BIOLOGICAL MONITORING DATA REPORT
MAY 2008
INDIAN CREEK
DONEGAL TOWNSHIP, WESTMORELAND COUNTY, PENNSYLVANIA

FOR

PENNSYLVANIA ENVIRONMENTAL COUNCIL
PITTSBURGH, PENNSYLVANIA
AND
MOUNTAIN WATERSHED ASSOCIATION
MELCROFT, PENNSYLVANIA

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1.0 INTRODUCTION

Pennsylvania Environmental Council (PEC) retained Civil & Environmental Consultants, Inc. (CEC) to provide professional ecological services related to Indian Creek (DEP Stream Code 38235) located in Donegal Township, Westmoreland County, Pennsylvania (Figures 1 and 2). The ecological services were conducted in May 2008 and included the collection of surface water samples for water quality analysis, habitat characteristics, and benthic macroinvertebrate and fish sampling.

1.1 PURPOSE

The purpose of this work was to collect and analyze biological and water quality data for the determination of aquatic life use in five stream locations within the Indian Creek watershed. Specifically, CEC collected surface water quality, habitat, and benthic macroinvertebrate data from one location on two unnamed tributaries to Indian Creek. Similar data plus fisheries data were collected at three locations on Indian Creek. These data will provide a baseline to help ensure that the quality of waters and their associated aquatic life uses are protected and maintained.

1.2 PA CHAPTER 93 AQUATIC LIFE PROTECTED USE

According to Pennsylvania's *Water Quality Standards* (Chapter 93, Title 25, Pennsylvania Code; PADEP 2005), Indian Creek (Source to Camp Run), including the headwater stream reaches within the study area, have a protected aquatic life use designation of Cold Water Fish (CWF) and special protection use of High Quality (HQ). The CWF protected use is defined as "maintenance or propagation, or both, of fish species including the family Salmonidae and additional flora and fauna which are indigenous to a cold water habitat".

1.3 STUDY AREA CHARACTERISTICS

The study area is located within the Appalachian Plateau physiographic province and the Central Appalachians, Forested Hills and Mountains Ecoregion. The site is located in the headwaters of Indian Creek, a tributary to the Youghiogheny River. The Youghiogheny River flows northwest into the Monongahela River at McKeesport, Pennsylvania.

The study area includes deciduous forest and bottomland hardwoods. The study area is bounded to the north by Interstate 76 (Pennsylvania Turnpike), while the remaining area is surrounded by undeveloped land. Photographs of the sampling stations are presented in Appendix A.

2.0 METHODS

2.1 STREAM PHYSICAL AND CHEMICAL PARAMETERS

Field water quality parameters, including temperature, dissolved oxygen (DO), pH, and conductivity were measured at five stations concurrent with benthic macroinvertebrate sampling (Table 1). Stream velocity was also measured at each station. Temperature, conductivity, and DO were measured in situ using a handheld YSI Model 85 meter. The pH was measured in situ using a handheld Cole Parmer Model 59002 meter. Velocity was measured along a cross-section using a calibrated Marsh-McBirney Model 2000 Flow-Mate stream velocity meter. Stream flow rates were measured within a riffle or run using the U.S. Geological Survey midsection, current meter method (Nolan and Shields 2000, Carter and Davidian 1968, Buchanan and Somers 1968).

Water quality measurements were recorded on a modified U.S. Environmental Protection Agency (USEPA 1999) Physical Characterization/Water Quality Field Data Sheet. Stream velocity, width, and depth measurements were recorded on the USEPA (1998) Field Measurement Form – Streams (Appendix B).

Surface water quality samples were collected on May 21, 2008, immediately chilled, and delivered to TestAmerica, Inc. (TA) located in Pittsburgh, Pennsylvania for analysis. Results of the water quality sampling are summarized in Table 2 and the analytical report from TA is provided in Appendix C.

2.2 STREAM HABITAT CHARACTERISTICS

Stream habitat characteristics were also recorded at the five stations within the study area. Habitat characteristics observed and recorded included the following: (1) visual appearance of water and sediment quality; (2) dimensions (length and width) of the wetted channel; (3) minimum and maximum water depth; and (4) degree of channel canopy cover (e.g., open, partly open, shaded, or partly shaded). These data were recorded on the USEPA (1999) Physical Characterization/Water

Quality Field Data Sheet for high gradient (riffle dominated) and low gradient (pool dominated) sections of stream (Appendix B).

2.3 STREAM BENTHIC MACROINVERTEBRATE COMMUNITY DATA

The following sections describe the methods used to collect and analyze benthic macroinvertebrate community data for this study.

2.3.1 Benthic Macroinvertebrate Community Samples

Benthic macroinvertebrate community samples were collected, identified and analyzed for the five stations using a combination of sampling protocols described in the following guidance documents:

- Pennsylvania Department of Environmental Protection (PADEP) *DRAFT-Pennsylvania DEP Multihabitat Stream Assessment Protocol* (PADEP 2007, Attachment A) was used for sample collection, preservation, processing, metric selection; and

- PADEP's TGD 563-2000-655, *Surface Water Protection – Underground Bituminous Coal Mining Operations, Appendix B-PADEP Low Gradient Stream Assessment Protocol, pp. 30-41,* (PADEP 2005, Attachment B) was also consulted for metric selection.

Benthic macroinvertebrate taxa were identified to the genus level using keys by Peckarsky et al. (1990), Merritt and Cummins (1996), Pennak (1989), Stewart and Stark (2002), Wiggins (2000), and Thorp and Covich (1991).

Benthic macroinvertebrate samples were collected in accordance with the conditions of Pennsylvania Fish and Boat Commission (PAFBC) 2008 Scientific Collector Type III Permit (No. 159). A D-frame dip net (12 inches wide x 10 inches high x 18 inches deep) with nylon Nitex multifilament net (500 micron mesh size) was used to collect one qualitative sample from each sampling station. Each sampling station identified for assessment was 100 meters long. After identifying and quantifying the available habitat types present within the sampling station (i.e., Snag, Submerged

Aquatic Vegetation, Cobble/Gravel, Sand/Fine Sediment, and Coarse Particulate Organic Matter (CPOM)), ten benthic sampling locations were selected that effectively represented the observed habitats so that at least two jabs were collected in each type of habitat present. Detailed descriptions of each habitat type (e.g., Snag, CPOM, etc.) are presented in both Table 1 of Attachment A (PADEP 2007) and Table B.1 of Attachment B (PADEP TGD 2005). Each "jab" consisted of a 30-inch-long sweep of a 0.3-meter wide area. When one or more of the specified habitats was absent from the sampling station, the jabs allocated to these missing habitats were re-assigned to the available habitats, proportionately among the most extensive habitat type(s) in the sampling station.

Immediately after collecting an individual jab, the net was carefully inverted and the contents were emptied into a benthos bucket equipped with a 500 micron screen bottom. The net was examined for clinging organisms, which were also transferred into the bucket. After the ten jabs were collected, the organisms and material retained in the benthos bucket were transferred into a 2-gallon sample bucket and preserved with ethanol (approximately 70% final concentration). The station number, stream name and date were marked on each sample bucket. The bucket was sealed and returned to the CEC laboratory for analysis.

A 200 +/- 20% organism sub-sample was processed in the CEC laboratory from the composite sample collected at each sampling station, according to the methods described in PADEP (2007). The sub-samples were identified and enumerated. Identifications were made employing a (20 to 120X) stereomicroscope and a tungsten halogen light with a bifurcated gooseneck extension. All sorted macroinvertebrates were stored in 70 percent ethanol solution and archived for future reference. CEC identified most insect taxa to the genus level and other taxa to the lowest practical level, with the exception of Turbellaria, Nemertea, and Nematoda, which were identified to phylum level; Oligochaeta, which was identified to class level; and Hydracarina, Chironimidae, Curculionidae, Ceratopogonidae, Decapoda, Gastropoda, and Pelecypoda, which were identified to family level. The benthic macroinvertebrate identification and enumeration data are presented in Appendix D.

2.3.2 Benthic Macroinvertebrate Community Metrics

Biological metrics were computed from benthic macroinvertebrate identification and enumeration data collected at the five sampling stations. These metrics have been developed by PADEP (2007) to calculate a Total Biological Score for a stream benthic macroinvertebrate sample. The Total Biological Score (TBS) can then be compared to the PADEP (2007) protocol benchmark (55) to determine if the stream is impaired or attaining for aquatic life use.

The following benthic macroinvertebrate community metrics were computed using the PADEP (2007) Multihabitat Stream Assessment Protocol:

1. Number of EPT Taxa – Defined as the total number of taxa in the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) collected in a sub-sample. This metric, according to the USEPA (1989, 1990, and 1999), generally decreases as a result of impacts caused by human activities.

2. Taxa Richness – Defined as the total number of benthic macroinvertebrate taxa collected in a sub-sample. This metric, according to the USEPA (1989, 1990, and 1999), is a measure of the overall diversity of the macroinvertebrate assemblage, which generally decreases as a result of impacts caused by human activities.

3. Beck4 – Defined as a pollution weighted taxa richness measure, based on Hilsenhoff Biotic Index Scores (Hils). This is a modified Beck's Index giving organisms with a Hils score of 0 or 1 two points and organisms with Hils scores of 2, 3, or 4 are given one point.

4. Shannon Diversity Index – This index measures taxa abundance and evenness in the sub-sample by dividing the number of individuals in a taxa by the total number of individuals in the sub-sample and then multiplying by the natural logarithm of this proportion. This is computed for all taxa in the sub-sample. The results are then summed and multiplied by -1.

5. Number of Mayfly Taxa – Total number of mayflies (Ephemeroptera) in the sub-sample.

6. Number of Caddisfly Taxa – Total number of caddisflies (Trichoptera) in the sub-sample.

The following benthic macroinvertebrate community metrics were also computed to provide additional background information, by using the PADEP TGD (2005) Appendix B – PADEP Low Gradient Stream Assessment Protocol:

1. Taxa Richness

2. Trichoptera Taxa Richness – Total number of caddisfly taxa

3. Percent of EPT Taxa – Defined as the percentage of individuals belonging to the orders Ephemeroptera (E), Plecoptera (P), and Trichoptera (T). This metric, according to the USEPA (1989, 1990, and 1999), also generally decreases as a result of impacts caused by human activities.

4. Intolerant Taxa Richness – Defined as the total number of taxa with a pollution tolerance value less than 5 (PADEP TGD 2005).

5. Filterer-Collector + Predator Taxa Richness – Defined as the total number of taxa in the filterer-collector or predator functional feeding groups (PADEP TGD 2005).

Tolerance values and Functional Feeding Group designations used to calculate the Beck4 metrics in Table 5 and the Intolerant taxa richness and Filterer-Collector + Predator taxa richness metrics in Table 6 were obtained from an expanded taxa list provided to CEC by Mr. Charles McGarrell of the PADEP Central Office via e-mail transmission to Michael Davison dated November 23, 2005. The expanded taxa list includes additional taxa not present in Table B.3 in the PADEP (2005) TGD.

The calculated metric scores (Table 4), from each protocol, were input into a Normalized Metric Score equation [(Observed Value/95th percentile) X 100], according to the 95th percentile values presented in each protocol (See Attachment A and Attachment B). A TBS was calculated from the mean of the normalized metric scores (See Tables 5 and 6). In those instances where the observed

value is higher than the 95th percentile value for a metric, the normalized score is converted to a maximum of 100 before the TBS is calculated.

2.4 FISH COMMUNITY DATA

The following sections describe the methods used to collect and analyze the fish community data for this study.

2.4.1 Fish Community Samples

Fish community samples were collected, identified, and analyzed at three Indian Creek stations using a combination of sampling protocols described in USEPA's Rapid Bioassessment Protocols for use in Wadeable Streams and Rivers (USEPA 1999). Fish were collected in accordance with the conditions of PAFBC 2008 Scientific Collector Type III Permit (No. 159). Also, the American Fisheries Society's *Fisheries Techniques, Second Edition* (AFS 1996) was consulted for electrofishing operational and safety guidelines. The fish community sampling procedure used by CEC is described below.

Fish were collected at the three stations during daylight hours using a rechargeable battery-powered, backpack-mounted, variable voltage, pulsed-DC output, Smith Root Model LR-24 electrofishing unit, with an 11-inch anode ring mounted on a handheld fiberglass pole and a trailing cable rattail cathode. A single electrofishing pass technique was used at each station. Fish were collected in a downstream to upstream direction working in a meandering pattern across the stream channel. Fish were identified to species on site, enumerated, measured, and returned to the stream alive. Any evidence of fish disease, tumors, fin damage, and/or skeletal anomalies was recorded. These data were recorded on modified USEPA (1999) Fish Sampling Field Data Sheets (Appendix B).

2.4.2 Fish Community Metrics

Biological metrics were computed from fish species and abundance data collected at the three sampling stations. Fish community metrics have been developed and tested by the USEPA and other agencies to correlate fish community structure to the overall quality of the aquatic ecosystem and to assess the nature and magnitude of disturbances to aquatic systems (USEPA 1989, 1993, and 1999). The use of these metrics in aquatic biomonitoring studies has become widely accepted; however, metrics must be interpreted with caution, especially where specific metric-based water quality criteria have not been developed for a given ecological or geographical region. The fish community metrics computed for this study includes the following:

1. Number of Fish Collected – Defined as the total number of individuals collected in a sample.

2. Catch Per Unit Effort – (CPUE) Expressed as number of fish collected per minute sampled (number fish/minute) or number of fish collected per foot of stream sampled (number fish/foot). CPUE, according to AFS (1996), is indicative of (but not an estimate of) fish population abundance, and is a sensitive indicator of biotic integrity.

3. Species Richness – Defined as the total number of fish species collected in a sample. This metric, according to the USEPA (1989, 1993, and 1999), is a measure of the overall diversity of the fish assemblage, which generally decreases as a result of impacts from human activities.

4. Shannon-Weaver Diversity Index – Employing a formula presented by Shannon and Weaver (1963), this diversity index was calculated to provide a measure of fish species composition, which generally decreases as a result of impacts caused by human activities (USEPA 1990). This index is a probability that measures the average degree of uncertainty (i.e., diversity) of predicting a species of a given individual picked at random from a community. The Shannon-Weaver Index varies from a value of 0.00 for communities with only a single species to higher values (> 3.50) for communities having many species, each with a few individuals.

5. Maximum Length of each Species – The total length measured from the tip of the nose to the tip of the tail.

3.0 RESULTS AND DISCUSSION

The following narrative presents the findings of the biological monitoring performed within the Indian Creek watershed. Summary tables can be found in the Tables section of this report and tabulated raw data can be found in the Appendices.

3.1 STREAM SAMPLING STATIONS

During a period from May 21 to May 22, 2008, CEC sampled a total of five stations within the Indian Creek watershed (Figure 2). These included sampling stations IC-1, IC-2, and IC-3 on Indian Creek and sampling stations UNT IC-1 and UNT IC-2 on unnamed tributaries to Indian Creek.

3.2 STREAM BIOLOGICAL MONITORING

Data collected at these sites included stream water quality parameters (Table 1), surface water quality analysis (Table 2), stream habitat characteristics (Table 3), and benthic macroinvertebrate community metrics (Table 4). Tables 5 and 6 provide the observed values and normalized scores for each of the biological metrics calculated from the analysis of the 200 +/- 20% organism sub-sample created for each sampling station. The fish community data and metrics are summarized in Table 7. These data are discussed in the following sections.

3.2.1 Indian Creek

CEC personnel sampled Indian Creek stations IC-1, IC-2, and IC-3 on May 21, 2008 (Figure 2). Sampling station IC-1 is located approximately 500 feet downstream from the confluence with UNT IC-1, while sampling station IC-2 is located approximately 1,500 feet upstream from the confluence. Sampling station IC-3 is located approximately 250 upstream from the confluence with UNT IC-2. The Global Positioning System (GPS) locations for these stations are the following:

STATION	LONGITUDE	LATITUDE
IC-1	79°14'49.87" W	40°06'37.57" N
IC-2	79°14'29.56" W	40°06'23.33" N
IC-3	79°14'15.61" W	40°06'14.37" N

The range in field water quality parameters for Indian Creek are: water temperature of 10.9° to 12.0° C, conductivity of 153 to 170 uS/cm, pH of 6.94 to 7.18, and dissolved oxygen (DO) of 9.31 to 10.20 mg/L (Table 1). Chloride concentrations ranged from 39.6 mg/L at IC-2 to 48.0 mg/L at IC-3. None of the measured water quality parameters exceeded applicable water quality standards; however, the Indian Creek sampling stations contained higher chloride concentrations values than are normally found in unimpaired streams (Table 2). Chloride concentrations in surface water are normally less than 10 mg/L and often less than 1 mg/L (Health Canada 1987). The high chloride values are most likely attributed to surface water runoff and groundwater infiltration from a nearby road salt storage dome owned by the Pennsylvania Turnpike Commission. The road salt storage dome is adjacent to station IC-3 and is located upstream from stations IC-1 and IC-2. Overall, these values indicate water quality conditions generally supportive of aquatic life.

Habitat characteristics at the three stations varied with relation to; stream discharge rates 5.26 to 7.83 (cfs); stream width, 5 to 14 feet; and USEPA habitat assessment scores 124 to 142 for high gradient (riffle/run) habitats (Table 3). Habitat assessment scores were performed to determine the suitability of habitats to promote the establishment and maintenance of benthic macroinvertebrate populations. CEC did not perform a USEPA habitat assessment for the low gradient habitats for the sampling stations on Indian Creek due to a lack of habitat. The results of these parameters are consistent with "marginal" to "sub-optimal" conditions for riffle/run habitats.

One benthic macroinvertebrate sample was collected and analyzed at each of the three sampling stations in Indian Creek (Table 4 and Appendix D). The samples collected at IC-1, IC-2, and IC-3 contained 14, 20, and 22 taxa, respectively. The dominant species within the samples included small minnow mayflies (*Acentrella*) and midge fly larvae (Chironomidae). The samples at IC-1 and IC-3

contained a total of 7 EPT taxa which accounted for 85% and 24%, respectively, of the total abundance while the IC-2 sample contained a total of 11 EPT taxa which accounted for 75% of the total abundance. The Shannon-Diversity Index values ranged from 1.27 (poor) for station IC-1 to 1.87 (fairly poor) for station IC-2. Station IC-2 has the highest Shannon Diversity Index and the highest number of EPT taxa. The biological metrics suggest that the benthic macroinvertebrate community for station IC-2 is slightly more diverse than stations IC-1 and IC-3.

A Total Biological Score (TBS) calculated using the PADEP (2007) Multihabitat Stream Assessment Protocol is on Table 5. The highest TBS (62.4) was from the middle station (IC-2), while the lowest TBS (39.3) was from the most downstream station (IC-1). Therefore, station IC-2 is considered attaining (i.e., TBS>55) for aquatic life use, while stations IC-1 and IC-3 are considered impaired for aquatic life use.

TBS were also calculated using the PADEP (2005) Low Gradient Stream Assessment Protocol and the results are presented in Table 6. The highest TBS (71.7) was measured at IC-2, while the lowest TBS (46.8) was measured at IC-1. The TBS calculated using the two different PADEP protocols show similar trends.

A total of 17 fish representing 1 species were collected during the electrofishing survey of Indian Creek (Table 7). The only fish species collected were wild brown trout (*Salmo trutta*). A total of 13 wild brown trout were collected from station IC-3, while only 1 brown trout was collected from station IC-1. No disease, tumors, fin damage, and/or skeletal anomalies were observed on any of the fish collected.

3.2.2 Unnamed Tributaries to Indian Creek

CEC personnel sampled the unnamed tributaries to Indian Creek, stations UNT IC-1 and UNT IC-2, on May 22, 2008 (Figure 2). Sampling station UNT IC-1 is located approximately 300 feet upstream from its confluence with Indian Creek while UNT IC-2 is located approximately 1,300 feet upstream from its confluence with Indian Creek. The Global Positioning System (GPS) locations for these stations are the following:

STATION	LONGITUDE	LATITUDE
UNT IC-1	79°14'45.52" W	40°06'30.09" N
UNT IC-2	79°14'19.54" W	40°06'06.72" N

The range in field water quality parameters for these two stations are: water temperature of 7.8° to 8.1° C, conductivity of 32 to 37 uS/cm, pH of 6.04 to 6.24, and DO of 8.00 to 10.60 mg/L (Table 1). None of the other measured water quality parameters (Table 2) exceeded applicable water quality standards. These values indicate water quality conditions generally supportive of aquatic life.

Habitat characteristics at the two stations varied with relation to; stream discharge rates 0.12 to 0.76 (cfs) and stream width, 2 to 7 feet. The USEPA habitat assessment scores were similar, 161 and 162, for high gradient (riffle/run) habitats, while the score was 130 (UNT IC-2) for low gradient (pool/glide) habitats (Table 2). The habitat assessment score of 130 for low gradient habitats was out of a possible 180; only nine of the ten parameters are used for low gradient streams (PADEP 2007). Channel sinuosity is not used because of the range of sinuosity as defined in the PADEP (2007) protocol is not applicable to Pennsylvania streams. CEC did not perform a USEPA habitat assessment for the low gradient habitats for sampling station UNT IC-1 due to a lack of habitat. The results of the habitat assessment are consistent with "optimal" conditions for riffle/run habitats and "suboptimal" conditions for pool/glide habitats.

One benthic macroinvertebrate sample was collected and analyzed at each of the two sampling stations (Table 4 and Appendix D). The samples collected at UNT IC-1 and UNT IC-2 contained 19 and 33 taxa, respectively. The dominant species within the samples included midge fly larvae (*Chironomidae*) at UNT IC-1 and rolled-winged stoneflies (*Leuctra*) at UNT IC-2. The sample at UNT IC-1 contained a total of 10 EPT taxa which accounted for 31% of the total abundance, while the UNT IC-2 sample contained a total of 22 EPT taxa which accounted for 61% of the total abundance. The Shannon-Diversity Index values ranged from 1.99 (fairly poor) for UNT IC-1 to 2.66 (good) for UNT IC-2. The biological metrics suggest that the benthic macroinvertebrate community for station UNT IC-2 is more diverse than UNT IC-1. Station UNT IC-2 has a higher Shannon Diversity Index, higher number of taxa, and a higher number of EPT taxa.

A Total Biological Score (TBS) calculated using the PADEP (2007) Multihabitat Stream Assessment Protocol is on Table 5. The higher TBS (92.4) was from station UNT IC-2. Station UNT IC-1 has a TBS of 63.2. Overall, stations UNT IC-1 and UNT IC-2 are considered attaining (i.e., TBS>55) for aquatic life use.

TBS were also calculated using the PADEP (2005) Low Gradient Stream Assessment Protocol and the results are presented in Table 6. The TBS were 54.9 and 87.6 at station UNT IC-1 and UNT IC-2, respectively. The TBS calculated using the different PADEP protocols show similar trends.

4.0 SUMMARY AND CONCLUSIONS

This investigation was comprised of the collection of ecological and surface water quality data related to Indian Creek located in Donegal Township, Westmoreland County, Pennsylvania. A total of five stations were sampled between May 21 and May 22, 2008. This included three stations in Indian Creek (IC-1, IC-2, and IC-3) and two stations on unnamed tributaries to Indian Creek (UNT IC-1 and UNT IC-2).

Instream measurements of temperature, conductivity, pH, and dissolved oxygen and other surface water quality parameters indicate overall water quality conditions generally supportive of aquatic life. USEPA habitat assessment scores for the majority of the streams were indicative of marginal to optimal conditions for riffle/run habitats and were indicative of suboptimal conditions for pool/glide habitats. The lowest habitat assessment scores were documented in Indian Creek at stations IC-1 and IC-2 mainly due to their velocity/depth regime, stream channelization, lack of vegetative protection, and width of riparian zone. It is also possible that the benthic community at Indian Creek sampling station IC-3 is being affected by elevated chloride concentrations attributed to surface water runoff and groundwater infiltration from an adjacent road salt storage dome owned by the Pennsylvania Turnpike Commission. It is likely that the low Total Biological Score for station IC-1 is largely due to the lack of instream habitat and stream channelization.

