creek, drains areas of Clarks Summit and Clarks Green. It is primarily stabilized or channelized and runs along roadways and residential and commercial properties, receiving significant amounts of storm water runoff. Summit Lake Creek originates at the South Abington – Newton Twp. border and flows from the west into Leggetts Creek. Its upper stretches are more natural and undisturbed, however, lower portions also flow through developed areas.

From Layton Road downstream for about 1.5 miles, through The Notch, Leggetts Creek closely follows Rtes. 6 & 11. The Notch, or Leggetts Gap, is a water gap cut by Leggetts Creek through the Lackawanna Mountain range. In addition to Leggetts Creek, the former Lackawanna Railroad (now the Canadian Pacific), Rtes. 6 & 11, and I-81 use the narrow gap to enter and leave the Lackawanna Valley.

Commercial properties along Rtes. 6 & 11 have encroached into and restrict the stream's riparian corridor. The channel is stabilized along the highway. The Chinchilla wastewater treatment plant discharges its effluent into this reach of the stream.

During summer, low-flow periods, effluent makes up most of the flow in the stream. From the discharge point downstream to The Notch, the creek is bounded by Rtes. 6 & 11 off the north bank and a well-established, native tree and understory cover along the south bank.

Sections of the stream are also rip rapped through this reach, as it runs within close proximity to the highway. The stream corridor is narrow, as it begins to flow through the Notch and under Rtes. 6 & 11 in a large concrete culvert. Just downstream of the Rtes. 6 & 11 culvert, a first order tributary enters the stream. From its source on Bell Mountain, the tributary descends a steep gradient and flows under Rte. 6 near the Viewmont Shopping Mall. Upper reaches are natural

and undisturbed by development however, from the highway to its confluence with Leggetts Creek, the tributary is channelized or stabilized around and under parking lots and roadways. From the culvert under Rtes. 6 & 11 downstream 2 miles to the confluence, Leggetts Creek and its corridor are impacted by urban development and debris, and past mining operations. Conditions are not as impacted within the first 0.5 mile portion of this stretch however. Residential development is away from the stream corridor and stable vegetative cover generally exists along a natural stream channel. (McGurl, 2001, pg. 292)

***Plan for Future Monitoring of Leggetts Creek***

The Lackawanna County Conservation District has already begun more intensive monitoring of Leggetts Creek. We have chosen sites above and below the treatment plant in order to gain a clear understanding of what the upgrades will have contributed to improving the health of the stream.

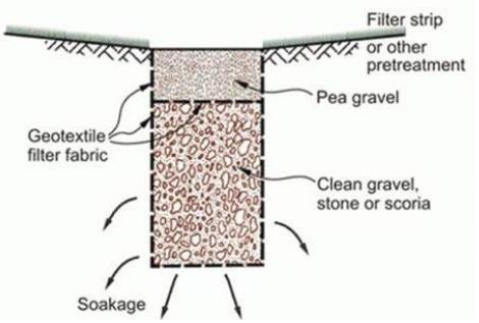
We have also started studying the contour of the stream so that we can gain a better understanding of the flow rates and a more accurate estimate of its contribution to the Lackawanna River.

Once we have accumulated enough data to make a conclusion, we will amend this report to include both the data and the conclusion.

The District continues to play a role, along with other government agencies and non-profit organizations, in educating the general public on stormwater runoff and non-point source pollution. Therefore we also recommend that residence contact their county conservation districts to see how they can implement these important practices and do their part to contribute to improved water quality.

***Recommendations***

In addition to continuing to monitor Leggetts Creek, the Lackawanna County Conservation District recommends that the urbanized areas adjacent to the river and its tributaries, incorporate current stormwater best management practices (BMPs) such as rain barrels, rain gardens, curb and gutter elimination in residential areas and bioretention cells in parking lots and along roadways.




Infiltration trenches can be used in place of curbs and rain barrels can be used when disconnecting downspouts. Rain Gardens can be installed at extended down spouts.Grassed swales, green parking designs and vegetated roofs can be used wherever appropriate and will help to allow infiltration of stormwater into the ground.

**Infiltration Trenches**

These BMPs allow for infiltration of stormwater and can help to eliminate pollutants from stormwater before it reaches the waterways such as streams, rivers and lakes. The EPA has a comprehensive list of BMPs at: http://www.epa.gov/oaintrnt/stormwater/best_practices.htm#best_practices and the PA DEP has a stormwater best management manual that can be found at: http://www.elibrary.dep.state.pa.us/dsweb/View/Collection-8305 .

Many urban and suburban municipalities are now implementing stormwater BMP ordinances requiring their residence to handle any additional runoff from new development and to include these BMPs in their development plans.

# VI. Appendix A (Chemistry Data)

Chemistry Sites 1-6

Lackawanna County, PA

Chemistry Data Provided by Lackawanna County Conservation District

Through the Coldwater Conservation Planning Grant

April 2013 – April 2014

**West Branch Tinklepaugh Creek (Intermittent)-Site 1-Chemistry Data_41.493069, -75.591259; Elevation: 310 MASL**

| | 2013 | | | | | | | | | | 2014 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 23-Apr | 28-Apr | May | 1-Jul | 29-Jul | Aug | Sept | Oct | 4-Dec | Dec | Jan | 1-Mar | 1-Apr | Avg. | Min | Max | STDEV |
| EC (µS/cm) | 27.80 | 49.50 | 25.30 | 29.00 | | | | | 14.00 | 19.00 | | | 36.25 | 28.69 | 14.00 | 49.50 | 11.64 |
| TDS (mg/L) | 10.00 | 10.00 | 10.00 | 20.00 | | | | | 7.00 | 20.00 | F | F | 20.00 | 13.86 | 7.00 | 20.00 | 5.84 |
| pH | 6.95 | 7.52 | 7.13 | 7.31 | | | | | 7.95 | 7.48 | R | R | 6.38 | 7.25 | 6.38 | 7.95 | 0.50 |
| DO (%) | 148.35 | 172.40 | 159.20 | 105.50 | D | D | D | D | 83.06 | TI | O | O | TI | 133.70 | 83.06 | 172.40 | 37.82 |
| Temp. (°C) | 7.47 | 9.61 | 12.42 | 18.08 | R | R | R | R | 7.00 | 3.39 | Z | Z | 3.28 | 8.75 | 3.28 | 18.08 | 5.24 |
| Salinity (ppm) | 10.00 | na | 10.00 | 10.00 | Y | Y | Y | Y | TI | TI | E | E | 10.00 | 10.00 | 10.00 | 10.00 | 0.00 |
| Nitrates (mg/L) | N/A | N/A | N/A | N/A | | | | | N/A | N/A | N | N | N/A | N/A | N/A | N/A | N/A |
| Phosphates (mg/L) | N/A | N/A | N/A | N/A | | | | | N/A | N/A | | | N/A | N/A | N/A | N/A | N/A |
| Surrogate St. Flow ($ft^2$) | 2.64 | 0.87 | 1.50 | 2.00 | | | | | 1.65 | 2.52 | | | 2.28 | 1.92 | 0.87 | 2.64 | 0.63 |

