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INNOVATIVE RECLAMATION TECHNOLOGIES & ENGINEERING CO., INC.

211 MAIN STREET, P.O. BOX 306, CARYVILLE, TENNESSEE 37714

FAK: 423505-1

June 23, 2008

Mr. Douglas K. Siddell, Supervisor Technical Group Office of Surface Mining Reclamation and Enforcement 710 Locust Street, Second Floor Knoxville, Tennessee 37902 DAT 7-7 DRM-7-7 Tile-TNO071633

Subject: Crossville Coal Inc - Mine No. 1 - OSM Permit #3190

Macroinvertebrate Surveys

Dear Mr. Siddell:

Attached for your review is the bi-annual stream survey conducted for the spring time of the year for 2008. This macroinvertebrate survey was performed by Pennington and Associates, Inc. and included stream flow measurements and collection of water quality samples. The stream surveys (2 locations) were conducted on April 17, 2008 and indicated that the benthic macroinvertebrate community at each station was diverse and represents aquatic communities under little or no impairment.

The analyses of the collected water quality samples are included with this transmittal. The analyses of the collected PAH samples indicated all parameters to be below detection limits.

Please note that this letter along with the attached stream survey report constitute the reporting requirements for this aquatic and water quality monitoring plan. If you have any questions or need further information, please contact me at the address given above or telephone (423)-566-1915.

Sincerely,

Tim K. Slone, PE, Pl

On Behalf of Crossville Coal

Attachment Enclosures

cc: Mr. Mike Webster, Crossville Coal Inc

Mr. Don Owens, TDEC

7006 2150 0002 8671 1790

USFW

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National Park Service Big South Fork NRRA

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BENTHIC MACROINVERTEBRATE SURVEY ROGERS AND ISLAND CREEKS CUMBERLAND AND MORGAN COUNTIES, TENNESSEE

APRIL 2008

FOR

HILLS BOROUGH RESOURCES USA CROSSVILLE COAL, INC. P.O. Box 267 Harriman, Tennessee 37748

PREPARED BY

Pennington and Associates, Inc. 570 East 10th Street Cookeville, Tennessee 38501 931-526-6038

EXECUTIVE SUMMARY

The objectives of the April 17, 2008 study included the physio-chemical and benthic macroinvertebrate community characterizations of Rogers Creek and Island Creek in the vicinity of Crossville Coal, Inc. removal operations. Both stations were sampled for benthic macroinvertebrate community composition, physio-chemical composition, (pH, temperature, conductivity, and dissolved oxygen) and habitat characterization.

Physical conditions at the two stations were similar with a substrate of boulder, cobble and gravel. Flow was approximately 6.6 cfs at Rogers Creek and 43 cfs at Island Creek. Habitat was assessed to be "Not Impaired" at both stations. In terms of water quality, differences between the creek stations were minimal.

Benthic macroinvertebrates were collected and analyzed according to Tennessee Bioassessment procedures and additional community measures as presented by Pennington and Associates, Inc. (2006). Additional community structure analyses included Shannon's Index of Diversity, Pielou's Evenness, Jaccard's Coefficient and Percent Similarity. Both Creeks support a diverse benthic macroinvertebrate community within each study reach. At least 27 species were taken from Rogers Creek and 32 from Island Creek. Stonefly species were dominant at both locations. Diversity Indices and evenness values were high at both locations, indicative of diverse benthic community structure existing under good water quality conditions. A comparison of the stations using Tennessee's Bioassessment metrics has both stations scoring as non-impaired and supporting.

In conclusion, it appears that the benthic macroinvertebrate community at both stations is diverse and represents aquatic communities under little or no impairment.

INTRODUCTION

Pennington and Associates, Inc. (PAI) surveyed Rogers Creek and Island Creek downstream of Crossville Coal, Inc. company's operations, Cumberland County, Tennessee on April 17, 2008. The survey was conducted to determine physio-chemical and benthic macroinvertebrate fauna characteristics of the creeks below the influence of the coal removal operations. The survey was accomplished as part of a permit requirement and followed the established protocols established by the State of Tennessee (TDEC 2006).

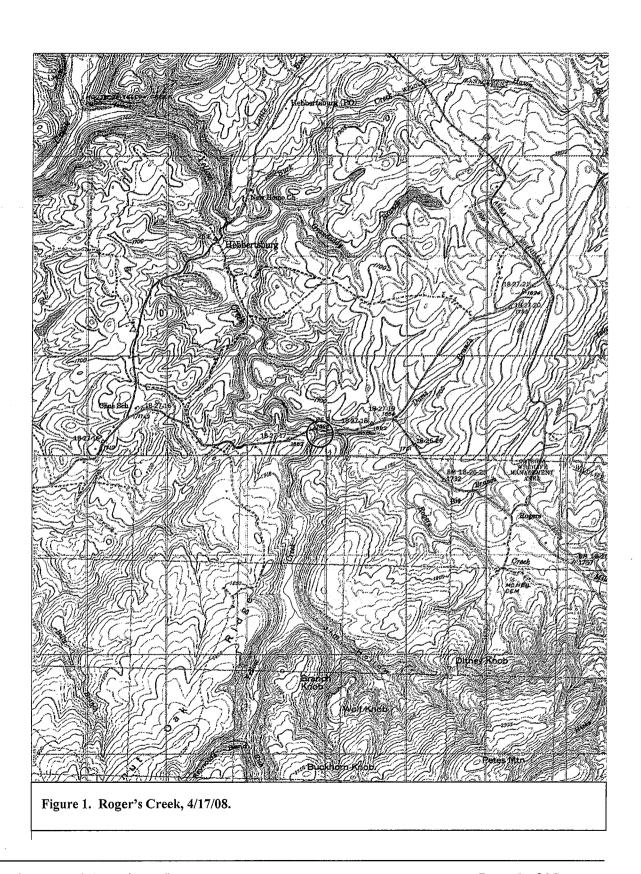
Since macroinvertebrate populations are more indicative of the relative health of a stream, attention is normally focused on this group. Macroinvertebrates are found in all aquatic habitats, they are less mobile than most other groups of aquatic organisms, such as fish, they are easily collected, and most have relatively long periods of development in the aquatic environment. Thus, macroinvertebrate species should reflect deleterious events that have occurred in the aquatic environment during any stage of their development.

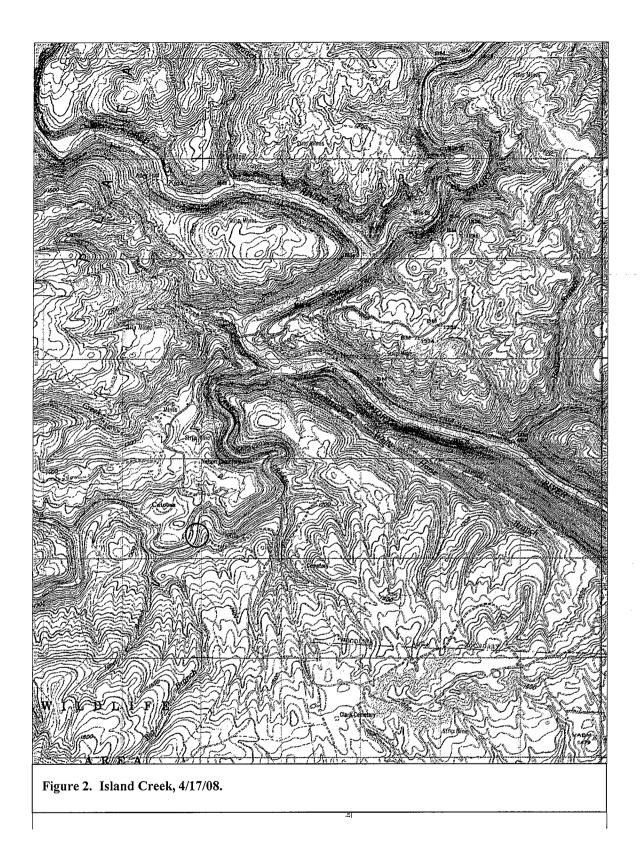
SAMPLING LOCATION

Pennington and Associates, Inc.

