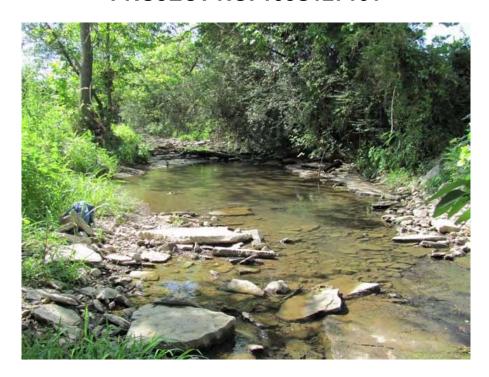
# CITY OF FRANKLIN MACROINVERTEBRATE STREAM SURVEY REPORT PROJECT NO. 103S127101



Prepared for

# **City of Franklin, Tennessee** 109 3<sup>RD</sup> Avenue South

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February 11, 2011

Prepared by



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#### 1.0 INTRODUCTION

Tetra Tech EM, Inc. (Tetra Tech) has prepared this Macroinvertebrate Stream Survey Report for The City of Franklin in accordance with the proposal prepared by Tetra Tech on August 27, 2009 and the Professional Services Agreement and Addendum signed October 15, 2009. This report summarizes the project objectives, methods, results, and conclusions of the macroinvertebrate stream sampling activities performed by the City of Franklin Stormwater Management Division (SMD) staff and Tetra Tech between September 2010 and February 2011.

The stream surveys outlined in this report were performed in order to meet the biological monitoring requirements under the National Pollution Discharge Elimination System (NPDES) General Permit From Small Municipal Separate Stormwater Sewer System (MS4), Permit No. TNS000000. The City of Franklin SMD will use the findings of the macroinvertebrate stream survey to assess the current biological integrity of the selected streams. Additionally, the City of Franklin SMD intends to use the data collected during this preliminary survey as a baseline to compare future stream surveys in order to gauge the effectiveness of the City's MS4 program.

The following six streams within the city of Franklin, Tennessee have been listed on the Proposed Final Version Year 2010 303(d) List [303(d) List)] as being impaired for siltation, which is prepared by the Tennessee Department of Environment and Conservation (TDEC), Division of Water Pollution Control (WPC) (TDEC WPC 2010a) and were chosen for sampling:

- **Donelson Creek**
- Fivemile Creek
- Liberty Creek
- Sharps Branch
- Spencer Creek
- Watson Branch

All of the stream sample sites are located within the Harpeth River Watershed [hydrologic unit code (HUC) 05130204] and within the Interior Plateau, Outer Nashville Basin Ecoregion (71h) of Tennessee (Griffith et al. 1998, Arnwine et al. 2000). The Interior Plateau extends from southern Indiana and Ohio to northern Alabama. The geology of the inner plateau is distinctly different from the coastal plains of the western Tennessee ecoregions, and elevations are lower than the Appalachian ecoregions to the east. The Outer Nashville Basin consists primarily of rolling hills.

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The region includes most of the outer areas of the generally non-cherty Ordovician limestone bedrock. The ecoregion consists of limestone rocks and soil that are high in phosphorus. The land consists predominantly of deciduous forest with pasture and cropland. Streams in the Outer Nashville Basin Ecoregion are low to moderate gradient, with productive, nutrient-rich waters, resulting in algae, rooted vegetation, and occasionally high densities of fish (Griffith et al. 1998, Arnwine et al. 2000).

The site locations are depicted on Figures 1 through 7 in Appendix A. The site names, station numbers, latitude and longitude, general site locations, and 303(d) List assessment category designations are presented below in Table 1 – Stream Sampling Site Locations.

Table 1 – Stream Sampling Site Locations						
Site Name	Station Number	Latitude/ Longitude	Stream Mile	Approximate Site Location	303(d) List Assessment Category*	
Donelson Creek	DONEL000.3WI	35°53.543'/ -86°50.846'	0.3	Moore's Elementary School	4a	
Fivemile Creek	FMILE001.5WI	35°52.125'/ -86°50.109'	1.5	Old Peytonsville Road	4a	
Watson Branch	WATSO000.6WI	35°54.562'/ -86°50.791'	0.6	South Royal Oaks Road	4a	
Sharps Branch	SHARP000.7WI	35°55.384'/ -86°52.777'	0.7	11 <sup>th</sup> Avenue at Highway 96 West	4a	
Liberty Creek	LIBER000.7WI	35°55.743'/ -86°51.362'	0.7	Eddy Lane	5	
Spencer Creek	SPENC000.8WI	35°56.61'/ -86°51.318'	0.8	McMahon Road and Franklin Road	5	

<sup>\*</sup>As defined in Proposed Final Version Year 2010 303(d) List (TDEC WPC 2010a):

Category 4a = One or more uses are not being met. However, Total Maximum Daily Loads (TMDLs) have been completed and approved for all listed pollutants.

Category 5 = One or more uses are not being met. A TMDL is needed for the listed pollutants.



#### 2.0 **METHODS**

The macroinvertebrate stream survey activities were performed in general accordance with the TDEC, WPC, Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys, Revised October 2006, here-in referred to as the QSSOP (TDEC WPC 2006). The QSSOP was used as a general guidance document and any deviations are described throughout this section.

#### 2.1 **Personnel Qualifications**

Field sampling activities were performed by City of Franklin SMD personnel under the direction of Ms. Crystal Bishop, City of Franklin Stormwater Coordinator and Certified MS4 Specialist (CMS4S). Data analysis and report preparation were completed by Ms. Amy Tolley, a Tetra Tech biologist with over 4 years experience conducting biological/ecological assessments. Additionally, Ms. Tolley assisted in the completion of stream survey forms and habitat assessment sheets for this series of surveys. Mr. David Scarboro, a Tetra Tech Environmental Scientist with over 11 years of experience in hydrological and biological monitoring projects, completed the technical review of this report. Ms. Dana Lingle, an Ecologist also with Tetra Tech has over 11 years of experience performing ecological and biological assessments completed the quality control review of this report. Copies of key personnel resumes are included in Appendix B.

#### 2.2 **Field Activities**

Stream sampling activities were performed by City of Franklin SMD personnel between July 22, 2010 and August 3, 2010. Global Positioning System (GPS) points were collected at each stream sampling site and a field station number was assigned following Section I.I, Protocol B of the QSSOP. Stream characteristics, i.e. reach length, stream width, bank hieght and location of high watermarks, were recorded. Stream width is calculated and reported as the average of three transects across the sample reach. Water quality data (pH, temperature, conductivity, and dissolved oxygen) was collected within the riffle area of the sample reach prior to sampling activities using a calibrated Troll 9500 multi parameter water quality meter. Stream velocity data was measured using a Swoofer 1500 flow meter within the riffle habitat and riffle depth estimations were completed using methods detailed in Gorman and Karr (1978). All stream characteristics were recorded on the appropriate Stream Survey Form during field visits following Section I.I Protocol E of the QSSOP. Additional watershed support data was compiled and

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reported utilizing various TDEC WPC reports (TDEC 2010, TDEC WPC 2006, TDEC WPC 2007, TDEC WPC 2010a, and TDEC WPC 2010b) by Tetra Tech personnel. Copies of the Stream Survey Forms are included in Appendix C.

City of Franklin SMD personnel also completed a Habitat Assessment Data Sheet for High Gradient Streams at each site during the sampling activities. The following ten habitat parameters were evaluated based on a score of 0 to 20, with 20 being the highest quality rating:

- Epifaunal Substrate/ Available Cover,
- Stream Embeddness
- Velocity/ Depth Regime
- Sediment Deposition
- Channel Flow Status
- Channel Alteration
- Riffle Frequency
- Bank Stability (for each stream bank)
- Protective Vegetation (for each stream bank) and
- Riparian Vegetation Width (for each stream bank).

Copies of the Habitat Assessment Data Sheets are included in Appendix C. Photograph documentation of each site showing upstream and downstream conditions is included in Appendix D.

City of Franklin SMD performed benthic macroinvertebrate sampling following Section I.I, Protocol G of the QSSOP for Semi-quantitative Riffle Kick sampling (SQKICK) as is recommended for riffle streams larger than one meter wide in Ecoregion 71h. Sampling was performed using a 1 meter square kick net with 500-micron mesh. Three kicks were performed downstream to upstream at each site, except at Sharps Branch where four kicks were performed due to the low number of organisms collected during the first three kicks. Forceps and water rinses were used to remove clinging organisms from the net and from rocks, leaves, and debris captured during sampling. The organisms were then placed in 500 milliliter (mL) nalgene bottles. Each of the six sites met the guidelines for comparison to the QSSOP reference database, therefore, upstream or watershed references were not required.



Sample sorting was performed by City of Franklin SMD personnel. The SQKICK samples from each site were reduced to subsamples of 200+/- 20% (160 to 240) organisms following Section I.I, Protocol I, Subsampling Procedures for Semi-quantitative Samples of the QSSOP. The subsamples were transferred to clean 500 mL nalgene bottles, preserved with 80% ethanol, and labeled for laboratory analysis. The organisms not included in the subsamples were placed back in the original bottles and are currently in storage at Tetra Tech's Nashville Office where they will be retained for up to five years.

#### 2.3 Macroinvertebrate Analysis and Data Reduction

On August 31, 2010, Tetra Tech personnel delivered the samples to a laboratory subcontractor for taxonomic analysis following Section I.I, Protocol J, Taxonomy of Semi-quantitative Samples. The laboratory utilized the taxonomic data to calculate the seven biometrics of the macroinvertebrate stream index (data reduction) following Section I.I, Protocol K. The seven biometrics are outlined below:

- Ephemeroptera, Plecoptera, and Trichoptera (EPT) Richness
- Taxa Richness
- Percent Oligochaete and Chironomids (Percent OC)
- EPT Abundance (% EPT)
- North Carolina Biotic Index (NCBI)
- Percent Nutrient Tolerant Organisms (NUTOL) and
- **Percent Clingers**

Definition of and methods for calculating each biometric value are found in Section I.I, Protocol K, Date Reduction of Semi-Quantitative Samples of the QSSOP.

#### 2.4 **Biological Condition and Habitat Condition Determination**

Upon receipt of the analytical results, Tetra Tech equalized the biometric values by assigning a 0, 2, 4, or 6 to each value based on comparison to the Biocriteria Table for Ecoregion 71h, Appendix A: Ecoregion Reference Information following Section I.I, Protocol K of the QSSOP. The seven equalized biometric scores were then totaled to obtain the Macroinvertebrate Index Score (MI Score) of each site, and then compared to the Index Score Ratings for Ecoregion 71h, January through December; Table 4: Determination of Biological Condition Based on Index Scores by Bioregions and Season, Section I.I, Protocol K of the QSSOP in order to estimate the

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biological condition of the sample reach. For Ecoregion 71h, a MI Score of greater than or equal to 32 is considered non-impaired, or supporting; a score of 21 to 31 is considered slightly impaired, or partially supporting; a score of 10 to 20 is considered moderately imparied, or partially supporting; and less than 10 is considered severly impaired, or non-supporting.