**Hulls Creek (Perennial)-Site 2-Chemistry Data_41.492683, -75.619283; Elevation: 415 MASL**

| | 2013 | | | | | | | | | | 2014 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 23-Apr | 28-Apr | May | 1-Jul | 29-Jul | Aug | Sept | Oct | 4-Dec | Dec | Jan | 1-Mar | 1-Apr | Avg. | Min | Max | STDEV |
| EC (µS/cm) | 200.00 | 206.00 | 276.00 | 179.50 | 314.50 | 305.00 | 218.50 | 232.00 | 193.00 | 214.00 | 679.00 | 389.90 | 277.50 | 283.45 | 179.50 | 679.00 | 133.21 |
| TDS (mg/L) | 135.00 | 135.00 | 190.00 | 120.00 | 140.00 | 50.00 | 109.00 | 115.50 | 97.00 | 200.00 | 490.00 | 270.00 | 130.00 | 167.81 | 50.00 | 490.00 | 110.87 |
| pH | 7.59 | 7.83 | 7.61 | 7.66 | 7.72 | 7.63 | 6.82 | 8.07 | 7.62 | 7.57 | 7.89 | 7.82 | 7.00 | 7.60 | 6.82 | 8.07 | 0.34 |
| DO (%) | 116.60 | 117.75 | 143.60 | 151.55 | 62.45 | 249.02 | 91.82 | 30.80 | 108.22 | TI | 85.10 | TI | TI | 115.69 | 30.80 | 249.02 | 59.11 |
| Temp. (°C) | 7.86 | 9.89 | 13.36 | 18.81 | 21.64 | 21.39 | 14.10 | 11.50 | 16.11 | 3.94 | 2.56 | 4.05 | 2.17 | 11.34 | 2.17 | 21.64 | 6.96 |
| Salinity (ppm) | 90.00 | 95.00 | 140.00 | 90.00 | 70.95 | TI | TI | TI | TI | TI | 310.00 | 160.00 | 135.00 | 136.37 | 70.95 | 310.00 | 76.54 |
| Nitrates (mg/L) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Phosphates (mg/L) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Surrogate St. Flow ($ft^2$) | 3.60 | 1.79 | 2.25 | 4.84 | 1.07 | 1.45 | 1.98 | 1.25 | 3.75 | 2.40 | 1.91 | 3.11 | 6.38 | 2.75 | 1.07 | 6.38 | 1.55 |

**Eddy Creek (Ephemeral)-Site 3-Chemistry Data_41.445380, -75.605979; Elevation: 271 MASL**

| | 2013 | | | | | | | | | | 2014 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 23-Apr | 28-Apr | May | *1-July | 29-Jul | Aug | Sept | Oct | 4-Dec | Dec | Jan | 1-Mar | 1-Apr | Avg. | Min | Max | STDEV |
| EC (µS/cm) | | | | 203.50 | | | | | | | | | | 203.50 | 203.50 | 203.50 | N/A |
| TDS (mg/L) | | | | 140.00 | | | | | | | | | | 140.00 | 140.00 | 140.00 | N/A |
| pH | D | D | D | 6.99 | D | D | D | D | D | D | D | D | D | 6.99 | 6.99 | 6.99 | N/A |
| DO (%) | R | R | R | 66.50 | R | R | R | R | R | R | R | R | R | 66.50 | 66.50 | 66.50 | N/A |
| Temp. (°C) | Y | Y | Y | 23.42 | Y | Y | Y | Y | Y | Y | Y | Y | Y | 23.42 | 23.42 | 23.42 | N/A |
| Salinity (ppm) | | | | 100.00 | | | | | | | | | | 100.00 | 100.00 | 100.00 | N/A |
| Nitrates (mg/L) | | | | N/A | | | | | | | | | | N/A | N/A | N/A | N/A |
| Phosphates (mg/L) | | | | N/A | | | | | | | | | | N/A | N/A | N/A | N/A |
| Surrogate St. Flow ($ft^2$) | | | | N/A | | | | | | | | | | N/A | N/A | N/A | N/A |

**Legget's Creek (Perennial)-Site 4-Chemistry Data_41.443691, -75.646085; Elevation: 221 MASL**

| | 2013 | | | | | | | | | | 2014 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 23-Apr | 28-Apr | May | 1-Jul | 29-Jul | Aug | Sept | Oct | 4-Dec | Dec | Jan | 1-Mar | 1-Apr | Avg. | Min | Max | STDEV |
| EC (µS/cm) | 561.00 | 572.50 | 727.50 | 607.00 | 580.00 | 726.50 | 583.00 | 710.00 | 538.00 | 557.50 | 756.00 | 979.50 | 909.50 | 677.54 | 538.00 | 979.50 | 141.13 |
| TDS (mg/L) | 385.00 | 400.00 | 500.00 | 420.00 | 290.00 | 50.00 | 292.50 | 364.00 | 269.00 | 560.00 | 520.00 | 680.00 | 625.00 | 411.96 | 50.00 | 680.00 | 168.92 |
| pH | 9.23 | 9.02 | 7.98 | 7.84 | 8.08 | 7.64 | 8.12 | 8.60 | 7.85 | 7.97 | 8.23 | 8.27 | 7.71 | 8.20 | 7.64 | 9.23 | 0.49 |
| DO (%) | 139.70 | 150.75 | 236.75 | 76.05 | 83.82 | 181.64 | 134.45 | 28.95 | 68.93 | TI | 92.76 | TI | TI | 119.38 | 28.95 | 236.75 | 61.33 |
| Temp. (°C) | 9.67 | 14.78 | 12.78 | 20.36 | 22.64 | 22.14 | 15.95 | 11.05 | 7.70 | 5.44 | 2.58 | 0.97 | 5.00 | 11.62 | 0.97 | 22.64 | 7.27 |
| Salinity (ppm) | 280.00 | 280.00 | 360.00 | 300.00 | TI | TI | TI | TI | TI | TI | 330.00 | 430.00 | 435.00 | 345.00 | 280.00 | 435.00 | 66.14 |
| Nitrates (mg/L) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 2.50 | N/A | N/A | N/A | N/A | 2.50 | 2.50 | 2.50 | N/A |
| Phosphates (mg/L) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 1.58 | N/A | N/A | N/A | N/A | 1.58 | 1.58 | 1.58 | N/A |
| Surrogate St. Flow ($ft^2$) | 14.40 | 13.80 | 14.40 | 12.67 | 6.37 | 4.69 | 18.75 | 13.80 | 15.00 | 13.38 | 17.29 | 14.20 | 41.25 | 15.38 | 4.69 | 41.25 | 8.66 |