Sampling locations are shown in Figures 1 and 2. Rogers Creek – Located in Cumberland County, just upstream confluence with Yellow Creek, Latitude N36⁰00.115', Longitude W084⁰47.001' (Figure 1). Island Creek - Located in Morgan County, approximately one mile upstream confluence with Emory River at road crossing near Catoosa, Latitude N3603.182', longitude W084⁰40.030' (Figure 2).

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PHYSICAL CHARACTERSTICS

Rogers Creek and Island Creek originate on the Cumberland Plateau at an elevation of approximately 2300 feet. Rogers Creek in Cumberland County flows northwest to its confluence with Yellow Creek while Island Creek in Morgan County flows east to northeast to the Emory River. Usage of the watershed is primarily agriculture, forest and some coal mining.

Physical characteristics of the sampling sites are summarized in Table 1. Rogers Creek was approximately 24 feet wide (Photo 2) 8 inches deep and had a flow determination to be near 6.6 cfs. A pebble count had the substrate at Rogers Creek to consist of mostly boulders (43%) cobble (28%) and gravel (13%). Island Creek (Photo 1) was 36 feet wide and 10 inches deep. The flow at Island Creek was near 43 cfs. The substrate at Island Creek was mostly cobble (54%), gravel (21%), boulder (17%) and small amounts of sand (7%). Habitat at both locations scored as non-impaired.

MATERIALS AND METHODS

At each of the two stations, two $\sim 1 \text{m}^2$ semi-quantitative riffle kick samples (SQKICK) were taken in the runs and riffles at the area of low and high velocity. The two $\sim 1 \text{m}^2$ Kicks were taken in equal proportions using a coarse 500 μm mesh kick seine. In the field, the samples were transferred to plastic containers labeled on the outside and inside of the containers and preserved with 10% formalin.

In the laboratory, all benthic samples were washed in a 120-micron mesh screen. After washing, the macroinvertebrates were removed from the detritus using Tennessee Protocols (200 +/- 20% individuals) under 5x magnification and preserved in 85% ethanol. The organisms were identified to the lowest practical taxonomic level (genus) using available keys (Pennington and Associates, Inc. 2006) and counted. Identifications were made with a stereomicroscope (7X to 60X). Slide mounts were made of the chironomids, simuliids, oligochaetes and small crustaceans, and identifications were made with a compound microscope. The chironomids, simuliids, and oligochaetes were cleared for 24 hours in cold 10% KOH. Temporary mounts were made in glycerin and the animals returned to 80% ethanol after identification. When permanent mounts were desired, the organisms were transferred to 95% ethanol for 30 minutes and mounted in euperol.

SUBSTRATE DETERMINATION

A classification of substrate based on the size scale proposed by Wentworth (Compton 1962) was used to categorized the substrate. A 100 pebble count was conducted at each location following procedures developed by Bevenger and King (1995). This classification of detrital sediments is by grain diameter and is as follows:

Diameters	Approximate Inch	Name of Loose
	Equivalents	Aggregate
>256 mm 64 to 256 mm 2 to 64 mm 1/16 to 2 mm 1/256 to 1/16 mm <1/256 mm	>10 inch 2.5 to 10 inch 0.08 to 2.5 inch 0.002 to 0.08 inch 0.00015 to 0.002 inch <0.00015 inch	Boulder Cobble Gravel Sand Silt Clay

COMMUNITY STRUCTURE MEASURES

Core benthic macroinvertebrate community metrics were calculated for each station and compared to the Tennessee ecoregion reference data base (TDEC 2006). Seven core metrics were calculated and include:

- Taxa Richness (TR) Total number of distinct taxa (genera for comparison to Tennessee ecoregion data). In general, increasing taxa richness reflects increasing water quality, habitat diversity and habitat suitability (KDOW 2002).
- 2. **Ephemeroptera, Plecoptera, and Trichoptera Richness (EPT)** Total number of distinct taxa within the generally pollution sensitive insect orders of EPT. This index value will usually increase with increasing water quality, habitat diversity and habitat stability. (Plafkin et al. 1989).
- 3. North Carolina Biotic Index (NCBI) The Biotic Index was originally developed by Hilsenhoff (1982) as a rapid method for evaluating water quality in Wisconsin streams by summarizing the overall pollution tolerance of a benthic arthropod community with a single value from 0-5. Hilsenhoff (1987) later refined the index and expanded the scale from 0-10. The biotic index is an average of tolerance values, and measures saprobity (pertaining to tolerance of organic enrichment) and to some extent trophism. Range of the index ranges from 0 (no apparent organic pollution) to 10 (severe organic pollution). Tennessee and KDOW use tolerance values developed by North Carolina Division of Environmental Management (NCDEM) (NCDENR 2006) and these values were used in this study. An increasing Biotic Index value indicates decreasing water quality. The formula for the Biotic Index is as follows:

$$NCBI = \sum \frac{x_i t_i}{n}$$

Where: $x_i = number of individuals within a taxon$

 t_i = tolerance value of a taxon

n = total number of individuals in the sample

According to Hilsenhoff (1987) the calculated Biotic Index values for Wisconsin streams reflect the following:

Biotic Index	Water Quality	Degree of Organic Pollution
0.00 - 3.50	Excellent	No apparent organic pollution
3.51 - 4.50	Very Good	Possibly slight organic pollution
4.51 - 5.50	Good	Some organic pollution
5.51 - 6.50	Fair	Fairly significant organic pollution
6.51 - 7.50	Fairly Poor	Significant organic pollution
7.51 - 8.50	Poor	Very significant organic pollution
8.51 - 10.00	Very Poor	Severe organic pollution

Historically, NCDEM used the following modified Hilsenhoff Biotic Index scale to assign water quality condition in North Carolina streams for three ecoregions.

Condition	Mountain	Piedmont	Coastal Plain
Excellent	<4.05	<5.19	<5.47
Good	4.06-4.88	5.19-5.78	5.47-6.05
Good to Fair	4.89-5.74	5.79-6.48	6.06-6.72
Fair	5.75-7.00	6.49-7.48	6.73-7.73
Poor	>7.00	>7.48	>7.73

The state of Tennessee uses a four tier scoring criteria which is based on Hilsenhoff's values calibrated for each Tennessee ecoregion. TDEC's scoring criteria for biotic index values for streams of the interior plateau ecoregions are as follows.