The ten individual habitat scores from the Habitat Assessment Data Sheet for High Gradient Streams were totaled for each site and recorded on the form. In order to determine the habitat condition of the sampling reach, the total habitat assessment score (HA Score) was compared to Table 1: *Habitat Assessment Guidelines*, Section I.I, Protocol D of the QSSOP. The highest score possible is 200 for Ecoregion 71h, for High Gradient streams during the index period January through December. A HA Score of greater than or equal to 117 is considered not impaired; a score of 116 to 92 is considered moderately impaired; and a score of less than or equal to 91 is considered severely impaired. Regional Expectations for Individual Habitat Parameters in Ecoregion 71h are outlined in Appendix A of the QSSOP.



#### 3.0 **RESULTS**

The results of the macroinvertebrate stream surveys performed in August and September 2010 are summarized below. The findings are representative of conditions within the stream reach at the time of sampling.

#### 3.1 Water Quality

The water quality results are recorded on the Field Measurements section of the Stream Survey Form for each site (Appendix C) and are sumamrized below in Table 2; Water Quality Measurements.

The pH values (8.05 – 8.63 standard units) were indicative of slightly alkaline conditions at all sites. Water temperatures at the sites were similar; however, appear to be slightly higher at the sites with less canopy cover - Watson Branch, Liberty Creek, and Fivemile Creek. Dissolved oxygen levels were similar at all sites and ranged from 6.27 and 7.60 milligrams per liter (mg/L). Conductivity varied between the sites and ranged from 483.3 micro Siemens per centimeter (µS/cm) at Fivemile Creek and 926.4 µS/cm at Sharps Branch. There appears to be a correlation between conductivity and the MI Scores for the sites: as the conductivity increases the benthic macroinvertebrate community appears to be more impaired in terms of the MI Scores.

#### 3.2 **Habitat Assessment and Macroinvertebrate Analysis**

The following summarizes the habitat assessment and macroinvertebrate analysis results for each of the six stream reaches, which are presented in Table 3. Copies of the laboratory analytical and data reduction results and the chains of custody (COCs) are included in Appendix E.

# **Donelson Creek**

Donelson Creek is a second order stream. The sample reach is located in a predominantly residential area. Moore's Elementary School is located to the north of the stream reach. The riparian area is wooded providing shade to most of the creek; however, it is less than 6 meters wide on the north side (left stream bank). The stream reach is small (1.5 to 3 meters wide) and relatively low gradient. The substrate is predominantly boulder and bedrock with a moderate amount of silt deposits. Some algae growth was observed.

# TABLE 2 FIELD WATER QUALITY MEASUREMENTS

Station Number	Stream Name	Latitude/ Longitude	Sample Date	pH (SU)	Conductivity (µS/cm)	Temperature (Fahrenheit)	Dissolved Oxygen (mg/L)
DONEL000.3WI	Donelson Creek	35°53.543'/ -86°50.846'	7.22.2010	8.58	621.4	74.91	7.61
FMILE001.5WI	Fivemile Creek	35°52.125'/ -86°50.109'	7.22.2010	8.30	483.3	78.20	7.10
WATSO000.6WI	Watson Branch	35°54.562'/ -86°50.791'	7.27.2010	8.63	756.1	76.51	6.89
SHARP000.7WI	Sharps Branch	35°55.384'/ -86°52.777'	7.27.2010	8.38	926.4	75.25	6.70
LIBER000.7WI	Liberty Creek	35°55.743'/ -86°51.362'	7.29.2010	8.05	577.0	77.45	6.28
SPENC000.8WI	Spencer Creek	35°56.61'/ -86°51.318'	8.3.2010	8.39	840.8	73.93	6.39

Notes:

 $\begin{array}{c} mg/L \\ \mu S/cm \\ SU \end{array}$ 

milligrams per liter micro Siemens per centimeter

standard units

TABLE 3 ASSESSMENT SCORES AND RESULTS - DONELSON CREEK					
STATION NO: DONEL000.3WI	STREAM: Donelson Creek	STREAM ORDER: 2			
LOCATION: Moore's Elementary School	ECOREGION: 71h	HUC NO: TN05130204			
WATERSHED GROUP: Harpeth River	<b>DATE SAMPLED:</b> 7.22.2010	SAMPLE TYPE: SQKICK			
Total Number of Individuals in Sample = 202					
BIOMETRIC	VALUE	CALIBRATED SCORE <sup>1</sup>			
Taxa Richness	20	4			
EPT Richness	6	2			
% OC	7.92%	6			
% EPT	70.79%	6			
NCBI	4.73	4			
% NUTOL	57.92%	2			
% CLINGERS	59.90%	6			
		30			
MACROINVERTEBRATE INDEX SCORE = 30					
<sup>2</sup> Not Impaired ≥32 Slightly Impaired - 21-31 Moderately Impaired - 10-20 Severely Impaired <10					
HABITAT ASSESSMENT SCORE = 96	, , , , , , , , , , , , , , , , , , ,				
<sup>3</sup> Not Impaired ≥ 117 <i>Moderately Impaired</i> 92-116 Severely Impaired ≤ 91					

#### Notes:

- 1 Calculated using the scoring calibration values for Bioregions 71h, January through December, as found in the State of Tennessee Department of Environment and Conservation, Division of Water Pollution Control, Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys, Revised October 2006 (SOP for Macroinvertebrate Stream Surveys), Appendix A.
- 2 Biological condition categories for Bioregions 71h, January through December, as found in the SOP for Macroinvertebrate Stream Surveys, Table 4. The italicized category represents the biological condition of the stream based on the Macroinvertebrate Index Score.
- 3 Habitat Assessment Categories for Bioregion 71h, High Gradient Form, January through December, as found in the SOP for Macroinvertebrate Stream Surveys, Table 1. The italicized category represents the habitat condition of the stream based on the total habitat assessment score.

NO - Number

HUC - Hydrologic unit code

Taxa Richness - Total number of distinct genera found in a subsample

EPT Richness - Total number of genera within the orders Ephemeroptera, Plecoptera, and Trichoptera found in the subsample

% OC - Percent Oligochaetes and Chironomidae

% EPT - Percent Ephemeroptera, Plecoptera, and Trichoptera

NCBI - North Carolina Biotic Index

% NUTOL - Percent nutrient tolerant organisms

TABLE 3-Continued ASSESSMENT SCORES AND RESULTS - FIVEMILE CREEK					
STATION NUMBER: FMILE001.5WI	STREAM: Fivemile Creek	STREAM ORDER: 4			
LOCATION: Old Peytonsville Road	ECOREGION: 71H	HUC NO: TN05130204			
WATERSHED GROUP: Harpeth River	<b>DATE SAMPLED:</b> 7.22.2010	SAMPLE TYPE: SQKICK			
Total Number of Individuals in Sample = 201					
METRIC	VALUE	CALIBRATED SCORE <sup>1</sup>			
Taxa Richness	15	2			
EPT Richness 9		4			
% OC	1.00%	6			
% EPT	88.56%	6			
NCBI	4.61	6			
% NUTOL	13.93%	6			
% CLINGERS	87.56%	6			
	36				
MACROINVERTEBRATE INDEX SCORE = 36					
<sup>2</sup> Not Impaired ≥ 32 Slightly Impaired - 21-31 Moderately Impaired - 10-20 Severely Impaired <10					
HABITAT ASSESSMENT SCORE = 83					
<sup>3</sup> Not Impaired ≥ 117 Moderately Impaired 92-116 Severely Impaired ≤ 91					

#### Notes:

- 1 Calculated using the scoring calibration values for Bioregions 71h, January through December, as found in the State of Tennessee Department of Environment and Conservation, Division of Water Pollution Control, Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys, Revised October 2006 (SOP for Macroinvertebrate Stream Surveys), Appendix A.
- 2 Biological condition categories for Bioregions 71h, January through December, as found in the SOP for Macroinvertebrate Stream Surveys, Table 4. The italicized category represents the biological condition of the stream based on the Macroinvertebrate Index Score.
- 3 Habitat Assessment Categories for Bioregion 71h, High Gradient Form, January through December, as found in the SOP for Macroinvertebrate Stream Surveys, Table 1. The italicized category represents the habitat condition of the stream based on the total habitat assessment score.

NO - Number

HUC - Hydrologic unit code

Taxa Richness - Total number of distinct genera found in a subsample

EPT Richness - Total number of genera within the orders Ephemeroptera, Plecoptera, and Trichoptera found in the subsample

% OC - Percent Oligochaetes and Chironomidae

% EPT - Percent Ephemeroptera, Plecoptera, and Trichoptera

NCBI - North Carolina Biotic Index

% NUTOL - Percent nutrient tolerant organisms

TABLE 3-Continued ASSESSMENT SCORES AND RESULTS - WATSON BRANCH					
STATION NO: WATSO000.6WI	STREAM: Watson Branch	STREAM ORDER: 3			
LOCATION: South Royal Oaks Road	ECOREGION: 71h	<b>HUC NO:</b> TN05130204			
WATERSHED GROUP: Harpeth River	<b>DATE SAMPLED:</b> 7.27.2010	SAMPLE TYPE: SQKICK			
Total Number of Individuals in Sample = 206					
METRIC	VALUE	CALIBRATED SCORE <sup>1</sup>			
Taxa Richness	20	4			
EPT Richness	4	2			
% OC	7.77%	6			
% EPT	21.84%	2			
NCBI	4.91	4			
% NUTOL	70.39%	2			
% CLINGERS	47.57%	4			
		24			
MACROINVERTEBRATE INDEX SCORE = 2	4				
<sup>2</sup> Not Impaired ≥32 Slightly Impaired - 21-31 Moderately Impaired - 10-20 Severely Impaired <10					
HABITAT ASSESSMENT SCORE = 111	· · · · · · · · · · · · · · · · · · ·				
<sup>3</sup> Not Impaired ≥ 117 <i>Moderately Impaired</i> 92-116	Severely Impaired ≤ 91				

#### Notes

- 1 Calculated using the scoring calibration values for Bioregions 71h, January through December, as found in the State of Tennessee Department of Environment and Conservation, Division of Water Pollution Control, Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys, Revised October 2006 (SOP for Macroinvertebrate Stream Surveys), Appendix A.
- 2 Biological condition categories for Bioregions 71h, January through December, as found in the SOP for Macroinvertebrate Stream Surveys, Table 4. The italicized category represents the biological condition of the stream based on the Macroinvertebrate Index Score.
- 3 Habitat Assessment Categories for Bioregion 71h, High Gradient Form, January through December, as found in the SOP for Macroinvertebrate Stream Surveys, Table 1. The italicized category represents the habitat condition of the stream based on the total habitat assessment score.