| Un-Named Trib (Intermittent)-Site 5-Chemistry Data_41.45533, -75.621428; Elevation: 227 MASL | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2013 | | | | | | | | | | 2014 | | | | | | |
| | 23-Apr | 28-Apr | May | 1-Jul | 29-Jul | Aug | Sept | Oct | 4-Dec | Dec | Jan | 1-Mar | 1-Apr | Avg. | Min | Max | STDEV |
| EC (µS/cm) | 179.80 | 187.05 | 235.00 | 141.15 | | | | | 115 | No Testing Conducted | | | | 171.60 | 115.00 | 235.00 | 45.98 |
| TDS (mg/L) | 120.00 | 130.00 | 160.00 | 90 | | | | | 58 | | | | | 111.60 | 58.00 | 160.00 | 39.02 |
| pH | 7.75 | 8.27 | 7.68 | 7.21 | | | | | 7.50 | | | | | 7.68 | 7.21 | 8.27 | 0.39 |
| DO (%) | 143.85 | 157.10 | 85.85 | 74.90 | D | D | D | D | 74.28 | | | | | 107.20 | 74.28 | 157.10 | 40.05 |
| Temp. (°C) | 14.39 | 13.39 | 15.50 | 19.81 | R | R | R | R | 7.30 | | | | | 14.08 | 7.30 | 19.81 | 4.51 |
| Salinity (ppm) | 80.00 | 90.00 | 110.00 | 70.00 | Y | Y | Y | Y | TI | | | | | 87.50 | 70.00 | 110.00 | 17.08 |
| Nitrates (mg/L) | N/A | N/A | N/A | N/A | | | | | N/A | | | | | N/A | N/A | N/A | N/A |
| Phosphates (mg/L) | N/A | N/A | N/A | N/A | | | | | N/A | | | | | N/A | N/A | N/A | N/A |
| Surrogate St. Flow ($ft^2$) | 1.105 | 2.91 | 2.10 | 4.46 | 0 | 0 | 0 | 0 | 1.00 | | | | | 1.29 | 0.00 | 4.46 | 1.59 |

| Un-Named Trib (Intermittent)-Site 6-Chemistry Data_41.452346, -75.622909; Elevation: 225 MASL | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2013 | | | | | | | | | | 2014 | | | | | | |
| | 23-Apr | 28-Apr | May | 1-Jul | 29-Jul | Aug | Sept | Oct | 4-Dec | Dec | Jan | 1-Mar | 1-Apr | Avg. | Min | Max | STDEV |
| EC (µS/cm) | 168.10 | 198.40 | 167.45 | 140.60 | 178.00 | | 194.00 | 174.00 | 116.00 | No Testing Conducted | | | | 167.07 | 116.00 | 198.40 | 27.21 |
| TDS (mg/L) | 110.00 | 130.00 | 110.00 | 134.00 | 88.00 | | 97.00 | 111.00 | 57.00 | | | | | 104.63 | 57.00 | 134.00 | 24.52 |
| pH | 8.35 | 8.75 | 7.29 | 6.90 | 7.11 | D | 6.20 | 7.40 | 7.46 | | | | | 7.43 | 6.20 | 8.75 | 0.80 |
| DO (mg/L) | 136.50 | 139.00 | 85.00 | 135.50 | 43.45 | R | 127.56 | 91.80 | 78.26 | | | | | 104.63 | 43.45 | 139.00 | 35.18 |
| Temp. (°C) | 16.78 | 19.22 | 14.72 | 24.17 | 25.06 | Y | 18.30 | 20.00 | 7.60 | | | | | 18.23 | 7.60 | 25.06 | 5.52 |
| Salinity (ppm) | 80.00 | 90.00 | 80.00 | 100.00 | N/A | | N/A | N/A | N/A | | | | | 87.50 | 80.00 | 100.00 | 9.57 |
| Nitrates (mg/L) | N/A | N/A | N/A | N/A | N/A | | N/A | N/A | N/A | | | | | N/A | N/A | N/A | N/A |
| Phosphates (mg/L) | N/A | N/A | N/A | N/A | N/A | | N/A | N/A | N/A | | | | | N/A | N/A | N/A | N/A |
| Surrogate St. Flow ($ft^2$) | 6.62 | 3.57 | 0.05 | 1.10 | 0.06 | 0 | 3.42 | 3.50 | 5.51 | | | | | 2.65 | 0.00 | 6.62 | 2.47 |

**Meters used for this study:**

1. LaMotte Tracer Pocketester (Code 1749) (Salt, TDS, EC, Temp.) - Removed from service in July. Replaced by #3.
2. Extech Instruments, Dissolved Oxygen, DO600, ExStik II - Removed from service March 2014 (Technical Issues Dec 2013)
3. Hanna Waterproof Combo Tester for pH, EC, TDS, Temp.
4. Oakton Waterproof pHTestr 30-Replaced by #3 in July

# VII. Appendix B (Benthic Macroinvertebrate Indexes)

Explanation of Benthic Macroinvertebrate Indexes

The following definitions were taken from:

*Biological Survey of the Lackawanna River Watershed*

*Lackawanna County, PA*

*Technical Report Provided Through the*

*Trout Unlimited AMD Technical Assistance Program*

September 2012

**APPENDIX B:** Description of biological metrics that were used in this project.

***Taxa Richness***
This is a count of the total number of taxa in a sample or sub-sample. This metric is expected to decrease with increasing anthropogenic stress to a stream ecosystem, reflecting loss of taxa and increasing dominance of a few pollution-tolerant taxa.

***EPT Taxa Richness***
This metric is comprised of the number of taxa belonging to the orders Ephemeroptera, Plecoptera, and Trichoptera (EPT). Common names for these orders are mayflies, stoneflies, and caddisflies, respectively. The aquatic life stages of these three insect orders are generally considered sensitive to, or intolerant of, pollution (Lenat and Penrose 1996). 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.