The dominant invertebrate taxa collected from the five sampling stations included midge fly larvae (*Chironomidae*), mayflies (*Acentrella*), and stoneflies (*Leuctra*). The benthic macroinvertebrate data was used to compute a Total Biological Score for each sampling station. Total Biological Scores were computed using the 2007 PADEP Multihabitat Stream Assessment Protocol. Of the six stream metrics used to compute the Total Biological Score, the number of caddisfly (Trichoptera) taxa metric typically scored the lowest for each 200 +/- 20% organism sub-sample. A maximum of six Trichoptera taxa were identified from the five samples, significantly below the 95th percentile value of 11 taxa. Total Biological Scores from stations IC-2, UNT IC-1, and UNT IC-2 were considered attaining for aquatic life use. Total Biological Scores from stations IC-1 and IC-3 were considered impaired for aquatic life use, mainly due to a low number of total taxa, caddisfly taxa, and mayfly taxa. In addition, Total Biological Scores were also computed using the 2005 PADEP TGD-

Appendix B PADEP Low Gradient Stream Assessment Protocol and showed similar trends to the Multihabitat Stream Assessment Protocol.

A fish survey was performed at three of the five sampling stations. Wild brown trout (*Salmo trutta*) was the only species collected. A total of 13 wild brown trout were collected from station IC-3, 3 from station IC-2, and only 1 was collected from station IC-1. Size of the fish collected ranged from 152 millimeters to 295 millimeters in length. No disease, tumors, fin damage, and/or skeletal anomalies were observed on any of the fish collected.

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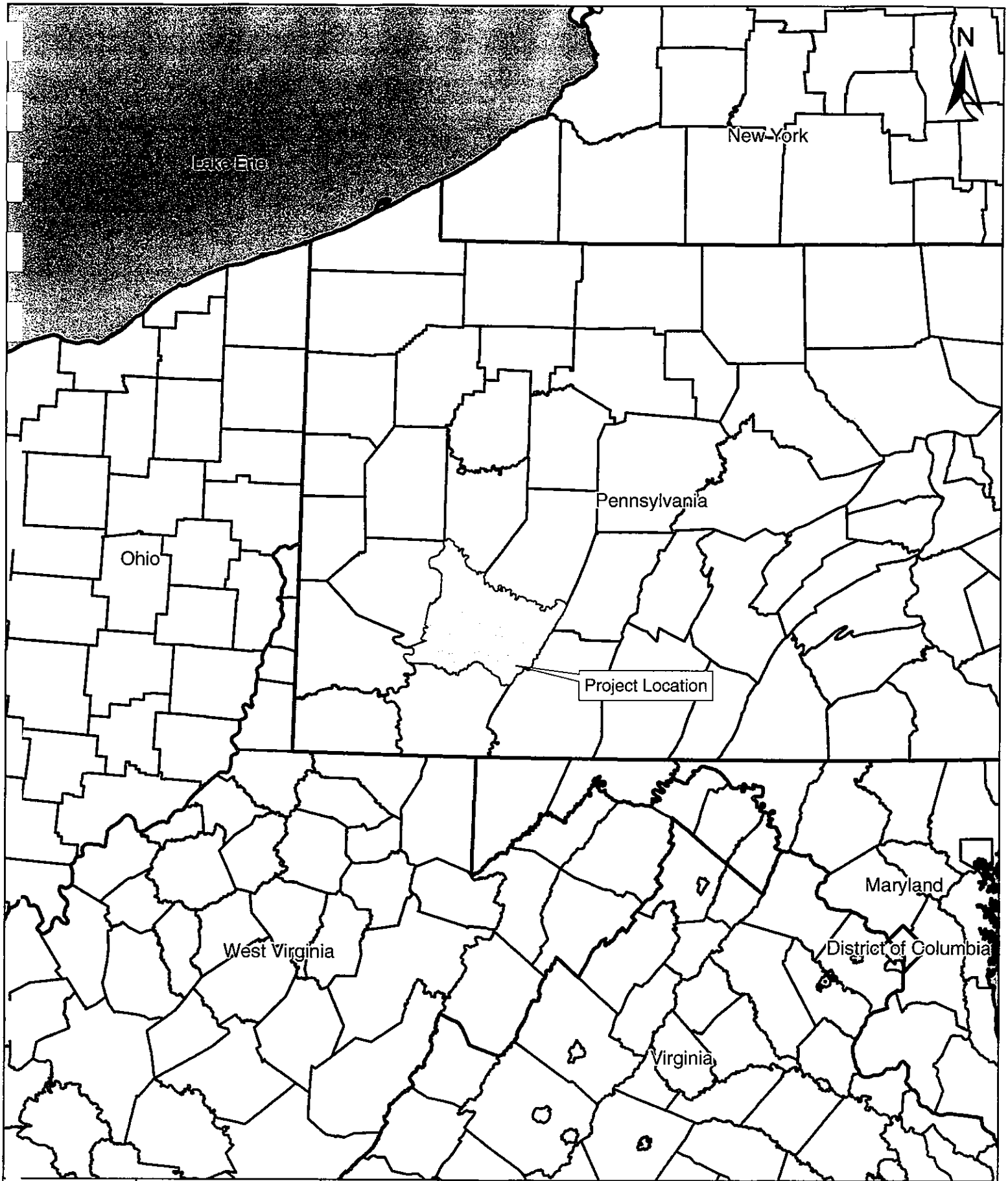
FIGURE



SCALE: 1" = 200,000'

0 100,000 200,000 Feet

ISSUED FOR: PENNSYLVANIA ENVIRONMENTAL COUNCIL

VICINITY MAP
INDIAN CREEK
DONEGAL TOWNSHIP
WESTMORELAND COUNTY, PA

Legend

Westmoreland County, Pennsylvania

*Hand signature on file

ISSUED BY:

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.
333 Baldwin Road
Pittsburgh, PA 15205-9702
1-800-365-2324

Columbus, OH * Cincinnati, OH * Indianapolis, IN * Nashville, TN * Chicago, IL * St. Louis, MO * Export, PA * Detroit, MI * Phoenix, AZ

DWN BY: CLC	PROJECT NO.: 070-846	FIGURE: 1
CHK BY: DAM*	DATE: 7/9/2008	

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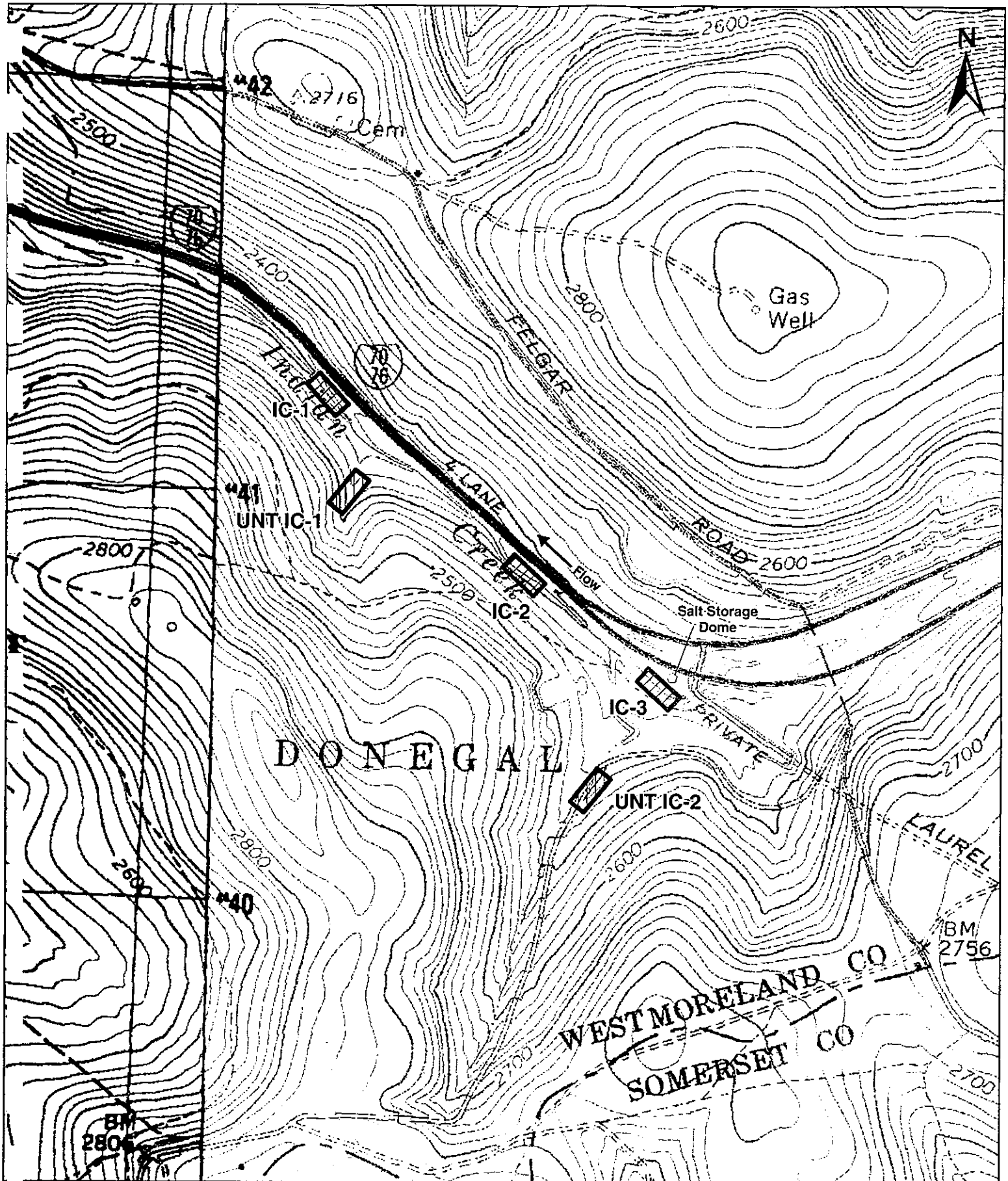

SCALE: 1" = 1,000' | 0 500 1,000 Feet

ISSUED FOR: PENNSYLVANIA ENVIRONMENTAL COUNCIL

SAMPLING STATION LOCATION MAP
INDIAN CREEK
DONEGAL TOWNSHIP
WESTMORELAND COUNTY, PA

.egend

- Fish and Benthic Sampling Station
- Benthic Sampling Station Only
- Salt Storage Dome

*Hand signature on file

ISSUED BY:

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333 Baldwin Road
Pittsburgh, PA 15205-9702
1-800-365-2324

DWN BY: CLC	PROJECT NO.: 070-846	FIGURE: 2
CHK BY: DAM*	DATE: 7/9/2008	

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TABLES

TABLE 1
INSTREAM WATER QUALITY PARAMETERS
MAY 2008
INDIAN CREEK
DONEGAL TOWNSHIP, WESTMORELAND COUNTY, PENNSYLVANIA
CEC PROJECT 070-846

PARAMETERS	Indian Creek (IC-1)		Indian Creek (IC-2)		Indian Creek (IC-3)		Unnamed Tributary to Indian Creek (UNT IC-1)		Unnamed Tributary to Indian Creek (UNT IC-2)	
	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle	Pool
Water Temperature (°C)	10.9	NM	12.0	NM	11.2	NM	8.1	8.1	7.8	NM
Dissolved Oxygen (mg/L)	9.31	NM	10.05	NM	10.20	NM	9.94	8.00	10.60	NM
pH (Standard Units)	7.18	NM	6.94	NM	7.08	NM	6.24	6.04	6.07	NM
Conductivity (µS/cm)	167	NM	153	NM	170	NM	37	37	32	NM

NM = Not Measured (i.e., habitat not present in sampling reach)

TABLE 2
STREAM SURFACE WATER ANALYSIS RESULTS
MAY 2008
INDIAN CREEK
DONEGAL TOWNSHIP, WESTMORELAND COUNTY, PENNSYLVANIA
CEC PROJECT 070-846

PARAMETERS	Indian Creek (IC-1)	Indian Creek (IC-2)	Indian Creek (IC-3)	Unnamed Tributary to Indian Creek (UNT IC-1)	Unnamed Tributary to Indian Creek (UNT IC-2)
Chloride (mg/L)	44.7	39.6	48.0	1.6	0.6
Total Dissolved Solids (mg/L)	89.0	90.0	101.0	21.0	27.0
Total Suspended Solids (mg/L)	ND	ND	ND	ND	8.0

ND = Not Detected

TABLE 3
STREAM HABITAT CHARACTERISTICS
MAY 2008
INDIAN CREEK
DONEGAL TOWNSHIP, WESTMORELAND COUNTY, PENNSYLVANIA
CEC PROJECT 070-846

HABITAT CHARACTERISTIC	Indian Creek (IC-1)	Indian Creek (IC-2)	Indian Creek (IC-3)	Unnamed Tributary to Indian Creek (UNT IC-1)		Unnamed Tributary to Indian Creek (UNT IC-2)
	Riffle	Riffle	Riffle	Riffle	Pool	Riffle
Reach Length Sampled (meters)	100	100	100	100		100
Stream Width (feet)	7-11	5-9	8-14	2-5		3-7
Stream Depth (inches)	5-24	5-30	3-24	2-4	4-8	2-10
Stream Velocity (cubic feet per second)	7.83	6.10	5.26	0.12		0.76
USEPA (1999) Habitat Assessment Score (out of possible 200)[a]	142	128	124	162	130[b]	161
Percent of Maximum Possible USEPA (1999) Habitat Assessment Score (Narrative Criteria) [a]	71% (Sub-Optimal)	64% (Marginal)	62% (Marginal)	81% (Optimal)	72% (Sub-Optimal)	81% (Optimal)

[a] U.S. Environmental Protection Agency (1999).

[b] Score out of possible 180, PADEP (2007)

TABLE 4
STREAM BENTHIC MACROINVERTEBRATE COMMUNITY METRICS
MAY 2008
INDIAN CREEK
DONEGAL TOWNSHIP, WESTMORELAND COUNTY, PENNSYLVANIA
CEC PROJECT 070-846

METRIC	SAMPLING STATIONS				
	Indian Creek (IC-1)	Indian Creek (IC-2)	Indian Creek (IC-3)	Unnamed Tributary to Indian Creek (UNT IC-1)	Unnamed Tributary to Indian Creek (UNT IC-2)
Number Collected	201	220	237	206	227
Number of Taxa	14	20	22	19	33
Percent Dominant Taxon	62.7% Acentrella	48.6% Acentrella	57.4% Chironomidae	45.6% Chironomidae	18.9% Leuctra
Number of EPT Taxa	7	11	7	10	22
Percent Abundance of EPT Taxa	84.6%	74.5%	24.1%	30.6%	61.2%
Shannon Diversity Index[a]	1.27	1.87	1.60	1.99	2.66

[a] Employing formula presented in PADEP (2007)

TABLE 5
TOTAL BIOLOGICAL SCORE CALCULATIONS - PADEP MULTIHABITAT STREAM ASSESSMENT PROTOCOL
MAY 2008
INDIAN CREEK
DONEGAL TOWNSHIP, WESTMORELAND COUNTY, PENNSYLVANIA
CEC PROJECT 070-846

STATIONS		METRICS[a]						Total Biological Score	Rating *Comparison to Protocol Benchmark
		EPT Taxa	Total Taxa	Beck4	Shannon Diversity	Number of Caddisfly Taxa	Number of Mayfly Taxa		
Indian Creek (IC-1)	Metric	7	14	8	1.27	3	2	***39.3***	Impaired for Aquatic Life Use
	Score	**41.2**	**45.2**	**36.4**	**52.3**	**27.3**	**33.3**		
Indian Creek (IC-2)	Metric	11	20	16	1.87	5	3	***62.4***	Attaining for Aquatic Life Use
	Score	**64.7**	**64.5**	**72.7**	**77.0**	**45.5**	**50.0**		
Indian Creek (IC-3)	Metric	7	22	10	1.60	4	2	***48.9***	Impaired for Aquatic Life Use
	Score	**41.2**	**71.0**	**45.6**	**65.8**	**36.4**	**33.3**		
Unnamed Tributary to Indian Creek (UNT IC-1)	Metric	10	19	20	1.99	4	3	***63.2***	Attaining for Aquatic Life Use
	Score	**58.8**	**61.3**	**90.9**	**81.9**	**36.4**	**50.0**		
Unnamed Tributary to Indian Creek (UNT IC-2)	Metric	22	33	37	2.66	6	9	***92.4***	Attaining for Aquatic Life Use
	Score	**100.0**	**100.0**	**100.0**	**100.0**	**54.5**	**100.0**		

[a] Metric values are from Table 4 and Appendix D.
[b] Standard values from PADEP (2007).

Note:

Metric	Percentile for "best" value	Standard (Best Value)[b]
EPT Taxa	95th	17
Total Taxa	95th	31
Beck4	95th	22
Shannon Diversity	95th	2.43
Number of Caddisfly Taxa	95th	11
Number of Mayfly Taxa	95th	6

* Multihabitat Aquatic Life Use (ALU) Benchmark (PADEP 2007)
Total Biological Score >55 considered Attaining for Aquatic Life Use
Total Biological Score <55 considered Impaired for Aquatic Life Use

TABLE 6
TOTAL BIOLOGICAL SCORE CALCULATIONS - APPENDIX B PADEP LOW GRADIENT STREAM ASSESSMENT PROTOCOL
MAY 2008
INDIAN CREEK
DONEGAL TOWNSHIP, WESTMORELAND COUNTY, PENNSYLVANIA
CEC PROJECT 070-846

STATIONS		METRICS[a]					Total Biological Score
		Taxonomic Richness	Trichoptera Taxa Richness	Percent EPT Taxa	Intolerant Taxa Richness	Filterer-Collector + Predator Taxa Richness	
Indian Creek (IC-1)	Metric	14	3	84.6	6	3	***46.8***
	Score	**45.9**	**28.6**	**100.0**	**37.5**	**22.2**	
Indian Creek (IC-2)	Metric	20	5	74.5	11	11	***72.7***
	Score	**65.6**	**47.6**	**100.0**	**68.8**	**81.5**	
Indian Creek (IC-3)	Metric	22	4	24.1	8	9	***56.9***
	Score	**72.1**	**38.1**	**39.1**	**50.0**	**66.7**	
Unnamed Tributary to Indian Creek (UNT IC-1)	Metric	19	4	30.6	14	5	***54.9***
	Score	**62.3**	**38.1**	**49.7**	**87.5**	**37.0**	
Unnamed Tributary to Indian Creek (UNT IC-2)	Metric	33	6	61.2	23	11	***87.6***
	Score	**100.0**	**57.1**	**99.4**	**100.0**	**81.5**	

[a] Metric values are from Table 4 and Appendix D.
[b] Standard values from PADEP TGD (2005).

Note:

Metric	Percentile for "best" value	Standard (Best Value) from Statewide Low Gradient Stream Dataset[b]
Taxonomic Richness	95th	30.5
Trichoptera Taxa Richness	95th	10.5
Percent EPT Taxa	95th	61.6
Intolerant Taxa Richness	95th	16
Filterer-Collector + Predator Taxa Richness	95th	13.5

TABLE 7
FISH COMMUNITY SURVEY DATA AND METRICS
MAY 2008
INDIAN CREEK
DONEGAL TOWNSHIP, WESTMORELAND COUNTY, PENNSYLVANIA
CEC PROJECT 070-846

COMMON NAME	SCIENTIFIC NAME	POLLUTION TOLERANCE	Indian Creek (IC-1)	Indian Creek (IC-2)	Indian Creek (IC-3)
			Length (mm)	Length (mm)	Length (mm)
			min [redacted] max	min [redacted] max	min [redacted] max
Brown Trout	*Salmo trutta*	Intermediate[a]	203 [redacted] 203	170 [redacted] 195	152 [redacted] 295
Number Fish Collected			1	3	13
Species Richness			1	1	1
Shannon-Weaver Diversity Index[b]			0	0	0
Reach Length Of Stream Sampled (meters)			100	100	100
Time Sampled (minutes)			19	14	11
Catch Per Foot (fish/foot)			0.003	0.009	0.040
Catch Per Minute (fish/minute)			0.053	0.214	1.182
OTHER VERTEBRATE SPECIES					
Green Frog	*Rana clamitans melanota*	NA	1	0	0
Larval salamander		NA	0	1	0

[a] United States Environmental Protection Agency (USEPA 1999)
[b] Employing formula presented in USEPA (1990)
NA= Not Applicable

APPENDIX A

PHOTOGRAPHS OF SAMPLING STATIONS

APPENDIX A
SAMPLING STATION PHOTOGRAPHS
INDIAN CREEK
DONEGAL TOWNSHIP, WESTMORELAND COUNTY, PENNSYLVANIA
CEC PROJECT 070-846

SAMPLING LOCATION ON INDIAN CREEK (IC-1) LOOKING UPSTREAM AT DOWNSTREAM LIMIT OF REACH

SAMPLING LOCATION ON INDIAN CREEK (IC-1) LOOKING UPSTREAM NEAR UPSTREAM LIMIT OF REACH

APPENDIX A
SAMPLING STATION PHOTOGRAPHS
INDIAN CREEK

SAMPLING LOCATION ON INDIAN CREEK (IC-2) LOOKING UPSTREAM AT DOWNSTREAM LIMIT OF REACH

SAMPLING LOCATION ON INDIAN CREEK (IC-2) LOOKING UPSTREAM NEAR UPSTREAM LIMIT OF REACH

APPENDIX A
SAMPLING STATION PHOTOGRAPHS
INDIAN CREEK

SAMPLING LOCATION ON INDIAN CREEK (IC-3) LOOKING UPSTREAM AT DOWNSTREAM LIMIT OF REACH

SAMPLING LOCATION ON INDIAN CREEK (IC-3) LOOKING UPSTREAM NEAR UPSTREAM LIMIT OF REACH

APPENDIX A
SAMPLING STATION PHOTOGRAPHS
INDIAN CREEK

WILD BROWN TROUT (*Salmo trutta*) COLLECTED FROM IC-3 SAMPLING LOCATION

SAMPLING LOCATION ON UNNAMED TRIBUTARY TO INDIAN CREEK (UNT IC-1) LOOKING UPSTREAM NEAR DOWNSTREAM LIMIT OF REACH

APPENDIX A
SAMPLING STATION PHOTOGRAPHS
INDIAN CREEK

SAMPLING LOCATION ON UNNAMED TRIBUTARY TO INDIAN CREEK (UNT IC-1) LOOKING UPSTREAM AT UPSTREAM LIMIT OF REACH

SAMPLING LOCATION ON UNNAMED TRIBUTARY TO INDIAN CREEK (UNT IC-2) LOOKING UPSTREAM NEAR DOWNSTREAM LIMIT OF REACH

APPENDIX A
SAMPLING STATION PHOTOGRAPHS
INDIAN CREEK

SAMPLING LOCATION ON UNNAMED TRIBUTARY TO INDIAN CREEK (UNT IC-2) LOOKING UPSTREAM AT UPSTREAM LIMIT OF REACH

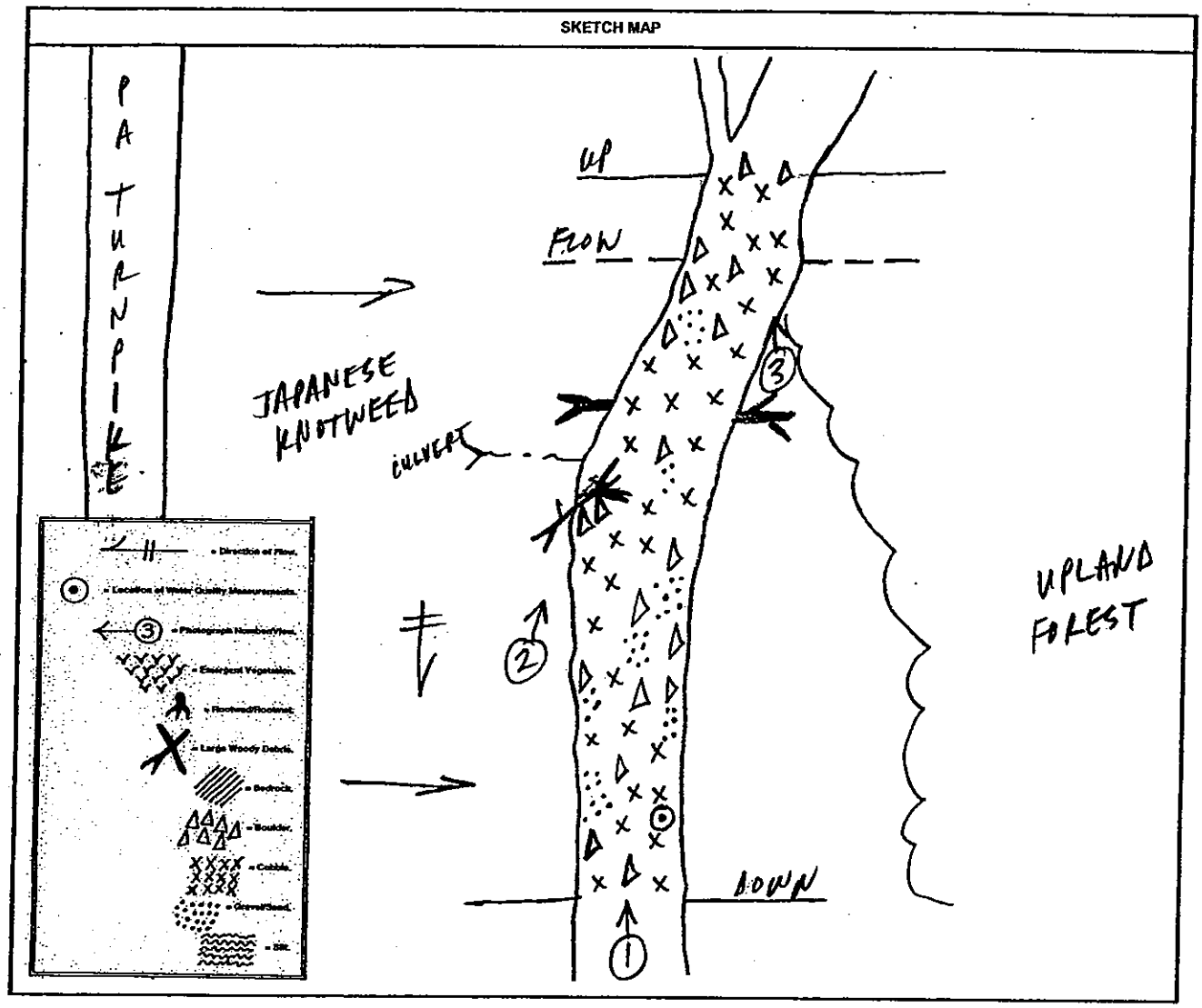
APPENDIX B

STREAM BIOMONITORING FIELD DATA FORMS

PHYSICAL HABITAT/WATER QUALITY FIELD DATA SHEET (Page 1)