NO - Number

HUC - Hydrologic unit code

Taxa Richness - Total number of distinct genera found in a subsample

EPT Richness - Total number of genera within the orders Ephemeroptera, Plecoptera, and Trichoptera found in the subsample

% OC - Percent Oligochaetes and Chironomidae

% EPT - Percent Ephemeroptera, Plecoptera, and Trichoptera

NCBI - North Carolina Biotic Index

% NUTOL - Percent nutrient tolerant organisms

TABLE 3-Continued ASSESSMENT SCORES AND RESULTS - SHARPS BRANCH				
STATION NUMBER: SHARP000.7WI	STREAM: Sharps Branch	STREAM ORDER: 2		
LOCATION: 11th Avenue at Highway 96 West	ECOREGION: 71H	HUC NO: TN05130204		
WATERSHED GROUP: Harpeth River	<b>DATE SAMPLED:</b> 7.27.2010	SAMPLE TYPE: SQKICK		
Total Number of Individuals in Sample = 166				
METRIC	VALUE	CALIBRATED SCORE <sup>1</sup>		
Taxa Richness	13	2		
EPT Richness	1	0		
% OC	43.37%	4		
% EPT	1.20%	0		
NCBI	6.17	4		
% NUTOL	80.72%	0		
% CLINGERS	19.28%	2		
		12		
MACROINVERTEBRATE INDEX SCORE = 12				
<sup>2</sup> Not Impaired ≥32 Slightly Impaired - 21-31 <i>Moderately Impaired - 10-20</i> Severely Impaired <10				
HABITAT ASSESSMENT SCORE = 82				
	everely Impaired ≤ 91			

#### Notes:

- 1 Calculated using the scoring calibration values for Bioregions 71h, January through December, as found in the State of Tennessee Department of Environment and Conservation, Division of Water Pollution Control, Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys, Revised October 2006 (SOP for Macroinvertebrate Stream Surveys), Appendix A.
- 2 Biological condition categories for Bioregions 71h, January through December, as found in the SOP for Macroinvertebrate Stream Surveys, Table 4. The italicized category represents the biological condition of the stream based on the Macroinvertebrate Index Score.
- 3 Habitat Assessment Categories for Bioregion 71h, High Gradient Form, January through December, as found in the SOP for Macroinvertebrate Stream Surveys, Table 1. The italicized category represents the habitat condition of the stream based on the total habitat assessment score.

NO - Number

HUC - Hydrologic unit code

Taxa Richness - Total number of distinct genera found in a subsample

EPT Richness - Total number of genera within the orders Ephemeroptera, Plecoptera, and Trichoptera found in the subsample

% OC - Percent Oligochaetes and Chironomidae

% EPT - Percent Ephemeroptera, Plecoptera, and Trichoptera

NCBI - North Carolina Biotic Index

% NUTOL - Percent nutrient tolerant organisms

TABLE 3-Continued ASSESSMENT SCORES AND RESULTS - LIBERTY CREEK			
CTATION NO. LIDEDOOG 714/1	CTDF AM. Liberty Creek	CTDEAM OPDED: 0	
STATION NO: LIBER000.7WI	STREAM: Liberty Creek	STREAM ORDER: 2	
LOCATION: Eddy Lane	ECOREGION: 71h	HUC NO: TN05130204	
WATERSHED GROUP: Harpeth River	<b>DATE SAMPLED:</b> 7.29.2010	SAMPLE TYPE: SQKICK	
Total Number of Individuals in Sample = 217			
METRIC	VALUE	CALIBRATED SCORE <sup>1</sup>	
Taxa Richness	24	4	
EPT Richness	4	2	
% OC	20.74%	6	
% EPT	23.96%	2	
NCBI	6.60	2	
% NUTOL	31.80%	6	
% CLINGERS	28.57%	2	
		24	
% CLINGERS  MACROINVERTEBRATE INDEX SCORE = 2			
<sup>2</sup> Not Impaired ≥32 Slightly Impaired - 21-31	Moderately Impaired - 10-20 Severely Imp	paired <10	
HABITAT ASSESSMENT SCORE = 96			
Not Impaired ≥ 117 <i>Moderately Impaired</i> 92-116	Severely Impaired ≤ 91		

#### Notes:

- 1 Calculated using the scoring calibration values for Bioregions 71h, January through December, as found in the State of Tennessee Department of Environment and Conservation, Division of Water Pollution Control, Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys, Revised October 2006 (SOP for Macroinvertebrate Stream Surveys), Appendix A.
- 2 Biological condition categories for Bioregions 71h, January through December, as found in the SOP for Macroinvertebrate Stream Surveys, Table 4. The italicized category represents the biological condition of the stream based on the Macroinvertebrate Index Score.
- 3 Habitat Assessment Categories for Bioregion 71h, High Gradient Form, January through December, as found in the SOP for Macroinvertebrate Stream Surveys, Table 1. The italicized category represents the habitat condition of the stream based on the total habitat assessment score.

NO - Number

HUC - Hydrologic unit code

Taxa Richness - Total number of distinct genera found in a subsample

EPT Richness - Total number of genera within the orders Ephemeroptera, Plecoptera, and Trichoptera found in the subsample

% OC - Percent Oligochaetes and Chironomidae

% EPT - Percent Ephemeroptera, Plecoptera, and Trichoptera

NCBI - North Carolina Biotic Index

% NUTOL - Percent nutrient tolerant organisms

TABLE 3-Continued ASSESSMENT SCORES AND RESULTS - SPENCER CREEK				
STATION NUMBER: SPENC000.8WI	STREAM: Spencer Creek	STREAM ORDER: 4		
LOCATION: McMahon Road/Franklin Road	ECOREGION: 71H	HUC NO: TN05130204		
WATERSHED GROUP: Harpeth River	<b>DATE SAMPLED:</b> 8.3.2010	SAMPLE TYPE: SQKICK		
Total Number of Individuals in Sample = 257		•		
BIOMETRIC	VALUE	CALIBRATED SCORE <sup>1</sup>		
Taxa Richness	10	2		
EPT Richness	5	2		
% OC	0.00%	6		
% EPT	94.94%	6		
NCBI	5.61	4		
% NUTOL	75.88%	2		
% CLINGERS	98.83%	6		
		28		
MACROINVERTEBRATE INDEX SCORE =	28			
Not Impaired ≥32 Slightly Impaired - 21-31	Moderately Impaired - 10-20 Severely Im	paired <10		
HABITAT ASSESSMENT SCORE = 124	, , , , , , , , , , , , , , , , , , ,			
<sup>3</sup> Not Impaired ≥ 117 Moderately Impaired 92-110	6 Severely Impaired ≤ 91			

#### Notes

- 1 Calculated using the scoring calibration values for Bioregions 71h, January through December, as found in the State of Tennessee Department of Environment and Conservation, Division of Water Pollution Control, Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys, Revised October 2006 (SOP for Macroinvertebrate Stream Surveys), Appendix A.
- 2 Biological condition categories for Bioregions 71h, January through December, as found in the SOP for Macroinvertebrate Stream Surveys, Table 4. The italicized category represents the biological condition of the stream based on the Macroinvertebrate Index Score.
- 3 Habitat Assessment Categories for Bioregion 71h, High Gradient Form, January through December, as found in the SOP for Macroinvertebrate Stream Surveys, Table 1. The italicized category represents the habitat condition of the stream based on the total habitat assessment score.

NO - Number

HUC - Hydrologic unit code

Taxa Richness - Total number of distinct genera found in a subsample

EPT Richness - Total number of genera within the orders Ephemeroptera, Plecoptera, and Trichoptera found in the subsample

% OC - Percent Oligochaetes and Chironomidae

% EPT - Percent Ephemeroptera, Plecoptera, and Trichoptera

NCBI - North Carolina Biotic Index

% NUTOL - Percent nutrient tolerant organisms



The Macroinvertebrate Index Score (MI) for the Donelson Creek sample site is 30, which is considered slightly impaired for streams in Ecoregion 71h. Based on the comparison of the individual biometric values to the Biocriteria Table for the ecoregion, EPT Richness and Percent NUTOL are moderately impaired (calibrated values of 2); Taxa Richness and NCBI are slightly impaired (calibrated values of 4); and Percent EPT, Percent OC, and Percent Clingers are not impaired (calibrated values of 6).

The Habitat Assessment Score for the sampling reach of Donelson Creek is 96, which is considered moderately impaired for streams in Ecoregion 71h. The left stream bank riparian vegetative zone width and the left stream bank stability are ranked as poor by City of Franklin SMD personnel. Embeddedness, velocity/depth regime, sediment deposition, channel flow, right stream bank stability, and vegetative protection for both stream banks are ranked as marginal. Epifaunal substrate/available cover, channel alteration, frequency of riffles, and right stream bank riparian vegetative zone width are ranked suboptimal. None of the ten habitat parameters are ranked as optimal. Epifaunal substrate/available cover and channel alteration scores are within the regional expectations when compared with the ratings for 75 percent of the reference streams in Ecoregion 71h.

# **Fivemile Creek**

The Fivemile Creek sample reach, a fourth order steam, is located in an area dominated by residences and pastureland. The stream reach is small (1.5 to 3 meters wide) and low gradient. The vegetation on the riparian edges of the stream banks are less than 6 meters wide creating only partial shade for the stream. Rip-rap was observed on the left stream bank and a road bridge is located just downstream of the sample collection points. The substrate is predominantly bedrock with a moderate amount of silt and mud deposits.

The MI Score for the sampling reach of Fivemile Creek is 36, which is considered not impaired. Based on the comparison of the individual biometric values to the Biocriteria Table for the ecoregion, Taxa Richness is moderately impaired and EPT Richness is slightly impaired. The remaining biometrics are not impaired.

The HA Score for the sampling reach of Fivemile Creek is 83, which is considered severely impaired. Embeddedness, left stream bank vegetative protection, and the riparian vegetative zone widths for both stream banks are ranked as poor. The velocity/depth regime, channel flow status, left bank stability, and right bank vegetative protection are ranked as marginal. Epifaunal



substrate/available cover, sediment deposition, channel alteration, frequency of riffles, and right stream bank stability are ranked as suboptimal. None of the ten habitat parameters are ranked as optimal. Epifaunal substrate/available cover and sediment deposition scores are within the regional expectations when compared with the ratings for 75 percent of the reference streams in Ecoregion 71h.

# **Watson Branch**

Watson Branch is a third order stream. The sampling reach for the Watson Branch flows through an expanding residential area with some areas of pasture. The stream reach is small (1.5 to 3 meters wide) and low gradient. The stream is only partly shaded. The substrate is predominantly gravel and sand with a moderate amount of mud, sand, and silt deposits. A sand bar is located within the stream reach. Rooted vegetation was observed in the stream. A road bridge is located downstream of the sample reach.

The MI Score for the sampling reach of Watson Branch is 24, which is considered slightly impaired. Based on the comparison of the individual biometric values to the Biocriteria Table for the Ecoregion 71h, EPT Richness, Percent EPT, and Percent NUTOL are moderately impaired and Taxa Richness, NCBI, and Percent Clingers are slightly impaired. Only Percent OC is not impaired.

The HA Score for the sampling reach of Watson Branch is 111, which is considered moderately impaired. Epifaunal substrate/available cover, sediment deposition, channel flow status, left bank stability, and right vegetative protection, and left bank riparian vegetative zone width are ranked as marginal. Embeddedness, velocity/depth regime, channel alteration, frequency of riffles, right bank stability, left vegetative protection, and right riparian vegetative zone width are ranked as suboptimal. None of the ten habitat parameters are ranked as optimal or poor. Embeddedness, velocity/depth regime, and channel alteration scores are within the regional expectations when compared with the ratings for 75 percent of the reference streams in Ecoregion 71h.

# **Sharps Branch**

Sharps Branch is a second order stream. The Sharps Branch sample reach is located in a commercial and residential area with some industry. The stream reach is small at 1.5 to 3 meters wide and low gradient. The riparian vegetation is less than 4 meters wide. The substrate is predominantly gravel and sand with a moderate amount of silt, sand, and mud deposits. No algae or rooted vegetation were observed in the stream reach. Litter, including glass and plastic was



observed during sampling activities.

The MI Score for the sampling reach of Sharps Branch is 12, which is considered moderately impaired. A total of only 166 organisms were collected during macroinvertebrate sampling at Sharps Branch even though an extra kick was performed. Based on comparison of the individual biometric values to the Biocriteria Table for the Ecoregion 71h, EPT Richness, Percent EPT, and Percent NUTOL are severely impaired; Taxa Richness and Percent Clingers are moderately impaired; and Percent OC and NCBI are slightly impaired. The remaining biometrics are designated as not impaired.