***Shannon Diversity Index***
The Shannon Diversity Index is a community composition metric that takes into account both taxonomic richness and evenness of individuals across taxa of a sample or sub-sample. In general, this metric is expected to decrease in value with increasing anthropogenic stress to a stream ecosystem, reflecting loss of pollution-sensitive taxa and increasing dominance of a few pollution-tolerant taxa.

***Hilsenhoff Biotic Index***
This community composition and tolerance metric is calculated as an average of the number of individuals in a sample or sub-sample, weighted by pollution tolerance values. The Hilsenhoff Biotic Index was developed by William Hilsenhoff (Hilsenhoff 1977, 1987; Klemm et al. 1990) and generally increases with increasing ecosystem stress, reflecting dominance of pollution-tolerant organisms. Pollution tolerance values used to calculate this metric are largely based on organic nutrient pollution. Therefore, care should be given when interpreting this metric for stream ecosystems that are largely impacted by acidic pollution from abandoned mine drainage or acid deposition.

***Beck's Index***
This metric combines taxonomic richness and pollution tolerance. It is a weighted count of taxa with PTVs of 0, 1, or 2. It is based on the work of William H. Beck in 1955. The metric is expected to decrease in value with increasing anthropogenic stress to a stream ecosystem, reflecting the loss of pollution-sensitive taxa.

***Percent (%) Intolerance Index***
This community composition and tolerance metric is the percentage of individuals with PTVs of 0 to 3 in a sample or sub-sample and is expected to decrease in value with increasing anthropogenic stress to a stream ecosystem, reflecting the loss of pollution-sensitive organisms.

# VIII. Appendix C (Fishery Survey, Leggetts Creek)

Fishery Survey of Leggetts Creek Lackawanna County, PA

Technical Report Provided Through the

Trout Unlimited AMD Technical Assistance Program

November 2013

*Background and Methods*

The Lackawanna County Conservation District (LCCD) requested technical assistance from Trout Unlimited (TU) to assess the fish community in Leggetts Creek, a tributary to the Lackawanna River. Leggetts Creek begins near Clark's Summit and flows through Leggett's Gap. The mainstem of Leggetts Creek begins at the Griffin Reservoir in South Abington Township, which serves as the drinking water supply for residents in the Leggetts Creek watershed. Leggetts Creek flows for a total of 8.0 miles and drains an area of approximately 18.5 square miles. This is the third largest tributary watershed to the Lackawanna River. Leggetts Creek enters the Lackawanna River at river mile 14.5 in the city of Scranton. The Leggetts Creek watershed is primarily developed and is listed by the Pennsylavania Department of Environmental Protection (DEP) as impaired due to urban development issues.

Abandoned mine drainage from the Marvine #6 colliery previously impaired the lower portion of Leggetts Creek. This site was reclaimed in 2001, however some coal culms may remain at or near the site.

The objective of this project was to provide the LCCD with results from a fishery survey of Leggetts Creek to supplement data provided as part of the 2011 biological assessment completed through TU's AMD Technical Assistance program. In addition, results from this project will be used to support a current project by the LCCD aimed at assessing the water quality and biology of the tributaries to the AMD impaired lower portion of the Lackawanna River.

A fishery survey was completed on 31 July 2013 near the confluence of Leggetts Creek with the Lackawanna River (41.444785N; -75.643187W) (Figure 1). The fishery survey began just upstream of the Wells Road crossing on Leggetts Creek and proceeded upstream for 101 meters and covered all available habitat. The survey site included LCCD's water quality monitoring site on Leggetts Creek. The fishery survey was completed using a Smith-Root LR24 backpack electrofisher. The survey was completed during low flow conditions to ensure the efficiency of the sampling procedure. All fish were identified to species in the field and assigned a relative abundance according to Pennsylvania Fish and Boat Commission protocol (< 2 individuals = rare; 2 – 8 individuals = present; 9 – 33 individuals = common; > 33 individuals = abundant). Trout species were measured for total length prior to release and grouped into 25 mm size classes. A total of four wetted widths were taken along the survey reach to obtain an average width that was used to calculated trout density.

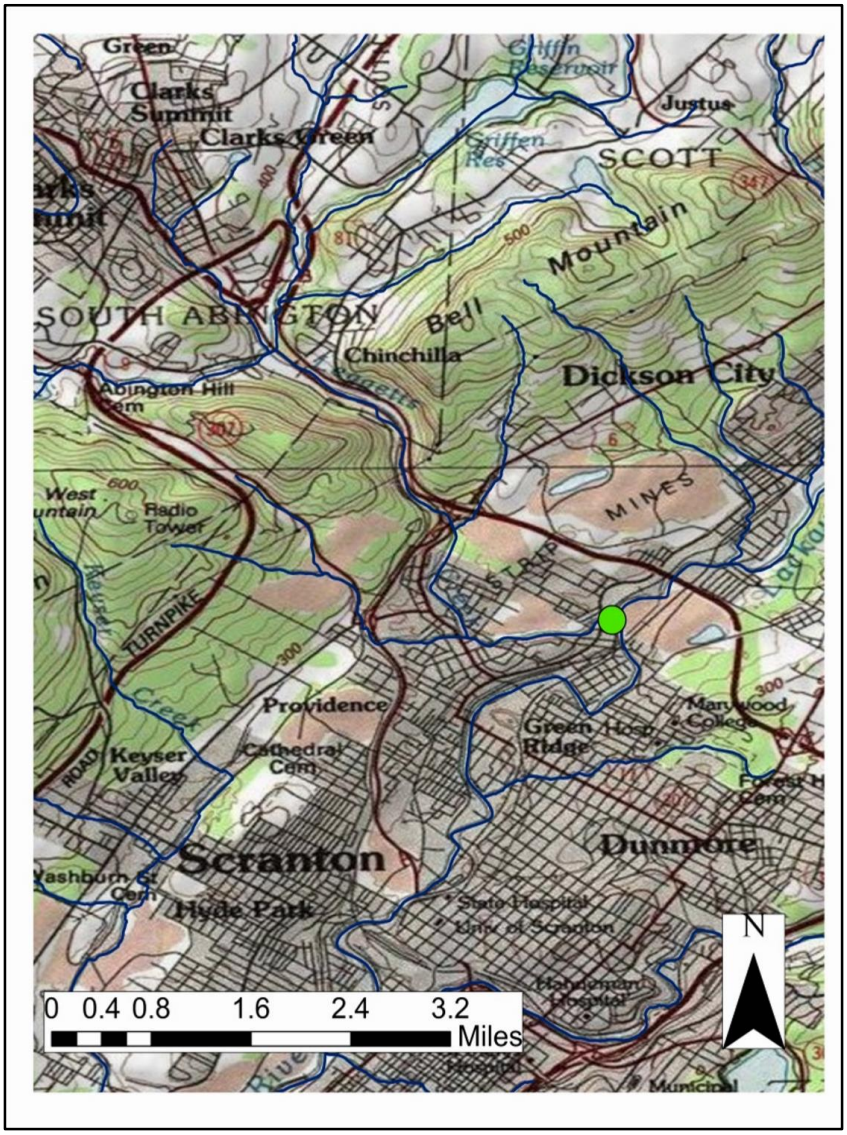



**Figure 1:** Map of the lower section of Leggetts Creek. The starting point of the fishery survey is indicated in green near the mouth of Leggetts Creek.