Station: IC-1		Project No.: 070-846	
Stream Name: INDIAN CREEK		Date/Time: 5.21.08	1105
River Basin: MONONGAHELA		Investigators: JEM, DAM, DJP	

SKETCH MAP



WEATHER CONDITIONS	Air Temperature: 50 C			
	Weather	Now	Past 24 hrs	Past 7 days
	Heavy Rain		✓	✓
	Steady Rain			
	Intermit. Rain			
	% Cloud Cover	30%		
	Clear/Sunny			
	Other:			

HABITAT LENGTHS IN SAMPLING REACH		
Habitat	Length (steps)	Length (ft)
Riffle	→	328
Run		
Pool	→	0
Glide		
Total		328

STREAM CHARACTER-IZATION							
Subsystem:	Perennial ✓	Intermittent ___	Tidal ___				
Type:	Coldwater ✓	Warmwater ___					
Origin:	Spring-fed ___	Wetland ___	Montane ___	Glacial ___	Mixture ✓	Other ___	

GPS UNIT USED: GEOXT RENTAL 1	CAMERA USED: E	PHOTO NO.S: 1-5

PHYSICAL HABITAT/WATER QUALITY FIELD DATA SHEET (Page 2)

Station: IC-1		Project No.: 070-846	
Stream Name: INDIAN CREEK		Date/Time: 5.21.08	1105
River Basin: OHIO		Investigators: JEM, DAM, DJY	

WATERSHED FEATURES

Predominant Surrounding Landuse
☑ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☑ Other PA TURNPIKE
☐ Residential

Local Watershed NPS Pollution
☐ No evidence ☑ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☐ None ☑ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☑ Trees ☑ Shrubs ☐ Grasses ☑ Herbaceous
dominant species present RED MAPLE, KNOTWEED, GOLDENROD

INSTREAM FEATURES

Estimated Reach Length 328'
Estimated Stream Width 7-11'
Sampling Reach Area 100M
Area in km² (m²x1000)
Estimated Stream Depth 5-24"
Surface Velocity (at thalweg)

Canopy Cover ☑ Open
☐ Partly open ☐ Partly shaded ☐ Shaded
High Water Mark 2-3'

Proportion of Reach Represented by Stream Morphology Types
☑ Riffle ___% ☐ Run 100 %
☐ Pool ___% ☑ Glide ___%
Channelized ☑ Yes ☐ No
Dam Present ☐ Yes ☑ No

STREAM DEPTH:
Riffle/Run = 5-24"
Pool/Glide = NA

LARGE WOODY DEBRIS

LWD ✓
Density of LWD < 1%

AQUATIC VEGETATION

NA

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae
dominant species present
Portion of the reach with aquatic vegetation

WATER QUALITY

POOL:
Temperature =
Conductivity = NA
Dissolved Oxygen =
pH =

RIFFLE:
Temperature = 10.9
Conductivity = 167
Dissolved Oxygen = 9.31
pH = 7.18

Water Odors
☑ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☑ None ☐ Other

Turbidity (if not measured)
☐ Clear ☑ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other

SEDIMENT/ SUBSTRATE

Odors
☑ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other

Oils
☑ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☑ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%) RR

Substrate Type	Diameter	% Composition in Sampling Reach	
Bedrock		0	
Boulder	> 256 mm (10")	30	
Cobble	64-256 mm (2.5"-10")	50	
Gravel	2-64 mm (0.1"-2.5")	10	
Sand	0.06-2mm (gritty)	10	
Silt	0.004-0.06 mm	0	
Clay	< 0.004 mm (slick)	0	

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)

Substrate Type	Characteristic	% Composition in Sampling Area
Detritus	sticks, wood, coarse plant materials (CPOM)	—
Muck-Mud	black, very fine organic (FPOM)	—
Marl	grey, shell fragments	—

STREAM DISCHARGE FIELD DATA FORM

Station: IC-1	Project No.: 070-846
Stream Name: INDIAN CREEK	Date/Time: 5.21.08 1240
River Basin: OHIO	Investigators: JEM, DAM, DVP
Method: Midsection, current meter method	Flow Meter (Model and No.): MARSH-McBIRNEY FLOWMATE 2000
Stream Wetted Width: 10.5 feet	Starting Point: RDB (LDB)

Distance (ft)[1]	Width (ft)[2]	Depth (ft)[3]	Observation Depth[4]	Velocity (ft/s)	Notes/Comments
0.5	0.5	0.15	0.60	0.25	BY DAM
1.5	1.0	0.40	0.60	1.15	
2.5	1.0	0.50	0.60	2.41	
3.5	1.0	0.75	0.60	2.15	
4.5	1.0	0.65	0.60	1.54	
5.5	1.0	0.50	0.60	1.65	
6.5	1.0	0.70	0.60	1.01	
7.5	1.0	0.75	0.60	1.30	
8.5	1.0	0.45	0.60	1.39	
9.5	1.0	0.50	0.60	0.81	
10.5	1.0	0.10	0.60	0.00	
					7.83 cfs
					3516.5 gpm

[1] Distance from starting point on stream bank to velocity and depth measurement midpoint or "observation vertical"

[2] Width of measurement section; see Figure 1, sketch of midsection method, for width computation equations

[3] Depth at velocity measurement midpoint or "observation vertical"

[4] Observation depth of velocity measurement - either 0.6 depth (one point method) or 0.2 and 0.8 depth (two point method)

BENTHIC MACROINVERTEBRATE FIELD DATA SHEET

Station: IC-1	Project No.: 070-846
Stream Name: INDIAN CREEK	Date/Time: 5.21.08 1125
River Basin: OHIO	Investigators: JEM, DAM, DOP

Habitat Type	Description	Sample Technique	D-Frame Sample Tally	
			Proposed	Actual
Cobble/Gravel Substrate	Stream bottom areas consisting of mixed gravel and larger substrate particles; cobble gravel substrates are typically located in relatively fast flowing, "erosional" areas of the stream channel	Macroinvertebrates are collected by placing the net on the substrate by the downstream end of an area of gravel or larger substrate particles and simultaneously pushing down on the net while pulling it in an upstream direction with adequate force to dislodge substrate particles and the aquatic macroinvertebrates associated with these materials. Large stones and organic material contained in the net are discarded after they are carefully inspected for the presence of attached organisms, which are removed and retained with the remainder of the sample. One jab consists of passing the net over approximately 30 inches of substrate.	6	6
Snag	Snag habitat consists of submerged sticks, branches, and other woody debris that appears to have been submerged long enough to be colonized by aquatic macroinvertebrates. Preferred snags for sampling include small- to medium-sized sticks and branches (preferably about 4 inches in diameter) that have accumulated a substantial amount of organic matter (twigs, leaves, uprooted aquatic macrophytes, etc.) that is colonized by aquatic macroinvertebrates.	When possible, the net is placed immediately downstream of the snag in either the water column or stream bottom in an area where water is flowing through the snag at a moderate velocity. The snag is then kicked in such a manner that aquatic macroinvertebrates and organic matter are dislodged from the snag and carried by the current into the net. If the snag cannot be kicked, then it is sampled by jabbing the net into a downstream area of the snag and moving it in an upstream direction with enough force to dislodge and capture aquatic macroinvertebrates that have colonized the snag. One jab equals an area of approximately 0.23m^2 (12" X 30")	2	2
Coarse Particulate Organic Matter (CPOM)	CPOM consists of a mix of plant parts (leaves, bark, twigs, seeds, etc.) that have accumulated on the stream bottom in depositional areas of the stream channel. In situations where there is substantial variability in the composition of CPOM deposits within a given sample reach (e.g., deposits consisting primarily of white pine needles and deposits consisting primarily of hardwood tree leaves), a variety of CPOM deposits are sampled. Leaf packs in higher velocity ("erosional") areas of the channel, however, are not included in the CPOM samples	CPOM deposits are sampled by passing the net along a 30-inch-long path through the accumulated organic material so as to collect the material and its associated aquatic macroinvertebrates. When CPOM deposits are extensive, only the upper portion of the accumulated organic material is collected to ensure that the collected material is from the aerobic zone.	0	0
Submerged Aquatic Vegetation (SAV)	SAV habitat consists of rooted aquatic macrophytes.	SAV is sampled by drawing the net in an upstream direction along a 30-inch-long path through the vegetation. Efforts should be made to avoid collecting the stream bottom sediments and organisms when sampling SAV areas.	0	0
Sand/Fine Sediment	Sand/fine sediment habitat includes stream bottom areas that are comprised primarily of sand, silt, and/or clay.	Sand/fine sediment areas are sampled by bumping or tapping the net along the surface of the substrate while slowly drawing the net in an upstream direction along a 30-inch-long path of stream bottom. Efforts should be made to minimize the amount of debris collected in the net by penetrating only the upper-most layer of sand/silt deposits. Excess sand and silt are removed from the sample by repeatedly dipping the net into the water column and lifting it out of the stream to wash fine sediment through the net.	2	2

NOTES:

1. Two samples should be collected from each of the five habitats and all ten net samples are composited into a single sample.
2. If one or more of the habitats to be sampled are absent from the sample reach, redistribute the ten samples among the remaining habitats present in proportion to the quantity of habitat present in the sampling reach.

COMMENTS:

BY DAM

FISH SAMPLING FIELD DATA SHEET (PAGE 1)

Station: IC-1		Project No.: 070-846	
Stream Name: INDIAN CREEK		Date/Time: 5.21.08	1210
River Basin: OHIO		Investigators: JEM, DAM, DJP	

Sample Collection

Capture Method: Backpack ✓ Longline ____ Tote Barge ____ Boat ____

Electrofisher Model: SMITH ROOT LR-24

Other: ____ Block Nets Used? Yes ____ No ✓

DC ✓ AC ____ Volts 600 Amps .24-.29 Shock Time (sec): 1133

Reach Length (ft): 328 Stream Width (ft) : Max 11' Mean 9'

SPECIES	RIFFLE TALLY	POOL TALLY
Blacknose Dace		
Bluntnose Minnow		
Creek Chub		
Central Stoneroller		
Common Carp		
Silverjaw Minnow		
SHINERS: Common Shiner		
SHINERS: Emerald Shiner		
SHINERS: Mimic Shiner		
SHINERS: Rosyface Shiner		
SHINERS: Sand Shiner		
SHINERS: Silver Shiner		
SHINERS: Spotfin Shiner		
SHINERS: Striped Shiner		
* Archived Minnows		

OVER →

FISH SAMPLING FIELD DATA SHEET (PAGE 2)

Station: IC-1		Project No.: 070-846	
Stream Name: INDIAN CREEK		Date/Time: 5.21.08	1210
River Basin: OHIO		Investigators: JEM, DAM, DJP	

	SPECIES	RIFFLE TALLY	POOL TALLY
CATFISH	Yellow Bullhead		
	Channel Catfish		
	Stonecat		
	Brindled Madtom		
DARTERS	Banded Darter		
	Fantail Darter	/	
	Greenside Darter		
	Johnny Darter		
	Rainbow Darter		
	Variegate Darter		
	Logperch		
SUCKERS	White Sucker		
	Northern Hogsucker		
	Golden Redhorse		
	Black Redhorse		
	* Archived Redhorse Spp.		
PAN and SPORT FISH	Rock Bass		
	Bluegill		
	Pumpkinseed		
	Green Sunfish		
	White Crappie		
	Black Crappie		
	Smallmouth Bass		
	Largemouth Bass		
	Rainbow Trout		
	Brown Trout	1 (1) WILD 203 mm	PHOTO #5
	1 GREEN FROG		

HIGH GRADIENT STREAMS HABITAT ASSESSMENT FIELD DATA SHEET (Page 1)

Station:	IC-1	Project No.:	070-846
Stream Name:	INDIAN CREEK	Date/Time:	5.21.08 1145
River Basin:	OHIO	Investigators:	JEM, DAM, DP

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 15	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	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 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is <0.3 m/s, deep is >0.5 m.)	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 low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 8	20 19 18 17 16	15 14 13 12 11	10 9 (8) 7 6	5 4 3 2 1 0
4. 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 gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 16	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 16	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HIGH GRADIENT STREAMS HABITAT ASSESSMENT FIELD DATA SHEET (Page 2)

Station:	IC-1	Project No.:	070-846
Stream Name:	INDIAN CREEK	Date/Time:	5.21.08 1145
River Basin:	OHIO	Investigators:	JEM, DAM, DP

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 4	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 (4) 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 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 a ratio of >25.
SCORE 19	20 (19) 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 8 (LB)	Left Bank 10 9	(8) 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	(8) 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 10 (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 (6)	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	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 (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE 4 (RB)	Right Bank 10 9	8 7 6	5 (4) 3	2 1 0

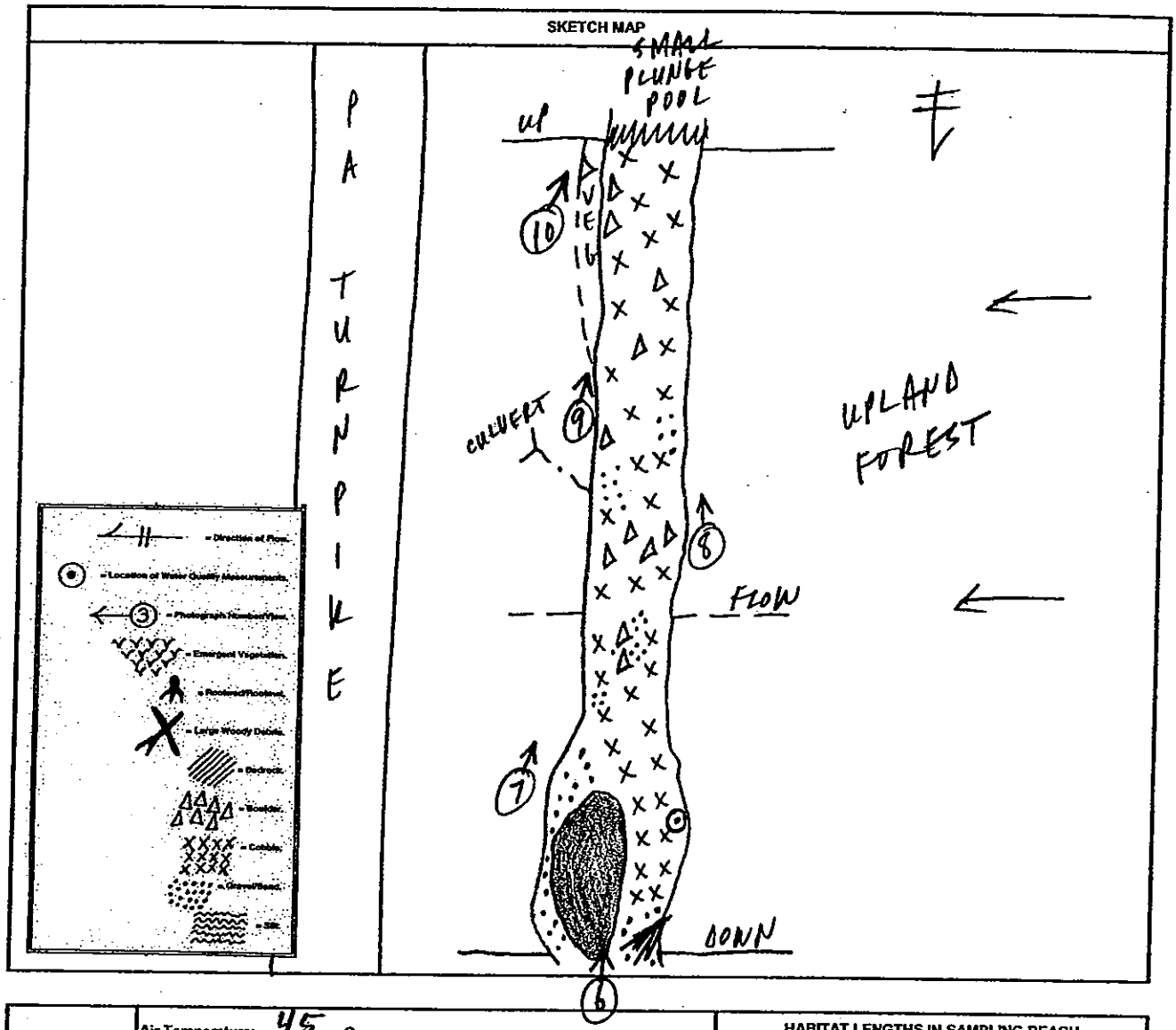
Total Score 142

Narrative categories and scoring ranges: Optimal = 156-200; Sub-optimal = 106-155; Marginal = 56-105; Poor = 0-55

PHYSICAL HABITAT/WATER QUALITY FIELD DATA SHEET (Page 1)

Station: IC-2		Project No.: 070-846	
Stream Name: INDIAN CREEK		Date/Time: 5.21.08	1405
River Basin: MONONGAHELA		Investigators: JEM, DAM, DOP	

SKETCH MAP



WEATHER CONDITIONS

Air Temperature: 45 C

Weather	Now	Past 24 hrs	Past 7 days
Heavy Rain		✓	✓
Steady Rain			
Intermit. Rain	✓		
% Cloud Cover			
Clear/Sunny			

Other:

HABITAT LENGTHS IN SAMPLING REACH

Habitat	Length (steps)	Length (ft)
Riffle		328
Run		
Pool		0
Glide		
Total		328

STREAM CHARACTERIZATION

Subsystem:	Perennial ✓	Intermittent ___	Tidal ___				
Type:	Coldwater ✓	Warmwater ___					
Origin:	Spring-fed ___	Wetland ___	Montane ___	Glacial ___	Mixture ✓	Other ___	

GPS UNIT USED:	GEOXT RENTAL 1	CAMERA USED:	E	PHOTO NO.S:	1 - 10

PHYSICAL HABITAT/WATER QUALITY FIELD DATA SHEET (Page 2)

Station: IC-2	Project No.: 070-846
Stream Name: INDIAN CREEK	Date/Time: 5.21.08 1305
River Basin: OHIO	Investigators: JEM, DAM, DJP

WATERSHED FEATURES

Predominant Surrounding Landuse
☑ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☑ Other PA TURNPIKE
☐ Residential

Local Watershed NPS Pollution
☐ No evidence ☑ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☐ None ☑ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☑ Trees ☐ Shrubs ☐ Grasses ☑ Herbaceous
dominant species present RED MAPLE, POA SP.

INSTREAM FEATURES

Estimated Reach Length 328'
Estimated Stream Width 5-9'
Sampling Reach Area 100 M
Area in km² (m²x1000)
Estimated Stream Depth 5-30"
Surface Velocity (at thalweg)

Canopy Cover ☑ Open
☐ Partly open ☐ Partly shaded ☐ Shaded
High Water Mark 2-3'

Proportion of Reach Represented by Stream Morphology Types
☑ Riffle ~~%~~ ☐ Run 100 %
☐ Pool %
☐ Glide %
Channelized ☑ Yes ☐ No
Dam Present ☐ Yes ☑ No

STREAM DEPTH:
Riffle/Run = 5-30"
Pool/Glide = NA

LARGE WOODY DEBRIS

LWD ✓
Density of LWD <1%

AQUATIC VEGETATION

NA

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae
dominant species present
Portion of the reach with aquatic vegetation

WATER QUALITY

POOL:
Temperature =
Conductivity = NA
Dissolved Oxygen =
pH =

RIFFLE:
Temperature = 12.0
Conductivity = 153.0
Dissolved Oxygen = 10.05
pH = 6.94

Water Odors
☑ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☑ None ☐ Other

Turbidity (if not measured)
☑ Clear ☑ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other

SEDIMENT/ SUBSTRATE

Odors
☑ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other

Oils
☑ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☐ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%) RR

Substrate Type	Diameter	% Composition in Sampling Reach
Bedrock		0
Boulder	> 256 mm (10")	30
Cobble	64-256 mm (2.5"-10")	50
Gravel	2-64 mm (0.1"-2.5")	10
Sand	0.06-2mm (gritty)	10
Silt	0.004-0.06 mm	0
Clay	< 0.004 mm (slick)	0

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)

Substrate Type	Characteristic	% Composition in Sampling Area
Detritus	sticks, wood, coarse plant materials (CPOM)	—
Muck-Mud	black, very fine organic (FPOM)	—
Marl	grey, shell fragments	—

STREAM DISCHARGE FIELD DATA FORM

Station: IC-2	Project No.: 070-846
Stream Name: INDIAN CREEK	Date/Time: 5.21.08 1430
River Basin: OHIO	Investigators: JEM, DAM, DJP
Method: Midsection, current meter method	Flow Meter (Model and No.): MARSH-McBIRNEY FLOWMATE 2000
Stream Wetted Width: 7.0 feet	Starting Point: (RDB) LDB

Distance (ft)[1]	Width (ft)[2]	Depth (ft)[3]	Observation Depth[4]	Velocity (ft/s)	Notes/Comments
0.50	0.50	0.3	0.60	0.21	BY DJP
1.50	1.0	0.55	0.60	1.39	
2.50	1.0	0.75	0.60	1.44	
3.00	1.0	0.80	0.60	1.46	
3.50	1.0	0.85	0.60	1.43	
4.00	1.0	0.90	0.60	1.34	
4.50	1.0	0.70	0.60	0.91	
					6.10 cfs
					2739 gpm

[1] Distance from starting point on stream bank to velocity and depth measurement midpoint or "observation vertical"

[2] Width of measurement section; see Figure 1, sketch of midsection method, for width computation equations

[3] Depth at velocity measurement midpoint or "observation vertical"

[4] Observation depth of velocity measurement - either 0.6 depth (one point method) or 0.2 and 0.8 depth (two point method)

BENTHIC MACROINVERTEBRATE FIELD DATA SHEET

Station:	IC-2	Project No.:	070-846
Stream Name:	INDIAN CREEK	Date/Time:	5.21.08 1405
River Basin:	OHIO	Investigators:	JEM, DAM, DJF

Habitat Type	Description	Sample Technique	D-Frame Sample Tally	
			Proposed	Actual
Cobble/Gravel Substrate	Stream bottom areas consisting of mixed gravel and larger substrate particles; cobble gravel substrates are typically located in relatively fast flowing, "erosional" areas of the stream channel	Macroinvertebrates are collected by placing the net on the substrate by the downstream end of an area of gravel or larger substrate particles and simultaneously pushing down on the net while pulling it in an upstream direction with adequate force to dislodge substrate particles and the aquatic macroinvertebrates associated with these materials. Large stones and organic material contained in the net are discarded after they are carefully inspected for the presence of attached organisms, which are removed and retained with the remainder of the sample. One jab consists of passing the net over approximately 30 inches of substrate.	6	6
Snag	Snag habitat consists of submerged sticks, branches, and other woody debris that appears to have been submerged long enough to be colonized by aquatic macroinvertebrates. Preferred snags for sampling include small- to medium-sized sticks and branches (preferably about 4 inches in diameter) that have accumulated a substantial amount of organic matter (twigs, leaves, uprooted aquatic macrophytes, etc.) that is colonized by aquatic macroinvertebrates.	When possible, the net is placed immediately downstream of the snag in either the water column or stream bottom in an area where water is flowing through the snag at a moderate velocity. The snag is then kicked in such a manner that aquatic macroinvertebrates and organic matter are dislodged from the snag and carried by the current into the net. If the snag cannot be kicked, then it is sampled by jabbing the net into a downstream area of the snag and moving it in an upstream direction with enough force to dislodge and capture aquatic macroinvertebrates that have colonized the snag. One jab equals an area of approximately 0.23m^2 (12" X 30")	2	2
Coarse Particulate Organic Matter (CPOM)	CPOM consists of a mix of plant parts (leaves, bark, twigs, seeds, etc.) that have accumulated on the stream bottom in depositional areas of the stream channel. In situations where there is substantial variability in the composition of CPOM deposits within a given sample reach (e.g., deposits consisting primarily of white pine needles and deposits consisting primarily of hardwood tree leaves), a variety of CPOM deposits are sampled. Leaf packs in higher velocity ("erosional") areas of the channel , however, are not included in the CPOM samples	CPOM deposits are sampled by passing the net along a 30-inch-long path through the accumulated organic material so as to collect the material and its associated aquatic macroinvertebrates. When CPOM deposits are extensive, only the upper portion of the accumulated organic material is collected to ensure that the collected material is from the aerobic zone.	0	0
Submerged Aquatic Vegetation (SAV)	SAV habitat consists of rooted aquatic macrophytes.	SAV is sampled by drawing the net in an upstream direction along a 30-inch-long path through the vegetation. Efforts should be made to avoid collecting the stream bottom sediments and organisms when sampling SAV areas.	0	0
Sand/Fine Sediment	Sand/fine sediment habitat includes stream bottom areas that are comprised primarily of sand, silt, and/or clay.	Sand/fine sediment areas are sampled by bumping or tapping the net along the surface of the substrate while slowly drawing the net in an upstream direction along a 30-inch-long path of stream bottom. Efforts should be made to minimize the amount of debris collected in the net by penetrating only the upper-most layer of sand/silt deposits. Excess sand and silt are removed from the sample by repeatedly dipping the net into the water column and lifting it out of the stream to wash fine sediment through the net.	2	2

NOTES:

1. Two samples should be collected from each of the five habitats and all ten net samples are composited into a single sample.
2. If one or more of the habitats to be sampled are absent from the sample reach, redistribute the ten samples among the remaining habitats present in proportion to the quantity of habitat present in the sampling reach.