The HA Score for the sampling reach of Sharps Branch is 82, which is considered severely impaired. Frequency of riffles and riparian vegetative zone width for both stream banks are ranked poor. Epifaunal substrate/available cover, embeddedness, velocity/depth regime, sediment deposition, and vegetative protection of both stream banks are ranked as marginal. Channel flow status, channel alteration, and bank stability for both stream banks are ranked as suboptimal. None of the ten habitat parameters are ranked as optimal. Channel flow status and channel alteration scores are within the regional expectations when compared with the ratings for 75 percent of the reference streams in Ecoregion 71h.

# **Liberty Creek**

Liberty Creek is a second order stream. The Liberty Creek sample reach is located in a mixed use area and receives surface runoff from commercial, industrial, and residential areas. The stream width is small at 1.5 to 3 meters wide within the reach and is low gradient. The majority of the riparian area consists of maintained grass with a sparse low canopy producing partial shade for the stream. Liberty Creek passes through a road culvert downstream of the sampling reach at Eddy Lane. The substrate is predominantly bedrock with a moderate amount of mud, sand, and silt deposits. Rooted vegetation was observed in the stream.

The MI Score for the Liberty Creek site is 24, which is considered slightly impaired. Based on the comparison of the individual biometric values to the Biocriteria Table for the Ecoregion 71h, EPT Richness, Percent EPT, NBCI, and Percent Clingers are moderately impaired; Taxa Richness is slightly impaired; and Percent OC is not impaired.

The HA Score for the sampling reach of Liberty Creek is 96, which is considered moderately impaired. The riparian vegetative zone width for both steam banks is ranked poor.



Embeddedness, velocity/depth regime, frequency of riffles, bank stability of both stream banks and vegetative protection of both stream banks are ranked as marginal. Epifaunal substrate/available cover, sediment deposition, channel flow status, and channel alteration are ranked as suboptimal. None of the ten habitat parameters are ranked as optimal. Epifaunal substrate/available cover, sediment deposition, channel flow status, and channel alteration scores are within the regional expectations when compared with the ratings for 75 percent of the reference streams in Ecoregion 71h.

### **Spencer Creek**

Spencer Creek is a fourth order stream. The Spencer Creek sample reach is located in an urban area with residences and agricultural land directly adjacent to the site. Franklin Road is to the east and Mack C. Hatcher Memorial Parkway is to the north; both are moderate to high use transit corridors. The stream is 3 to 10 meters in width and has a moderate gradient. The stream is mostly shaded with deciduous trees. The substrate consists primarily of cobble, boulder, and gravel with moderate silt deposits. A road bridge is located directly upstream of the sample reach. Rip-rap was observed within the sample reach.

The MI Score for the sampling reach of Spencer Creek is 28, which is considered slightly impaired. Based on comparison of the biometric values to the Biocriteria Table for the ecoregion, Taxa Richness, EPT Richness, and Percent NUTOL are moderately impaired and NCBI is slightly impaired. Percent OC, Percent EPT, and Percent Clingers are not impaired.

The HA Score for the sampling reach of Spencer Creek is 124, which is considered not impaired. Left bank vegetative protection and right bank riparian vegetative zone width are ranked as marginal. Epifaunal substrate/available cover, embeddedness, velocity/depth regime, sediment deposition, channel flow status, channel alteration, frequency of riffles, bank stability of both stream banks, right bank vegetative protection, and right bank riparian vegetative zone width are ranked as suboptimal. None of the ten habitat parameters are ranked as optimal. Epifaunal substrate/available cover, velocity/depth regime, sediment deposition, channel flow status, channel alteration, and frequency of riffles are within the regional expectations when compared with the ratings for 75 percent of the reference streams in Ecoregion 71h.

None of the streams are considered navigable waters, Exceptional Tennessee Waters, or Outstanding National Resource Waters. Likewise, they are not permitted for domestic or



industrial water supply; or used for trout fishing. No advisories were identified in association with any of the sample sites.



# 4.0 CONCLUSIONS

The results of the Macroinvertebrate Stream Survey indicate that all six of the streams sites sampled during this assessment have impaired biological condition, habitat condition, or both. These findings were expected based on the inclusion of all six streams on the Proposed Final Version 303(d) List for 2010 (TDEC WPC 2010b). Streams on the 303(d) List have been designated by TDEC WPC as water quality limited and have one or more properties that violate water quality standards. All of the streams that were visited during the sampling index period show increasing signs from urban impact.

The City of Franklin intends to use the findings of this survey to steer the direction and development of goals for the City's MS4 program in order to meet the total maximum daily loads (TMDLs) for pollutants established for these streams and other 303(d) listed streams within the City's jurisdiction. The information collected during this survey provides insight into the current health and condition of these streams and potential sources of impact. The data will be used as a baseline for ongoing surveys at these sites and to interpret trends in impairment over time. From these trends in water quality and biological integrity, the city will have a greater amount of information to base their decisions on stormwater management.



## 5.0 REFERENCES

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- Tennessee Department of Environmental Conservation (TDEC), Division of Water Pollution Control (WPC). 2006. Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys. October (Revised).
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- USGS. 1981. 7.5 Minute Topographical Quadrangle Map, Leipers Fork, Tennessee.
- USGS. 1982. 7.5 Minute Topographical Quadrangle Map, Bethesda, Tennessee.
- USGS. 1997. 7.5 Minute Topographical Quadrangle Map, Franklin, Tennessee.



# APPENDIX A - FIGURES

Figure 1 – Topographic Map

Figure 2 – Site Location Map, Donelson Creek

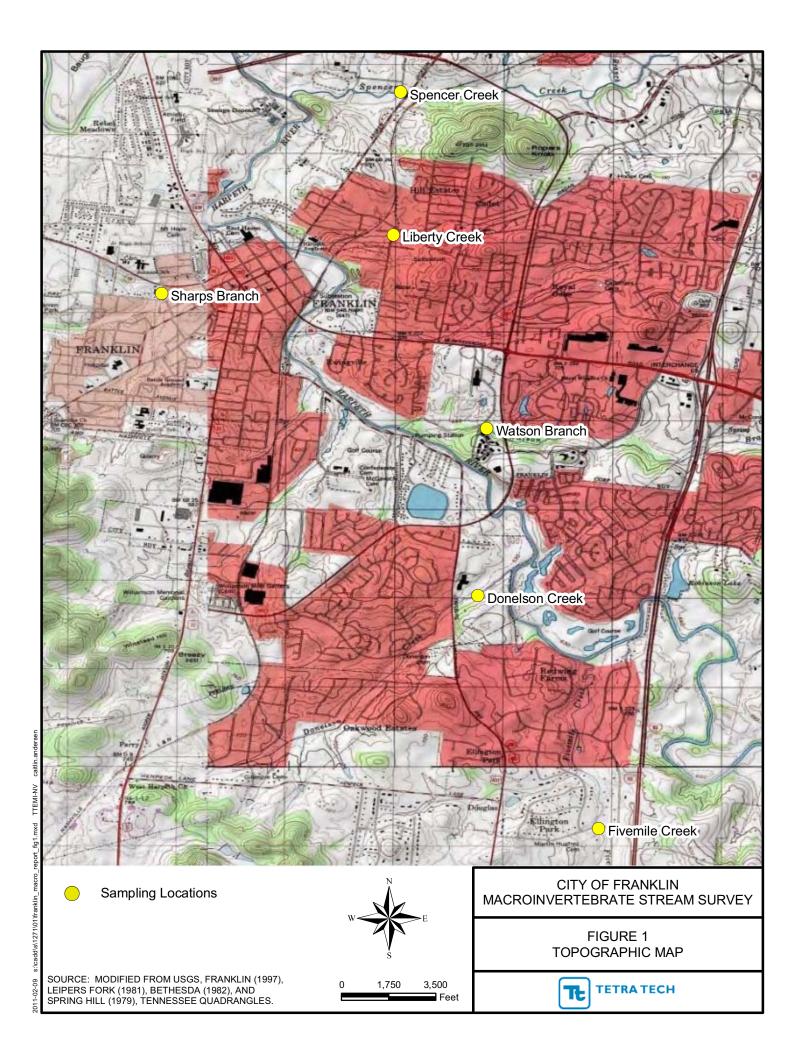
Figure 3 – Site Location Map, Fivemile Creek

Figure 4 – Site Location Map, Watson Branch

Figure 5 – Site Location Map, Sharps Branch

Figure 6 – Site Location Map, Liberty Creek

Figure 7 – Site Location Map, Spencer Creek







0 100 200

CITY OF FRANKLIN MACROINVERTEBRATE STREAM SURVEY

FIGURE 2 SITE LOCATION MAP DONELSON CREEK



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SOURCE: MODIFIED FROM USDA, 2008.



SOURCE: MODIFIED FROM USDA, 2008.



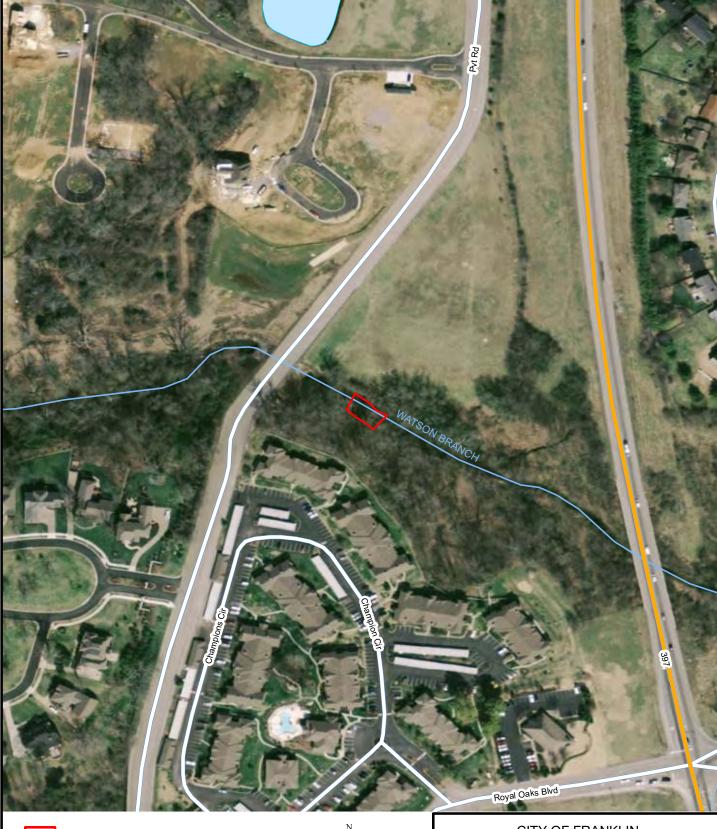
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CITY OF FRANKLIN MACROINVERTEBRATE STREAM SURVEY

FIGURE 3 SITE LOCATION MAP FIVEMILE CREEK



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SOURCE: MODIFIED FROM USDA, 2008.