Results

A total of nine (9) brown trout were collected during the fishery survey. Brown trout ranged in total length from 84 to 316 mm with a mean of 139 mm. Mean stream width was 5.45 meters. Density of brown trout was 164 trout per hectare. Figure 2 shows the size class distribution of brown trout captured within the survey reach. Other fish species present their relative abundance are shown in Table 1. These results of the fishery survey have been sent to the Pennsylvania Fish and Boat Commission and may lead to the addition of Leggetts Creek to the "wild trout list". This designation

would include an upgrade of all of the associated wetlands to Exceptional Value by the DEP and offer the stream additional protections.

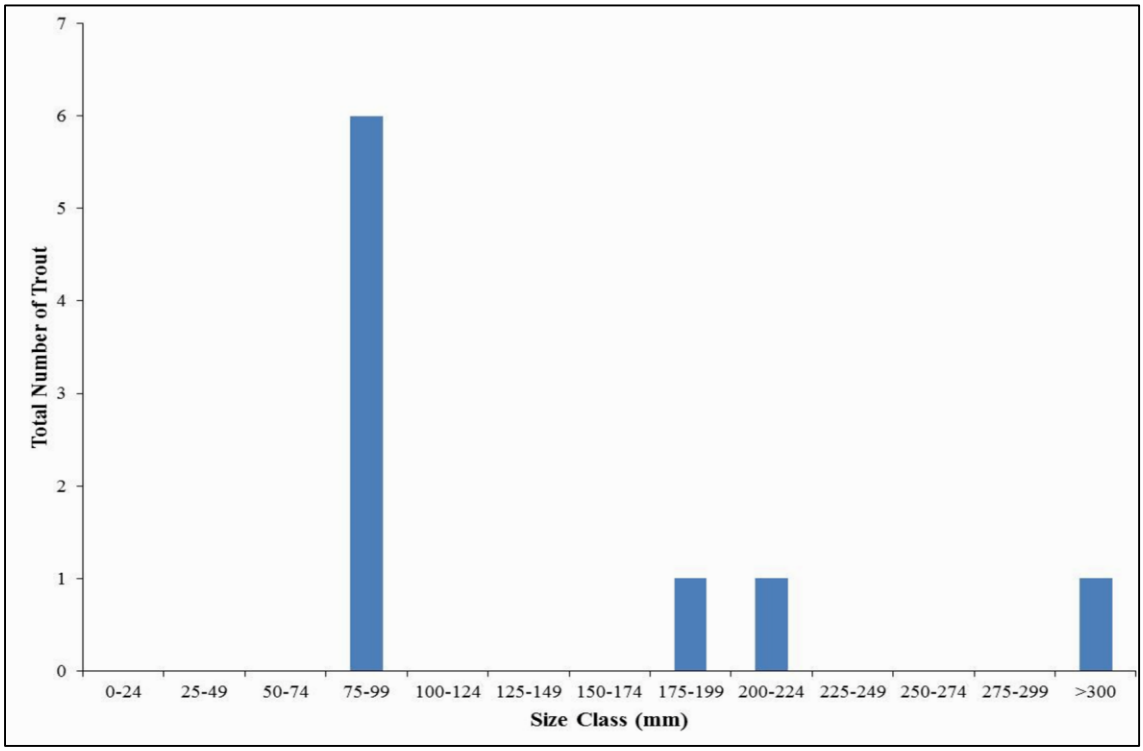



Figure 2:

Size class (mm) distribution of brown trout collected during the fishery survey of Leggetts Creek.

**Table 1:** Fish species and relative abundance collected during the fishery survey of Leggetts Creek.

| Common Name | Scientific Name | Relative Abundance |
|---|---|---|
| Brown Trout | Salmo trutta | Common |
| Cutlips Minnow | Exoglossum maxillingua | Common |
| Longnose Dace | Rhinichthys cataractae | Present |
| Blacknose Dace | Rhinichthys atratulus | Present |
| Bluegill | Lepomis macrochirus | Present |
| Brown Bullhead | Ameiurus nebulosus | Rare |
| Largemouth Bass | Micropterus salmoides | Present |
| Pumpkinseed | Lepomis gibbosus | Rare |
| Bluntnose Minnow | Pimephales notatus | Rare |

# IX. Appendix D (Habitat Assessments)

Habitat Assessment of Sites 1-6

Lackawanna County, PA

Provided by Lackawanna County Conservation District Through the

Coldwater Conservation Planning Grant

August 7, 2013

3800-FM-BPNPSM0402 4/2012

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF POINT AND NON-POINT SOURCE MANAGEMENT

# WATER QUALITY NETWORK
# HABITAT ASSESSMENT

WATERBODY NAME W.B. TINKLEPAUGH CREEK STR CODE/RMI _____

STATION NUMBER 1 LOCATION 41.493069, -75.591259

DATE 7 AUG 2013 TIME 10:51 A.M.