COMMENTS:

BY DAM

FISH SAMPLING FIELD DATA SHEET (PAGE 1)

Station: IC-2	Project No.: 070-846
Stream Name: INDIAN CREEK	Date/Time: 5.21.08 1440
River Basin: OHIO	Investigators: JEM, DAM, DJT

Sample Collection

Capture Method: Backpack ✓ Longline ____ Tote Barge ____ Boat ____

Electrofisher Model: SMITH ROOT LR-24

Other: ____ Block Nets Used? Yes ____ No ✓

DC ✓ AC ____ Volts 600 Amps .24-.29 Shock Time (sec): 847

Reach Length (ft): 328 Stream Width (ft) : Max 9' Mean 7'

	SPECIES	RIFFLE TALLY	POOL TALLY
	Blacknose Dace		
	Bluntnose Minnow		
	Creek Chub		
	Central Stoneroller		
	Common Carp		
	Silverjaw Minnow		
SHINERS	Common Shiner		
SHINERS	Emerald Shiner		
SHINERS	Mimic Shiner		
SHINERS	Rosyface Shiner		
SHINERS	Sand Shiner		
SHINERS	Silver Shiner		
SHINERS	Spotfin Shiner		
SHINERS	Striped Shiner		
	* Archived Minnows		

OVER →

FISH SAMPLING FIELD DATA SHEET (PAGE 2)

Station: IC-2	Project No.: 070-846
Stream Name: INDIAN CREEK	Date/Time: 5.21.08 1440
River Basin: OHIO	Investigators: JEM, DAM, DJP

	SPECIES	RIFFLE TALLY	POOL TALLY
CATFISH	Yellow Bullhead		
	Channel Catfish		
	Stonecat		
	Brindled Madtom		
DARTERS	Banded Darter		
	Fantail Darter		
	Greenside Darter		
	Johnny Darter		
	Rainbow Darter		
	Variegate Darter		
	Logperch		
SUCKERS	White Sucker		
	Northern Hogsucker		
	Golden Redhorse		
	Black Redhorse		
	* Archived Redhorse Spp.		
PAN and SPORT FISH	Rock Bass		
	Bluegill		
	Pumpkinseed		
	Green Sunfish		
	White Crappie		
	Black Crappie		
	Smallmouth Bass		
	Largemouth Bass		
	Rainbow Trout		
	Brown Trout	III (3) 195 mm	1
		172 mm	3 WILD
	1 LARVAL	170 mm	
	SALAMANDER		

HIGH GRADIENT STREAMS HABITAT ASSESSMENT FIELD DATA SHEET (Page 1)

Station: IC-2	Project No.: 070-846
Stream Name: INDIAN CREEK	Date/Time: 5.21.08 1420
River Basin: OHIO	Investigators: JEM, DAM, DP

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 15	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	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 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	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 low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 8	20 19 18 17 16	15 14 13 12 11	10 9 (8) 7 6	5 4 3 2 1 0
4. 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 gravel, sand or fine sediment; 5-30% of the bottom affected; ~~slight deposition in pools~~.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 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 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 16	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HIGH GRADIENT STREAMS HABITAT ASSESSMENT FIELD DATA SHEET (Page 2)

Station: IC-2	Project No.: 070-846
Stream Name: INDIAN CREEK	Date/Time: 5.21.08 1420
River Basin: OHIO	Investigators: JEM, DAM, BVP

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present; usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 4	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 (4) 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous; placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 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 a ratio of >25.
SCORE 19	20 (19) 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 6 (LB)	Left Bank 10 9	(8) 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 (6)	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 10 (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE 3 (RB)	Right Bank 10 9	8 7 6	5 4 (3)	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	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 (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE 0 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 (0)

PA TWAPIK

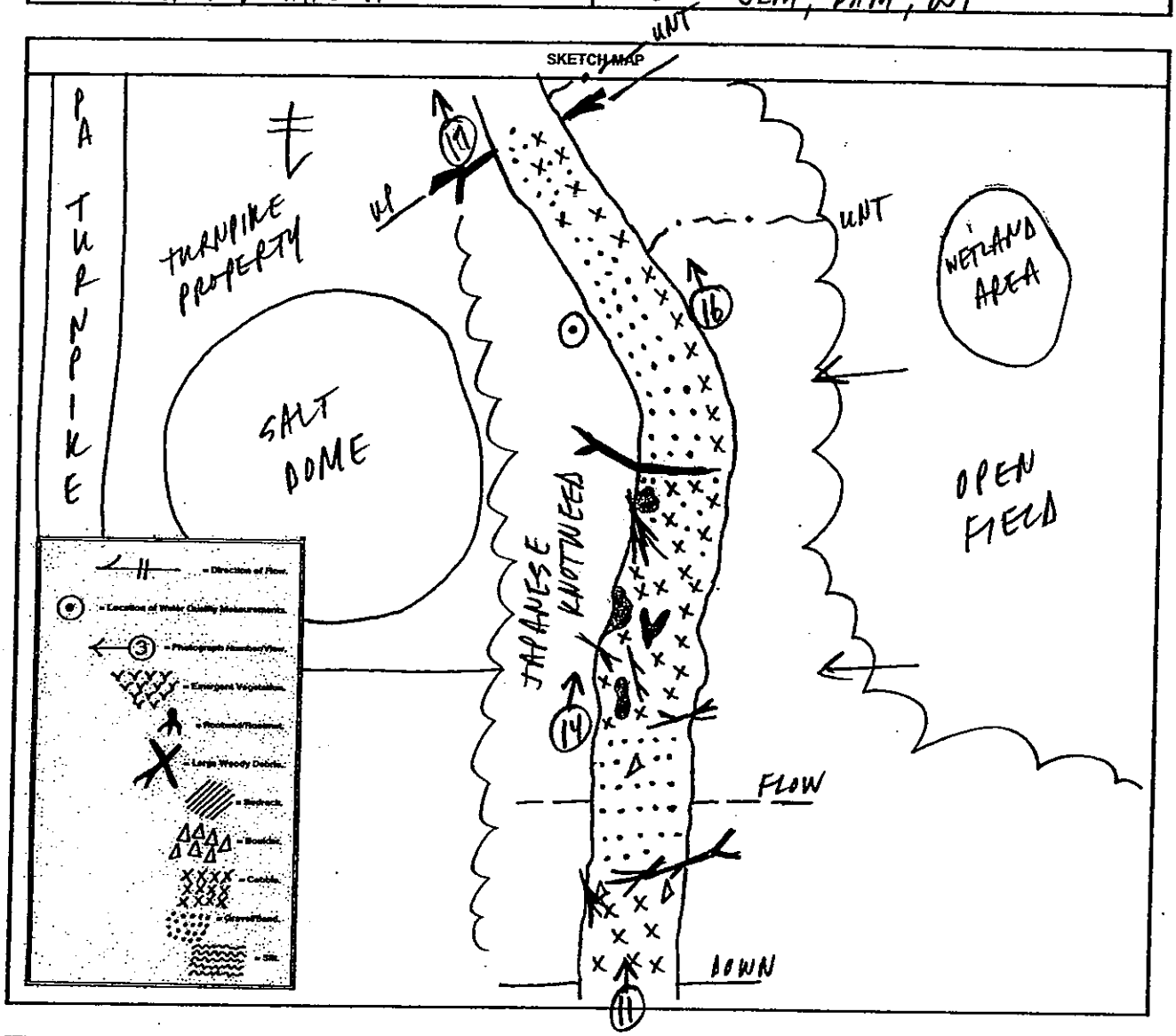
Total Score 128

Narrative categories and scoring ranges: Optimal = 156-200; Sub-optimal = 106-155; Marginal = 56-105; Poor = 0-55

PHYSICAL HABITAT/WATER QUALITY FIELD DATA SHEET (Page 1)

Station: IC-3		Project No.: 070-846	
Stream Name: INDIAN CREEK		Date/Time: 5.21.08	1525
River Basin: MONONGAHELA		Investigators: JEM, PAM, DJP	

SKETCH MAP



WEATHER CONDITIONS	Air Temperature: 45 C			
	Weather	Now	Past 24 hrs	Past 7 days
	Heavy Rain		✓	✓
	Steady Rain			
	Intermit. Rain	✓		
	% Cloud Cover			
	Clear/Sunny			
	Other:			

HABITAT LENGTHS IN SAMPLING REACH

Habitat	Length (steps)	Length (ft)
Riffle	→	328'
Run		
Pool	→	0'
Glide		
Total		328'

STREAM CHARACTER-IZATION							
Subsystem:	Perennial ✓	Intermittent ___	Tidal ___				
Type:	Coldwater ✓	Warmwater ___					
Origin:	Spring-fed ___	Wetland ___	Montane ___	Glacial ___	Mixture ✓	Other ___	

VEOXT

GPS UNIT USED: RENTAL 1	CAMERA USED: E	PHOTO NO.S: 11 – 23

PHYSICAL HABITAT/WATER QUALITY FIELD DATA SHEET (Page 2)

Station: IC-3		Project No.: 070-846	
Stream Name: INDIAN CREEK		Date/Time: 5.21.08	1525
River Basin: OHIO		Investigators: JEM, DAM, DVP	

WATERSHED FEATURES

Predominant Surrounding Landuse
☑ Forest ☐ Commercial
☑ Field/Pasture ☐ Industrial
☐ Agricultural ☑ Other TURNPIKE PROPERTY
☐ Residential

Local Watershed NPS Pollution
☐ No evidence ☑ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☐ None ☑ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☑ Trees ☑ Shrubs ☐ Grasses ☐ Herbaceous

dominant species present _____

INSTREAM FEATURES

Estimated Reach Length 328'
Estimated Stream Width 8-14'
Sampling Reach Area 100M
Area in km² (m²x1000) _____
Estimated Stream Depth 3-24"
Surface Velocity (at thalweg) _____

Canopy Cover ☐ Open
☐ Partly open ☑ Partly shaded ☐ Shaded

High Water Mark 2-3'

Proportion of Reach Represented by Stream Morphology Types
☑ Riffle ~~%~~ ☐ Run 100%
☐ Pool _____ % ☑ Glide _____ %

Channelized ☑ Yes ☐ No

Dam Present ☐ Yes ☑ No

STREAM DEPTH:
Riffle/Run = 3-24"
Pool/Glide = NA

LARGE WOODY DEBRIS

LWD ✓
Density of LWD <5%

AQUATIC VEGETATION

NA

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae

dominant species present _____

Portion of the reach with aquatic vegetation _____

WATER QUALITY

POOL:
Temperature =
Conductivity = NA
Dissolved Oxygen =
pH =

RIFFLE:
Temperature = 11.2
Conductivity = 170
Dissolved Oxygen = 10.20
pH = 7.08

Water Odors
☑ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other _____

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☑ None ☐ Other _____

Turbidity (if not measured)
☐ Clear ☑ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other _____

SEDIMENT/ SUBSTRATE

Odors
☑ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other _____

Oils
☑ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other _____

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☑ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%) 100

Substrate Type	Diameter	% Composition in Sampling Reach	
Bedrock		0	
Boulder	> 256 mm (10")	5	
Cobble	64-256 mm (2.5"-10")	30	
Gravel	2-64 mm (0.1"-2.5")	50	
Sand	0.06-2mm (gritty)	10	
Silt	0.004-0.06 mm	5	
Clay	< 0.004 mm (stick)	0	

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)

Substrate Type	Characteristic	% Composition in Sampling Area
Detritus	sticks, wood, coarse plant materials (CPOM)	<5%
Muck-Mud	black, very fine organic (FPOM)	—
Marl	grey, shell fragments	—

STREAM DISCHARGE FIELD DATA FORM

Station: IC-3	Project No.: 070-846
Stream Name: INDIAN CREEK	Date/Time: 5.21.08 1655
River Basin: OHIO	Investigators: JEM, DAM, DJP
Method: Midsection, current meter method	Flow Meter (Model and No.): MARSH-McBIRNEY FLOWMATE 2000
Stream Wetted Width: 12 feet	Starting Point: RDB (LDB)

Distance (ft)[1]	Width (ft)[2]	Depth (ft)[3]	Observation Depth[4]	Velocity (ft/s)	Notes/Comments
0.5	0.50	0.55	0.60	0.66	BY DJP
1.5	1.0	0.40	0.60	0.83	
2.5	1.0	0.30	0.60	1.09	
3.5	1.0	0.30	0.60	1.27	
4.5	1.0	0.35	0.60	1.50	
5.5	1.0	0.40	0.60	1.43	
6.5	1.0	0.50	0.60	1.49	
7.5	1.0	0.50	0.60	1.87	
8.5	1.0	0.50	0.60	1.77	
9.5	1.0	0.30	0.60	1.23	
10.5	1.0	0.30	0.60	0.03	
11.5	1.0	0.25	0.60	0.00	
					5.26 cfs
					2361.5 gpm

[1] Distance from starting point on stream bank to velocity and depth measurement midpoint or "observation vertical"

[2] Width of measurement section; see Figure 1, sketch of midsection method, for width computation equations

[3] Depth at velocity measurement midpoint or "observation vertical"

[4] Observation depth of velocity measurement - either 0.6 depth (one point method) or 0.2 and 0.8 depth (two point method)

BENTHIC MACROINVERTEBRATE FIELD DATA SHEET

Station:	IC-3	Project No.:	070-846
Stream Name:	INDIAN CREEK	Date/Time:	5.21.08 1540
River Basin:	OHIO	Investigators:	JEM, DAM, DJP

Habitat Type	Description	Sample Technique	D-Frame Sample Tally	
			Proposed	Actual
Cobble/Gravel Substrate	Stream bottom areas consisting of mixed gravel and larger substrate particles; cobble gravel substrates are typically located in relatively fast flowing, "erosional" areas of the stream channel	Macroinvertebrates are collected by placing the net on the substrate by the downstream end of an area of gravel or larger substrate particles and simultaneously pushing down on the net while pulling it in an upstream direction with adequate force to dislodge substrate particles and the aquatic macroinvertebrates associated with these materials. Large stones and organic material contained in the net are discarded after they are carefully inspected for the presence of attached organisms, which are removed and retained with the remainder of the sample. One jab consists of passing the net over approximately 30 inches of substrate.	4	4
Snag	Snag habitat consists of submerged sticks, branches, and other woody debris that appears to have been submerged long enough to be colonized by aquatic macroinvertebrates. Preferred snags for sampling include small- to medium-sized sticks and branches (preferably about 4 inches in diameter) that have accumulated a substantial amount of organic matter (twigs, leaves, uprooted aquatic macrophytes, etc.) that is colonized by aquatic macroinvertebrates.	When possible, the net is placed immediately downstream of the snag in either the water column or stream bottom in an area where water is flowing through the snag at a moderate velocity. The snag is then kicked in such a manner that aquatic macroinvertebrates and organic matter are dislodged from the snag and carried by the current into the net. If the snag cannot be kicked, then it is sampled by jabbing the net into a downstream area of the snag and moving it in an upstream direction with enough force to dislodge and capture aquatic macroinvertebrates that have colonized the snag. One jab equals an area of approximately 0.23m² (12" X 30")	2	2
Coarse Particulate Organic Matter (CPOM)	CPOM consists of a mix of plant parts (leaves, bark, twigs, seeds, etc.) that have accumulated on the stream bottom in depositional areas of the stream channel. In situations where there is substantial variability in the composition of CPOM deposits within a given sample reach (e.g., deposits consisting primarily of white pine needles and deposits consisting primarily of hardwood tree leaves), a variety of CPOM deposits are sampled. Leaf packs in higher velocity ("erosional") areas of the channel, however, are not included in the CPOM samples	CPOM deposits are sampled by passing the net along a 30-inch-long path through the accumulated organic material so as to collect the material and its associated aquatic macroinvertebrates. When CPOM deposits are extensive, only the upper portion of the accumulated organic material is collected to ensure that the collected material is from the aerobic zone.	2	2
Submerged Aquatic Vegetation (SAV)	SAV habitat consists of rooted aquatic macrophytes.	SAV is sampled by drawing the net in an upstream direction along a 30-inch-long path through the vegetation. Efforts should be made to avoid collecting the stream bottom sediments and organisms when sampling SAV areas.	0	0
Sand/Fine Sediment	Sand/fine sediment habitat includes stream bottom areas that are comprised primarily of sand, silt, and/or clay.	Sand/fine sediment areas are sampled by bumping or tapping the net along the surface of the substrate while slowly drawing the net in an upstream direction along a 30-inch-long path of stream bottom. Efforts should be made to minimize the amount of debris collected in the net by penetrating only the upper-most layer of sand/silt deposits. Excess sand and silt are removed from the sample by repeatedly dipping the net into the water column and lifting it out of the stream to wash fine sediment through the net.	2	2

NOTES:

1. Two samples should be collected from each of the five habitats and all ten net samples are composited into a single sample.
2. If one or more of the habitats to be sampled are absent from the sample reach, redistribute the ten samples among the remaining habitats present in proportion to the quantity of habitat present in the sampling reach.

COMMENTS:

BY DAM

FISH SAMPLING FIELD DATA SHEET (PAGE 1)

Station: IC-3	Project No.: 070-846
Stream Name: INDIAN CREEK	Date/Time: 5.21.08 1610
River Basin: OHIO	Investigators: JEM, DAM, DAP

Sample Collection

Capture Method: Backpack ✓ Longline ____ Tote Barge ____ Boat ____

Electrofisher Model: SMITH ROOT LR-24

Other: ____ Block Nets Used? Yes ____ No ✓

DC ✓ AC ____ Volts 230 Amps .20-.29 Shock Time (sec): 663

Reach Length (ft): 328 Stream Width (ft) : Max 14' Mean 10'

	SPECIES	RIFFLE TALLY	POOL TALLY
	Blacknose Dace		
	Bluntnose Minnow		
	Creek Chub		
	Central Stoneroller		
	Common Carp		
	Silverjaw Minnow		
SHINERS	Common Shiner		
SHINERS	Emerald Shiner		
SHINERS	Mimic Shiner		
SHINERS	Rosyface Shiner		
SHINERS	Sand Shiner		
SHINERS	Silver Shiner		
SHINERS	Spotfin Shiner		
SHINERS	Striped Shiner		
	* Archived Minnows		

OVER →

FISH SAMPLING FIELD DATA SHEET (PAGE 2)

Station: IC-3	Project No.: 070-846
Stream Name: INDIAN CREEK	Date/Time: 5.21.08 1610
River Basin: OHIO	Investigators: JEM, DAM, NP

	SPECIES	RIFFLE TALLY	POOL TALLY
CATFISH	Yellow Bullhead		
	Channel Catfish		
	Stonecat		
	Brindled Madtom		
DARTERS	Banded Darter		
	Fantail Darter		
	Greenside Darter		
	Johnny Darter		
	Rainbow Darter		
	Variegate Darter		
	Logperch		
SUCKERS	White Sucker		
	Northern Hogsucker		
	Golden Redhorse		
	Black Redhorse		
	* Archived Redhorse Spp.		
PAN and SPORT FISH	Rock Bass		
	Bluegill		
	Pumpkinseed		
	Green Sunfish		
	White Crappie		
	Black Crappie		
	Smallmouth Bass		
	Largemouth Bass		
	Rainbow Trout		
	Brown Trout	IIII IIII III (13)	IIIII #5 12, 13, 15 19-23
	* ALL WILD	177 mm 189 mm 176 mm	
		295 mm 272 mm 152 mm	
		127 mm 213 mm 198 mm	
		204 mm 182 mm	
		197 mm 203 mm	

HIGH GRADIENT STREAMS HABITAT ASSESSMENT FIELD DATA SHEET (Page 1)

Station: IC-3	Project No.: 070-846
Stream Name: INDIAN CREEK	Date/Time: 5.21.08 1555
River Basin: OHIO	Investigators: JEM, DAM, DJP

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 12	20 19 18 17 16	15 14 13 (12) 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	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 15	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	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 low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 10	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
4. 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 gravel, sand or fine sediment; 5-30% of the bottom affected; ~~slight deposition in pools~~.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 15	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 18	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HIGH GRADIENT STREAMS HABITAT ASSESSMENT FIELD DATA SHEET (Page 2)

Station: IC-3	Project No.: 070-846
Stream Name: INDIAN CREEK	Date/Time: 5.21.08 1555
River Basin: OHIO	Investigators: JEM, DAM, DAP

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 7	20 19 18 17 16	15 14 13 12 11	10 9 8 (7) 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 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 a ratio of >25.
SCORE 11	20 19 18 17 16	15 14 13 12 (11)	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 7 (LB)	Left Bank 10 9	8 (7) 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 (7) 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 8 (LB)	Left Bank 10 9	(8) 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 (6)	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	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 6 (LB)	Left Bank 10 9	8 7 (6)	5 4 3	2 1 0
SCORE 2 (RB)	Right Bank 10 9	8 7 6	5 4 3	(2) 1 0