Ecoregion		Non-impaired	Slightly	Moderately	Severely
			Impaired	Impaired	Impaired
Cumberlan (68a)	d Plateau	<4.78	4.78-6.51	6.52-8.26	>8.26
Western Pe	nnyroyal				
Karst (71e)		< 5.09	5.09-6.72	6.73-8.36	>8.36
Western Hi	ghland				
Rim (71g)	i.	<4.69	4.69-6.45	6.46-8.23	>8.23
Eastern Hig	ghland	•			•
Rim (71f)		"	66	66	66
Outer Nash	ville				
Basin (71h)	1	"	66	cc	46
Inner Nash	ville				
Basin (71i)		<5.49	5.49-6.99	7.00-8.49	>8.49

4.	Percent Ephemero	ptera, Plecoptera	a and Trichoptera	(EPT Abundance):

5. **Percent Oligochaeta and Chironomidae** (%OC) – This metric measures the relative abundance of these generally pollution tolerant organisms. Increasing abundances of oligochaetes and chironomids suggests decreasing water quality and/or habitat conditions. % OC = Number of OC individuals

6. Percent Nutrient Tolerant Organisms (%NUTOL) -

7. **Percent Clingers** (Percent contribution of organisms that build fixed retreats or have adaptations to attach to surfaces in flowing water)-

The seven metrics; 1. Taxa richness, 2. EPT taxa, 3. NCBI, 4. % EPT, 5. %OC, 6. % NUTOL and 7. % Clingers calculated for the two stream locations were compared to the Tennessee ecoregion reference streams. The data for the two stream locations were equalized by assigning a score of 6 (non-impaired), 4 (slightly impaired), 2 (moderately impaired), or 0 (severely impaired) based on comparison to the Tennessee Ecoregion reference data base (TDEC 2006). The scores were summed to determine biological condition of each of the stream locations.

Brower and Zar (1984) provide a detailed discussion of a variety of techniques for measuring community structure. The use of diversity indices is based upon the observation that

normally undisturbed environments support communities with large numbers of species having no individuals present in overwhelming abundance. If the species of a disturbed community are ranked by numerical abundance, there may be relatively few species with large numbers of individuals. Mean diversity is affected by both "richness" of species (or abundance of different species) and by the distribution of individuals among the species. High species diversity indicates a highly complex community.

Species diversity was estimated using Shannon's Index of Diversity (H):

$$H = -\sum p_i \log p_i$$

where p_i is the proportion of the total number of individuals occurring in species i ($p_i=n_i/N$), N is the total number of individuals in all species.

Diversity indices take into account both the species richness and the evenness of the individuals' distribution among the species. Separate measures of these two components of diversity are often desirable. Species richness can be expressed simply as the number of species in the community. Evenness may be expressed by considering how close a set of observed species abundance are to those from an aggregation of species having maximum possible diversity for a given N and S (Brower and Zar 1984).

Evenness is calculated as follows:

Pielou
$$J' = H/H_{max}$$

where H is calculated diversity and $H_{\mbox{max}}$ is maximum possible diversity.

Community similarity between sites is measured by Jaccards Coefficient, and Percent Similarity.

Jaccards Coefficient =
$$\frac{C}{S_1 + S_2 - C}$$

where S =Species in each community (S_1 is reference Community)

and C =Species common to both communities

Percent Similarity, for a two-community comparison, is calculated as follows: The number of individuals in each species is calculated as a fractional portion of the total community. The

value for species i in community 1 is compared to the value for species i in community 2. The lower of the two is tabulated. This procedure is followed for each species. The tabulated list (of the lower of each pair of values) is summed. The sum is defined as the Percent Similarity of the two communities.

PHYSICAL AND CHEMICAL PARAMETERS

The physical and field chemical parameters measured included pH, dissolved oxygen, temperature, conductivity, stream width, depth, velocity and flow. Values of pH were determined at each station with a Fisher Accument Field pH meter. Dissolved oxygen and temperature were determined with an YSI Model 51 Dissolved Oxygen Meter. Temperature was also verified with a field centigrade thermometer. A LaMotte conductivity meter was used to measure conductivity. Width of the streambed was taken at each station using a tape measure. Depth was taken at approximate one-foot intervals across the stream at the location used for width measurements. Average depth was determined by adding the readings taken across the stream at each location used for width measurement and dividing by one more than the number of readings. This is to allow for 0 depth at each side (Lagler 1973). Velocity was measured approximately every two feet across the stream with a Gurley Flow Meter. Approximate flow was determined by the following formula:

R = V D a W

Where R is equal to the volume of flow in cubic feet per second (cfs); W is average width in feet; D is average depth in feet; V is the velocity (ft/sec); and a is a constant for correction of stream-velocity (0.8 if the bottom is strewn with rocks and coarse gravel, 0.9 if smooth).

RESULTS AND DISCUSSION

Physical characteristics of the two stations are listed in Table 1. Table 2 contains all water quality data collected from each location. A list of all species of aquatic benthic macroinvertebrates, assigned tolerance values and functional feeding groups from each station are shown in Table 3. A summary of benthic community measures is presented in Table 4. A summary of Tennessee Bioassessment metrics and scores is presented in Table 5. All field data including habitat assessment field data sheets are presented in the appendix.

In terms of physical habitat for aquatic life, both stations rated a score considered "Not Impaired" (Table 1). Both sites were similar in physical habitat with the exception of Rogers Creek having a sixth the flow of Island Creek. The substrate at both sites was a mixture of boulder and cobbles with smaller amounts of gravel.

Water quality information shown in Table 2 indicates pH near neutral (7.38-6.98) at both creek stations. As in 2007, conductivity measurements were only slightly higher at Rogers Creek (73 μ s) when compared to Island Creek (63 μ s). Temperature ranged from 9.7 °C at Rogers Creek to 10.6 °C at Island Creek. Dissolved oxygen ranged from 10.13 mg/l at Rogers Creek to 10.28 mg/l at Island Creek.

Both Creeks support diverse aquatic communities within each study reach. A minimum of 48 aquatic species was taken from the two sites (Table 3). Rogers Creek had a minimum of 27 species while Island Creek had 32 species. The stonefly *Amphinemura sp.* (35.6%) was again dominant in Rogers Creek and co-dominant (28.3%) in Island Creek (Table 3). The stonefly *Leuctra sp.* was again dominant (31.3%) at the Island Creek location.

The summary of diversity values listed in Table 4 (3.3 at both) indicates that the populations at both locations were very diverse and representative of streams with good water quality (Weber 1973). The diversity value reflects the distribution of individuals among the species where an even distribution of individuals among species would yield the maximum diversity value and the restriction of individuals to a few species would produce a low diversity value.

The evenness values shown in Table 4 were 0.7 at Rogers Creek and 0.67 at Island Creek. According to Weber (1973), values of equitability between 0.6 to 0.8 are representative of streams in the southeast unaffected by oxygen demanding wastes.

A comparison of the stations using Tennessee Bioassessment metrics presented in Table 5 has both sites as non-impaired when compared to the target scores of Bioregion 68a (Biocriteria Tables in Tennessee Department of Environment and Conservation, 2006). Rogers Creek scored 36 out of 42 while Island Creek scored 42 out of a maximum of 42.

A comparison of the two sites using species in common (Table 4) shows Rogers Creek and Island Creek had less than 1/4 their species in common (0.23). In terms of percent similarity (Table 4) the two stations were 53.1% comparable.

A revised Biotic Index was introduced by Hilsenhoff (1987) and is used as metric No. 5 in Table 4. The Hilsenhoff Biotic Index value 2.45 calculated for the communities at Island Creek and the value 3.03 at Rogers Creek indicate non-impaired conditions or "Excellent" water quality conditions when using Hilsenhoff's (1987) scoring criteria.