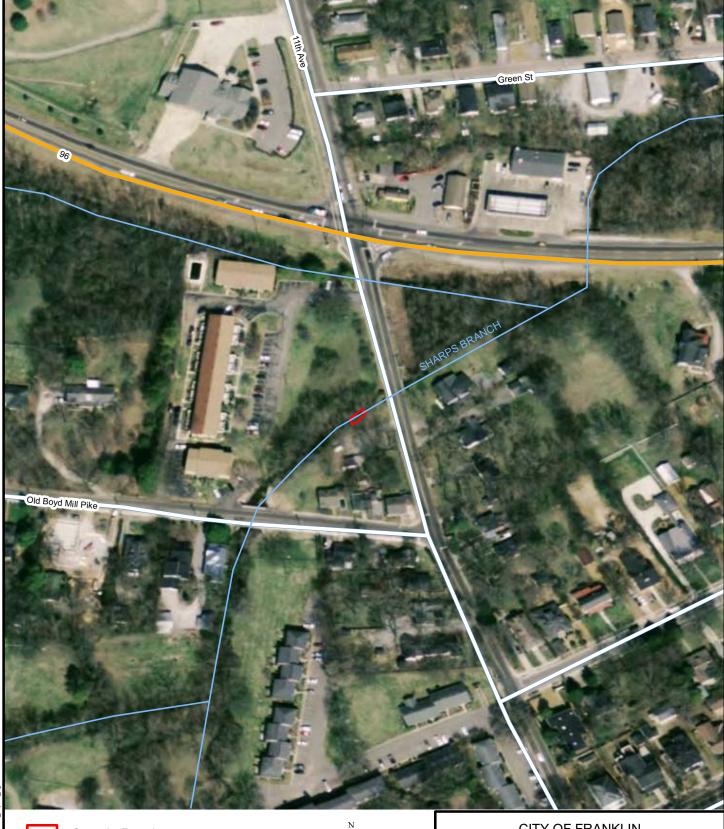


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FIGURE 4 SITE LOCATION MAP WATSON BRANCH



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SOURCE: MODIFIED FROM USDA, 2008.



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FIGURE 5 SITE LOCATION MAP SHARPS BRANCH



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FIGURE 6 SITE LOCATION MAP LIBERTY CREEK





SOURCE: MODIFIED FROM USDA, 2008.



200

MACROINVERTEBRATE STREAM SURVEY

FIGURE 7 SITE LOCATION MAP SPENCER CREEK





APPENDIX B – RESUMES

# **Biologist**

# Tetra Tech EM, Inc. – Nashville, TN

# **Education/Special Training**

M.S. Biology, Middle Tennessee State University, Murfreesboro, Tennessee. December 2009.

B.S. Biology, Bethel College, McKenzie, Tennessee. December 2001.

AHERA Asbestos Inspector Course (24 Hour) and Refresher (8 Hour) – META Inc. –

December 2006, Refresher (8 Hour) January 2009 and January 2008.

Mold Supervisor/Inspector Training, July 2010.

Hazardous Waste Operations and Emergency Response (HAZWOPER) Health and

Safety Training, OSHA 29CFR 1910.120, 40-hour, HazMat Training, June 2006.

HAZWOPER Health and Safety Training, OSHA 29CFR 1910.102, 8-hour refresher,

HazMat Training, March 2009, February 2008, and February 2007.

American Red Cross, Wilderness First Aid and Adult CPR, March 2009.

Incident Response Command 100, 200; 2006.

U.S. Army Corps of Engineers (USACE) Wetland Delineation & Management Training Program, 2009.

# **Registrations/Certifications**

2009, USACE Certified Wetland Delineator

2009, American Red Cross, Wilderness First Aid certified

2008, 2009, 2010, American Red Cross, Adult First Aid and CPR certified

2007-2010, AHERA Accredited Asbestos Inspector Refresher

2007-2010, 8-hour HAZWOPER certified Refresher

2006, AHERA Accredited Asbestos Inspector

2006, 40-hour HAZWOPER certified

# Qualifications

Ms. Tolley has over seven years experience as a biologist and over four years experience with Tetra Tech as a biologist and environmental consultant. Her areas of expertise include Phase I and Phase II Environmental Site Assessments, asbestos, lead-based paint, and mold inspections/surveys, comprehensive stream assessments, wetland assessments and delineations, waters of the U.S. Evaluations, amphibian surveys. Additional experience has included fish sampling, amphibian monitoring and toxicology and histological examination, visual stream characterization assessments, and soil/sediment, surface water, and groundwater sampling.

# **Relevant Experience**

Comprehensive Stream Assessments, 2010 - Ms. Tolley and a team of Tetra Tech scientists performed comprehensive stream assessments of over 50 high-gradient, perennial streams in West Virginia for the development of permitting requirement protocols by U.S. Army Corps of Engineers. Ms. Tolley's specific tasks included performing amphibian surveys, benthic macroinvertebrate collection, water quality and chemistry sample collection, physical habitat characterization, land use determination, and completion of the State of North Carolina Perennial Stream Rating Form.

Wind Energy Farms and Transmission Line Sites - Wetland and Waters of the U.S. Evaluations - 2007-2010 – Ms. Tolley and a team of Tetra Tech scientists have conducted field assessments for

jurisdictional wetlands and other Waters of the U.S. for wind farm projects, including two approximate 10,000-acre wind turbine project areas in northern Texas, a 200-mile wind farm transmission line in Texas, a 10,000-acre wind farm in Oklahoma, and a 24,000-acre wind farm in northern Indiana. Ms. Tolley also assisted in preparing maps and reports, which assisted the client in determining the location of the aquatic features that should be avoided for future placement of wind turbine pads and other necessary supporting structures of the project. Tetra Tech assisted the client in determining whether the project activities would result in permanent or temporary disturbance of the waters of U.S. in excess of that covered under the USACE Nationwide Permit (NWP).

**Wetland Delineations, Nationwide, Ongoing -** Ms. Tolley conducts jurisdictional wetland delineations for several private clients in Tennessee, Ohio, and Kentucky. The delineations involve on-site field delineations, report preparations and submittal to regulatory agencies (TDEC and USACE), and confirmation visits with the regulatory agencies.

Wetland and Stream Mitigation and Monitoring Project, 2008 to 2009 - Ms. Tolley has conducted wetland and stream mitigation activities at a subdivision development site in Tennessee. Activities included riparian and wetland vegetation and erosion monitoring.

Phase I Environmental Site Assessments, Nationwide, Ongoing – Ms. Tolley has performed over 100 Phase I Environmental Site Assessments (ESA) and Real Estate Transaction Screens (RETS) to satisfy due diligence, environmental compliance, and health and safety concerns for various private clients in multiple states across the US. Based on the findings of the reports, clients are able to select specific sites to perform additional investigation in order to limit their environmental liability. Ms. Tolley also prepares proposals, Phase II sampling events, and asbestos, lead-based paint, and mold sampling events and the associated reports for follow-up investigations at these sites.

**Phase II Environmental Site Assessments, Tennessee, Ongoing** - Ms. Tolley performs Phase II ESAs, including soil and groundwater sampling, to satisfy due diligence, environmental compliance, and health and safety concerns for various private clients.

**Certified Asbestos Inspector, Tennessee, Ongoing -** Ms. Tolley performs both limited and comprehensive asbestos assessments at properties in Tennessee, for various clients. The work involves conducting preliminary visual assessments and proposals, sample collection of various building materials, draft report submitted to the client, abatement proposal, submittal of a final report, and completion of asbestos Operations and Maintenance Plans.

**Lead-Based Paint Assessments, Nationwide, Ongoing -** Ms. Tolley performs lead-based paint assessments for various private clients in multiple states across the US. The work involves conducting preliminary visual assessments and proposals, lead-based paint sample collection, report submittal to the client, abatement proposal, and completion of lead-based paint operations and maintenance plans.

**Mold and Water Intrusion Assessments, Nationwide, Ongoing** – Ms. Tolley performs mold and water intrusion assessments for various private clients in multiple states across the US. The work involves conducting preliminary visual assessments and proposals, mold sampling and air monitoring, report submittal to the client, abatement proposal, and abatement oversight.

**UST System Compliance Inspections** — Ms. Tolley has performed UST system compliance inspections and associated environmental site assessments for multiple gasoline station portfolios. The inspections typically consist of evaluating the facility registration, tanks, sump equipment, spill buckets, leak detection equipment, cathodic protection equipment, and fuel dispensers.

**Regulatory File Review, Ongoing** – Ms. Tolley has performed dozens of regulatory file reviews to obtain compliance and remediation activity information for underground storage tank facilities, various hazardous waste facilities, Resource Conservation and Recovery Act (RCRA) facilities, and Comprehensive Environmental Response and Conservation Liability Information System (CERCLIS).

Volunteer Army Ammunition Plant/Chattanooga, TN Groundwater Monitoring, 2006 - Ms. Tolley performed groundwater sampling of monitoring wells located on and within the vicinity of the Ammunition Plant. The VAAP manufactured trinitrotoluene (TNT) for ammunitions used during World War II and has extensive contamination in the soil and groundwater. Four-inch and two-inch monitoring wells were purged and sampled using submersible pumps and hand bailers. The samples were collected to be analyzed for explosives, nitrates/nitrites, sulfides, total and dissolved metals, and total organic carbons.

Ammonia Pipeline Groundwater Monitoring and Remediation, Nebraska, 2006 to 2010 - Ms. Tolley assistants in preparation, development, and coordination of groundwater monitoring activities and remediation activities at several anhydrous ammonia pipeline release sites. Ms. Tolley has performed groundwater modeling for development of Alternate Cleanup Levels (ACLs) for these sites. Ms. Tolley has also provided support in sampling and monitoring of groundwater wells located along the pipeline. The samples are analyzed for ammonia, nitrates, and nitrites.

**Groundwater Monitoring of Landfills, 2006 -** Ms. Tolley performed groundwater sampling of monitoring wells located at various landfills in Tennessee. Four inch and two inch monitoring wells were purged and sampled by submersible pumps and hand bailers. The samples collected were analyzed nitrates/nitrites, total dissolved metals, sulfides and total organic carbons.

Comprehensive Stream Assessments, 2010 - Ms. Tolley and a team of Tetra Tech scientists performed comprehensive stream assessments of over 50 high-gradient, perennial streams in West Virginia for the development of permitting requirement protocols by U.S. Army Corps of Engineers. Ms. Tolley's specific tasks included performing amphibian surveys, benthic macroinvertebrate collection, water quality and chemistry sample collection, physical habitat characterization, land use determination, and completion of the State of North Carolina Perennial Stream Rating Form.

Wind Energy Farms and Transmission Line Sites - Wetland and Waters of the U.S. Evaluations - 2007-2010 – Ms. Tolley and a team of Tetra Tech scientists have conducted field assessments for jurisdictional wetlands and other Waters of the U.S. for wind farm projects, including two approximate 10,000-acre wind turbine project areas in northern Texas, a 200-mile wind farm transmission line in Texas, a 10,000-acre wind farm in Oklahoma, and a 24,000-acre wind farm in northern Indiana. Ms. Tolley also assisted in preparing maps and reports, which assisted the client in determining the location of the aquatic features that should be avoided for future placement of wind turbine pads and other necessary supporting structures of the project. Tetra Tech assisted the client in determining whether the project activities would result in permanent or temporary disturbance of the waters of U.S. in excess of that covered under the USACE Nationwide Permit (NWP).

**Wetland Delineations, Nationwide, Ongoing -** Ms. Tolley conducts jurisdictional wetland delineations for several private clients in Tennessee, Ohio, and Kentucky. The delineations involve on-site field delineations, report preparations and submittal to regulatory agencies (TDEC and USACE), and confirmation visits with the regulatory agencies.