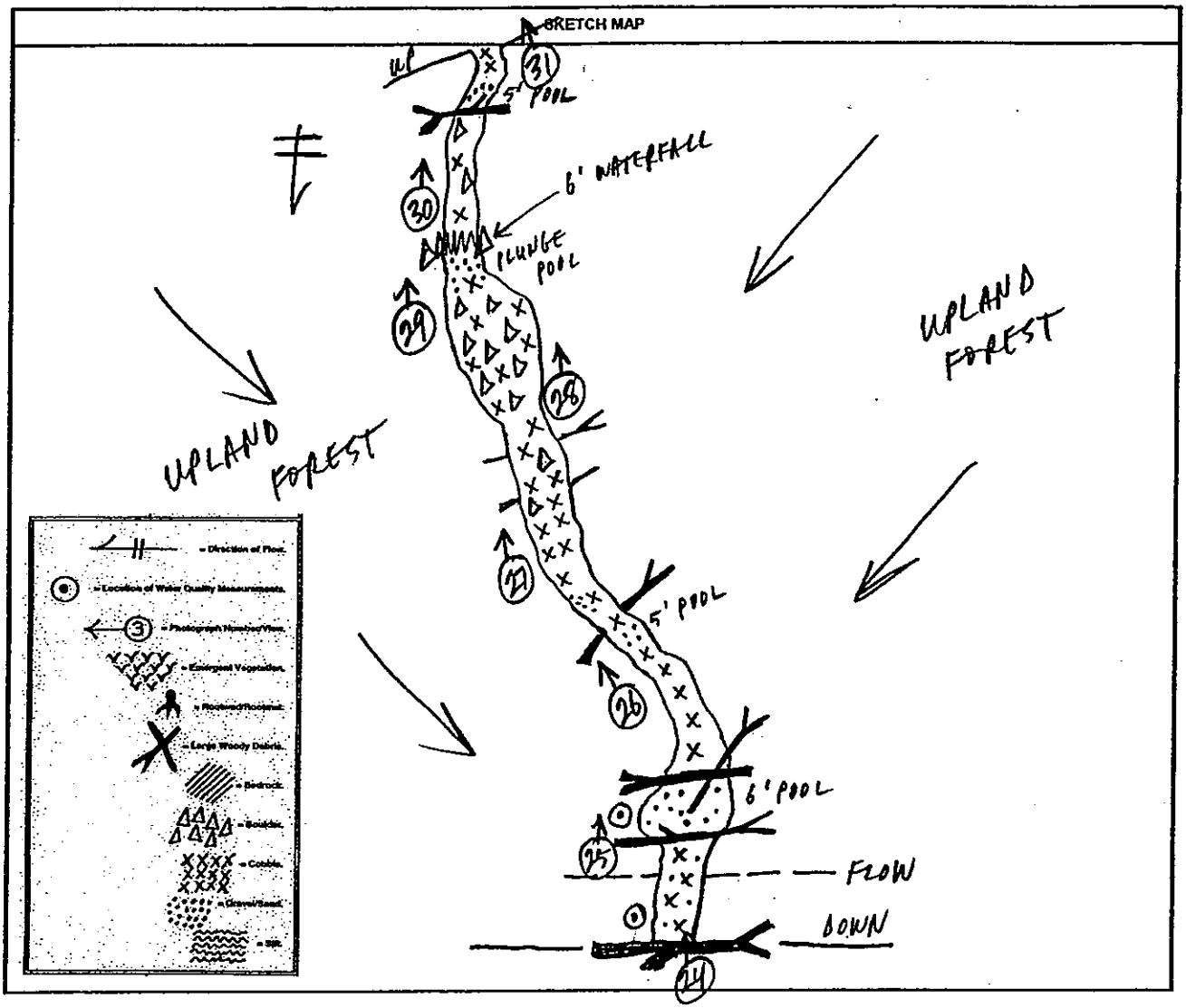
Total Score 124

Narrative categories and scoring ranges: Optimal = 156-200; Sub-optimal = 106-155; Marginal = 56-105; Poor = 0-55

PHYSICAL HABITAT/WATER QUALITY FIELD DATA SHEET (Page 1)

Station: UNT IC-1		Project No.: 070-846	
Stream Name: UNT TO INDIAN CREEK		Date/Time: 5.22.08	0800
River Basin: MONONGAHELA		Investigators: DTP	

SKETCH MAP



WEATHER CONDITIONS	Air Temperature: 45 C			
Weather	Now	Past 24 hrs	Past 7 days	
Heavy Rain		✓	✓	
Steady Rain				
Intermit. Rain				
% Cloud Cover	100			
Clear/Sunny				
Other:				

HABITAT LENGTHS IN SAMPLING REACH		
Habitat	Length (steps)	Length (ft)
Riffle	→	312'
Run		
Pool	→	16'
Glide		
Total		328'

STREAM CHARACTER-IZATION								
Subsystem:	Perennial ✓	Intermittent ____	Tidal ____					
Type:	Coldwater ✓	Warmwater ____						
Origin:	Spring-fed ____	Wetland ____	Montane ____	Glacial ____	Mixture ✓	Other ____		

GPS UNIT USED: GEOXT LENTHL 1	CAMERA USED: E	PHOTO NO.S: 24-31			

PHYSICAL HABITAT/WATER QUALITY FIELD DATA SHEET (Page 2)

Station: UNT IC-1		Project No.: 070-846	
Stream Name: UNT TO INDIAN CREEK		Date/Time: 5.22.08	0800
River Basin: OHIO		Investigators: MT	

WATERSHED FEATURES

Predominant Surrounding Landuse
☑ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other
☐ Residential

Local Watershed NPS Pollution
☑ No evidence ☐ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☑ None ☐ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☑ Trees ☑ Shrubs ☐ Grasses ☐ Herbaceous
dominant species present RED MAPLE, BLK CHERRY, STRIPED MAPLE, BIRC

INSTREAM FEATURES

Estimated Reach Length 328'
Estimated Stream Width 2-5'
Sampling Reach Area 100 M
Area in km² (m²x1000)
Estimated Stream Depth 2-8"
Surface Velocity (at thalweg)

Canopy Cover ☐ Open
☐ Partly open ☐ Partly shaded ☑ Shaded
High Water Mark ≅ 1'

Proportion of Reach Represented by Stream Morphology Types
☑ Riffle % ☐ Run 95 %
☑ Pool % ☐ Glide 5 %
Channelized ☐ Yes ☑ No
Dam Present ☐ Yes ☑ No

STREAM DEPTH:
Riffle/Run = 2-4"
Pool/Glide = 4-8"

LARGE WOODY DEBRIS

LWD ✓
Density of LWD <5%

AQUATIC VEGETATION

NA

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae
dominant species present
Portion of the reach with aquatic vegetation

WATER QUALITY

POOL:
Temperature = 8.1
Conductivity = 37
Dissolved Oxygen = 8.00
pH = 6.04

RIFFLE:
Temperature = 8.1
Conductivity = 37
Dissolved Oxygen = 9.94
pH = 6.24

Water Odors
☑ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☑ None ☐ Other

Turbidity (if not measured)
☑ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other

SEDIMENT/ SUBSTRATE

Odors
☑ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other

Oils
☑ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☑ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%) RE PE

Substrate Type	Diameter	% Composition in Sampling Reach	
Bedrock		0	0
Boulder	> 256 mm (10")	40	0
Cobble	64-256 mm (2.5"-10")	40	15
Gravel	2-64 mm (0.1"-2.5")	10	25
Sand	0.06-2mm (gritty)	10	50
Silt	0.004-0.06 mm	0	10
Clay	< 0.004 mm (slick)	0	0

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)

Substrate Type	Characteristic	% Composition in Sampling Area
Detritus	sticks, wood, coarse plant materials (CPOM)	<5%
Muck-Mud	black, very fine organic (FPOM)	—
Marl	grey, shell fragments	—

STREAM DISCHARGE FIELD DATA FORM

Station: UNT IC-1		Project No.: 070-846	
Stream Name: UNT TO INDIAN CREEK		Date/Time: 5.22.08	0925
River Basin: OHIO		Investigators: NP	
Method: Midsection, current meter method		Flow Meter (Model and No.): MARSH-MCBIRNEY FLOWMATE 2000	
Stream Wetted Width: 2 feet		Starting Point: (RDB) LDB	

Distance (ft)[1]	Width (ft)[2]	Depth (ft)[3]	Observation Depth[4]	Velocity (ft/s)	Notes/Comments
0.25	0.25	0.10	0.60	0.00	
0.75	0.50	0.10	0.60	1.15	
1.25	0.50	0.10	0.60	0.65	
1.75	0.50	0.10	0.60	0.50	
					0.12 cfs
					51.6 gpm

[1] Distance from starting point on stream bank to velocity and depth measurement midpoint or "observation vertical"

[2] Width of measurement section; see Figure 1, sketch of midsection method, for width computation equations

[3] Depth at velocity measurement midpoint or "observation vertical"

[4] Observation depth of velocity measurement - either 0.6 depth (one point method) or 0.2 and 0.8 depth (two point method)

BENTHIC MACROINVERTEBRATE FIELD DATA SHEET

Station: UNT IC-1	Project No.: 070-846
Stream Name: UNT TO INDIAN CREEK	Date/Time: 5.27.08 0855
River Basin: OHIO	Investigators: MH

Habitat Type	Description	Sample Technique	D-Frame Sample Tally	
			Proposed	Actual
Cobble/Gravel Substrate	Stream bottom areas consisting of mixed gravel and larger substrate particles; cobble gravel substrates are typically located in relatively fast flowing, "erosional" areas of the stream channel	Macroinvertebrates are collected by placing the net on the substrate by the downstream end of an area of gravel or larger substrate particles and simultaneously pushing down on the net while pulling it in an upstream direction with adequate force to dislodge substrate particles and the aquatic macroinvertebrates associated with these materials. Large stones and organic material contained in the net are discarded after they are carefully inspected for the presence of attached organisms, which are removed and retained with the remainder of the sample. One jab consists of passing the net over approximately 30 inches of substrate.	4	4
Snag	Snag habitat consists of submerged sticks, branches, and other woody debris that appears to have been submerged long enough to be colonized by aquatic macroinvertebrates. Preferred snags for sampling include small- to medium-sized sticks and branches (preferably about 4 inches in diameter) that have accumulated a substantial amount of organic matter (twigs, leaves, uprooted aquatic macrophytes, etc.) that is colonized by aquatic macroinvertebrates.	When possible, the net is placed immediately downstream of the snag in either the water column or stream bottom in an area where water is flowing through the snag at a moderate velocity. The snag is then kicked in such a manner that aquatic macroinvertebrates and organic matter are dislodged from the snag and carried by the current into the net. If the snag cannot be kicked, then it is sampled by jabbing the net into a downstream area of the snag and moving it in an upstream direction with enough force to dislodge and capture aquatic macroinvertebrates that have colonized the snag. One jab equals an area of approximately 0.23m^2 (12" X 30")	2	2
Coarse Particulate Organic Matter (CPOM)	CPOM consists of a mix of plant parts (leaves, bark, twigs, seeds, etc.) that have accumulated on the stream bottom in depositional areas of the stream channel. In situations where there is substantial variability in the composition of CPOM deposits within a given sample reach (e.g., deposits consisting primarily of white pine needles and deposits consisting primarily of hardwood tree leaves), a variety of CPOM deposits are sampled. Leaf packs in higher velocity ("erosional") areas of the channel, however, are not included in the CPOM samples	CPOM deposits are sampled by passing the net along a 30-inch-long path through the accumulated organic material so as to collect the material and its associated aquatic macroinvertebrates. When CPOM deposits are extensive, only the upper portion of the accumulated organic material is collected to ensure that the collected material is from the aerobic zone.	2	2
Submerged Aquatic Vegetation (SAV)	SAV habitat consists of rooted aquatic macrophytes.	SAV is sampled by drawing the net in an upstream direction along a 30-inch-long path through the vegetation. Efforts should be made to avoid collecting the stream bottom sediments and organisms when sampling SAV areas.	0	0
Sand/Fine Sediment	Sand/fine sediment habitat includes stream bottom areas that are comprised primarily of sand, silt, and/or clay.	Sand/fine sediment areas are sampled by bumping or tapping the net along the surface of the substrate while slowly drawing the net in an upstream direction along a 30-inch-long path of stream bottom. Efforts should be made to minimize the amount of debris collected in the net by penetrating only the upper-most layer of sand/silt deposits. Excess sand and silt are removed from the sample by repeatedly dipping the net into the water column and lifting it out of the stream to wash fine sediment through the net.	2	2

NOTES:

1. Two samples should be collected from each of the five habitats and all ten net samples are composited into a single sample.
2. If one or more of the habitats to be sampled are absent from the sample reach, redistribute the ten samples among the remaining habitats present in proportion to the quantity of habitat present in the sampling reach.

COMMENTS:

HIGH GRADIENT STREAMS HABITAT ASSESSMENT FIELD DATA SHEET (Page 1)

Station:	UNT IC-1	Project No.:	070-846
Stream Name:	UNT TO INDIAN CREEK	Date/Time:	5.22.08 0935
River Basin:	OHIO	Investigators:	DT

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 13	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	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 15	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	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 low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 10	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
4. 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 gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 15	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and mininal 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 15	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HIGH GRADIENT STREAMS HABITAT ASSESSMENT FIELD DATA SHEET (Page 2)

Station:	UNT IC-1	Project No.:	070-846
Stream Name:	UNT TO INDIAN CREEK	Date/Time:	5.22.08 0935
River Basin:	OHIO	Investigators:	DP

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 19	20 (19) 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 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 a ratio of >25.
SCORE 17	20 19 18 (17) 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 9 (LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 (9)	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 10 (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	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 (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0

Total Score 162

Narrative categories and scoring ranges: Optimal = 156-200; Sub-optimal = 106-155; Marginal = 56-105; Poor = 0-55

LOW GRADIENT STREAMS HABITAT ASSESSMENT FIELD DATA SHEET (Page 1)

Station:	UNT Ic-1	Project No.:	070-846
Stream Name:	UNT TO INDIAN CREEK	Date/Time:	5.22.08 0945
River Basin:	OHIO	Investigators:	DJP

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 11	20 19 18 17 16	15 14 13 12 (11)	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE 9	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE 4	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 (4) 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 13	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 16	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

LOW GRADIENT STREAMS HABITAT ASSESSMENT FIELD DATA SHEET (Page 2)

Station:	UNT IC-1	Project No.:	070-846
Stream Name:	UNT TO INDIAN CREEK	Date/Time:	5.22.08 0945
River Basin:	UHTO	Investigators:	DP

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 19	20 (19) 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE 9	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 9 (LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 (9)	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 10 (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	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 (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0

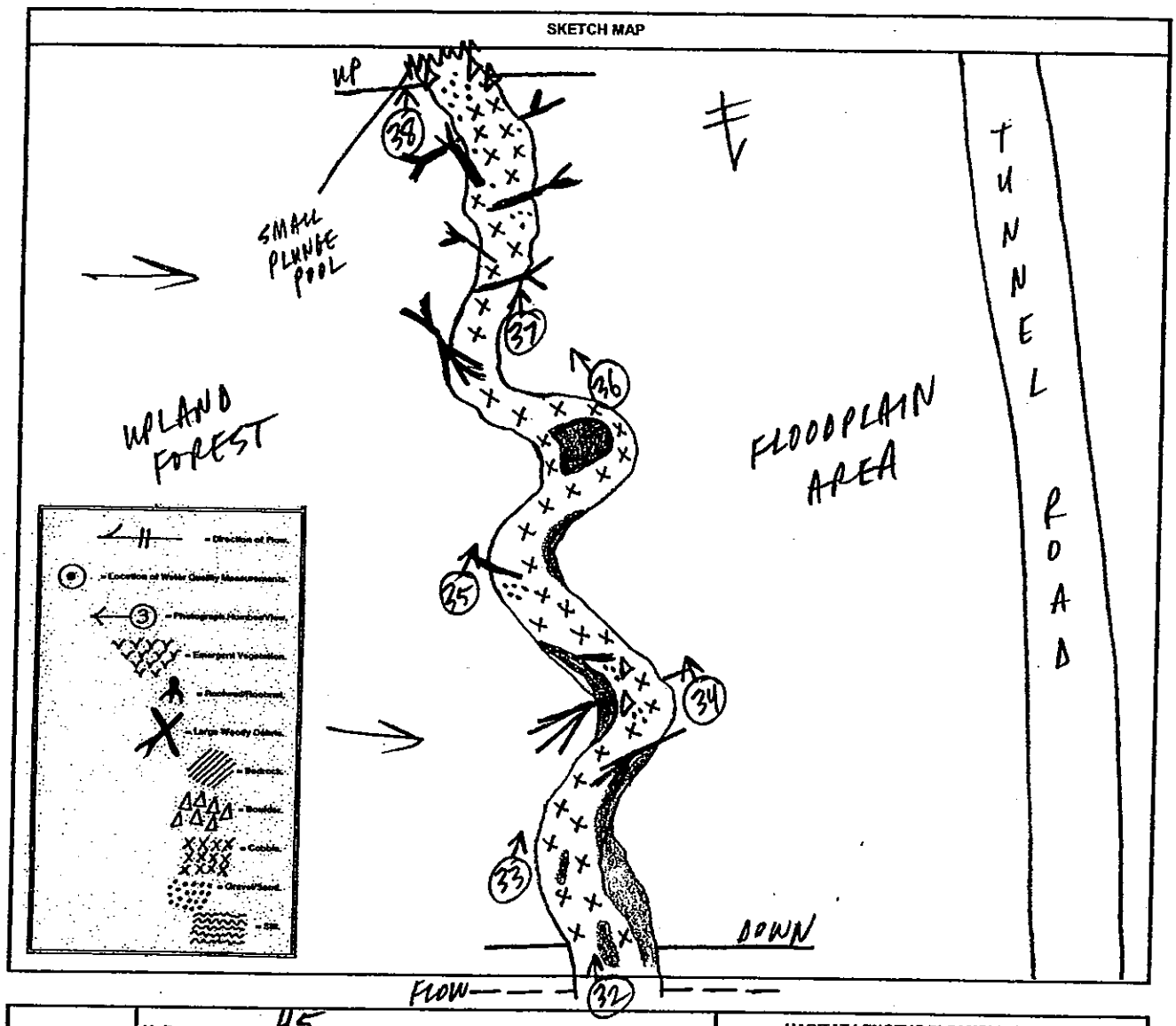
Total Score 139 130

Narrative categories and scoring ranges: Optimal = 156-200; Sub-optimal = 106-155; Marginal = 56-105; Poor = 0-55

PHYSICAL HABITAT/WATER QUALITY FIELD DATA SHEET (Page 1)

Station: UNT IC-2		Project No.: 070-846	
Stream Name: UNT TO INDIAN CREEK		Date/Time: 5.22.08	1015
River Basin: MONONGAHELA		Investigators: DJ	

SKETCH MAP



WEATHER CONDITIONS	Air Temperature: 45 C			
	Weather	Now	Past 24 hrs	Past 7 days
	Heavy Rain		✓	✓
	Steady Rain			
	Intermit. Rain			
	% Cloud Cover	100%		
	Clear/Sunny			
	Other:			

HABITAT LENGTHS IN SAMPLING REACH		
Habitat	Length (steps)	Length (ft)
Riffle 3	→	328'
Run 3		
Pool 3	→	0'
Glide 3		
Total		328'

STREAM CHARACTER-IZATION							
Subsystem:	Perennial ___	✓ Intermittent ___	Tidal ___				
Type:	Coldwater ___	✓ Warmwater ___					
Origin:	Spring-fed ___	Wetland ___	Montane ___	Glacial ___	Mixture ✓	Other ___	

GPS UNIT USED: GEOXT RENTAL	CAMERA USED: E	PHOTO NO.S: 32-38

PHYSICAL HABITAT/WATER QUALITY FIELD DATA SHEET (Page 2)

Station: UNT IC-2		Project No.: 070-846	
Stream Name: UNT TO INDIAN CREEK		Date/Time: 5.22.08	1015
River Basin: OHIO		Investigators: BP	

WATERSHED FEATURES

Predominant Surrounding Landuse
☑ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☑ Other TUNNEL RD.
☐ Residential

Local Watershed NPS Pollution
☐ No evidence ☑ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☐ None ☑ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☑ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous
dominant species present RED MAPLE, OAK, BIRCH

INSTREAM FEATURES

Estimated Reach Length 328'
Estimated Stream Width 3-7'
Sampling Reach Area 100m
Area in km² (m²x1000)
Estimated Stream Depth 2-10"
Surface Velocity (at thalweg)

Canopy Cover ☐ Open
☐ Partly open ☐ Partly shaded ☑ Shaded

High Water Mark

Proportion of Reach Represented by Stream Morphology Types
☑ Riffle % ☐ Run 100%
☐ Pool % ☐ Glide %

Channelized ☐ Yes ☑ No

Dam Present ☐ Yes ☑ No

STREAM DEPTH:
Riffle/Run = 2-10"
Pool/Glide = NA

LARGE WOODY DEBRIS

LWD ✓
Density of LWD <5%

AQUATIC VEGETATION

NA

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae
dominant species present
Portion of the reach with aquatic vegetation

WATER QUALITY

POOL:
Temperature =
Conductivity = NA
Dissolved Oxygen =
pH =

RIFFLE:
Temperature = 7.8
Conductivity = 32
Dissolved Oxygen = 10.60
pH = 6.07

Water Odors
☑ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☑ None ☐ Other

Turbidity (if not measured)
☑ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other

SEDIMENT/ SUBSTRATE

Odors
☑ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other

Oils
☐ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☑ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)

Substrate Type	Diameter	% Composition in Sampling Reach
Bedrock		0
Boulder	> 256 mm (10")	5
Cobble	64-256 mm (2.5"-10")	60
Gravel	2-64 mm (0.1"-2.5")	20
Sand	0.06-2mm (gritty)	10
Silt	0.004-0.06 mm	5
Clay	< 0.004 mm (slick)	0

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)

Substrate Type	Characteristic	% Composition in Sampling Area
Detritus	sticks, wood, coarse plant materials (CPOM)	
Muck-Mud	black, very fine organic (FPOM)	
Marl	grey, shell fragments	

STREAM DISCHARGE FIELD DATA FORM

Station: UNT IC-2		Project No.: 070-846	
Stream Name: UNT TO INDIAN CREEK		Date/Time: 5.22.08	1110
River Basin: OHIO		Investigators: MJ	
Method: Midsection, current meter method		Flow Meter (Model and No.): MARSH MCBIRNEY FLOWMATE 2000	
Stream Wetted Width: 5.0 feet		Starting Point: (RDB) LDB	

Distance (ft)[1]	Width (ft)[2]	Depth (ft)[3]	Observation Depth[4]	Velocity (ft/s)	Notes/Comments
0.5	0.5	0.1	0.60	0.00	
1.5	1.0	0.2	0.60	0.70	
2.5	1.0	0.3	0.60	1.26	
3.5	1.0	0.2	0.60	1.17	
4.5	1.0	0.1	0.60	0.09	
					0.76 cfs
					341.6 gpm

[1] Distance from starting point on stream bank to velocity and depth measurement midpoint or "observation vertical"

[2] Width of measurement section; see Figure 1, sketch of midsection method, for width computation equations

[3] Depth at velocity measurement midpoint or "observation vertical"

[4] Observation depth of velocity measurement - either 0.6 depth (one point method) or 0.2 and 0.8 depth (two point method)

BENTHIC MACROINVERTEBRATE FIELD DATA SHEET

Station:	UNT IC-2	Project No.:	070-646
Stream Name:	UNT TO INDIAN CREEK	Date/Time:	5.22.08 1045
River Basin:	OHIO	Investigators:	KP

Habitat Type	Description	Sample Technique	D-Frame Sample Tally	
			Proposed	Actual
Cobble/Gravel Substrate	Stream bottom areas consisting of mixed gravel and larger substrate particles; cobble gravel substrates are typically located in relatively fast flowing, "erosional" areas of the stream channel	Macroinvertebrates are collected by placing the net on the substrate by the downstream end of an area of gravel or larger substrate particles and simultaneously pushing down on the net while pulling it in an upstream direction with adequate force to dislodge substrate particles and the aquatic macroinvertebrates associated with these materials. Large stones and organic material contained in the net are discarded after they are carefully inspected for the presence of attached organisms, which are removed and retained with the remainder of the sample. One jab consists of passing the net over approximately 30 inches of substrate.	6	6
Snag	Snag habitat consists of submerged sticks, branches, and other woody debris that appears to have been submerged long enough to be colonized by aquatic macroinvertebrates. Preferred snags for sampling include small- to medium-sized sticks and branches (preferably about 4 inches in diameter) that have accumulated a substantial amount of organic matter (twigs, leaves, uprooted aquatic macrophytes, etc.) that is colonized by aquatic macroinvertebrates.	When possible, the net is placed immediately downstream of the snag in either the water column or stream bottom in an area where water is flowing through the snag at a moderate velocity. The snag is then kicked in such a manner that aquatic macroinvertebrates and organic matter are dislodged from the snag and carried by the current into the net. If the snag cannot be kicked, then it is sampled by jabbing the net into a downstream area of the snag and moving it in an upstream direction with enough force to dislodge and capture aquatic macroinvertebrates that have colonized the snag. One jab equals an area of approximately 0.23m^2 (12" X 30")	2	2
Coarse Particulate Organic Matter (CPOM)	CPOM consists of a mix of plant parts (leaves, bark, twigs, seeds, etc.) that have accumulated on the stream bottom in depositional areas of the stream channel. In situations where there is substantial variability in the composition of CPOM deposits within a given sample reach (e.g., deposits consisting primarily of white pine needles and deposits consisting primarily of hardwood tree leaves), a variety of CPOM deposits are sampled. Leaf packs in higher velocity ("erosional") areas of the channel, however, are not included in the CPOM samples	CPOM deposits are sampled by passing the net along a 30-inch-long path through the accumulated organic material so as to collect the material and its associated aquatic macroinvertebrates. When CPOM deposits are extensive, only the upper portion of the accumulated organic material is collected to ensure that the collected material is from the aerobic zone.	0	0
Submerged Aquatic Vegetation (SAV)	SAV habitat consists of rooted aquatic macrophytes.	SAV is sampled by drawing the net in an upstream direction along a 30-inch-long path through the vegetation. Efforts should be made to avoid collecting the stream bottom sediments and organisms when sampling SAV areas.	0	0
Sand/Fine Sediment	Sand/fine sediment habitat includes stream bottom areas that are comprised primarily of sand, silt, and/or clay.	Sand/fine sediment areas are sampled by bumping or tapping the net along the surface of the substrate while slowly drawing the net in an upstream direction along a 30-inch-long path of stream bottom. Efforts should be made to minimize the amount of debris collected in the net by penetrating only the upper-most layer of sand/silt deposits. Excess sand and silt are removed from the sample by repeatedly dipping the net into the water column and lifting it out of the stream to wash fine sediment through the net.	2	2

NOTES:

1. Two samples should be collected from each of the five habitats and all ten net samples are composited into a single sample.
2. If one or more of the habitats to be sampled are absent from the sample reach, redistribute the ten samples among the remaining habitats present in proportion to the quantity of habitat present in the sampling reach.