CONCLUSIONS

Rogers Creek and Island Creek are species rich and support diverse aquatic fauna. Biotic Index values for the benthic macroinvertebrate communities at both stations are representative of "Very Good to Excellent" water quality conditions. Both locations scored as non-impaired when compared to the Tennessee Reference stream database. It appears that the benthic communities at both stations are diverse and indicate little or no impairment.



Photo 1. Island Creek, 4/17/08.

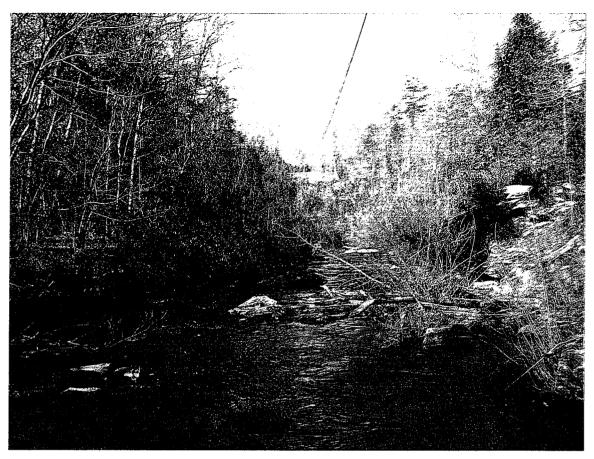


Photo 2. Rogers Creek, 4/17/08.

Table 1. Physical Characteristics of Island and Rogers Creeks, April 17, 2008.

PARAMETER	STATION			
	ROGERS CREEK	ISLAND CREEK		
WIDTH (FT)	24	36		
AVERAGE DEPTH (FT)	0.66	0.84		
a VELOCITY (FT/SEC)	0.52	1.77		
FLOW (FT³/SEC)	6.6	42.8		
HABITAT ASSESSMENT SCORE	171	183		
	Not Impaired	Not Impaired		
SUBSTRATE (Pebble Count)				
Silt/Clay	2.9			
Very Fine Sand		4		
Fine Sand		. 1		
Medium Sand	1.9	4.9		
Coarse Sand	1.0	1.0		
Very Coarse Sand		3.0		
Fine Gravel	4.8	3.0		
Medium Gravel	5.8	9.8		
Coarse Gravel	2.9	9.6 7.8		
Very Coarse Gravel	0.0	30.4		
Small Cobble	9.6	30.4 17.6		
Large Cobble	18.3	5.9		
Small Boulder	17.3	5.9		
Medium Boulder	13.5	16.7		
Large-Very Large Boulder	13.5	2.9		
Bedrock	8.7	۷.5		

^a A correction for stream velocity (0.8 if bottom is strewn with cobble and coarse gravel, 0.9 if smooth)

Table 2. Water Quality Characteristics of Island and Rogers Creeks, April 17, 2008.

PARAMETER	STATION			
	ROGERS CREEK	ISLAND CREEK		
Ph (Std. Units)	7.38	6.98		
Dissolved Oxygen (mg/l)	10.13	10.28		
Temperature (⁰ C)	9.7	10.6		
Conductivity (us/cm)	73	63		
Turbidity	Clear	Clear		

Table 3. Benthic Macroinvertebrates Collected From Cumberland County, Tennessee, April 17, 2008.

SPECIES T.V. F.F.G. CL Island Rogers

Creek Creek

				OICCK	OTOOK
DI ATVILLI BEINTING					
PLATYHELMINTHES Turbellaria					
Tricladida					
Dugesiidae					
Cura sp.	5			1	
ANNELIDA	. •				
Oligochaeta		CG			
Tubificida					
Enchytraeidae	9.8	CG		1	
ARTHROPODA					
Crustacea					
Amphipoda	7.4	CG			
Gammaridae					*
Gammarus sp.	9.1	SH			1
Decapoda					
Cambaridae	7.5				
Cambarus sp.	7.6	CG		1	
Insecta					
Ephemeroptera					
Ameletidae		CG			
Ameletus sp.	2.4	CG		2	10
Baetidae	6.1	CG			
Baetis sp.	4.5	CG		_	1
Plauditus sp.	4.5	CG		8	27
Ephemerellidae	1.9	SC	٠.	•	40
Ephemerella sp.	2	SC	CL	9	13
Eurylophella sp.	4.3	SC	CL	5	2
Heptageniidae	1.5	SC	CL		3 1
Leptophlebiidae	1.8	CG			ı
Odonata					
Gomphidae	5	P P		2	
Lanthus sp.	1.8	Г		4	
Plecoptera	0.7	Р			,
Chloroperlidae	0.7	r		3	10
<i>Haploperla brevis</i> Leuctridae	0.2	SH		Ü	, 0
Leuctra sp.	0.7	SH	CL	62	20
Nemouridae	1.2	SH		-	
Amphinemura sp.	3.3	SH		56	67
Peltoperlidae	2.3	SH			1
Perlidae	1.5	Р	CL		1
. 0,11440	_				

Table 3.	Benthic Macroinvertebrates Collected From
	erland County, Tennessee, April 17, 2008.

Cumberiand County,					
SPECIES	1.V.	F.F.G.	CL		_
				Creek	Creek
		_	~ !	4	
Acroneuria sp.	1.5	P	CL	1	
Acroneuria abnormis	1.5	P	CL	9	
Perlodidae	1.6	P	CL		
Diploperla sp.	2.1				1
Isoperla sp.	1.5	P	CL		10
Megaloptera					
Corydalidae		Р			
Corydalus cornutus	5.2	Р	CL	1	
Nigronia serricornis	5.3	Р	CL	2	
Trichoptera					
Hydropsychidae	2.9	FC	CL	1	
Lepidostomatidae	0.9	SH			
Lepidostoma sp.	0.9	FC		5	2
Leptoceridae	2.7	CG			
Mystacides sepulchralis	2.7	CG			1
Philopotamidae		FC	CL		
Chimarra obscurus	2.8	FC	CL	1	
Dolophilodes sp.	8.0	FC	L' CL		1
Polycentropodidae	4	FC	CL		
Polycentropus sp.	3.5	FC	CL	4	
Rhyacophilidae		P	CL		
Rhyacophila sp.	0.7	Р	CL	2	1
Coleoptera					
Dryopidae					
Helichus basalis	4.6	SC	CL	3	
Elmidae		CG			
Oulimnius latiusculus	1.8	CG	CL	4	
Psephenidae		sc			
Psephenus herricki	2.4	SC	CL	. 2	
Diptera					
Chironomidae					
Conchapelopia sp.	4.5	P		1	
Dicrotendipes neomodestus		CG		1	
Orthocladius sp.	6	CG		Ź	1
Orthocladius lignicola	6	CG			1
Parametriocnemus sp.	3.7	CG		1	2
Polypedilum illinoense	5.7	SH		1	
Tanytarsus sp.	6.8	FC		1	2
Tribelos fuscicorne				2	
Tvetenia paucunca	3.7	CG			2
Empididae	7.6	Р			
Hemerodromia sp.	7.6	P			1
Simuliidae	3.5	FC	CL		
Ciridinado	J. J	- -			

Table 3. Benthic Macroinvertebrates Collected From Cumberland County, Tennessee, April 17, 2008.

SPECIES	T.V.	F.F.G.	CL	Island Creek	Rogers Creek
Prosimulium sp.	4	FC	CL	4	
Simulium sp.	4	FC	CL		3
Tipulidae	4.9	SH			
Antocha sp.	4.3	CG	CL		4
Hexatoma sp.	4.3	Р		1	
Tipula sp.	7.3	SH		1	1
TOTAL NO. OF ORGANISMS		*		198	188
TOTAL NO. OF TAXA				32	27

Table 4. Benthic Macroinvertebrate Community Measures, Rogers and Island Creeks, April 17, 2007.