Wetland and Stream Mitigation and Monitoring Project, 2008 to 2009 - Ms. Tolley has conducted wetland and stream mitigation activities at a subdivision development site in Tennessee. Activities included riparian and wetland vegetation and erosion monitoring.

The Effects of Polychlorinated Biphenyls on Hatching Success, Mortality, Growth and Development and Gonadal Differentiation in the Gray Treefrog (*Hyla Chrysoscelis*), Master's Thesis, 2004-2009 - Ms. Tolley performed live sample collection and rearing of gray treefrog tadpoles, extraction, and analysis of polychlorinated biphenyls (PCBs) from the treefrog tissues along with soil and water samples using gas chromatography and electron capture detection (GC/ECD)/mass spectrum analysis (GC/MS). Ms. Tolley also completed a histological examination of the treefrog body tissues to identify malformations or mutations developed from exposure to the PCBs.

**Biological and Environmental Research and Sample Collection, Middle Tennessee State University, 2003-2006 -** Ms. Tolley worked for the Middle Tennessee State University Biology Department as part of a team conducting freshwater fish collection and identification by electro-fishing and netting in the Stones River Watershed; as a laboratory assistant conducting isolation and cultivation of bacteria from animal feces and water samples; and as a graduate teaching assistant. Ms. Tolley participated in various research projects at MTSU including Size Specific Habitat Segregation and Intra-specific Interactions in Banded Sculpin (*Cottus carolinae*), published in the 2005 Southeastern Naturalist, which involved an in-stream habitat study of the banded sculpin, stream sediment classification, water depth and flow rate, experimental design, and construction of stream flow-through chambers.

# **Publications and Presentations**

**Tolley A.** 2010. Geographic distribution: Anaxyrus americanus. Herpetological Review 41(4):506.

Tolley A. 2010. Geographic distribution: *Pseudacris crucifer*. Herpetological Review 41(4):508.

Tolley A. 2010. Geographic distribution: Pseudacris feriarum. Herpetological Review 41(4):508.

**Tolley A.** 2010. Geographic distribution: *Scaphiopus holbrookii*. Herpetological Review 41(4):506.

**Tolley A.** 2009. The Effects of Polychlorinated Biphenyls (PCBs) on Hatching Success, Morphology, Time to Death, and Gonadal Differentiation of the Cope's Gray Treefrog, *Hyla Chrsoscelis*: Middle Tennessee State University. 63p.

Koczaja C, McCall L, Fitch E, Glorioso B, Hanna C, Kyzar J, Niemiller M, Spiess J, **Tolley A**, Wyckoff R, and Mullen D. 2005. Size-specific habitat segregation and intraspecific interactions in banded sculpin (*Cottus carolinae*). Southeastern Naturalist 4:207–218.

**Tolley A.** 2005. The Effects of Polychlorinated Biphenyls (PCBs) on Gonadal Differentiation in the Gray Treefrog, *Hyla chrysoscelis*. Society of Environmental Toxicology and Chemistry National Meeting.

**Tolley A.** 2004. The Effects of Polychlorinated biphenyls (PCBs) on the Gray Treefrog, *Hyla Chrysoscelis*. Society of Environmental Toxicology and Chemistry Regional Meeting.

#### **Employment History**

2006 – Current Tetra Tech EM, Inc.

**Biologist** 

712 Melrose Ave. Nashville, TN 37211

2003 – 2005 Middle Tennessee State University

Graduate Research and Teaching Assistant

1301 East Main St. Murfreesboro, TN 37132

#### **Professional Memberships and Organizations**

Society of Environmental Toxicology and Chemistry (SETAC), Member 2005 to present.

Society of Wetland Scientists, Member, 2010.

Society for the Study of Amphibians and Reptiles, 2010.

Tennessee Wildlife Resources Agency, Tennessee Amphibian Monitoring Program, Volunteer, 2009 to present.

Stones River Watershed Association, Member and Volunteer 2008 to present.

Harpeth River Watershed Association, Volunteer, 2009.

Soil and Water Conservation Society, Member, 2007-2009.

American Water Resources Association, Tennessee Section, Member, 2009.

#### **Professional References**

Ron Grover, CHMM, Operations Manager Dana Lingle, Project Manager

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# DAVID SCARBORO ENVIRONMENTAL SCIENTIST

#### TETRA TECH-AAI, ORLANDO

#### **EDUCATION**

A.A. Valencia Community College, 2003

B.A. Environmental and Growth Management, Rollins College 2007

#### **DUTIES**

Mr. Scarboro completes a variety of tasks involving different facets of water quality. These differing facets include and are not limited to water quality sampling of surface, ground and stormwater, biological and habitat assessment, aquatic/ terrestrial vegetation identification, wetland delineation, stormwater conveyance inspection and photo reconnaissance. Additionally, Mr. Scarboro creates his own equipment and sampling protocols to fit site specific requirements if none exist.

#### **EXPERIENCE**

Mr. Scarboro has over 11 years of experience in hydrological and biological monitoring projects including:

United States Environmental Protection Agency National Rivers and Stream Assessment

Mr. Scarboro is part of one of many teams that blanked the entire United States in support of the

Mr. Scarboro is part of one of many teams that blanked the entire United States in support of the National River and Stream Assessment. Task performed have been physical habitat analysis, collection of aquatic macroinvertebrates, periphyton, sediment enzyme and water quality samples. His duties also included stream velocity measurements, elevation survey of stream transects, stream channel/ bank characterization, Thalweg profiling, identification of riparian legacy tree and alien invasive species, and processing of field samples prior to shipping for laboratory analysis.

#### Pasco County, Florida

Mr. Scarboro preformed twelve Stream Condition Index Surveys under the supervision of Jim Hulbert of Biointegrity Consulting over a two year period in support of the counties MS4 permit. This survey was used to identify biological changes in surface water quality as a result of changes in storm water management. Mr. Scarboro characterized habitats within study area and collected and preserved appropriate macroinvertebrate samples prior to laboratory identification to the lowest taxon. Additionally, Mr. Scarboro wrote reports indicating findings from sampling events.

#### Sanford Stormwater Monitoring Project, Seminole County, Florida

Mr. Scarboro installed two stormwater sampling systems using Campbell Scientific computer and Sigma samplers for stormwater pollution removal efficiency study. The Campbell Scientific computer was used to calculate discharge and allow flow weighted sampling of specific rain fall requirements. Mr. Scarboro wrote subsequent machine language programs for this system to collect appropriate data from head values, discharge, and rainfall to calculate flow weighted sampling of stormwater being discharge from non point source "urban core".

#### Geiger Pond Treatment Efficiency Study, Pasco County, Florida

Mr. Scarboro designed and built two automated self contained sampling structures that contain solar powered refrigerated automatic samplers for verifying removal efficiently of designed wetland treatment system. Mr. Scarboro wrote machine language program to run Campbell Scientific computer used to calculate discharge, and collect other weather characteristics at the site.

#### Florida Fish and Wildlife Conservation Commission Beneficial Use Study,

Mr. Scarboro traveled to ten select lakes across Florida with state biologists to collect benthic sediments, surface water and tussock samples to indicate candidate lakes for additional restoration measures. During sampling Ekman dredge and piston samples were used to collect at depth samples for benthos sediment profiling and geotechnical characterization.

#### Florida Fish and Wildlife Conservation Commission Lake Tsala- Apopka Restoration, Citrus County, Florida.

Mr. Scarboro collected surface water column characteristics across fifteen separate lakes within the greater Tsala Apopka basin. Additionally Mr. Scarboro designed equipment to collect entire sediment columns of benthic material that ranged upwards of seventeen linear feet. Benthic sediment core samples were also collected as well as identification of exotic and native macrophytes. Mr. Scarboro inputs on site characterization were included in the report process.

Florida Fish and Wildlife Conservation Commission Lake Gant Restoration, Sumter County, Florida
Mr. Scarboro collected siltation depths across numerous points in lake for dredge material estimation as well
as samples of same material for laboratory analysis. Created device and collected intact sediment column
samples from lake surface to sandy soils of historic lake bottom to document sediment type and
characteristics. Assisted in aquatic, wetland and upland species identification and mapping.

#### Carter Creek Water Management Plan,

Mr. Scarboro completed extensive survey of water control and conveyance features over 39-square mile Cater Creek Watershed. Tasks included data collection of feature with the use of Trimble GEOXH and Wi-Fi compatible digital cameras and automatic leveling devices for greater accuracy for client.

#### Upper Peace River Water Management Plan,

Mr. Scarboro performed field reconnaissance and approximate methods survey of various water bodies and control/ conveyance structures through the entire 450-square mile watershed located in Polk and Hernando counties. These activities were in support of Southwest Florida Water Management continuous model development in the Upper Peace River basin.

#### Lake Josephine/ Jackson Creek Watershed,

Mr. Scarboro completed a siltation survey, benthic contours of Jackson Creek from numerous cross sections between Lake Jackson to Lake Josephine located in south Florida.

#### • North Port / Big Slough Water Management Program,

Mr. Scarboro performed detailed field reconnaissance of numerous surface water control and conveyance structures in support of continuous model data development within the 195-square mile Big Slough Watershed. The work included identification and detailed survey of important facilities, mapping of flooded areas, public contact and ground truthing and data preparation prior to ArcGIS input. Implemented approximate methods survey for selected surface water control structures.

#### City of Orlando and Winter Park, Florida

As part of continued lake monitoring services, Mr. Scarboro completed task involving lake and benthic sampling for NPDES compliance and alum system evaluation and monitoring.

• Emeralda Marsh, Ocklawaha Prairie, Sunny Hill Farms, Lake County and Marion County, Florida
After decades of "muck" farming at three separate farm areas there were reoccurring issues with surface
water nutrient loading from former land use. To assist in the restoration goals of the St. Johns River Water
Management District Mr. Scarboro assisted in collecting sediment surfacewater and benthic samples for
nutrient characterization. Additionally, Mr. Scarboro participated in surface water nutrient reduction in the
application of lime and Aluminum Sulfate across constructed surface water flow way treatment facility.

# Charlotte Harbor Surface Water Improvement Plan (SWIM), Charlotte County, Florida Mr. Scarboro performed tasks for this study that include field reconnaissance of storm water conveyance systems, stream gaging and sampling select of tributaries of Lemon Bay.

#### St. Lucie River Estuary Nutrient Study, Martin and St. Lucie County, Florida

Mr. Scarboro collected water column data with Hydrolab data sond, surface water samples, conducted stream gauging and installation and maintenance of underwater flow meters across 780 square mile St. Lucie River Estuary. Study for this area was created to document non point source nutrient loading into estuary. Data later used for construction of large scale surfacewater treatment facilities to reduce impact from surface waters flowing in to Estuary from Lake Okeechobee.

#### Caloosahatchee River and Estuary Nutrient Study, Lee County, Florida

Mr. Scarboro performed tasks for this study that included stream gauging, use of Hydrolab water quality meters for water quality data collection, and sampling select of tributaries of the Caloosahatchee River and select wastewater treatment facilities.

#### Other Water Quality Services in Florida

Mr. Scarboro has performed the: (1) collected surface, groundwater and lake water samples for research and NPDES compliance; (2) collected flow and timed sensitive surface water samples using automatic samplers; (3) gathered water column characteristics utilizing multi-probe data loggers; (4) performed wet bench services including jar testing used in creating budgets for surface water alum treatments; and (5) designed, built and operated temporary alum surface water treatment systems.