COMMENTS:

HIGH GRADIENT STREAMS HABITAT ASSESSMENT FIELD DATA SHEET (Page 1)

Station:	UNT IC-2	Project No.:	070-846
Stream Name:	UNT TO INDIAN CREEK	Date/Time:	5.22.08 1215
River Basin:	OHIO	Investigators:	DJF

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 18	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	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 14	20 19 18 17 16	15 (14) 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	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 low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 10	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
4. 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 gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 14	20 19 18 17 16	15 (14) 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 18	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HIGH GRADIENT STREAMS HABITAT ASSESSMENT FIELD DATA SHEET (Page 2)

Station:	UNT IC-2	Project No.:	070-846
Stream Name:	UNT TO INDIAN CREEK	Date/Time:	5.22.08 1215
River Basin:	OHIO	Investigators:	DOP

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 19	20 (19) 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous; placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 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 a ratio of >25.
SCORE 18	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 10 (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 (7) 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	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 (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 (7) 6	5 4 3	2 1 0

Total Score 161

Narrative categories and scoring ranges: Optimal = 156-200; Sub-optimal = 106-155; Marginal = 56-105; Poor = 0-55

APPENDIX C

TESTAMERICA, INC. LABORATORY ANALYTICAL REPORT

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

PROJECT NO. CEC INDIAN CK

CEC Indian Creek

Lot #: C8E220110

Dave Parise

Civil & Environmental Consulta
333 Baldwin Rd.
Pittsburgh, PA 15205

TESTAMERICA LABORATORIES, INC.

Carrie L. Gamber
Project Manager

May 30, 2008

JUN 06 2008

1 5

NELAC REPORTING:

At the time of analysis the laboratory was in compliance with the current NELAC standards and held accreditation for all analyses performed unless noted by a qualifier. The labs accreditation numbers are listed below. The format and contents of the report meets all applicable NELAC standards except as noted in the narrative and shall not be reproduced except in full, without the written approval of the laboratory. The table below presents a summary of the certifications held by TestAmerica Pittsburgh. Our primary accreditation authority for the Non-potable water and Solid & Hazardous waste programs is Pennsylvania DEP. A more detailed parameter list is available upon request. Please ask your project manager for this information when required.

Certifying State/Program	Certificate #	Program Types	TestAmerica
NFESC	NA	NAVY	X
US Dept of Agriculture	(#P330-07-00101)	Foreign Soil Import Permit	X
Arkansas	(#03-022-1)	WW	X
		HW	X
California – NELAC	04224CA	WW	X
		HW	X
Connecticut	(#PH-0688)	WW	X
		HW	X
Florida – NELAC	(#E87660)	WW	X
		HW	X
Illinois – NELAC	(#200005)	WW	X
		HW	X
Kansas – NELAC	(#E-10350)	WW	X
		HW	X
Louisiana – NELAC	(#93200)	WW	X
		HW	X
New Hampshire – NELAC	(#203002)	WW	X
		HW	X
New Jersey – NELAC	(PA-005)	WW	X
		HW	X
New York – NELAC	(#11182)	WW	X
		HW	X
North Carolina	(#434)	WW	X
		HW	X
Pennsylvania - NELAC	(#02-00416)	WW	X
		HW	X
South Carolina	(#89014001)	WW	X
		HW	X
Utah – NELAC	(STLP)	WW	X
		HW	X
West Virginia	(#142)	WW	X
		HW	X
Wisconsin	998027800	WW	X
		HW	X

The codes utilized for program types are described below:

HW Hazardous Waste certification
WW Non-potable Water and/or Wastewater certification
X Laboratory has some form of certification under the specific program. Many states certify laboratories for specific parameters or tests within a category. The information in the table indicates the lab is certified in a general category of testing. Please contact the laboratory if parameter specific certification information is required.

Updated: 12/28/07 C:\Documents and Settings\derubeisa\My Documents\NELAC NARRATIVE Pittsburgh.doc

CASE NARRATIVE

Civil & Environmental Consultants

LOT # C8E220110

Sample Receiving:
TestAmerica Pittsburgh, PA received samples on May 22, 2008. The cooler was received within the proper temperature range.

If project specific QC was not required for samples contained in this report, when batch QC was completed on these samples, anomalous results will be discussed below.

General Chemistry:
There were not problems associated with the analyses.

METHODS SUMMARY

C8E220110

PARAMETER	ANALYTICAL METHOD	PREPARATION METHOD
Chloride	MCAWW 300.0A	MCAWW 300.0A
Total Dissolved Solids SM 2540C (SM 20)	SM20 2540C	
Total Suspended Solids SM 2540 D	SM20 2540D	

References:

MCAWW "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, March 1983 and subsequent revisions.

SM20 "STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER", 20TH EDITION."

SAMPLE SUMMARY

C8E220110

WO #	SAMPLE#	CLIENT SAMPLE ID	SAMPLED DATE	SAMP TIME
KNM3N	001	IC-1	05/21/08	11:05
KNM3T	002	IC-2	05/21/08	13:20
KNM3V	003	IC-3	05/21/08	15:20
KNM3W	004	UNTIC-1	05/21/08	12:50
KNM3X	005	UNTIC-2	05/21/08	16:50

NOTE(S):

- The analytical results of the samples listed above are presented on the following pages.
- All calculations are performed before rounding to avoid round-off errors in calculated results.
- Results noted as "ND" were not detected at or above the stated limit.
- This report must not be reproduced, except in full, without the written approval of the laboratory.
- Results for the following parameters are never reported on a dry weight basis: color, corrosivity, density, flashpoint, ignitability, layers, odor, paint filter test, pH, porosity pressure, reactivity, redox potential, specific gravity, spot tests, solids, solubility, temperature, viscosity, and weight.

C8E220110

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TAL-4142 (0907) CLIENT CODE 1361

Client: CIVIL & ENVIRONMENTAL CONSULTANTS
Address: 333 BALDWIN ROAD
City: PITTSBURGH | State: PA | Zip Code: 15205
Project Name and Location (State): INDIAN CREEK, WESTMORELAND COUNTY
Contract/Purchase Order/Quote No.: QUOTE # 79607

Project Manager: DAVID PARISE
Telephone Number (Area Code)/Fax Number: 412-429-2324 412-429-2114
Site Contact: DAVID PARISE | Lab Contact: CARRIE GAMBER
Carrier/Waybill Number:

Date: 5/21/08
Chain of Custody Number: 367174
Lab Number:
Page 1 of 1

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil	Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/ NaOH	Analysis (Attach list if more space is needed): TDS	TSS	TOTAL CHLORIDE
IC-1	5.21.08	1105		✓			✓						✓	✓	✓
IC-2	5.21.08	1320		✓			✓						✓	✓	✓
IC-3	5.21.08	1520		✓			✓						✓	✓	✓
UNTIC-1	5.21.08	1250		✓			✓						✓	✓	✓
UNTIC-2	5.21.08	1650		✓			✓						✓	✓	✓

Special Instructions/ Conditions of Receipt

Possible Hazard Identification
☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal
☐ Return To Client ☑ Disposal By Lab ☐ Archive For _____ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required
☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☑ 14 Days ☐ 21 Days ☐ Other _____

QC Requirements (Specify)

1. Relinquished By	Date 5/21/08	Time 1845	1. Received By	Date 5/21/08	Time 1845
2. Relinquished By	Date	Time	2. Received By	Date 5-22-8	Time 0830
3. Relinquished By	Date	Time	3. Received By	Date	Time

Comments

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

Civil & Environmental Consultants Inc

Client Sample ID: IC-1

General Chemistry

Lot-Sample #...: C8E220110-001 Work Order #...: KNM3N Matrix.....: WATER
Date Sampled...: 05/21/08 Date Received..: 05/21/08

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION-ANALYSIS DATE	PREP BATCH #
Chloride	44.7	1.0	mg/L	MCAWW 300.0A	05/27/08	8148076
		Dilution Factor: 1		Analysis Time..: 00:00	MS Run #.....: 8148041	
Total Dissolved Solids	89.0	10.0	mg/L	SM20 2540C	05/22-05/23/08	8143331
		Dilution Factor: 1		Analysis Time..: 10:26	MS Run #.....: 8143177	
Total Suspended Solids	ND	4.0	mg/L	SM20 2540D	05/22-05/23/08	8143332
		Dilution Factor: 1		Analysis Time..: 00:00	MS Run #.....: 8143181	

Civil & Environmental Consultants Inc

Client Sample ID: IC-2

General Chemistry

Lot-Sample #...: C8E220110-002 Work Order #...: KNM3T Matrix.....: WATER
Date Sampled...: 05/21/08 Date Received..: 05/21/08

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION-ANALYSIS DATE	PREP BATCH #
Chloride	39.6	1.0	mg/L	MCAWW 300.0A	05/27/08	8148076
		Dilution Factor: 1		Analysis Time..: 00:00	MS Run #.....: 8148041	
Total Dissolved Solids	90.0	10.0	mg/L	SM20 2540C	05/22-05/23/08	8143331
		Dilution Factor: 1		Analysis Time..: 10:26	MS Run #.....: 8143177	
Total Suspended Solids	ND	4.0	mg/L	SM20 2540D	05/22-05/23/08	8143332
		Dilution Factor: 1		Analysis Time..: 00:00	MS Run #.....: 8143181	

Civil & Environmental Consultants Inc

Client Sample ID: IC-3

General Chemistry

Lot-Sample #...: C8E220110-003 Work Order #...: KNM3V Matrix.....: WATER
Date Sampled...: 05/21/08 Date Received..: 05/21/08

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION-ANALYSIS DATE	PREP BATCH #
Chloride	48.0	1.0	mg/L	MCAWW 300.0A	05/27/08	8148076
		Dilution Factor: 1		Analysis Time..: 00:00	MS Run #.....: 8148041	
Total Dissolved Solids	101	10.0	mg/L	SM20 2540C	05/22-05/23/08	8143331
		Dilution Factor: 1		Analysis Time..: 10:26	MS Run #.....: 8143177	
Total Suspended Solids	ND	4.0	mg/L	SM20 2540D	05/22-05/23/08	8143332
		Dilution Factor: 1		Analysis Time..: 00:00	MS Run #.....: 8143181	

Civil & Environmental Consultants Inc

Client Sample ID: UMTIC-1

General Chemistry

Lot-Sample #...: C8E220110-004 Work Order #...: KNM3W Matrix.....: WATER
Date Sampled...: 05/21/08 Date Received..: 05/21/08

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION-ANALYSIS DATE	PREP BATCH #
Chloride	1.6	1.0	mg/L	MCAWW 300.0A	05/27/08	8148076
		Dilution Factor: 1		Analysis Time..: 00:00	MS Run #.....: 8148041	
Total Dissolved Solids	21.0	10.0	mg/L	SM20 2540C	05/22-05/23/08	8143331
		Dilution Factor: 1		Analysis Time..: 10:26	MS Run #.....: 8143177	
Total Suspended Solids	ND	4.0	mg/L	SM20 2540D	05/22-05/23/08	8143332
		Dilution Factor: 1		Analysis Time..: 00:00	MS Run #.....: 8143181	

Civil & Environmental Consultants Inc

Client Sample ID: UNTIC-2

General Chemistry

Lot-Sample #...: C8E220110-005 Work Order #...: KNM3X Matrix.....: WATER
Date Sampled...: 05/21/08 Date Received..: 05/21/08

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION-ANALYSIS DATE	PREP BATCH #
Chloride	0.60 B	1.0	mg/L	MCAWW 300.0A	05/27/08	8148076
		Dilution Factor: 1		Analysis Time..: 00:00	MS Run #.....: 8148041	
Total Dissolved Solids	27.0	10.0	mg/L	SM20 2540C	05/22-05/23/08	8143331
		Dilution Factor: 1		Analysis Time..: 10:26	MS Run #.....: 8143177	
Total Suspended Solids	8.0	4.0	mg/L	SM20 2540D	05/22-05/23/08	8143332
		Dilution Factor: 1		Analysis Time..: 00:00	MS Run #.....: 8143181	

NOTE(S):

RL Reporting Limit

B Estimated result. Result is less than RL.

METHOD BLANK REPORT

General Chemistry

Client Lot #...: C8E220110

Matrix.....: WATER

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD	PREPARATION-ANALYSIS DATE	PREP BATCH #
Chloride		Work Order #: KNWGL1AA		MB Lot-Sample #: C8E270000-076		
	ND	1.0	mg/L	MCAWW 300.0A	05/27/08	8148076
		Dilution Factor: 1				
		Analysis Time..: 00:00				
Total Dissolved Solids		Work Order #: KNN1J1AA		MB Lot-Sample #: C8E220000-331		
	ND	10.0	mg/L	SM20 2540C	05/22-05/23/08	8143331
		Dilution Factor: 1				
		Analysis Time..: 10:26				
Total Suspended Solids		Work Order #: KNN1P1AA		MB Lot-Sample #: C8E220000-332		
	ND	4.0	mg/L	SM20 2540D	05/22-05/23/08	8143332
		Dilution Factor: 1				
		Analysis Time..: 00:00				

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

LABORATORY CONTROL SAMPLE EVALUATION REPORT

General Chemistry

Client Lot #...: C8E220110

Matrix.....: WATER

PARAMETER	PERCENT RECOVERY	RECOVERY LIMITS	METHOD	PREPARATION-ANALYSIS DATE	PREP BATCH #
Chloride		Work Order #: KNWGL1AC	LCS Lot-Sample#: C8E270000-076		
	99	(90 - 110)	MCANW 300.0A	05/27/08	8148076
		Dilution Factor: 1	Analysis Time..: 00:00		
Total Dissolved Solids		Work Order #: KNN1J1AC	LCS Lot-Sample#: C8E220000-331		
	94	(80 - 120)	SM20 2540C	05/22-05/23/08	8143331
		Dilution Factor: 1	Analysis Time..: 10:26		
Total Suspended Solids		Work Order #: KNN1P1AC	LCS Lot-Sample#: C8E220000-332		
	92	(80 - 120)	SM20 2540D	05/22-05/23/08	8143332
		Dilution Factor: 1	Analysis Time..: 00:00		

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE SAMPLE EVALUATION REPORT

General Chemistry

Client Lot #...: C8E220110
Date Sampled...: 05/19/08 **Date Received..:** 05/20/08 **Matrix.....:** WATER

PARAMETER	PERCENT RECOVERY	RECOVERY LIMITS	RPD	RPD LIMITS	METHOD	PREPARATION-ANALYSIS DATE	PREP BATCH #
Chloride		WO#: KNHE91AT-MS/KNHE91AU-MSD				MS Lot-Sample #: C8E200139-004	
	98	(80 - 120)			MCAWW 300.0A	05/27/08	8148076
	98	(80 - 120)	0.06	(0-20)	MCAWW 300.0A	05/27/08	8148076
		Dilution Factor: 1					
		Analysis Time..: 00:00					
		MS Run #.....: 8148041					
Chloride		WO#: KNM3X1AE-MS/KNM3X1AF-MSD				MS Lot-Sample #: C8E220110-005	
	94	(80 - 120)			MCAWW 300.0A	05/27/08	8148076
	94	(80 - 120)	0.08	(0-20)	MCAWW 300.0A	05/27/08	8148076
		Dilution Factor: 1					
		Analysis Time..: 00:00					
		MS Run #.....: 8148041					

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

SAMPLE DUPLICATE EVALUATION REPORT

General Chemistry

Client Lot #...: C8E220110 Work Order #...: KNM3N-SMP Matrix.....: WATER

KNM3N-DUP

Date Sampled...: 05/21/08 Date Received..: 05/21/08

PARAM	RESULT	DUPLICATE RESULT	UNITS	RPD	RPD LIMIT	METHOD	PREPARATION-ANALYSIS DATE	PREP BATCH #
Total Dissolved Solids						SD Lot-Sample #: C8E220110-001		
	89.0	92.0	mg/L	3.3	(0-20)	SM20 2540C	05/22-05/23/08	8143331
			Dilution Factor: 1			Analysis Time..: 10:26	MS Run Number..: 8143177	
Total Suspended Solids						SD Lot-Sample #: C8E220110-001		
	ND	ND	mg/L	13	(0-20)	SM20 2540D	05/22-05/23/08	8143332
			Dilution Factor: 1			Analysis Time..: 00:00	MS Run Number..: 8143181	

APPENDIX D

STREAM BENTHIC MACROINVERTEBRATE DATA

APPENDIX D
STREAM BENTHIC MACROINVERTEBRATE DATA
MAY 2008
INDIAN CREEK
DONEGAL TOWNSHIP, WESTMORELAND COUNTY, PENNSYLVANIA
CEC PROJECT 070-846

Indian Creek (IC-1) (5/21/2008)							
Taxon					Total	Tolerance Value[a]	Functional Feeding Group[a]
Phylum	Class	Order	Family	Genus			
Annelida	Oligochaeta				8	10	CG
Arthropoda	Crustacea	Decapoda	Cambaridae		1	6	CG
Arthropoda	Insecta	Coleoptera	Elmidae	Oulimnius	5	5	SC
Arthropoda	Insecta	Coleoptera	Psephenidae	Psephenus	1	4	SC
Arthropoda	Insecta	Diptera	Chironomidae		12	6	CG
Arthropoda	Insecta	Diptera	Empididae	Chelifera	3	6	PR
Arthropoda	Insecta	Diptera	Ephydridae	Parydra	1	6	PI
Arthropoda	Insecta	Ephemeroptera	Baetidae	Acentrella	126	4	SC
Arthropoda	Insecta	Ephemeroptera	Baetidae	Baetis	39	6	CG
Arthropoda	Insecta	Plecoptera	Nemouridae	Amphinemura	1	3	SH
Arthropoda	Insecta	Plecoptera	Pteronarcyidae	Pteronarcys	1	0	SH
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Diplectrona	1	0	FC
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsyche	1	5	FC
Arthropoda	Insecta	Trichoptera	Uenoidae	Neophylax	1	3	SC
					201		

Indian Creek (IC-2) (5/21/2008)							
Taxon					Total	Tolerance Value[a]	Functional Feeding Group[a]
Phylum	Class	Order	Family	Genus			
Annelida	Oligochaeta				6	10	CG
Arthropoda	Insecta	Coleoptera	Elmidae	Optioservus	4	4	SC
Arthropoda	Insecta	Coleoptera	Elmidae	Oulimnius	8	5	SC
Arthropoda	Insecta	Coleoptera	Psephenidae	Psephenus	2	4	SC
Arthropoda	Insecta	Diptera	Ceratopogonidae		1	6	PR
Arthropoda	Insecta	Diptera	Chironomidae		28	6	CG
Arthropoda	Insecta	Diptera	Empididae	Chelifera	2	6	PR
Arthropoda	Insecta	Diptera	Empididae	Hemerodromia	4	6	PR
Arthropoda	Insecta	Diptera	Tipulidae	Hexatoma	1	2	PR
Arthropoda	Insecta	Ephemeroptera	Baetidae	Acentrella	107	4	SC
Arthropoda	Insecta	Ephemeroptera	Baetidae	Baetis	30	6	CG
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	3	1	CG
Arthropoda	Insecta	Plecoptera	Chloroperlidae	Sweltsa	1	0	PR
Arthropoda	Insecta	Plecoptera	Nemouridae	Nemoura	5	1	SH
Arthropoda	Insecta	Plecoptera	Perlodidae	Yugus	1	2	PR
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	2	6	FC
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsyche	2	5	FC
Arthropoda	Insecta	Trichoptera	Philopotamidae	Dolophilodies	9	0	FC
Arthropoda	Insecta	Trichoptera	Philopotamidae	Wormaldia	1	0	FC
Arthropoda	Insecta	Trichoptera	Rhyacophilidae	Rhyacophila	3	1	PR
					220		

APPENDIX D
STREAM BENTHIC MACROINVERTEBRATE DATA

Indian Creek (IC-3) (5/21/2008)							
Taxon					Total	Tolerance Value[a]	Functional Feeding Group[a]
Phylum	Class	Order	Family	Genus			
Annelida	Oligochaeta				25	10	CG
Arthropoda	Crustacea	Decapoda	Cambaridae		1	6	CG
Arthropoda	Crustacea	Isopoda	Asellidae	Caecidotea	2	6	CG
Arthropoda	Insecta	Coleoptera	Elmidae	Optioservus	1	4	SC
Arthropoda	Insecta	Coleoptera	Elmidae	Oulimnius	1	5	SC
Arthropoda	Insecta	Coleoptera	Elmidae	Promoresia	1	2	SC
Arthropoda	Insecta	Diptera	Ceratopogonidae		1	6	PR
Arthropoda	Insecta	Diptera	Chironomidae		136	6	CG
Arthropoda	Insecta	Diptera	Empididae	Chelifera	1	6	PR
Arthropoda	Insecta	Diptera	Empididae	Hemerodromia	6	6	PR
Arthropoda	Insecta	Diptera	Tabanidae	Chrysops	1	7	PI
Arthropoda	Insecta	Diptera	Tipulidae		1	4	SH
Arthropoda	Insecta	Diptera	Tipulidae	Pseudolimnophila	1	2	PR
Arthropoda	Insecta	Ephemeroptera	Baetidae	Acentrella	31	4	SC
Arthropoda	Insecta	Ephemeroptera	Baetidae	Baetis	14	6	CG
Arthropoda	Insecta	Plecoptera	Nemouridae	Amphinemura	3	3	SH
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsyche	5	5	FC
Arthropoda	Insecta	Trichoptera	Lepidostomatidae	Lepidostoma	1	1	SH
Arthropoda	Insecta	Trichoptera	Polycentropodidae	Polycentropus	2	6	FC
Arthropoda	Insecta	Trichoptera	Rhyacophilidae	Rhyacophila	1	1	PR
Mollusca	Bivalvia	Veneroida	Sphaeriidae		1	8	FC
Mollusca	Gastropoda	Basommatophora	Planorbidae		1	6	FC
					237		