METRIC	ROGERS CREEK	ISLAND CREEK
Taxa Richness-Genera	27	32
Ephemeroptera, Plecoptera and		
Trichoptera (EPT) taxa Richness	17	14
Percent EPT	90.43%	84.85%
Percent Oligochaetes and Chironomids	4.26%	4.04%
North Carolina Biotic Index (NCBI)	3.03	2.45
Percent NUTOL	1.60%	2.02%
Percent Clingers	29.79%	55.56%
Shannon Diversity	3.33	3.37
Pielou's Evenness	0.70	0.67
Jaccard's Coefficient (Rogers Creek)		0.229
Percent Similarity (Rogers Creek)		53.1

Table 5. Summary of Tennessee Bioassessment Metrics, Protocol K, Rogers and Island Creeks, April 17, 2008.

101dila 010010,71pm 11, 20001					
METRIC	ROGER	(ISLAND	ND CREEK		
	Value	Score	Value	Score	
1. Taxa Richness (TR)	27	4	32	6	
2. EPT Richness (EPT)	17	6	14	6	
3. Percent EPT	90.43	6	84.85	6	
4. Percent Oligochaetes and Chironomids (OC)	4.26	6	4.04	6	
5. North Carolina Biotic Index (NCBI)	3.03	6	2.45	6	
6. Percent Clingers	29.79	2	55.56	6	
7. Percent NUTOL	1.60	6	2.02	6	
TOTAL VALUE		36		42	
INDEX SCORE	Nonim	paired	Nonim	paired	
	Supp	orting	Supp	orting	

Target score for Ecoregion 68a (Cumberland Plateau) from January thru June is 32.

REFERENCES

- Bevenger, G.S. and R.M. Fing. 1995. A Pebble Count Procedure for Assessing Watershed Cumulative Effects. Research Paper RM-RD-319, U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.
- Brower, T.E. and J.H. Zar. 1984. Field and Laboratory Methods for General Ecology. Second Edition. W.C. Brown, Dubuque. 226 pp.
- Compton, R. R. 1962. Manual of Field Geology. John Wiley and Sons, Inc., New York, NY. 378 pp.
- Hilsenhoff, W. L. 1982. Using a biotic index to evaluate water quality in streams. Department of Natural Resources, Madison, Wisconsin, Technical Bulletin No. 132: 22 pp.
- Hilsenhoff, W. L. 1987. An improved biotic index of organic stream pollution. The Great Lakes Entomologist, Vol. 20(1):31-39.
- Kentucky Department of Environmental Protection, Division of Water (KDOW). 2002.

 Methods for Assessing Biological Integrity of Surface Waters. Frankfort, Kentucky. 182 pp.
- Lagler, K. L. 1993. Freshwater Fishery Biology. WM. C. Brown, Co., Dubuque, Iowa. 421 pp.
- North Carolina Department of Environment, Health and Natural Resources. 2006. Standard Operating Procedures Biological Monitoring, Environmental Sciences Branch, Ecosystems Analysis Unit, Biological Assessment Group. Raleigh, North Carolina. 42 pp.
- Pennington and Associates, Inc. 2006. Standard Operating Procedures for Processing, Identification and Enumeration of Invertebrate Samples. Pennington and Associates, Inc. Unpublished Document, Cookeville, TN. 33 pp.
- Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross and R.M. Hughes. 1989. Rapid bioassessment protocols for use in streams and rivers: Benthic Macroinvertebrates and Fish. EPA/440/4-89/00/, Washington, D.C.
- Tennessee Department of Environment and Conservation, Division of Water Pollution Control. 2006. Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys. Nashville, TN.

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Rogers GAK 41	17/08	SIL	IFWW ZOH	EY FORM				٠
PASCILIFIE		A Steorie				120000000000000000000000000000000000000	2886888228866	1000
DEPTH (m)	RIFFLE	RUN	POOL		Staff Gauge	Bench Ht;		2000
WIDTH (m)	544	ļ		_	VELOCITY (FS)		٠.
	24	 		1	— —:	CFS)		
REACH LENGTH (m)		<u> </u>	<u> </u>	J .	HABITAT AS	SESSMENT S	CORE #	
Gradient (sample reach):			~	•	RR#	GF		
Size (stream width):			casca Casca					•
Superpart Walth):	V. Small (<1.	5m) Small	(1.5-3m) (u	ed (3-10m)	Large (10-25m)	Very Lrg (>2	imi	
SUBSURATE (Complete	ennerpartic	le count or	stimatesu	1600 (6) g				S 2.
Farticle Count - 100 me	asured partic	ies (mm).	-	Circle one:	RIFFLE ->	BUN See	Per ble l	
Size (mm) description <0.062 sällday	abbreviation	Record measure	ed panicle size. (Jse abbrev. belov	for smaller sizes.		TEL DIEC	DOW.
0.062-0.125 very fine sand	. ф	1-10	1	1	·,		1	
.0.125-250 fine sand	vts. fs .	11-20	1 1				1-1	
0.25-0.50 med sand.	ms r	21-30 31-40	+	 		1		
0.5-1.0 coarse sand	es	41-50	 	 			1	~
1.0-2.0 very coarse sand	(con actual size)	51-60	 	 	 	_!	1	
2.0-64.0 gravel	(use actual size)	61-70	1	1	+ + + + + + + + + + + + + + + + + + + +		1 1	•
64-256 . cobble	(USB actual size)	71-80			+			
256-4096 boulder	(use actual size)	81-90		7 - 1 -	 		 	
bedrock	bdnx	91-100	1		 		1-1	
woody debris	wood		i i		 		 	
SUBSTRATE (%)	A	See	Pedole	Campa	Sheet			•
5555115412 (76)	(Visual estim				JACK!			
BOULDER (> 10")	76 T		POOL	200	Ril	FLE RUN	POOL	
COBBLE (2.5-10")	2	%	<u>*</u>	CLAY	(slick)	%		2)
GRAVEL (0.1-2.57)	%	%	- %	SILT: DETRITUS	,,,,, <u> </u>	%		%
BEDROCK	%	%	%	MUCK-MUD	(CPOM)	- %		<u>د</u>
SAND (gritty)	%	%	%	MARL (shell	(CPOM)	%	% 9	4
Carrie		•				%	% 9	6
STREAMUSESUPPORT		WATER WITH	IDRAWL NO	TED .		•		
OT DOM: IED FOR:		·	POSTI	D FOR:	Bacteriological Ac	4.00	• .	•
	ind. H2O Supp	ily			Do Not Consume			
Trout >>	Navigation				Precautionary			
SUPPORT STATUS;	Nat. Repr?	· <u> </u>	•		Fish Tissue Adv	S 4		•
FULLY SUPPORTING (FS)		:		10.7			•	
COLET SUPPORTING (FS)	PARTIALLY SUP	PORTING (PS)		SUPPORTING, B	UT THREATENED	THS MONEY	-	
Photos Tyor N Roll			1033	TPG	UT THREATENED (AND SOURCE	PPORTING (NS)	
#ZID	440	hoto (ID)	10342		#/ID			
STREAM SKETCH (include t	low direction . r	nonh diatana	41.1					
. livestock access, riparian are	a etc:)	sauri distance	, distance from	n bridge, sam	pling points, trit	s, outalis.		
		• •			-			
				<u>:</u>				
•				De _l	oths (15/Min	•	
						·		
			· C. J.	; 4	1.7	27		
	•		fl/sec	4	e." Si	31	• •	
		0. 66	ft .		7"			
			+ wide		y 11	45		
•				1.7	7	7		
		8,24	f+3/sec		Ú.,	A.		
		U-N1	11 / 750	/	i"	31 cts/	N. W.	
Coll	ection Factor	X O.D		3	3"			
		6.50			9"	0.521	H/sec	
		المناس	1.3	•	/ //	-	· .	٠.
•		6.6	[75]		7"			
					2 "			
State of The			•				•	
State of TN			Page 2		79 77.1		•	
•			30 -	*	0.66		3/12/02	