AQUATIC ECOREGION _____ COUNTY LACKAWANNA

INVESTIGATORS M. GIAMBRA, C. NOLAN

FORM COMPLETED BY C. NOLAN

**RIFFLE/RUN PREVALENCE**

| Habitat Parameter | Category | | | |
|---|---|---|---|---|
| | 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. |
| SCORE 19 | 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 two 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. |
| SCORE 19 | 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. |
| SCORE 12 | 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). |
| SCORE 19 | 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 past 20 yr) may be present, but recent channelization is not present. | New embankments present on both banks; and 40-80% of stream reach channelized and disrupted. | Banks shored gabion or cement; over 80% of the stream reach channelized and disrupted. |
| SCORE 16 | 20 19 18 17 (16) | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 |
| Total Side 1 85 | | | | |

3800-FM-BPNPSM0402 4/2012

**RIFFLE/RUN PREVALENCE**

| Habitat Parameter | Category | | | |
|---|---|---|---|---|
| | Optimal | Suboptimal | Marginal | Poor |
| 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 formation, 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, constriction, and bends; moderate deposition of pools prevalent. | Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition. |
| SCORE 11 | 20 19 18 17 16 | 15 14 13 12 (11) | 10 9 8 7 6 | 5 4 3 2 1 |
| 7. Frequency of Riffles | 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 between ratio >25. |
| SCORE 18 | 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. |
| SCORE 8 | 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. |
| SCORE 13 | 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 streambank surface covered by vegetation. | 70-90% of the stream-bank surface covered by vegetation. | 50-70% of the stream-bank surfaces covered by vegetation. | Less than 50% of the streambank surface covered by vegetation. |
| SCORE 18 | 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, 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 vegetation is very high; vegetation has been removed to 2 inches or less in average stubble height. |
| SCORE 20 | (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 | Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone. | Width of riparian zone 12-18 meters; human activities have impacted zone only minimally. | Width of riparian zone 6-12 meters; human activities have impacted zone a great deal. | Width of riparian zone <6 meters; little or no riparian vegetation due to human activities. |
| SCORE 19 | 20 (19) 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 |
| Total Side 2 107 | | | | |
| Total Score 192 | | | | |

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF POINT AND NON-POINT SOURCE MANAGEMENT

# WATER QUALITY NETWORK
# HABITAT ASSESSMENT

WATERBODY NAME HULL CREEK STR CODE/RMI

STATION NUMBER 2 LOCATION 41.492683, -75.619283

DATE 7 AUG 2013 TIME 11:10

AQUATIC ECOREGION COUNTY LACKAWANNA

INVESTIGATORS M. GIAMBRA, C. NOLAN

FORM COMPLETED BY C. NOLAN

**RIFFLE/RUN PREVALENCE**

| Habitat Parameter | Category | | | |
|---|---|---|---|---|
| | 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. |
| SCORE 13 | 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 two 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. |
| SCORE 9 | 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. |
| SCORE 18 | 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). |
| SCORE 5 | 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 past 20 yr) may be present, but recent channelization is not present. | New embankments present on both banks; and 40-80% of stream reach channelized and disrupted. | Banks shored gabion or cement; over 80% of the stream reach channelized and disrupted. |
| SCORE 13 | 20 19 18 17 16 | 15 14 (13) 12 11 | 10 9 8 7 6 | 5 4 3 2 1 |
| Total Side 1 58 | | | | |

3800-FM-BPNPSM0402 4/2012

RIFFLE/RUN PREVALENCE

| Habitat Parameter | Category | | | |
|---|---|---|---|---|
| | Optimal | Suboptimal | Marginal | Poor |
| 6. Sediment Deposition<br>SCORE 19 | Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.<br>20 (19) 18 17 16 | Some new increase in bar formation, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools.<br>15 14 13 12 11 | Moderate deposition of new gravel, coarse sand on old and new bars; 30-50% of the bottom affected; sediment deposits at obstruction, constriction, and bends; moderate deposition of pools prevalent.<br>10 9 8 7 6 | Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.<br>5 4 3 2 1 |
| 7. Frequency of Riffles<br>SCORE 18 | Occurrence of riffles relatively frequent; distance between riffles divided by the width of the stream equals 5 to 7; variety of habitat.<br>20 19 (18) 17 16 | Occurrence of riffles infrequent; distance between riffles divided by the width of the stream equals 7 to 15.<br>15 14 13 12 11 | Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.<br>10 9 8 7 6 | Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is between ratio >25.<br>5 4 3 2 1 |
| 8. Channel Flow Status<br>SCORE 8 | Water reaches base of both lower banks and minimal amount of channel substrate is exposed.<br>20 19 18 17 16 | Water fills > 75% of the available channel; or <25% of channel substrate is exposed.<br>15 14 13 12 11 | Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.<br>10 9 (8) 7 6 | Very little water in channel and mostly present as standing pools.<br>5 4 3 2 1 |
| 9. Condition of Banks<br>SCORE 13 | Banks stable; no evidence of erosion or bank failure.<br>20 19 18 17 16 | Moderately stable; infrequent, small areas of erosion mostly healed over.<br>15 14 (13) 12 11 | Moderately unstable; up to 60% of banks in reach have areas of erosion.<br>10 9 8 7 6 | Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; on side slopes, 60-100% of bank has erosional scars.<br>5 4 3 2 1 |
| 10. Bank Vegetative Protection<br>SCORE 13 | More than 90% of the streambank surface covered by vegetation.<br>20 19 18 17 16 | 70-90% of the stream-bank surface covered by vegetation.<br>15 14 (13) 12 11 | 50-70% of the stream-bank surfaces covered by vegetation.<br>10 9 8 7 6 | Less than 50% of the streambank surface covered by vegetation.<br>5 4 3 2 1 |
| 11. Grazing or Other Disruptive Pressure<br>SCORE 20 | Vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally.<br>(20) 19 18 17 16 | Disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.<br>15 14 13 12 11 | Disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.<br>10 9 8 7 6 | Disruption of vegetation is very high; vegetation has been removed to 2 inches or less in average stubble height.<br>5 4 3 2 1 |
| 12. Riparian Vegetative Zone Width<br>SCORE 10 | Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.<br>20 19 18 17 16 | Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.<br>15 14 13 12 11 | Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.<br>(10) 9 8 7 6 | Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.<br>5 4 3 2 1 |
| Total Side 2 101 | | | | |
| Total Score 159 | | | | |

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BUREAU OF POINT AND NON-POINT SOURCE MANAGEMENT

# WATER QUALITY NETWORK
# HABITAT ASSESSMENT

WATERBODY NAME EDDY CREEK STR CODE/RMI _____

STATION NUMBER 3 LOCATION 41.445380, -75.605909

DATE 7 Aug 2013 TIME 11:25

AQUATIC ECOREGION _____ COUNTY LACKAWANNA

INVESTIGATORS M. GIAMBRA, C. NOLAN

FORM COMPLETED BY C. NOLAN RIFFLE/RUN PREVALENCE

| Habitat Parameter | Category | | | |
|---|---|---|---|---|
| | 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. |
| SCORE 1 | 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 two 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. |
| SCORE 0 | 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. |
| SCORE 1 | 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). |
| SCORE 0 | 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 past 20 yr) may be present, but recent channelization is not present. | New embankments present on both banks; and 40-80% of stream reach channelized and disrupted. | Banks shored gabion or cement; over 80% of the stream reach channelized and disrupted. |
| SCORE 19 | 20 (19) 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 |
| Total Side 1 21 | | | | |