Unnamed Tributary to Indian Creek (UNT IC-1) (5/22/2008)							
Taxon					Total	Tolerance Value[a]	Functional Feeding Group[a]
Phylum	Class	Order	Family	Genus			
Annelida	Oligochaeta				6	10	CG
Arthropoda	Crustacea	Isopoda	Asellidae	Caecidotea	15	6	CG
Arthropoda	Insecta	Coleoptera	Elmidae	Oulimnius	4	5	SC
Arthropoda	Insecta	Diptera	Ceratopogonidae		19	6	PR
Arthropoda	Insecta	Diptera	Chironomidae		94	6	CG
Arthropoda	Insecta	Diptera	Dixidae	Dixa	1	1	CG
Arthropoda	Insecta	Diptera	Tipulidae	Antocha	1	3	CG
Arthropoda	Insecta	Diptera	Tipulidae	Hexatoma	2	2	PR
Arthropoda	Insecta	Diptera	Tipulidae	Pseudolimnophila	1	2	PR
Arthropoda	Insecta	Ephemeroptera	Ameletidae	Ameletus	7	0	CG
Arthropoda	Insecta	Ephemeroptera	Baetidae	Acentrella	1	4	SC
Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae		2	4	CG
Arthropoda	Insecta	Plecoptera	Leuctridae	Leuctra	15	0	SH
Arthropoda	Insecta	Plecoptera	Nemouridae	Amphinemura	7	3	SH
Arthropoda	Insecta	Plecoptera	Peltoperlidae		22	2	SH
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Diplectrona	2	0	FC
Arthropoda	Insecta	Trichoptera	Lepidostomatidae	Lepidostoma	3	1	SH
Arthropoda	Insecta	Trichoptera	Rhyacophilidae	Rhyacophila	3	1	PR
Arthropoda	Insecta	Trichoptera	Uenoidae	Neophylax	1	3	SC
					206		

APPENDIX D
STREAM BENTHIC MACROINVERTEBRATE DATA

Unnamed Tributary to Indian Creek (UNT IC-2) (5/22/2008)							
Taxon					Total	Tolerance Value[a]	Functional Feeding Group[a]
Phylum	Class	Order	Family	Genus			
Annelida	Oligochaeta				1	10	CG
Arthropoda	Crustacea	Decapoda	Cambaridae		1	6	CG
Arthropoda	Insecta	Coleoptera	Elmidae	Oulimnius	26	5	SC
Arthropoda	Insecta	Coleoptera	Psephenidae	Ectopria	1	5	SC
Arthropoda	Insecta	Diptera	Ceratopogonidae		2	6	PR
Arthropoda	Insecta	Diptera	Chironomidae		35	6	CG
Arthropoda	Insecta	Diptera	Empididae	Chelifera	16	6	PR
Arthropoda	Insecta	Diptera	Syrphidae	Chrysogaster	1	10	CG
Arthropoda	Insecta	Diptera	Tipulidae	Hexatoma	2	2	PR
Arthropoda	Insecta	Diptera	Tipulidae	Limnophila	2	3	PR
Arthropoda	Insecta	Ephemeroptera	Ameletidae	Ameletus	1	0	CG
Arthropoda	Insecta	Ephemeroptera	Baetidae	Acentrella	2	4	SC
Arthropoda	Insecta	Ephemeroptera	Baetidae	Baetis	10	6	CG
Arthropoda	Insecta	Ephemeroptera	Baetidae	Diphetor	2	6	CG
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Drunella	5	1	SC
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	20	1	CG
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Epeorus	3	0	SC
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Leucrocuta	1	1	SC
Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae		3	4	CG
Arthropoda	Insecta	Odonata	Cordulegastridae	Cordulegaster	1	3	PR
Arthropoda	Insecta	Plecoptera	Chloroperlidae	Alloperla	1	0	CG
Arthropoda	Insecta	Plecoptera	Chloroperlidae	Haploperla	1	0	PR
Arthropoda	Insecta	Plecoptera	Chloroperlidae	Sweltsa	1	0	PR
Arthropoda	Insecta	Plecoptera	Leuctridae	Leuctra	43	0	SH
Arthropoda	Insecta	Plecoptera	Nemouridae	Amphinemura	22	3	SH
Arthropoda	Insecta	Plecoptera	Peltoperlidae		2	2	SH
Arthropoda	Insecta	Plecoptera	Perlodidae	Isoperla	4	2	PR
Arthropoda	Insecta	Trichoptera	Glossosomatidae	Agapetus	1	0	SC
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Diplectrona	13	0	FC
Arthropoda	Insecta	Trichoptera	Lepidostomatidae	Lepidostoma	1	1	SH
Arthropoda	Insecta	Trichoptera	Philopotamidae	Dolophilodies	1	0	FC
Arthropoda	Insecta	Trichoptera	Rhyacophilidae	Rhyacophila	1	1	PR
Arthropoda	Insecta	Trichoptera	Uenoidae	Neophylax	1	3	SC
					227		

[a] Tolerance Values and Functional Feeding Groups from PADEP TGD (2005).

NOTE: Functional Feeding Group designations are the following:

CG = Collector-Gatherer
SH = Shredder
FC = Filterer-Collector
PR = Predator
SC = Scraper
PI = Piercer
FC = Filterer-Collector

ATTACHMENT A

DRAFT - PADEP MULTIHABITAT STREAM ASSESSMENT PROTOCOL

Pennsylvania DEP Multihabitat Stream Assessment Protocol

Pennsylvania DEP Multihabitat Stream Assessment Protocol

This protocol identifies practical and regionally appropriate field, laboratory, and data analysis procedures needed to evaluate Pennsylvania's low-gradient streams. It also explains how to calculate the Total Biological Score of a stream macroinvertebrate sample and how this can be used to determine the aquatic life use status of that stream. The document that follows is a condensed version of "Pennsylvania DEP Multihabitat Stream Assessment Protocol, March 2007" and was designed for low-gradient waterways that are defined as having pool/glide channel morphology and naturally lack riffles.

Field Methods

All chemical water quality, physical habitat, and aquatic macroinvertebrate data is collected from a sample reach approximately 100 meters in length, during the months of October to May.

If water chemistry samples are taken for total phosphorus and total organic carbon, preserve them with 10% sulfuric acid. Samples analyzed for metals should be preserved with concentrated nitric acid to a pH <2. All samples are kept on ice and should be delivered to the DEP laboratory in Harrisburg, PA within 48 hours of collection.

Habitat Assessment

Physical habitat is documented using the EPA Glide/Pool Prevalence Habitat Assessment Field Data Sheet. This evaluation divides the habitat of the stream and its adjacent land use into ten parameters. Each parameter is scored on a scale of 0 to 20, with a higher score indicating better conditions. Depending on the score, a parameter can fall into one of four categories: Poor, Marginal, Suboptimal, and Optimal.

For the purpose of this protocol, only nine of the ten parameters are used. Channel Sinuosity is not used for low-gradient streams because the range of sinuosity as defined in the data sheet is not applicable to Pennsylvania streams. Thus, total habitat site scores can range from 0-180, with 180 being a perfect score.

Sampling

Aquatic macroinvertebrate samples are collected using a multihabitat sample collection method modified from that described in Barbour et al (1999). Organisms are collected from five different habitat types within the sample reach. Table 1 describes the five habitat types and explains the different sampling techniques. A total of 10 "jabs" are collected within each sample reach. Each jab consists of a 30-inch-long sweep of a 0.3-meter wide area, using a D-frame dip net (500 micron mesh). At least two jabs are made in each of the habitat types present within the sample reach.

Table 1. Stream Habitat Types and Field Sampling Techniques

Habitat Type	Description	Sample Technique
Cobble/ Gravel Substrate	Stream bottom areas consisting of mixed gravel and larger substrate particles; Cobble/gravel substrates are typically located in relatively fast-flowing, "erosional" areas of the stream channel	Macroinvertebrates are collected by placing the net on the substrate near the downstream end of an area of gravel or larger substrate particles and simultaneously pushing down on the net while pulling it in an upstream direction with adequate force to dislodge substrate materials and the aquatic macroinvertebrate fauna associated with these materials; Large stones and organic matter contained in the net are discarded after they are carefully inspected for the presence of attached organisms which are removed and retained with the remainder of the sample; One jab consists of passing the net over approximately 30 inches of substrate.
Snag	Snag habitat consists of submerged sticks, branches, and other woody debris that appears to have been submerged long enough to be adequately colonized by aquatic macroinvertebrates; Preferred snags for sampling include small to medium-sized sticks and branches (preferably < ~4 inches in diameter) that have accumulated a substantial amount of organic matter (twigs, leaves, uprooted aquatic macrophytes, etc.) that is colonized by aquatic macroinvertebrates.	When possible, the net is to be placed immediately downstream of the snag, in either the water column or on the stream bottom, in an area where water is flowing through the snag at a moderate velocity; The snag is then kicked in a manner such that aquatic macroinvertebrates and organic matter are dislodged from the snag and carried by the current into the net; If the snag can not be kicked, than it is sampled by jabbing the net into a downstream area of the snag and moving it in an upstream direction with enough force to dislodge and capture aquatic macroinvertebrates that have colonized the snag; One jab equals disturbing and capturing organisms from an area of ~0.23 m^2 (12" x 30")
Coarse Particulate Organic Matter (CPOM)	Coarse particulate organic matter (CPOM) consists of a mix of plant parts (leaves, bark, twigs, seeds, etc.) that have accumulated on the stream bottom in "depositional" areas of the stream channel; In situations where there is substantial variability in the composition of CPOM deposits within a given sample reach (e.g., deposits consisting primarily of white pine needles and other deposits consisting primarily of hardwood tree leaves), a variety of CPOM deposits are sampled; However, leaf packs in higher-velocity ("erosional") areas of the channel are not included in CPOM samples	CPOM deposits are sampled by lightly passing the net along a 30-inch long path through the accumulated organic material so as to collect the material and its associated aquatic macroinvertebrate fauna; When CPOM deposits are extensive, only the upper portion of the accumulated organic matter is collected to ensure that the collected material is from the aerobic zone
Submerged Aquatic Vegetation (SAV)	Submerged aquatic vegetation (SAV) habitat consists of rooted aquatic macrophytes	SAV is sampled by drawing the net in an upstream direction along a 30-inch long path through the vegetation; Efforts should be made to avoid collecting stream bottom sediments and organisms when sampling SAV areas.

Sand/Fine Sediment	Sand/fine sediment habitat includes stream bottom areas that are composed primarily of sand, silt, and/or clay.	Sand/fine sediment areas are sampled by bumping or tapping the net along the surface of the substrate while slowly drawing the net in an upstream direction along a 30-inch long path of stream bottom; Efforts should be made to minimize the amount of debris collected in the net by penetrating only the upper-most layer of sand/silt deposits; Excess sand and silt are removed from the sample by repeatedly dipping the net into the water column and lifting it out of the stream to remove fine sediment from the sample

First identify which habitat types are present within the sample reach. A minimum surface area of approximately 0.46 m^2 is required for a given habitat type to be sampled. If the total number of jabs (10) is not evenly divisible by the number of habitat types present, the remaining jab(s) are distributed among the most extensive habitat type(s) in the reach. All jabs are combined into several 2-liter largemouth jars and preserved in ethyl alcohol. Typically, the combined 10 jabs will fill three to four 2-liter sample jars about 2/3 full with organic and inorganic material. Sample jars are topped-off with 95% ethanol to ensure adequate sample preservation.

Laboratory Methods

In the laboratory, each combined macroinvertebrate sample is placed in an 8" x 14" pan divided into 28 2"x 2" grids. Using an illuminated magnifying lens, macroinvertebrates are picked from a minimum of four grids, selected at random, to generate a 200-organism (+/- 20%) sub-sample. Additional grids may be selected at random until the sub-sample is obtained. The organisms contained in the 200-organism sub-sample are identified to the lowest practical taxonomic level (usually genus). Some individuals collected will be immature and not exhibit the characteristics necessary for confident identification. If the individual cannot be confidently identified to the proper level, it should be discarded. All pupae are discarded. Certain groups are identified to a higher taxonomic level as follows:

Flatworms (Turbellaria) – Phylum Turbellaria
Segmented worms (Annelida), aquatic earthworms, & tubificids – Class Oligochaeta
Proboscis worms – Phylum Nemertea
Roundworms – Phylum Nematoda
Water mites – "Hydracarina" (an artificial taxonomic grouping of several mite superfamilies)
Midges – Family Chironimadae
Weevils – Family Curculionidae
Sand flies\no-see-ums – Ceratopogonidae
Decapoda, Gastropoda, and Pelecypoda are identified to family

Initial Processing of Raw Macroinvertebrate Sample

1. Fill a five-gallon bucket about 2/3 full with cold water.
2. Decant ethanol from samples by gently dumping the contents of sample bottles into a 500-micron sieve.
3. Gently rinse most of the silt and/or very-fine sand from the sample material in the sieve using an abundance of clean, cold water.

4. Gently transfer the rinsed sample material from the sieve into the five-gallon bucket.
5. Repeat step 2 until approximately ½ of the material contained in a given sample is transferred into the five-gallon bucket.
6. Gently agitate the contents of the bucket and decant the water and a portion of the bucket's contents into a 500-micron sieve.
7. Transfer the contents of the sieve into a clean, white, 8" x 14" pan marked into 2" x 2" grids.
8. Gently fill the five-gallon bucket about 2/3 full with clean cold water and repeat steps 6 & 7 until all organisms are transferred from the bucket into the pan.
9. Repeat steps 1 through 8 until all of the organisms contained in the sample are transferred to the 8" x 14" pan.

Picking the 200-Organism Sub-sample

1. Remove a reasonable amount of organic material from a randomly selected grid in the 8" x 14" pan and place it in a large clear glass or plastic dish (sample-picking dish) containing clean water. The sample-picking dish should be placed on top of a white paper towel or piece of paper.
2. Using an illuminated magnifying lens and forceps, grasp individual large pieces of debris from the sample-picking dish, dip them in a deep dish or bowl of cold water (rinse dish), and discard them. Usually after numerous large pieces of debris are discarded, more material from the selected grid can be placed in the sample-picking dish.
3. After the large pieces of debris are removed from the sample-picking dish, move the organic matter away from the front edge of the dish so that there is an area of the dish that is relatively free of debris.
4. Starting with the debris closest to the debris-free area of the sample-picking dish, start moving small allotments of debris into the previously debris-free area so that individual organisms can be clearly detected and transferred from the sample-picking dish to a 3"-diameter petrie dish or similar dish containing clean cold water or ethanol (sub-sample organism dish). Use a hand held counter and keep track of the number of "identifiable" organisms (i.e., organisms in good enough condition to be identified to genus for most taxa) transferred to the sub-sample organism dish.
5. Continue working from the front edge of the sample-picking dish toward the back edge of the dish until all organisms have been transferred from the sample-picking dish to the sub-sample organism dish. Sometimes the water in the sample-picking dish will become cloudy making it hard to see the organisms in the dish. If this happens, carefully pour off the water in the sample-picking dish, being careful not to pour off organisms and debris during the process, and replace it with clean, cold water. It is best to pour off water between steps 2 and 3 above.
6. Use forceps and netting attached to a pipette, pencil, or similar object, to transfer all of the contents of the randomly selected grid to the sample-picking dish and repeat steps 1- 4 above until all organisms have been placed in the sub-sample organism dish.

7. Repeat steps 1-5 above until a minimum of 4 randomly selected grids are processed. All organisms in the 4th grid are to be transferred to the sub-sample organism dish, even if the 200 +/- 20% criterion is already met. If the estimated number of "identifiable" organisms in the sub-sample is less than 160, process additional grids until a minimum of 160 organisms are contained in the sub-sample.
8. If the sub-sample contains more than 240 organisms after picking the fourth grid, place the sub-sample in a clean gridded pan containing a small amount of cold water. Using an illuminated magnifying lens, randomly select grids and transfer all organisms from these grids to a separate container, using a hand-held counter to keep track of the number of "identifiable" organisms transferred. Continue selecting grids and transferring organisms until a sub-sample of 200 +/- 20% is produced.

Metrics

Table 2 describes the six metrics used to calculate Total Biological Scores for samples collected using this protocol.

Table 2. Six Metrics used to Calculate Total Biological Scores of Samples Collected using the Multihabitat Stream Assessment Protocol

Metric	Discrimination Efficiency	Expected Response to Increasing Stress	Metric Description
EPT	100	Decrease	Sum of the total number of taxa found in the Orders Ephemeroptera (Mayfly), Plecoptera (Stonefly), and Trichoptera (Caddisfy) that were sub-sample.
Taxa Richness	94	Decrease	Total number of taxa in the sub-sample.
Beck4	82	Decrease	Pollution weighted taxa richness measure, based on Hilsenhoff Biotic Index Scores (Hils). This is a modified Beck's Index giving organisms with a Hils score of 0 or 1 two points and Hils scores of 2, 3, or 4 are given 1 point.
Shannon Diversity	88	Decrease	This index measures taxa abundance and evenness in the sub-sample by dividing the # of individuals in a taxa by the total # of individuals in the sub-sample and then multiplying by the natural logarithm of this proportion. This is done for all taxa in the sub-sample; the products are then summed and the answer multiplied by -1: $= -\sum_{i=1}^{TaxaRich} (p_i/P) \ln (p_i/P)$
# Mayfly Taxa	88	Decrease	Total number of Mayflies (Ephemeroptera) in the sub-sample

# Caddisfly Taxa	94	Decrease	Total number of Caddisflies (Trichoptera) in the sub-sample

Metric and Total Biological Score Calculations

The following provides a detailed explanation on how to calculate the six metric scores and the Total Biological Scores of two low gradient streams, Saw Creek and Wiconisco Creek. After the field and lab procedures have been completed, a macroinvertebrate list of 200 +/- 20% organisms will be produced. The following taxa lists are color coded to help distinguish the taxa and information that will be used to calculate the metrics.

Saw Creek (20040406-1705-CAM)				
Taxonomic Level	**Taxa Name**	**Number of Individuals**	**Hilsenhoff Score**	**Functional Feeding Group**
Diptera	Chironomidae	109	6	CG
Isopoda	Caecidotea	8	6	CG
Trichoptera	Pycnopsyche	16	4	SH
Ephemeroptera	Eurylophella	4	4	SC
Trichoptera	Platycentropus	2	4	SH
Diptera	Ceratopogonidae	3	6	PR
Bivalvia	Sphaeriidae	3	8	FC
Oligochaeta	Oligochaeta	3	10	CG
Trichoptera	Oecetis	1	8	PR
Hirudinea	Hirudinea	1	8	PR
Ephemeroptera	Stenonema	3	3	SC
Plecoptera	Amphinemura	3	3	SH
Trichoptera	Lype	7	2	CG
Plecoptera	Isoperla	3	2	PR
Plecoptera	Leuctra	5	0	SH
Trichoptera	Diplectrona	3	0	FC
Trichoptera	Wormaldia	1	0	FC
Trichoptera	Rhyacophila	3	1	PR
Trichoptera	Lepidostoma	1	1	SH
Plecoptera	Prostoia	3	2	SH
Trichoptera	Molanna	7	6	SC
Diptera	Simulium	13	6	FC
Diptera	Prosimulium	2	5	FC
Diptera	Pseudolimnophila	1	2	PR
Diptera	Dicranota	11	3	PR
Diptera	Tipula	1	4	SH

Wiconisco Creek (20050525-1030-CAM)				
Taxonomic Level	**Taxa Name**	**Number of Individuals**	**Hilsenhoff Score**	**Functional Feeding Group**
Diptera	Chironomidae	151	6	CG
Isopoda	Caecidotea	1	6	CG
Trichoptera	Platycentropus	1	4	SH
Diptera	Ceratopogonidae	2	6	PR
Bivalvia	Sphaeriidae	3	8	FC
Oligochaeta	Oligochaeta	35	10	CG
Amphipoda	Crangonyx	3	4	CG
Odonata	Calopteryx	1	6	PR
Plecoptera	Leuctra	1	0	SH
Megaloptera	Sialis	1	6	PR
Odonata	Lestes	1	9	PR
Odonata	Ischnura	1	9	PR

EPT

To calculate this metric, sum the total number of Mayfly (Ephemeroptera), Stonefly (Plecoptera), and Caddisfy (Trichoptera) taxa found in the sub-sample:

Saw Creek

Ephemeroptera = 2
Plecoptera = 4
Trichoptera = 9
15

Wiconisco Creek

Ephemeroptera = 0
Plecoptera = 1
Trichoptera = 1
2

Taxa Richness

This metric sums the total number of taxa identified in the sub-sample (count the number of rows in the above tables):

Saw Creek = **26**

Wiconisco Creek = **12**

Beck4

Beck4 is a pollution weighted taxa richness measure, based on Hilsenhoff Biotic Index Scores (Hils). Hilsenhoff's index measures the pollution tolerance of an organism on a scale of 0 to 10, where the organisms' tolerance level decreases with the score. This metric is a modification of Beck's Index; it was chosen because this version works better for low-gradient streams. Therefore, it differs from the Beck's Index used in the 6 D-Frame protocol. For Beck4, organisms with a Hils score of 0 or 1 are given 2 points and Hils scores of 2, 3, or 4 are given 1 point. In the tables, scores of 0 and 1 are highlighted in blue and scores of 2, 3, and 4 are highlighted in purple.

Saw Creek	Wiconisco Creek
Total # of taxa with Hils score of 0 or 1 = **5** 2 pts. x 5 = **10**	Total # of taxa with Hils score of 0 or 1 = **1** 2 pts x 1 = **2**
Total # of taxa with Hils score of 2,3,or4 = **11** 1 pt. x 11 = **11**	Total # of taxa with Hils score of 2,3,or4 = **2** 1 pt. x 2 = **2**
10 + 11 = 21	**2 + 2 = 4**

Shannon Diversity

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

$$= -\sum_{i=1}^{TaxaRich} (p_i/P) \ln (p_i/P$$

p_i = # of individuals in each taxa
P = total # of individuals identified in the sub-sample
TaxaRich = the total # of taxa in the sub-sample

Saw Creek

TaxaRich = 26
P = 217 (sum the Number of Individuals column in the above tables)

Wiconisco Creek

TaxaRich = 12
P = 201

p_i = this value is listed in the above tables in the Number of Individuals column.

Saw Creek

(109/217) ln (109/217) + (8/217) ln (8/217) + (16/217) ln (16/217).....(1/217) ln (1/217) = -2.12946 * -1 = **2.12946**

Wiconisco Creek

(151/201) ln (151/201) + (1/201) ln (1/201) + (1/201) ln (1/201).....(1/201) ln (1/201) = -0.875322793 * -1 = **0.87532**

Number of Caddisfly Taxa
To calculate this metric, sum the number of Caddisfly taxa present in the sub-sample.

Saw Creek
Trichoptera = 9

Wiconisco Creek
Trichoptera = 1

Number of Mayfly Taxa
Sum the total number of Mayfly taxa identified in the sub-sample.

Saw Creek
Ephemeroptera = 2

Wiconisco Creek
Ephemeroptera = 0

Now that the six metric scores have been calculated, the scores are plugged into the normalized metric score equation: (Observed Value / 95th percentile) x 100. Some metrics may have a normalized score greater than 100 because normalization is based on the 95th percentile values of the statewide dataset. Normalized metric scores above 100 are adjusted to a score of 100. The adjusted metric scores for the six metrics are summed and then averaged to give the Total Biological Score. Tables 3 and 4 below show how to calculate the normalized metric scores and Total Biological Scores for Saw Creek and Wiconisco Creek.