9.5 PEBBLE COUNT

_		PEBBLE COUNT		•
Stream Name: Ro		Date: 4/17/08		<u></u> .
Point of Assessment	E			
County:	River Basin:	WRD#		-
Eccregion:		Stream Order:		
	36-00 1940	84:783380		
Assessors:	· · · · · · · · · · · · · · · · · · ·	Time:		•
Trongs into	· · · · · · · · · · · · · · · · · · ·	and the second s		
Size Class	Size Range (mm) 1	Count	Total	%/Cum
Sitt/Clay	<0.062 <0.00	2 1//	. 3	2.9%
	AND .			
Very Fine	0.062-0.125 - 0.	6 5		-
Fine	0.125-0.25 -0-6	1		
Medium	0.25-0.50 -0.0	1 //	2	1.970
Coarse	0.50-1.0 -0.0		1. 1	101
Very Coarse	1-2 -0.6	8		
GR	AVEL			
Very Fine	2-4 - 0:16	1	7	
Fine	4-6 -0.24			
	6-8 - 0.31	111	5	4.8%
Medium	~ 8-12 -0.47	III		
	12-16 - 0. 63	IH:	b	5,8%
Coarse	16-24 - 0.9	li		
•	24-32 - 1.3		३	29%
Very Coarse	32-48 - 1.9			
	48-64 - 2.5			•
COE	BBLE			
Small	64-96 - 3.8	<i>t</i>		*
	96-128 - 5.0	LANT 1111 (s	10	9.6%
Large	128-192 - 7.6	F-1-1-1141		110 1
	P	WITHIT III	19	18.39
BOUL	DER	1011		
Small	256-384 - 15.1 1.	25' LHT LHT 11		-
	384-512 - 20,1 /,		18	17.39
Medium	512-1024 - 40.3 3		14	12 001
arge-Very Large	1024-4096-161.71		14	13.501
BEDR		W (111 1/1 141	9	0 = 0

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HABITAT ASSESSMENT DATA SHEET- HIGH GRADIENT STREAMS (FRONT)

STREAM NAME	ROBER CK		LOCATION	<u> </u>	
STATION #			ECOREGIO		
LAT 36.001	1940 LONG 84,		RIVER BAS		
WBID/HUC			INVESTIGAT		······································
FORM COMPLETED	BY Wendell Pennis	's torr	DATE YATA	ME 9:30 (M) PM	
Habitat Parameter	Condition Category	J'''			
	Optimal	Suboptimal		Marginal	Poor
l. Epifaunal Substrate/Available Cover	Circater than 70% of substrate favorable for epifamial colonization and fish cover; mix of snages, 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 s well-suited for fi col* zation pot adequate habital maintenance of presence of addi substrate in the fi newfall, but not for colonization high end of scale	uil entiul; for populations; tional from of yet prepared (may rate at	20-40% mix of stable habitat; availability less than desirable; substrate frequently disturbed or removed	Less than 20% stuble habitat; Jack of Stabitat is obvious; substrate unstable or lacking
SCORE	20 19 18 17 16	15 14 13	12 11	10 9 8 7 6	5 4 3 2 1
2. Embeddedness	Gravei, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble a particles are 25-surrounded by fi	50%	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 76% surrounded by fine sediment.
SCORE	20 (19) 18 17 16	15 14 13	12 11	10 9 8 7 6	5 4 3 2 8
3. Velocity/Beptii Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast- shallow) (Slow is<0.3m/s deep is>0.5m)	Only 3 of the 4 r present (if fast-si missing score lo- regimes).	hallow is	Only 2 of the 4 habitat regimes present (if fast- shallow or slow-shallow are missing, score low)	Dominated by 1 welocity/depth regime (usually slow-deep)
SCORE	20 19 (18) 17 16	15 14 13	12 11	10 9 8 7 6	5 4 3 2 1
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low – gradient streams) of the boxom affected by sediment deposition	Some new increase formation, mostle gravel, sand or fi 5-30% (20-50% gradient) of the laffected; slight dipools	y from ine sediment; for low- tottom	Moderate deposition of new gravel, aand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased far development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition
SCORE	20 19 (18) 7 16	15 14 13.	12 11	10 9 6 7 6	54321
5. Channel Flow Status	Water reacties base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills> 75% available channe channel substrate	l; or 25 % of	Waters fills 25-75 % of the savailable channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 9 18 17 16	15 14 13	12 (1	10 9 8 7 6	5 4 3 2 1

Rogers Creek

Division of Water Pollution Control SOP for Macroinvertebrate Stream Surveys Revision 3 Effective Date: November 2003 Appendix B: Page 5 of 12

HABITAT ASSESSMENT DATA SHEET-HIGH GRADIENT STREAMS (BACK)

6. Channel	Optimal			
		Suboptimal	Murginul	Poor
Aiteration	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 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 of coment; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or semoved entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 3
7. Frequency of Riffles (or beads)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5-7); 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 >35.
SCORE	20 19 (18)17 16	15 14 13 12 14	10 9 8 7 6	5 4 3 2 1
B. Bank Stability (score each bank) Note: determine left or right side by (acing 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 back in reach has areas of crosion.	Moderately unstable; 30- 60 % of bank in reach has areas of erosion; high erosion potential during floods	Unstable; many croded area "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60 100% of bank has crosional scars
SCORE(LB)	Left Bank 10 9	8 7 6	(5) 4 3	2 1 0
SCORE(RB)	Right Bank 10	8 7 6	5 4 3	2 1 0
l. Vegetative Protective (score tach bank) Note: determine left or right side by acing 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. Left Bank 10 9	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 covere by vegetation, disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height
CORE (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
(110)	mgm pank 10 y	8 7 6	(3) 4 3	.2 1 .0
egefative Zone Všdth (score a ch ank riparia 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 20nc 12-18 meters; human activities have impacted zone only minimally	Width of riparian zone 4-, 12 meters; human activities have impacted zone a gree, deal,	Width of siparian zone <6 meters: little or no riparian regetation due to human activities.
	Left Bank 10 9 Right Bank 10 9	8 7 6	5 4 3	2 1 0