3800-FM-BPNPSM0402 4/2012

RIFFLE/RUN PREVALENCE

| Habitat Parameter | Category | | | |
|---|---|---|---|---|
| | Optimal | Suboptimal | Marginal | Poor |
| 6. Sediment Deposition<br>SCORE 1 | Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.<br>20 19 18 17 16 | Some new increase in bar formation, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools.<br>15 14 13 12 11 | Moderate deposition of new gravel, coarse sand on old and new bars; 30-50% of the bottom affected; sediment deposits at obstruction, constriction, and bends; moderate deposition of pools prevalent.<br>10 9 8 7 6 | Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.<br>5 4 3 2 (1) |
| 7. Frequency of Riffles<br>SCORE 2 | Occurrence of riffles relatively frequent; distance between riffles divided by the width of the stream equals 5 to 7; variety of habitat.<br>20 19 18 17 16 | Occurrence of riffles infrequent; distance between riffles divided by the width of the stream equals 7 to 15.<br>15 14 13 12 11 | Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.<br>10 9 8 7 6 | Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is between ratio >25.<br>5 4 3 (2) 1 |
| 8. Channel Flow Status<br>SCORE 2 | Water reaches base of both lower banks and minimal amount of channel substrate is exposed.<br>20 19 18 17 16 | Water fills > 75% of the available channel; or <25% of channel substrate is exposed.<br>15 14 13 12 11 | Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.<br>10 9 8 7 6 | Very little water in channel and mostly present as standing pools.<br>5 4 3 (2) 1 |
| 9. Condition of Banks<br>SCORE 18 | Banks stable; no evidence of erosion or bank failure.<br>20 19 (18) 17 16 | Moderately stable; infrequent, small areas of erosion mostly healed over.<br>15 14 13 12 11 | Moderately unstable; up to 60% of banks in reach have areas of erosion.<br>10 9 8 7 6 | Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; on side slopes, 60-100% of bank has erosional scars.<br>5 4 3 2 1 |
| 10. Bank Vegetative Protection<br>SCORE 18 | More than 90% of the streambank surface covered by vegetation.<br>20 19 (18) 17 16 | 70-90% of the stream-bank surface covered by vegetation.<br>15 14 13 12 11 | 50-70% of the stream-bank surfaces covered by vegetation.<br>10 9 8 7 6 | Less than 50% of the streambank surface covered by vegetation.<br>5 4 3 2 1 |
| 11. Grazing or Other Disruptive Pressure<br>SCORE 19 | Vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally.<br>20 (19) 18 17 16 | Disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.<br>15 14 13 12 11 | Disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.<br>10 9 8 7 6 | Disruption of vegetation is very high; vegetation has been removed to 2 inches or less in average stubble height.<br>5 4 3 2 1 |
| 12. Riparian Vegetative Zone Width<br>SCORE 19 | Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.<br>20 (19) 18 17 16 | Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.<br>15 14 13 12 11 | Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.<br>10 9 8 7 6 | Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.<br>5 4 3 2 1 |
| Total Side 2 79 | | | | |
| Total Score 100 | | | | |

3800-FM-BPNPSM0402 4/2012

**RIFFLE/RUN PREVALENCE**

| Habitat Parameter | Category | | | |
|---|---|---|---|---|
| | Optimal | Suboptimal | Marginal | Poor |
| 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 formation, 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, constriction, and bends; moderate deposition of pools prevalent. | Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition. |
| SCORE 19 | 20 (19) 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 |
| 7. Frequency of Riffles | 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 between ratio >25. |
| SCORE 17 | 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. |
| SCORE 10 | 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. |
| SCORE 19 | 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 streambank surface covered by vegetation. | 70-90% of the stream-bank surface covered by vegetation. | 50-70% of the stream-bank surfaces covered by vegetation. | Less than 50% of the streambank surface covered by vegetation. |
| SCORE 14 | 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, 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 vegetation is very high; vegetation has been removed to 2 inches or less in average stubble height. |
| SCORE 17 | 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 | Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone. | Width of riparian zone 12-18 meters; human activities have impacted zone only minimally. | Width of riparian zone 6-12 meters; human activities have impacted zone a great deal. | Width of riparian zone <6 meters; little or no riparian vegetation due to human activities. |
| SCORE 10 | 20 19 18 17 16 | 15 14 13 12 11 | (10) 9 8 7 6 | 5 4 3 2 1 |
| Total Side 2 106 | | | | |
| Total Score 193 | | | | |

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BUREAU OF POINT AND NON-POINT SOURCE MANAGEMENT

# WATER QUALITY NETWORK
# HABITAT ASSESSMENT

WATERBODY NAME UNNAMED TRIB STR CODE/RMI _____

STATION NUMBER #5 LOCATION 41.459533, -75.621428

DATE 7 AUG. 2013 TIME 12:20

AQUATIC ECOREGION _____ COUNTY _____

INVESTIGATORS _____

FORM COMPLETED BY _____ *RIFFLE/RUN PREVALENCE*

| Habitat Parameter | Category | | | |
|---|---|---|---|---|
| | 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. |
| SCORE 8 | 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 two 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. |
| SCORE 6 | 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. |
| SCORE 8 | 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). |
| SCORE 2 | 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 past 20 yr) may be present, but recent channelization is not present. | New embankments present on both banks; and 40-80% of stream reach channelized and disrupted. | Banks shored gabion or cement; over 80% of the stream reach channelized and disrupted. |
| SCORE 11 | 20 19 18 17 16 | 15 14 13 12 (11) | 10 9 8 7 6 | 5 4 3 2 1 |