Saw Creek's Raw Metric Scores
EPT = 15
Taxa Richness = 26
Beck4 = 21
Shannon Diversity = 2.12946
Of Caddisfly Taxa = 9
Of Mayfly Taxa = 2

Wiconisco Creek's Raw Metric Score
EPT = 2
Taxa Richness = 12
Beck4 = 4
Shannon Diversity = 0.87532
Of Caddisfly Taxa = 1
Of Mayfly Taxa = 0

Table 3. Total Biological Score Calculation for Saw Creek

Metric	Equation	Observed Value	Normalized Metric Score	Adjusted Metric Score (100 Max)
EPT	(Observed / 17) x 100	15	88.2	88.2
Taxa Richness	(Observed / 31) x 100	26	83.9	83.9
Beck4	(Observed / 22) x 100	21	95.5	95.5

Shannon Diversity	(Observed / **2.43**) x 100	2.12946	87.6	87.6
# Of Caddisfly Taxa	(Observed / **11**) x 100	9	81.8	81.8
# Of Mayfly Taxa	(Observed / **6**) x 100	2	33.3	33.3
Total Biological Score				**78.4**

Table 4. Total Biological Score Calculation for Wiconisco Creek

Metric	Equation	Observed Value	Normalized Metric Score	Adjusted Metric Score (100 Max)
EPT	(Observed / **17**) x 100	2	11.8	11.8
Taxa	(Observed / **31**) x 100	12	38.7	38.7
Beck4	(Observed / **22**) x 100	4	18.2	18.2
Shannon Diversity	(Observed / **2.43**) x 100	0.87532	36.0	36.0
# Of Caddisfly Taxa	(Observed / **11**) x 100	1	9.1	9.1
# Of Mayfly Taxa	(Observed / **6**) x 100	0	0	0
Total Biological Score				**19.0**

Benchmark

The Total Biological Score of a site is then compared to the protocols benchmark. Sites scoring below the benchmark are considered impaired for aquatic life use and sites scoring above are considered attaining for aquatic life.

Table 5. Aquatic Life Use (ALU) Benchmark

Multihabitat ALU Benchmark
55

Therefore, Saw Creek would be documented as attaining for aquatic life use and Wiconisco Creek would be impaired for aquatic life use.

Literature Cited

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

ATTACHMENT B

PADEP TGD 563-2000-655
APPENDIX B - PADEP LOW GRADIENT STREAM ASSESSMENT PROTOCOL

Appendix B

PA DEP Low Gradient Steam Assessment Protocol

This protocol is designed to assess a stream's level of use attainment. As used with this guidance, the protocol is intended to yield aquatic life use attainment scores that can be used to document the condition of a stream before and after mining and to assess the magnitude of mining-induced change.

The protocol is based on the multihabitat approach described in the United States Environmental Protection Agency's Rapid Bioassessment Protocols for use in Wadeable Streams and Rivers (Barbour and others, 1999). It was selected for use with this guidance based on Department research and testing, which show it to be both practical and appropriate for assessing streams in Bio-regions 1 and 2, which include all of the Bituminous coal fields (See map in Fig. 1).

The protocol involves sampling a variety of habitat types as opposed to sampling only the most productive habitat. It is ideally suited to streams in Bio-regions 1 and 2, which tend to be dominated by pool/glide channel morphology. By sampling of multiple habitats, the protocol provides an assessment score that is reflective of the riffles, pools, glides and runs that may occur along a stream reach rather than a score reflecting only the most productive habitat (typically riffles).

The procedures used in performing the protocol are described in the following sections. It is important to note that the procedures are only applicable to "biologically diverse" stream segments identified according to the procedures described in Appendix A.

Figure B.1. Pennsylvania Bioregions (1 = Glaciated & Southwest Appalachian Plateau, 2 = Pocono,
Central Mountains, & Laurel Highlands, 3 = Central & Southeastern Lowlands)

Field Procedures

The first step is to identify individual stream reaches that are to be assessed and scored using the protocol. Each reach identified for assessment should be approximately 100 meter in length.

The second step is to identify the following habitats with the identified stream reach.

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

Descriptions of each habitat type are presented in Table B.1.

After identifying the habitat types that are present within the stream reach, it is necessary to select 10 sampling locations that effectively represent the observed habitats. Prospective sampling locations should have a minimum surface area of approximately 0.46 square meter to allow a jab consisting of a 30-inch long sweep of a 0.3 meter wide, D-frame dip net (500 mesh). Sampling locations should be selected so that at least two jabs are made in each type of habitat present within the stream reach. If the total number of jabs (10) is not divisible by the number of habitats present, the remaining jab(s) should be distributed among the most extensive habitat type(s) in the stream reach.

After selecting 10 appropriate jab locations, the next step is to perform the field collection of macroinvertebrates. To ensure that samples are suitable for aquatic life use attainment evaluations, sampling should be conducted during the period October to May. One jab is performed at each of the 10 selected sampling locations. All jabs are composited into several two-liter largemouth jars and preserved in ethyl alcohol. (10 jabs will typically yield three to four sample jars filled to 2/3 capacity) Sample jars are topped-off with 190-proof ethanol to ensure adequate preservation. Additional details regarding field sampling procedures may be obtained from Barbour and others (1999).

Table B.1 Habitat Types

Habitat Type	Description	Sample Technique
Cobble/ Gravel Substrate	Stream bottom areas consisting of mixed gravel and larger substrate particles; Cobble/gravel substrates are typically located in relatively fast-flowing, "erosional" areas of the stream channel	Macroinvertebrates are collected by placing the net on the substrate near the downstream end of an area of gravel or larger substrate particles and simultaneously pushing down on the net while pulling it in an upstream direction with adequate force to dislodge substrate materials and the aquatic macroinvertebrate fauna associated with these materials; Large stones and organic matter contained in the net are discarded after they are carefully inspected for the presence of attached organisms which are removed and retained with the remainder of the sample; One jab consists of passing the net over approximately 30 inches of substrate.
Snag	Snag habitat consists of submerged sticks, branches, and other woody debris that appears to have been submerged long enough to be adequately colonized by aquatic macroinvertebrates; Preferred snags for sampling include small to medium-sized sticks and branches (preferably < ~4 inches in diameter) that have accumulated a substantial amount of organic matter (twigs, leaves, uprooted aquatic macrophytes, etc.) that is colonized by aquatic macroinvertebrates.	When possible, the net is to be placed immediately downstream of the snag, in either the water column or on the stream bottom, in an area where water is flowing through the snag at a moderate velocity; The snag is then kicked in a manner such that aquatic macroinvertebrates and organic matter are dislodged from the snag and carried by the current into the net; If the snag can not be kicked, than it is sampled by jabbing the net into a downstream area of the snag and moving it in an upstream direction with enough force to dislodge and capture aquatic macroinvertebrates that have colonized the snag; One jab equals disturbing and capturing organisms from an area of ~0.23 m^2 (12" x 30")
Coarse Particulate Organic Matter (CPOM)	Coarse particulate organic matter (CPOM) consists of a mix of plant parts (leaves, bark, twigs, seeds, etc.) that have accumulated on the stream bottom in "depositional" areas of the stream channel; In situations where there is substantial variability in the composition of CPOM deposits within a given sample reach (e.g., deposits consisting primarily of white pine needles and other deposits consisting primarily of hardwood tree leaves), a variety of CPOM deposits are sampled; However, leaf packs in higher-velocity ("erosional") areas of the channel are not included in CPOM samples	CPOM deposits are sampled by lightly passing the net along a 30-inch long path through the accumulated organic material so as to collect the material and its associated aquatic macroinvertebrate fauna; When CPOM deposits are extensive, only the upper portion of the accumulated organic matter is collected to ensure that the collected material is from the aerobic zone
Submerged Aquatic Vegetation (SAV)	Submerged aquatic vegetation (SAV) habitat consists of rooted aquatic macrophytes	SAV is sampled by drawing the net in an upstream direction along a 30-inch long path through the vegetation; Efforts should be made to avoid collecting stream bottom sediments and organisms when sampling SAV areas.
Sand/Fine Sediment	Sand/fine sediment habitat includes stream bottom areas that are composed primarily of sand, silt, and/or clay.	Sand/fine sediment areas are sampled by bumping or tapping the net along the surface of the substrate while slowly drawing the net in an upstream direction along a 30-inch long path of stream bottom; Efforts should be made to minimize the amount of debris collected in the net by penetrating only the upper-most layer of sand/silt deposits; Excess sand and silt are removed from the sample by repeatedly dipping the net into the water column and lifting it out of the stream to remove fine sediment from the sample

Laboratory Methods

In the laboratory, each composited macroinvertebrate sample is placed in an 8" x 14" pan marked into 2" x 2" grids. Using an illuminated magnifying lense, macroinvertebrates are picked from a minimum of four grids, selected at random, to generate a 200-organism (+/- 20%) subsample. Additional grids are selected at random until the subsample is obtained. The organisms contained in the 200-organism subsample are identified to the lowest practical taxonomic level (usually genus) using Merritt and Cummins (1996), Peckarsky and others (1990), Stewart and Stark (1988), Wiggins (1996), and Smith (2001). Annelids are identified to class and Curculionidae, Chironomidae, Ceratopogonidae, Talitridae, Decapoda, Gastropoda, and Pelecypoda are identified to family.

Initial processing of the raw macroinvertebrate sample

1. Fill a five-gallon bucket about 2/3 full with cold water.
2. Decant ethanol from samples by gently dumping the contents of sample bottles into a 500 micron sieve.
3. Gently rinse most of the silt and/or very-fine sand from the sample material in the sieve using an abundance of clean, cold water.
4. Gently transfer the rinsed sample material from the sieve into the five-gallon bucket.
5. Repeat step 2 until approximately ½ of the material contained in a given sample is transferred into the five-gallon bucket.
6. Gently agitate the contents of the bucket and decant the water and a portion of the bucket's contents into a 500-micron sieve.
7. Transfer the contents of the sieve into a clean, white, 8" x 14" pan marked into 2" x 2" grids.
8. Gently fill the five-gallon bucket about 2/3 full with clean cold water and repeat steps 6 & 7 until all organisms are transferred from the bucket into the pan.
9. Repeat steps 1 through 8 until all of the organisms contained in the sample are transferred to the 8" x 14" pan.

Picking the 200-Organism Subsample

1. Remove a reasonable amount of organic material from a randomly selected grid in the 8" x 14" pan and place it in a large (approx. 5" diameter) clear glass or plastic dish (sample-picking dish) containing clean water. The sample-picking dish should be placed on top of a white paper towel or piece of paper.
2. Using an illuminated magnifying lens and forceps, grasp individual large pieces of debris from the sample-picking dish, dip them in a deep dish or bowl of cold water (rinse dish), and discard them. Usually after numerous large pieces of debris are discarded, more material from the selected grid can be placed in the sample-picking dish.

3. After the large pieces of debris are removed from the sample-picking dish, move the organic matter away from the front edge of the dish so that there is an area of the dish that is relatively free of debris.

4. Starting with the debris closest to the debris-free area of the sample-picking dish, start moving small allotments of debris into the previously debris-free area so that individual organisms can be clearly detected and transferred from the sample-picking dish to a 3"-diameter petrie dish or similar dish containing clean cold water or ethanol (subsample organism dish). Use a hand held counter and keep track of the number of "identifiable" organisms (i.e., organisms in good enough condition to be identified to genus for most taxa) transferred to the subsample organism dish.

5. Continue working from the front edge of the sample-picking dish toward the back edge of the dish until all organisms have been transferred from the sample-picking dish to the subsample organism dish. Sometimes the water in the sample-picking dish will become cloudy making it hard to see the organisms in the dish. If this happens, carefully pour off the water in the sample-picking dish, being careful not to pour off organisms and debris during the process, and replace it with clean, cold water. It is best to pour off water between steps 2 and 3 above.

6. Use forceps and netting attached to a pipet, pencil, or similar object, to transfer all of the contents of the randomly selected grid to the sample-picking dish and repeat steps 1 through 4 above until all organisms have been placed in the subsample organism dish.

7. Repeat steps 1 thru 5 above until a minimum of four randomly selected grids are processed. All organisms in the fourth grid are to be transferred to the subsample organism dish, even if the 200 +/- 20% criterion is already met. If the estimated number of "identifiable" organisms in the subsample is less than 160, process additional grids until a minimum of 160 organisms are contained in the subsample.

8. If the subsample contains more than 240 organisms after picking the fourth grid, place the subsample in a clean gridded pan containing a small amount of cold water. Using an illuminated magnifying lense, randomly select grids and transfer all organisms from these grids to a separate container, using a hand-held counter to keep track of the number of "identifiable" organisms transferred. Continue selecting grids and transferring organisms until a subsample of 200 +/- 20% is produced.

Data Analysis

The 200-organism subsample data are used to calculate values for the five biological metrics shown in Table B.2. The metrics were selected based on their ability to discriminate between minimally disturbed reference sites and stressed sites in both Bioregions 1 and 2.

Only "truly-aquatic" (hydropneustic) organisms included in the 200-organism subsample are used to generate metric scores. Therefore, no Hemiptera abundance data and only larval Haliplidae, Gyrinidae, Hydroscaphidae, Psephenidae, and Ptilodactylidae and adult and larval Elmidae, Coleoptera abundance data are used in the calculation of biological metric values. Pollution tolerance values and functional feeding group information are listed in Table B.3.

Table B.2 Biological Metrics

Biological Metric	Metric Category	Description	Predicted Response to Increasing Perturbation
Taxonomic Richness	Richness	Total number of taxa	Decrease
Trichoptera Taxa Richness	Richness	Total number of caddisfly taxa	Decrease
Percent EPT Taxa	Composition	The total number of Ephemeroptera (mayfly), Plecoptera (stonefly) and Trichoptera (caddisfly) taxa divided by the Total number of taxa	Decrease
Intolerant Taxa Richness	Tolerance	The total number of taxa with a pollution tolerance value <5	Decrease
Filterer-Collector + Predator Taxa Richness	Trophic	The total number of taxa in the filterer-collector or predator functional feeding groups	Decrease

Table B.3 Pollution Tolerance Values and Functional Feeding Group Designations

Order (Class)	Family	Taxa	Pollution Tolerance Value	Functional Feeding Group
Insecta	Collembola	Collembola	9	CG
Ephemeroptera	Ameletidae	Ameletus	0	CG
Ephemeroptera	Siphlonuridae	Siphlonuridae	7	CG
Ephemeroptera	Baetidae	Acentrella	4	SC
Ephemeroptera	Baetidae	Acerpenna	6	CG
Ephemeroptera	Baetidae	Baetis	6	CG
Ephemeroptera	Isonychiidae	Isonychia	3	CG
Ephemeroptera	Heptageniidae	Epeorus	0	SC
Ephemeroptera	Heptageniidae	Stenacron	4	SC
Ephemeroptera	Heptageniidae	Stenonema	3	SC
Ephemeroptera	Ephemerellidae	Drunella	1	SC
Ephemeroptera	Ephemerellidae	Ephemerella	1	CG
Ephemeroptera	Ephemerellidae	Eurylophella	4	SC
Ephemeroptera	Ephemerellidae	Serratella	2	CG
Ephemeroptera	Caenidae	Caenis	7	CG
Ephemeroptera	Leptophlebiidae	Habrophlebiodes	6	SC
Ephemeroptera	Leptophlebiidae	Leptophlebia	4	CG
Ephemeroptera	Ephemeridae	Ephemera	2	CG
Ephemeroptera	Ephemeridae	Litobrancha	6	CG
Odonata	Gomphidae	Gomphus	5	PR
Odonata	Gomphidae	Hagenius	3	PR
Odonata	Gomphidae	Lanthus	5	PR
Odonata	Gomphidae	Stylogomphus	4	PR
Odonata	Aeshnidae	Aeshna	5	PR
Odonata	Aeshnidae	Basiaeschna	5	PR
Odonata	Aeshnidae	Boyeria	2	PR
Odonata	Cordulegastridae	Cordulegaster	3	PR
Odonata	Corduliidae	Helocordulia	2	PR
Odonata	Libellulidae	Sympetrum	4	PR
Odonata	Calopterygidae	Calopteryx	6	PR
Odonata	Calopterygidae	Lestes	9	PR
Odonata	Coenagrionidae	Argia	6	PR
Odonata	Coenagrionidae	Enallagma	8	PR
Odonata	Coenagrionidae	Ischnura	9	PR
Plecoptera	Pteronarcyidae	Pteronarcys	0	SH
Plecoptera	Peltoperlidae	Tallaperla	0	SH
Plecoptera	Taeniopterygidae	Taeniopteryx	2	SH
Plecoptera	Taeniopterygidae	Strophopteryx	3	SH
Plecoptera	Nemouridae	Amphinemura	3	SH
Plecoptera	Nemouridae	Ostrocerca	2	SH
Plecoptera	Nemouridae	Prostoia	2	SH
Plecoptera	Nemouridae	Nemoura	1	SH
Plecoptera	Leuctridae	Leuctra	0	SH
Plecoptera	Capniidae	Allocapnia	3	SH
Plecoptera	Perlidae	Acroneuria	0	PR
Plecoptera	Perlidae	Perlesta	4	PR
Plecoptera	Perlodidae	Clioperla	2	PR
Plecoptera	Perlodidae	Isoperla	2	PR

Table B.3 Pollution Tolerance Values and Functional Feeding Group Designations (cont'd)

Order (Class)	Family	Taxa	Pollution Tolerance Value	Functional Feeding Group
Megaloptera	Sialidae	Sialis	6	PR
Megaloptera	Corydalidae	Chauliodes	4	PR
Megaloptera	Corydalidae	Nigronia	1	PR
Trichoptera	Philopotamidae	Chimarra	4	FC
Trichoptera	Philopotamidae	Dolophilodes	0	FC
Trichoptera	Philopotamidae	Wormaldia	0	FC
Trichoptera	Psychomyiidae	Lype	2	CG
Trichoptera	Polycentropodidae	Nyctiophylax	5	FC
Trichoptera	Polycentropodidae	Polycentropus	6	FC
Trichoptera	Dipseudopsidae	Phylocentropus	5	FC
Trichoptera	Hydropsychidae	Parapsyche	0	FC
Trichoptera	Hydropsychidae	Diplectrona	0	FC
Trichoptera	Hydropsychidae	Cheumatopsyche	6	FC
Trichoptera	Hydropsychidae	Hydropsyche	5	FC
Trichoptera	Rhyacophilidae	Rhyacophila	1	PR
Trichoptera	Glossosomatidae	Glossosoma	0	SC
Trichoptera	Glossosomatidae	Agapetus	0	SC
Trichoptera	Hydroptilidae	Hydroptila	6	SC
Trichoptera	Hydroptilidae	Oxyethira	3	CG
Trichoptera	Phryganeidae	Ptilostomis	5	SH
Trichoptera	Brachycentridae	Brachycentrus	1	FC
Trichoptera	Brachycentridae	Micrasema	2	SH
Trichoptera	Lepidostomatidae	Lepidostoma	1	SH
Trichoptera	Limnephilidae	Ironoquia	3	SH
Trichoptera	Limnephilidae	Apatania	3	SC
Trichoptera	Limnephilidae	Anabolia	5	SH
Trichoptera	Limnephilidae	Frenesia	4	SH
Trichoptera	Limnephilidae	Hydatophylax	2	SH
Trichoptera	Limnephilidae	Limnephilus	3	SH
Trichoptera	Limnephilidae	Platycentropus	4	SH
Trichoptera	Limnephilidae	Pycnopsyche	4	SH
Trichoptera	Uenoidae	Neophylax	3	SC
Trichoptera	Sericostomatidae	Psilotreta	0	SC
Trichoptera	Molannidae	Molanna	6	SC
Trichoptera	Calamoceratidae	Heteroplectron	5	SH
Trichoptera	Leptoceridae	Ceraclea	3	CG
Trichoptera	Leptoceridae	Mystacides	4	CG
Trichoptera	Leptoceridae	Oecetis	8	PR
Trichoptera	Leptoceridae	Triaenodes	6	SH
Lepidoptera	Pyralidae	Parapoynx	5	SH
Lepidoptera	Pyralidae	Acentria	5	SH
Coleoptera	Gyrinidae	Gyrinus	4	PR
Coleoptera	Haliplidae	Peltodytes	5	SH
Coleoptera	Psephenidae	Psephenus	4	SC
Coleoptera	Scirtidae	Cyphon	8	SC
Coleoptera	Scirtidae	Scirtes	8	SC

Table B.3 Pollution Tolerance Values and Functional Feeding Group Designations (cont'd)

Order (Class)	Family	Taxa	Pollution Tolerance Value	Functional Feeding Group
Coleoptera	Elmidae	Ancyronyx	2	CG
Coleoptera	Elmidae	Dubiraphia	6	SC
Coleoptera	Elmidae	Macronychus	2	SC
Coleoptera	Elmidae	Optioservus	4	SC
Coleoptera	Elmidae	Oulimnius	5	SC
Coleoptera	Elmidae	Promoresia	2	SC
Coleoptera	Elmidae	Stenelmis	5	SC
Coleoptera	Ptilodactylidae	Anchytarsus	5	SH
Diptera	Ceratopogonidae	Ceratopogonidae	6	PR
Diptera	Dixidae	Dixa	1	CG
Diptera	Dixidae	Dixella	1	CG
Diptera	Ptychopteridae	Ptychoptera	8	CG
Diptera	Dolichopodidae	Dolichopodidae	4	PR
Diptera	Empididae	Chelifera	6	PR
Diptera	Empididae	Clinocera	6	PR
Diptera	Empididae	Hemerodromia	6	PR
Diptera	Tabanidae	Chrysops	7	CG
Diptera	Tabanidae	Tabanus	5	PR
Diptera	Tipulidae	Tipula	4	SH
Diptera	Tipulidae	Antocha	3	CG
Diptera	Tipulidae	Dicranota	3	PR
Diptera	Tipulidae	Hexatoma	2	PR
Diptera	Tipulidae	Limnophila	3	PR
Diptera	Tipulidae	Ormosia	6	CG
Diptera	Tipulidae	Pilaria	7	PR
Diptera	Tipulidae	Pseudolimnophila	2	PR
Diptera	Simuliidae	Prosimulium	5	FC
Diptera	Simuliidae	Simulium	6	FC
Diptera	Chironomidae	Chironomidae	6	CG
Turbellaria	Turbellaria	Turbellaria	9	PR
Turbellaria	Planariidae	Dugesia	9	PR
Nematoda	Nematoda	Nematoda	9	CG
Gastopoda (Class)	Hydrobiidae	Hydrobiidae	8	SC
Gastopoda (Class)	Pleuroceridae	Pleuroceridae	7	SC
Gastopoda (Class)	Lymnaeidae	Lymnaeidae	7	SC
Gastopoda (Class)	Physidae	Physidae	8	SC
Gastopoda (Class)	Planorbidae	Planorbidae	6	SC
Gastopoda (Class)	Ancylidae	Ancylidae	7	SC
Bivalvia (Class)	Unionidae	Unionidae	4	FC
Bivalvia (Class)	Sphaeriidae	Sphaeriidae	8	FC
Bivalvia (Class)	Corbiculidae	Corbicula	5	FC
Hirudinea (Class)	Hirudinea (Class)	Hirudinea	8	PR
Oligochaeta (Class)	Oligochaeta (Class)	Oligochaeta	10	CG
Amphipoda	Crangonyctidae	Crangonyx	4	CG
Amphipoda	Gammaridae	Gammarus	6	CG
Amphipoda	Talitridae	Hyalella	8	CG
Decapoda	Cambaridae	Cambaridae	6	CG
Isopoda	Asellidae	Caecidotea	6	CG
Arachnida (Class)	Arachnida (Class)	Hydracarina	7	PR
Platyhelminthes	Platyhelminthes	Viviparidae	7	CG

After determining the observed values of the five biological metrics, it is necessary to normalize each value to a scale of 0 – 100 based on the 95th percentile value from DEP's statewide, low gradient stream dataset (n=50) using the following equation:

Normalized Metric Score = (Observed Value / 95th) x 100

The 95th percentile values from the statewide, low gradient stream dataset are as follows:

Biological Metric	95th Percentile Value of Statewide Dataset
Taxonomic Richness	30.5
Trichoptera Taxa Richness	10.5
Percent EPT Taxa	61.6
Intolerant Taxa Richness	16.0
Filterer-Collector + Predator Taxa Richness	13.5

The total biological score for a stream reach is calculated as the mean of the five normalized metric scores. Since metric scores are normalized based on the 95th percentile values of the statewide dataset, some of the scores may exceed a value of 100. All normalized metric scores that exceed a value of 100 are converted to 100 before calculating the total biological score for the stream reach. The following example illustrates the calculation of the total biological score for a stream reach.

Example Showing Calculation of Biological Score for Hypothetical Stream Reach

	Stream Reach X (pre-mining)		
Bioregion	1		
Biological Metric	**Observed Value**	**Normalized Score (Observed value / 95th Percentile value) * 100**	**Adjusted Value**
Taxa Richness	16	52.5	52.5
Trichoptera Richness	4	38.1	38.1
Percent EPT Richness	62.5	101.4	100.0
Intolerant Taxa Richness	7	43.8	43.8
FC + PR Taxa Richness	10	74.1	74.1
Total Biological Score (Mean of adjusted values)			**61.7**

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