SI	EMSORVEY	NEGRMATIC	Manage Con	000000000000000000000000000000000000000		CUM	muse.	A Section	siranolika -
SIA	TION NUMBER:	代の行い可能を登出	The state of the state of					DIA STATE	22027 220000
SIR	EAN NAME	- 5E5-c	and	CIP		ASSI	SSORS:	THE CONTRACTOR	CO. S. S. P. S. D. V. S. S. D. S.
NiA IIO	TION LOCATION		aun	The Tal		DATE	7	411	7108
WRIT	NTY CODE:(FIP:	s)	(STATE	CODE		TIME		7/3	14 EST
HUC	NAME:					STRE	AM MILE		23 /23/
LAT/	LONG DEC:					STRE	AM ORDER:		
ECO	LOGICAL SUBRI	36.	05306	84.66	276		SEGMENT		
HSG.	GUAD:	EGION:			بدحان	3020:			
						ELEVA	ATION (ft):		
CONTR	ECT/PURPOSE:					GAZE	TTEER PAGE		
SAMI	LES COLLECT	ED COM		982888980C04950	00000			-	
Aquat	ic Life Assessed:	Macroin	rertebrates)					288892AD9	28563
Туре	of benthic sample	BIORECON		Fish	Algae	. Othe	3r:		290031
THE PARTY	CALS/YOU N		SO ARCA	SO BANK DE	ENDY SURB	ER OTHER	3		•
	WEIGHOEDE DE	Vice in the second							•
METER	SUSED: 15	7 2							
		E WOI	THE SHE	RILIME	+ 6	Valia Com			
pH					······	(94	checher K		
• .	<u>. </u>	6,4	18	SU		0	$\boldsymbol{\mathcal{C}}$		
	CTIVITY	63	3 114	MHOS		DISSOL	VED OXYGEN	10.	28 PPM
(EMPE	TATURE	10.1	6	*c	•	TIME			FPAN
						OTHERS	•	Clea	
Previou	s 48 hours Precip	UNKNOWN	1000	, ,	. :			LIZER	· .
Ambient	Weather:	SUNNY		LITTLE	MODERA	TE HEAV	Y =100mma		7
	• . " •		CLOUDY	BREEZY	RAIN	SNOW			
WATE	SIED CLARA	TEDICTION	Office and a second			24217	AIR TEMP:		
UPSTRE	AM SURROUND		800 App.	QUALITY OF THE	DOSCI VERS	SAME MARKET	E COOCCO CONTRA		
*ASTURE	SOLUTOUNL	ANG LAND US	E (estimat	ed %)	-	A STREET, STRE			
ROPS		URBAN		RESID					
FOREST	100	NOUSTRY		OTHER					. •
IMPACT:	100	MINING					•		
CAUSES	rated S(IIg	nt), M(oderate). H(lah) me	Ignitude. Bla					
Pesticide	(0200)	Flow Alter.	(1500)	SOURCE	nk = not obs	erved			
Metals	(0500)	Habitat Alt.	(1600)	Point Sour	S.		Unknown	(9000)	
Ammonia		Thermal Att.	(1400)	Logging	ice: maust	(0100)	Municipal	(2000)	
Chlorine	(0700)	Pathogens	(1700)	Constanti	on;Land Deve	(2000)	Mining .	(5000)	
Nutrients	(0900)	Oil & grease		U/S Dam	OILLEIN DEW		Road /bridge	(3100)	
H	(1000)	Unknown	(0000)	Riparian lo	ec ·	(8800)	Urban Runot	(40000)	
Organic E	nrichment / Low I	Sitation	(1.100)	Agriculture	: Row crop	(7600)	Bank destabi	ization (770	01
Other:	- TOW	0.0.	(1200)	Livestock of	razing-riparis	(1000)	Imensive Fe	ediol (1600)	-
HYSICA	LS HEAVICH			Other:		ut (1410)	Dredging	(7200)	
URROUN	DING LAND US	AND WORLD	CS	SPENGTER.	ES ITE AUT	C. Drawn Care			
STIMATE	EN DOOR	E:			446	MEANSSES	(m) 200		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
	W HOR	LDB	·	RDB	٠.				
ASTUBE			URBAN	- NUB	LDB		RDS	LDB	
ROPS			1	<u> </u>		AESID.			
DREST	100	100	NDUSTRY			OTHER			
CANOPY	COVER: Estim	lateri-	MINING.			7	1		
	Measur	ad.	Open(0-10)	Partly Shar	ted 11-45)	Mostly Shader	Ġ:		
ANK HEIC	iHT (m):	eu	u/s	D/S			o(45-80) s	haded(>80)	
	DEPOSITS:		mercen y	HIGH W	ATER MARK	LB	Я	8	
YPE:		NONE	SLIGHT	MODERATE			<u> </u>		
RBIDITY	SLUDGE	MUD	SAND		EXCESSIVE	BLANKET			
GAE PRE	CEAGE	SLIGHT	MODERATE	SILT HIGH	NONE	OTHER	Conts	aminated	*****
DUATIC V		NONE S	LIGHT		OPAQUE				A or M
	EGET. ,	·		MODERATE TYPE	CHOKING	TYPE			·
- NONA	COMMENTS:	oil sheen, odor	colores	_	Non-				-
-				- Cleal		7			
•									
Cia		•						•	•
State of T	N			_					
				Page 1			•		

- Ish	and Cr.K	4.117/0	8 SIH	⊨AW SUK	VEY FORM			
PHE	ALSTO BALLET	MHACHERST	OSTEOMIN	27622223000000	200000000000000000000000000000000000000	300000000000000000000000000000000000000	000000000000000000000000000000000000000	00000000000000
	*	RIFFLE	RUN	POOL	201000000000000000000000000000000000000	State Comment		
DEPTH ((m) ·			1	٦.	Staff Gauge/I	sench Ht;	
WIDTH (m)	36'		1	-	VELOCITY (F		<u>; </u>
REACH	ENGTH (m)		 		- -		FS)	
		<u> </u>	<u> </u>			HABITAT ASS	SESSMENT SCOP	3E#:
Gradient	(sample reach):	P1-4			•	RR#	GP #	
Size (etc.	tam width):		· ·	ligh Casca				
SHOOT	cam wio(n):	V. Small (<1.5	5m) Small (1.5-3m) M	ed (3-10m).)j	arge (10-25m)	Very Lrg (>25m)	1.5
SOUDDIN	ATE (Complete	eithersparticl	ecountone	stimatesu	minic (2)	***************	**************************************	BOOK PROCESSION
Particle	Count - 100 me	asured particl	es.(mm).		Circle one:	SALLE E	000000000000000000000000000000000000000	200 CO. CO.
Size (mm)	description			d nadidneim I	to abben the	RIFFLE for smaller sizes.	RUN	
<0:062	silvciay	. ¢	1-10	1	JSE ZUDIEV, DEIOW	for smaller sizes.		
0.062-0.125	very fine sand	vis	11-20	 		+		
.0.125-,250	line sand	ts	21-30	1	 		<u></u>	
0.25-0.50	, med sand .	ms	31-40					
0.5-1,0	coarse sand .	cs :	41-50		1			
1.0-2.0	very coarse sand	(use actual size)	51-60	1		 		
2.0-64.0	gravel.	(vee actual size)	61-70	1		 		<u> </u>
64-256	cobbie	. (use actual size)	71-80			 	_	;
256-4096	boulder	(vere actual size)	81-90	1		1 1		
***	bedrock	bdrx	91-100	1.	- 1	 		
	woody debris	wood				 		_1
CUDOTO A		_	See Po	oble (٠ إل
SUBSTRA	IE (%)	(Visual estima	uesi '	ODIE (ount "	Sheet	•	
BOULDER	/- 400	RIFFLE	RUN.	POOL		RIFI	SUS SUM	
COBBLE (2	(> 10")	%	%	%	CLAY	(slick)		POOL
GRAVEL (1.2.5°	%	%	%	SILT			% %
BEDROCK	A1-2.3)		%	- %	DETRITUS (CPOM)		% %
	(gritty)	%	- %	%	MUCK-MUD	(FPOM)		% % % %
	1911177	%	%	%	MARL (shell	frags.)		
STREAM	ISE SUPPORT				. · ·			% %
CLASSIFIE	ED COD	V. S. S. S. S. S. V.	VATER WITH	DRAWL NO	TED .			
Dom: H20				POST	D FOR:	Bacteriological Adv	in.	•
TIER IVTIER	2.444	Ind. H2O Suppl	y			Do Not Consume	<u> </u>	
Trout >>		Navigation				Precautionary		-
	200	Nat. Repr?		•		Fish Tissue Advis.	***	
SUPPORT	SIATUS;					THE PERSON NAMED IN COLUMN NAM		- 10 1 2 2
FULLY SUPPO	DRTING (FS)	PARTIALLY SUPP	ORTING (PS)		100000000 ou			
	n	/	/	レココ・ノコ	- <u>- </u>	IT THREATENED (TI	H) . NONSUPPOI	ating (NS)
Photos 71	Or N Roll	/Disc # P	hoto #ID /	03651	24	## !		
#AD					<u> </u>	#/ID		
STREAM SI	CETCH (include fi	ow direction, re	ach distance.	distance from	n bridge :cam	pling points, tribs		
investock scc	ess, riparian area	a etc:)			www.c. sam	hard boluts, fribs	i, outalis.	7
•		•	•		11.			
		······································				1.4		· · · · · · · · · · · · · · · · · ·
		•		ع.بر ط3 ع.بر ط3	le 1	epths	CTS/Min	, ·
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	. ***				4	71	77	
		177	1ft/sec		• (,	12 "	100	
· • • • • • <u>•</u>	•	10/11	1,420		•	11 11	132	
		O,	84++			·/	76	
•		٠,٠				10'-	78	
			ft			GI	100	
				•		<i>.</i>	100	
		<u>.</u> 53	.52			911	166	
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		4	20 1	Ca	<i>'</i> ,	411 1	00	1.77 H/s.
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		. • •	٠. ب.		4	8 "		•
Siste of Th	st.	. • •	,			3 11	106.25	•
State of Th	4		n. Ç +.	Page 2	<u>- </u>	8 11 31 10.11 0.84	· 106.25	(12/02