#### **Computers, Software and Equipment**

Mr. Scarboro has experience with the following software: Microsoft Office Suite, Sigma Plot, Campbell Scientific (i.e. Ed log, Shortcut, CR Basic, CSI Edit, Pakcom), ISCO Flowlink, and WIN-SITU. Mr. Scarboro has experience utilizing the following equipment: Trimble Geo XH, Hydro-lab multi parameter data sonds, YSI multi-parameter meters, Eureka Manta and Amphibian water profiling data loggers, turbidity, pH, conductivity, TDS, Salinity meters, peristaltic pump, submersible pumps, Price and Pygmy, Marsh/Mcbirney flow meters, OVA\FID\PID, ISCO refrigerated and SIGMA automatic samplers, IN-SITU level loggers, Geonics EM electromagnetic surveyor, and CST auto levelers.

#### **Other Training**

#### United States Environmental Protection Agency National Rivers and Streams Assessment Training

#### United States Federal Emergency Management Agency

Introduction to Incident Command System IS-100 ICS for Single Resource and Initial Action Incidents IS-200 National Incident Management System IS-700 An Introduction, National Response Framework IS-800.B

#### Florida Department of Environmental Protection

Biocriteria Committee Semi Annual Meetings Certified Florida Stormwater Inspector Stream Condition Index Sampling Techniques SOP Sampling Training for Groundwater, Surface water and Wastewater

#### Florida Association of Benthologists

Aquatic Plant Workshop

### • Florida Association of Environmental Soils Scientists Hydric Soils Workshop

### • Richard Chinn Environmental Training

Army Corps Wetland Delineation Training FDEP Wetland Delineation Training

### Safety Links Inc.

Confined Space 40 Hour HAZWOPER CFR 1910.120

#### **Professional Affiliations**

Florida Association of Benthologists North America Lake Management Society American Society of Limnology and Oceanography

#### **Biologist/Ecologist**

#### Tetra Tech EM Inc. - Nashville, TN

#### EDUCATION/SPECIAL TRAINING/CERTIFICATIONS

M.S., Biology, Middle Tennessee State University, 1999

B.S., Zoology, University of Tennessee, Knoxville, 1992

OSHA 29 CFR 1910.120 Health and Safety Training (40 Hours)-Hazardous Waste Operations and Emergency Response (HAZWOPER) Training, 2000

8-Hour HAZWOPER Refresher Course, March 2009

EPA SESD Standard Operating Procedures and Overview Workshop, 2001

38-hour U.S. Army Corps of Engineers (USACE) Wetland Delineation & Management Training Program, 2001

Fundamentals of Erosion Prevention and Sediment Control Certification, November 2002

Design Principles for Erosion Prevention & Sediment Control for Construction Sites, Two Day Workshop, January 2003

OSHA Supervisor certified, 2004

Certified Adult First Aid, 2010

Certified Adult CPR, 2010

Construction Storm Water Permit Regulatory Requirements, Nashville, TN, December 9, 2005 ASTM International, Technical & Professional Training, Property Condition Assessments, ASTM 2018 Standard Guide for Property Condition Assessment, Baseline Property Condition Assessment Process, May 2006.

Direct Push Technologies training course, December 2007.

Project Management Training, Level 2, Tetra Tech 2009.

#### **QUALIFICATIONS**

Ms. Lingle has over eleven years experience as an environmental professional. She has performed at all levels, ranging from field personnel to Project Manager and Lead Biologist. Ms. Lingle provides environmental consulting services related to Biological Assessments, Ecological Risk Assessments (ERA), Wetland Assessments, Monitoring, and Mitigation Planning, Superfund Site Investigations, Storm Water Management and Erosion Control Assessments, National Pollutant Discharge and Elimination System (NPDES) Permitting and Storm Water Pollution Prevention Plan (SWPPP) Preparation for construction sites, Phase I Environmental Site Assessments (ESA), Property Condition Assessments (PCA) and Project Capital Needs Assessment (PCNA), and Groundwater Remediation, in support of private, federal government, and municipal clients. She has also participated in environmental permitting and compliance in relation to industrial, commercial development, retail development, and residential development sites.

#### RELEVANT EXPERIENCE

Biological Assessments / Ecological Risk Assessment / Wetlands Delineation, Assessment, and Monitoring/ Storm Water and Erosion Protection and Sediment Control (ESPC) Inspections

■ Private Client, East Tennessee and Kentucky. 2009 – present. Ms. Lingle conducted Storm Water Management and EPSC Inspections related to abandoned construction sites that were undergoing pre-foreclosure. The sites were under various states of disrepair, with significant erosion and loss of sediment control occurring at three of the sites. Significant sedimentation of a local creek was observed at one of the sites and significant road failure had occurred at another of the sites. At

each of the sites, Ms. Lingle completed an Erosion Protection and Sediment Control (EPSC) and Storm Water Inspection Checklist, which included documenting presence and condition of erosion controls and loss of sediment control from the site boundaries. Ms. Lingle also documented current site conditions using a handheld GPS unit and photographic documentation. File reviews at the local TDEC and Kentucky Department of Environmental Protection (KDEP) offices was also completed to determine if the construction activities previously conducted at the sites were properly permitted. A site meeting to discuss the status of the sites and to view current conditions was conducted with each of the state representatives, as well. Ms. Lingle prepared a Storm Water Management and EPSC Inspection Report and Corrective Action Plan for each of the sites. Corrective Actions included appropriate engineering requirements needed to stabilize the sites, recommendations for installation of EPSCs at the site, and schedule of EPSC inspections following appropriate TDEC and KDEP guidelines. Approximate cost to implement the repair activities is included. Tetra Tech is currently conducting oversight and storm water inspections for one of the sties that went into foreclosure and the bank client currently owns.

- Wind Farm Projects, Oklahoma, Ohio, and Texas. November 2007 2010. Ms. Lingle served as field team lead and project manager for two- two member teams to conduct a field assessment for jurisdictional wetlands and other waters of the U.S. for two approximate 30,000 acre wind turbine project areas in northeast and central Texas, one 10,000 acre wind farm in Oklahoma, and one 10,000 acre wind farm in Ohio. Tetra Tech uses handheld global positioning system (GPS) units to mark the location of wetlands and/or waters of the U.S. features of interest in the field. Using the GPS coordinates obtained in the field, Tetra Tech prepares maps and reports, which assist the client in determining the location of the aquatic features to be avoided for future placement of wind turbine pads and other necessary supporting structures of the project. Tetra Tech also assists the client in determining whether the project activities would result in permanent or temporary disturbance of the waters of U.S. in excess of that covered under the USACE Nationwide Permit (NWP) 12 for Utility Line Activities.
- 200-mile Electric Tie Line for Wind Energy, Texas, August 2008 March 2009. Ms. Lingle served as Tetra Tech's Project Manager, Wetland Field Effort Logistics Coordinator for wetland and waters of the U.S. evaluations being conducted along a 200-mile future electric transmission line that will extend from Abilene to San Antonio, Texas. Energy produced by wind farms in the Abilene area will be routed south along the tie line. Ms. Lingle also served as Field Team Lead in several mobilizations in September, October, December, and January. Extensive logistics coordination was required to meet the client's accelerated project schedule in order for construction to begin on a part of the line in December 2008. Approximately 30 to 40 miles of the line were evaluated per month. Wetland and waters of the U.S. features are captured using a handheld Trimble GPS device with submeter accuracy. This data is provided to the client in GIS to assist in their goal of avoidance of environmental impacts during construction activities.
- Private Client, Crossville, Tennessee. 2005 2009. Ms. Lingle provided technical services in order to obtain a TDEC Aquatic Resources Alteration Permit (ARAP) to permit the enclosure of 300 linear feet of an intermittent stream within an impermeable closed culvert system to allow future development of the property. To offset the loss of the stream, an on-site stream and wetland mitigation plan was prepared. Significant coordination with TDEC was required to obtain the ARAP permit. Ms. Lingle also prepared the Notice of Intent for the TDEC Construction Activity Storm Water Discharges and SWPPP as required under the NPDES Guidelines. Mitigation monitoring is to be completed by Tetra Tech once the construction of the mitigation area is complete.
- Highway 127 and Industrial Boulevard, Crossville, Tennessee 2005-2007 Ms. Lingle provided technical services in order to obtain a TDEC Aquatic Resources Alteration Permit (ARAP) to permit the enclosure of 250 feet of an intermittent stream within an impermeable closed culvert system to allow future development of the property. To off-set the loss of the stream channel, Ms. Lingle also prepared an off-site Stream Mitigation Plan. The ARAP process became more complex when it was determined that the site was adjacent to a facility that had impacted the groundwater with

- trichloroethylene (TCE). The groundwater underneath the site was also impacted with TCE. Ms. Lingle worked directly with TDEC personnel and the client to resolve issues with the ARAP submittal. Once the ARAP was approved by TDEC, Ms. Lingle subsequently provided additional services to the client that included a Phase I ESA and technical services in order to obtain a Brownfield Agreement for the property. Once the Brownfield Agreement was in place and the ARAP was accepted by TDEC, Ms. Lingle also prepared the Notice of Intent for the TDEC Construction Activity Storm Water Discharges and SWPPP as required under the NPDES Guidelines.
- 480-Acre Parcel, Erwinville, Louisiana, January 2008-February 2008. Ms. Lingle served as a member of a two person team to conduct field assessments for wetlands on a 480-acre tract of land in Erwinville, Louisiana. Approximately 130 acres of land was delineated as jurisdictional. Ms. Lingle will provide technical review assistance for the wetland delineation report, which will be provided to both the client and the USACE for confirmation. Ms. Lingle will also provide technical assistance to the client for future wetland permitting and mitigation actions.
- Private Client, Chattanooga, Tennessee, Paducah, Kentucky, and Columbus, Ohio, December 2007-March 2008. Ms. Lingle served as senior biologist in conducting wetland delineations for three locations. Two of the sites, which are partially developed with an auto auction business, were being evaluated for post-construction impacts into potential jurisdictional wetlands. Tetra Tech prepared reports of our findings, which can be provided to the USACE for confirmation of jurisdictional wetlands.
- Two Future Residential Developments, Van Buren County, TN, 2006 Ms. Lingle conducted wetland delineations for a 750-acre residential development and a 350-acre residential development. Work involved conducting field delineations, draft report submitted to the client and regulatory agencies (TDEC and USACE), confirmation site visit with the regulatory agencies, and submittal of a final delineation report. Approximately, 3.71 acres and 8.9 acres of wetlands were delineated and confirmed by the state and federal regulators for the two sites.
- Wilder Mountain Development, Wilder, TN, 2005-2006 Ms. Lingle conducted wetland delineations and stream determinations for a 3,500-acre residential development site following a Notice of Violation the development received for potential impacts to wetlands and streams from the construction of access roads and lack of maintenance of Sediment and Erosion Control Measures during the construction. Work involved conducting field delineations, draft reports submitted to the client and regulatory agencies, confirmation site visits with the regulatory agencies, and submittal of final delineation and stream determination reports. Approximately 6.33 acres were considered wetlands and 0.98 of the wetland had been permanently or temporarily impacted by construction activities. Twelve streams and 11 wet weather conveyances were identified during the stream determination. Nine of the streams were determined to be temporarily impacted by sediment from lack of sediment and erosion controls, which relates into 1,925 linear feet of stream and an additional 0.514 acre area impacted outside the stream channels.
- Aerojet General Corporation, Sacramento, CA 2005-Ongoing— Ms. Lingle assisted in development of a Field Sampling and Analysis Plan, Problem Formulation, Conceptual Site Model for the Ecological Risk Assessment for the Superfund Site.
- Morgan Contracting, Murfreesboro, TN 2004 2005 Ms. Lingle conducted monthly and rain event storm water and best management practices (BMP) inspections for a construction site laying storm sewer lines through the West Branch of the Stones River.
- North High School Wetland/Stream Restoration Monitoring Program, Home Depot, Kingsport, TN, 2003 2007 Ms. Lingle served as Project Manager and conducted aquatic sampling required for the 5-year wetland-monitoring program of a constructed wetland. An environmental lien for the wetland and stream enhancement area was recently acquired, which restricts future land development, and the site is no longer required to be monitored.