Total Side 1 35

3800-FM-BPNPSM0402 4/2012

RIFFLE/RUN PREVALENCE

| Habitat Parameter | Category | | | |
|---|---|---|---|---|
| | Optimal | Suboptimal | Marginal | Poor |
| 6. Sediment Deposition<br>SCORE 6 | Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.<br>20 19 18 17 16 | Some new increase in bar formation, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools.<br>15 14 13 12 11 | Moderate deposition of new gravel, coarse sand on old and new bars; 30-50% of the bottom affected; sediment deposits at obstruction, constriction, and bends; moderate deposition of pools prevalent.<br>10 9 8 7 (6) | Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.<br>5 4 3 2 1 |
| 7. Frequency of Riffles<br>SCORE 4 | Occurrence of riffles relatively frequent; distance between riffles divided by the width of the stream equals 5 to 7; variety of habitat.<br>20 19 18 17 16 | Occurrence of riffles infrequent; distance between riffles divided by the width of the stream equals 7 to 15.<br>15 14 13 12 11 | Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.<br>10 9 8 7 6 | Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is between ratio >25.<br>5 (4) 3 2 1 |
| 8. Channel Flow Status<br>SCORE 15 | Water reaches base of both lower banks and minimal amount of channel substrate is exposed.<br>20 19 18 17 16 | Water fills > 75% of the available channel; or <25% of channel substrate is exposed.<br>(15) 14 13 12 11 | Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.<br>10 9 8 7 6 | Very little water in channel and mostly present as standing pools.<br>5 4 3 2 1 |
| 9. Condition of Banks<br>SCORE 18 | Banks stable; no evidence of erosion or bank failure.<br>20 19 (18) 17 16 | Moderately stable; infrequent, small areas of erosion mostly healed over.<br>15 14 13 12 11 | Moderately unstable; up to 60% of banks in reach have areas of erosion.<br>10 9 8 7 6 | Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; on side slopes, 60-100% of bank has erosional scars.<br>5 4 3 2 1 |
| 10. Bank Vegetative Protection<br>SCORE 19 | More than 90% of the streambank surface covered by vegetation.<br>20 (19) 18 17 16 | 70-90% of the stream-bank surface covered by vegetation.<br>15 14 13 12 11 | 50-70% of the stream-bank surfaces covered by vegetation.<br>10 9 8 7 6 | Less than 50% of the streambank surface covered by vegetation.<br>5 4 3 2 1 |
| 11. Grazing or Other Disruptive Pressure<br>SCORE 13 | Vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally.<br>20 19 18 17 16 | Disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.<br>15 14 (13) 12 11 | Disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.<br>10 9 8 7 6 | Disruption of vegetation is very high; vegetation has been removed to 2 inches or less in average stubble height.<br>5 4 3 2 1 |
| 12. Riparian Vegetative Zone Width<br>SCORE 8 | Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.<br>20 19 18 17 16 | Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.<br>15 14 13 12 11 | Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.<br>10 9 (8) 7 6 | Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.<br>5 4 3 2 1 |
| Total Side 2 83 | | | | |
| Total Score 118 | | | | |

3800-FM-BPNPSM0402 4/2012

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF POINT AND NON-POINT SOURCE MANAGEMENT

# WATER QUALITY NETWORK
# HABITAT ASSESSMENT

WATERBODY NAME UNNAMED TRIB #6 STR CODE/RMI _____

STATION NUMBER 6 LOCATION 41.452546, -75.622909

DATE 7 AUG. 2013 TIME 11:45

AQUATIC ECOREGION _____ COUNTY LACK

INVESTIGATORS M. GIAMBRA, C. NOLAN

FORM COMPLETED BY _____ *RIFFLE/RUN PREVALENCE*

| Habitat Parameter | Category | | | |
|---|---|---|---|---|
| | 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. |
| SCORE 7 | 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 two 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. |
| SCORE 11 | 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. |
| SCORE 5 | 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). |
| SCORE 3 | 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 past 20 yr) may be present, but recent channelization is not present. | New embankments present on both banks; and 40-80% of stream reach channelized and disrupted. | Banks shored gabion or cement; over 80% of the stream reach channelized and disrupted. |
| SCORE 17 | 20 19 18 (17) 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 |

Total Side 1 43

3800-FM-BPNPSM0402 4/2012

*RIFFLE/RUN PREVALENCE*

| Habitat Parameter | Category | | | |
|---|---|---|---|---|
| | Optimal | Suboptimal | Marginal | Poor |
| 6. Sediment Deposition<br>SCORE 11 | Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.<br>20 19 18 17 16 | Some new increase in bar formation, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools.<br>15 14 13 12 (11) | Moderate deposition of new gravel, coarse sand on old and new bars; 30-50% of the bottom affected; sediment deposits at obstruction, constriction, and bends; moderate deposition of pools prevalent.<br>10 9 8 7 6 | Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.<br>5 4 3 2 1 |
| 7. Frequency of Riffles<br>SCORE 8 | Occurrence of riffles relatively frequent; distance between riffles divided by the width of the stream equals 5 to 7; variety of habitat.<br>20 19 18 17 16 | Occurrence of riffles infrequent; distance between riffles divided by the width of the stream equals 7 to 15.<br>15 14 13 12 11 | Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.<br>10 9 (8) 7 6 | Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is between ratio >25.<br>5 4 3 2 1 |
| 8. Channel Flow Status<br>SCORE 8 | Water reaches base of both lower banks and minimal amount of channel substrate is exposed.<br>20 19 18 17 16 | Water fills > 75% of the available channel; or <25% of channel substrate is exposed.<br>15 14 13 12 11 | Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.<br>10 9 (8) 7 6 | Very little water in channel and mostly present as standing pools.<br>5 4 3 2 1 |
| 9. Condition of Banks<br>SCORE 14 | Banks stable; no evidence of erosion or bank failure.<br>20 19 18 17 16 | Moderately stable; infrequent, small areas of erosion mostly healed over.<br>15 (14) 13 12 11 | Moderately unstable; up to 60% of banks in reach have areas of erosion.<br>10 9 8 7 6 | Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; on side slopes, 60-100% of bank has erosional scars.<br>5 4 3 2 1 |
| 10. Bank Vegetative Protection<br>SCORE 19 | More than 90% of the streambank surface covered by vegetation.<br>20 (19) 18 17 16 | 70-90% of the stream-bank surface covered by vegetation.<br>15 14 13 12 11 | 50-70% of the stream-bank surfaces covered by vegetation.<br>10 9 8 7 6 | Less than 50% of the streambank surface covered by vegetation.<br>5 4 3 2 1 |
| 11. Grazing or Other Disruptive Pressure<br>SCORE 19 | Vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally.<br>20 (19) 18 17 16 | Disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.<br>15 14 13 12 11 | Disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.<br>10 9 8 7 6 | Disruption of vegetation is very high; vegetation has been removed to 2 inches or less in average stubble height.<br>5 4 3 2 1 |
| 12. Riparian Vegetative Zone Width<br>SCORE 7 | Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.<br>20 19 18 17 16 | Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.<br>15 14 13 12 11 | Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.<br>10 9 8 (7) 6 | Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.<br>5 4 3 2 1 |
| Total Side 2 86 | | | | |
| Total Score 129 | | | | |

# X. References

Lackawanna River Corridor Association. (Nov 2001). LRCA.org. Lackawanna River Watershed Conservation Plan. Retrieved April 8, 2014 http://www.dcnr.state.pa.us/cs/groups/public/documents/document/DCNR_001596.pdf