9.5 PEBBLE COUNT

Stream Name: 1	sland Creek PEBBLE COUNT Date: 4/17/6	28	
Point of Assessment			
County: 1/10/20	River Basin: WRD#		
Eccregion:	Stream Order		(<u> </u>
Lat/Long coordinates			· · · · · · · · · · · · · · · · · · ·
Assessors: <u>Perv</u>	in for and Associatione: 1244		
Person	Do oth		· · · · · · · · · · · · · · · · · · ·
Size Class	Size Range (mm) 14/25 Count	Total	% Cum.
Sitt/Clay	<0.062 <0.002	1.000	78 CAUTH.
s	AND		1.
Very Fine	0.062-0.125 - 0.05		
Fine -	0.125-0.25 -06/		1%
Medium	0.25-0.50 -0.02 '///	4	4.9
Coarse.	0.50-1.0 -0:04	1 .	7.7
Very Coarse	1-2 -0.08 +		1%
GR	AVEL		1/4
Very Fine	24 - 0:16 1	*	,01
Fine	4-6 -0.24 /		1%
	6-8 - 0.31	2	200
Medium	~ 8-12 -0.47		2%
	12-16 - 0. 63 ///		1.2
Coarse	16-24 - 0.9 111/		
	24-32 - 1.3 //	10	
Very Coarse	32-48 - 1.9 //	10	9.87
	48-64 - 2.5 14111		
COB	414.4	8	7.8%
Small	64.96 - 3.8 HM III		
Andrews St. 10 Co.			:
Large	128-192 - 7.6 Left [f]		30.4%
	192-256 - 10.1 14/7/1/		
BOUL		18	17.6%
Small			
-	256-384 - 15.1 1.25 W		
Medium	384-512 - 20.1 . 7'	6	5.9%
arge-Very Large	512-1024 - 40.3 3.3 JHT JH		
	1024-4096-14, 13.4 4# 1	17	16.7%
BEDRO	OCK 11	3	2.9%

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME IS LANCE (1/K	LOCATION
STATION#RIVERMILE	STREAM CLASS
LAT #36.05306 LONG W54.66728	RIVER BASIN
STORET#	AGENCY
INVESTIGATORS PENNINFRATIUSSE	ciates, Zuc
Wendell Pennington	DATE 4/17/08. TIME 125/4 AM PM REASON FOR SURVEY

	Habitat		Conditio	n Category	
	- Parameter	Optimal	Suboptimal	Marginal	Poor
	1. Epifaunzi Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover, mix of smags, 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 slable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfail, but not yet prepared for colonization (may rate at high end of scale).		Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
-5	SCORE			10.000	
Parameters to be evaluated in sampling reach	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.
ie	SCORE		THE STATE OF THE S	TO LONG THE SECOND	
ers to be evalu	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).
amer.	SCORE	M IS WELL			
Per	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 har development; more than 50% of the bottom changing frequently; pools atmost absent due to substantial sediment deposition.
-	SCORE		15 . 以 30 . 37 . 13		
<u></u>	5. Channel Flow Status	minimal amount of	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		TESTE OF E	40.7	Aprile ggs

Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition - Form 2

A-7

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Habitat		Condition	n Category	·		
Parameter	Optimal	Suboptimal	Marginal	Poer		
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; ov 80% of the stream re- channelized and disrupted. Instream habitat greatly aftened removed entirely.		
SCORE	20 / 19 / 18 17 16	16 14 13 12 11	10 9 8 7 6	5, 4 3 2, 1		
7. Frequency of Riffics (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream :1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural</td <td>Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.</td> <td>Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 1.5 to 2.5.</td> <td>Generally all flat wat or shallow riffles; po habitat; distance bety riffles divided by the width of the stream is ratio of >25.</td>	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 1.5 to 2.5.	Generally all flat wat or shallow riffles; po habitat; distance bety riffles divided by the width of the stream is ratio of >25.		
SCORE	obstruction is important.	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1		
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of crosion or bank failure absent or minimal; little potential for future problems.	Moderately stable; infrequent, small areas of crosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30- 60% of bank in reach has areas of crosion; high erosion potential during floods.			
SCORE (LB) SCORE (RB)	Left Bank (0 9 Right Bank (0 9	(8) 7 6 8 (0) 6	5 4 3	0 24 19 0		
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate ripanan 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, disniption 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 streamba vegetation is very high vegetation has been removed to 5 centimeters or less in average stubble height		
SCORE(LB)	Ceft Danks (D) 9	8 7 6	5 4 3	2 1 2		
SCORE(RB)	Right Ban (10) 3 :	1. 18 Table	5 4 3	12 14 10 0		
18. Riparian Vegetative Zone Width (score each bank riparian zone)	activities (i.e., parking	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparisn zone 6-12 meters; human sctivities have impacted zone a great deal.	Width of riparian zone meters: little or no riparian vegetation due to human activities. 		
SCORE(LB)	Halling to 10 1/24	7 6	6.5 70 A THE CO.	21 7 A - 0		
SCORE (RB)	Right Black 10 . / 9	6		2 0		

Total Score 183

A-8 Appendix A-1: Habitat Assessment and Physicochemical Characterization Field Data Sheets - Form 2