#### **Groundwater Remediation**

Ammonia Release Sites, Nebraska and Iowa 2006-2010 – Ms. Lingle served as Project Manager for eight (originally twelve) groundwater remediation sites that were caused by releases to the soil and groundwater from an anhydrous ammonia pipeline. The primary goal was to work with the client and the state regulatory agencies to receive closure for the sites. Four sites have achieved closure under Ms. Lingle's management. Ms. Lingle coordinated quarterly and semi-annual groundwater monitoring. Groundwater plume delineation studies have been conducted at several of the sites and future activities will include installation of additional groundwater monitoring wells and remediation efforts. Ms. Lingle will be proposing alternate cleanup levels for several sites, which exhibit minimal impacts to the groundwater. For sites with higher impacts to the groundwater, Ms. Lingle is currently studying alternative remediation techniques to potentially be used at these sites.

#### Site Assessment Investigations / Superfund Remedial Investigations / Regulatory Compliance

- Memphis Housing Authority-Legends Park and University Place 2005 2009 Technical Reviewer and Assessor/Sampler. Over the course of this project, Ms. Lingle has assisted in the development of site specific work plans and conducted technical edits of deliverable work products. She also developed response to comments received from the TDEC Division of Remediation, specifically addressing questions related to human health risks associated with site contaminants. Ms. Lingle ultimately completed a Level I Human Health Risk Assessment for arsenic and lead, in response to the comment. Ms. Lingle has served as a member of the soil and groundwater sampling team on multiple occasions and completed Phase I ESAs for multiple parcels of the University Place Redevelopment. As part of the initial ESA, there was an extensive historical document review for the property.
- Volunteer Oil Emergency Response, Henryville, TN, 2006 Under the START 3 contract, Ms. Lingle served as Project Manager for the Emergency Response activities for a tanker truck spill of used oil at the Buffalo River in Henryville, TN. Tetra Tech/START conducted oversight activities and assisted the EPA on-scene coordinator (OSC) activities to evaluate the downstream impacts of the oil spill. A letter report of activities conducted was completed at the end of the response.
- American Heritage Shutters (AHS), Memphis, TN, 2005 Under the START Contract, Ms. Lingle served as sampling team member, Site Safety Coordinator, and sample processor using Forms II Lite in support of the sampling investigation for the AHS site. Sampling conducted included groundwater, sediment, surface soil, and subsurface soil following EPA Certified Laboratory Procedures chain-of-custody protocols and EPA EISOQAM.
- Project manager to prepare HRS Documentation Record for two facilities in Memphis, Tennessee; one facility in Nashville, Tennessee; and one facility in Tullahoma, Tennessee. Responsibilities included reviewing site files, field sampling, and collecting information sufficient to reassess the threat posed to human health and the environment, and to determine the need for appropriate action using the HRS for migration pathways.

# Phase I Site Investigations / Property Condition Assessments / Property Condition Needs Assessments / Pesticide and Mold Sampling

- Property Condition Assessments and Project Capital Needs Assessments, Various Locations, Ongoing. Ms. Lingle has completed PCA and PCNA site visits for over 100 facilities (restaurant, warehouse, skilled nursing facilities, and closed bank branch facilities). The PCA includes evaluations of the site grounds, structural systems, building envelope, interior building components, mechanical systems, life safety, and code compliance. The PCA reports also included estimates for the physical needs over a 10-year term (adjusted for inflation), initial deposits, annual deposits, immediate critical repair costs, immediate non-critical repair costs, and replacement reserves.
- Phase I Environmental Site Investigations and Spill Prevention Control and Countermeasure Plans (SPCC), Various Private Clients, Ongoing Ms. Lingle has performed over 300 Phase I

Environmental Site Assessments (ESA) to satisfy due diligence for various private clients. These Phase I ESAs were completed in various states, including Florida, Georgia, Michigan, South Carolina, Tennessee, Virginia, Missouri, Illinois, Indiana, New Jersey, New York, Michigan, and Kansas. Ms. Lingle also has performed over 20 SPCC Plans for these clients.

#### PROFESSIONAL ORGANIZATIONS/ASSOCIATIONS

Society of Environmental Toxicology and Chemistry (SETAC) Soil and Water Conservation Society

#### PRESENTATIONS AND PUBLICATIONS

Abstract: "Influence of Mercury and Sodium Chloride on *Spartina* as a Food Source." Georgia Journal of Science, 57(2):148-149, 1999.

Poster Presentation: "Biodegradation of Trichloroethylene in the root rhizosphere of *Typha Latifolia* as compared to anaerobic sediments - a microcosm study." National SETAC 20<sup>th</sup> Annual Meeting, Charlotte, N.C., November 1998.

Technical Report: "Survivorship and Reproductive Success of Blue Grosbeaks (*Guiraca caerulea*) in Cotton Fields and Their Environs in Western Tennessee After Treatments of Pirate ® Insecticide - Miticide (AC 303630 in a 36C Formulation) - a Pilot Study in Preparation for a Two Year Monitoring Study ©." F.C. Bailey, D.L. Lingle, and J. Nehring. 1997.

#### EMPLOYMENT HISTORY

September 1999 - Present Tetra Tech EM Inc.

Nashville, Tennessee

April 1999 - Sept 1999 Vanderbilt University

Nashville, Tennessee

1996 – 1998 Middle Tennessee State University

Murfreesboro, Tennessee

#### PROFESSIONAL REFERENCES

Available upon request



APPENDIX C - STREAM SURVEY AND HABITAT ASSESSMENT FORMS

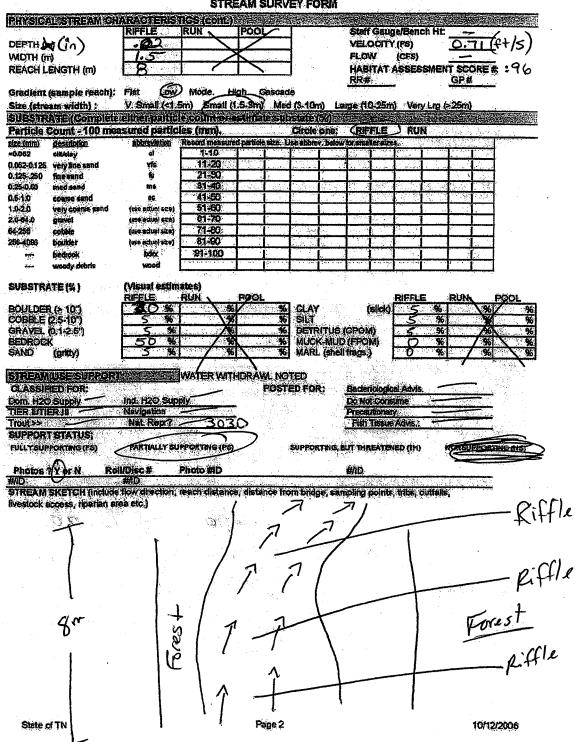
Division of Water Pollution Control QSSOP for Macroinvertebrate Stream Surveys Revision 4 Effective Date: October 2006 Appendix B: Page 8 of 12

#### STREAM SURVEY FORM

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STREAM SURVEY INFO STATION NUMBER: STATION LOCATION: COUNTY: WBID#HUC: WATERSHED GROUP # LATITUDE DECIDEG LONGITUDE DECIDEG ECOLOGICAL SUBRECH PROJECTIPURPOSE: SAMPLES COLUTECTEL AQUADO LIE ASSESSED	DON Done WI TNOS J 35, 89 -86,80 Macroinvert	2383 1743	ul n - Schon	Algae	ASSESSI DATE: TIME: STREAM STREAM DRAINAGE ELEVATI GAZETTE USOS QU	MILE: ORDER; SE AREA ON (M): SER PAGE	7/2	w. In	· · · · · · · · · · · · · · · · · · ·
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#### STREAM SURVEY FORM



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### HABITAT ASSESSMENT DATA SHEET- HIGH GRADIENT STREAMS (FRONT)

STREAM NAME	DONELSON CREE	<b>X</b>	LOCATION	Moores Elenent	ary School			
STATION# 178	NELOOS WI		ECOREGIO		7			
LAT 35' 53.54	13" - N LONG -86"	50.846 W	WATERSH	ED GROUP the AUL	Rest			
WBID/HUC Z	51302040105	a de la composición dela composición de la composición dela composición de la composición de la composición dela composición dela composición de la composic	INVESTIGAT		ler JWHAL			
FORM COMPLETED	BY CBIGNAL	Andrew St. 199 St. 1994 St. 1995	DATE 7/22/10	TIME 1.36 AM (PM')				
Hahitat Parameter	Candition Category	vision de la company						
	Optimal '	Suboptimal		Marginal	Poor			
1. Eqitsunal Substrate/Available Cover	Greater than 70% of substrate favorable for epifanual colonization and fish cover, mix of snaps, 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)	well-suited for colonization p adequate habi	otential; at for f populations; ditional a from of it yet prepared it (may rate at	20-40% mix of stable hisbitat; availability less than desirable; substrate frequently disturbed or removed	Less than 20% stable habitat; fack 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			
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble particles are 2 surrounded by		Gravel, cotble, and boulder particles are 50-75% succounded by fine sediment.	Gravel, cobble, and boulder particles are more than 76% surrounded by fine sediment.			
SCORE 10	20 19 18 17 16	15 14 13	12 .11 (	10 9 8 7. 6	5 4 3 2 1			
3. Velocity/Depth Regime	All four velocity/depth regimes present (alow-deep, slow-shallow, fast-deep, fast- shallow) (Slow is<0.3m/s deep is >0.5m)	Only 3 of the a present (if fast missing score regimes).	alallow is	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 9	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 bottom affected by sediment deposition	Some new incr formation, mor gravel, sand or 5-30% (20-50) gradient) of the affected; slight pools	stly from fine sediment; % for low- a bottom	Moderate deposition of new gravel, sand 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 hends; 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 8	20 19 18 17 16	15 14 13	12 11	10 9 (8) 7 6	5 4 3 2 1			
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills> 75 available chan channel substr	nel; or 25 % of	Waters 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 /D	20 19 18 17 16	15 14 13	12 11	10) 9 8 7 6	5 4 3 2 1			

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### HABITAT ASSESSMENT DATA SHEET-HIGH GRADIENT STREAMS (BACK)

Habitat Parameter				
	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 of coment, over 80% of the stream reach channelized and discupted. Instream habitat greatly altered or removed entirely.
score 15	20 19 18 17 16	<b>/19</b> 14 13 12 11	10 9 8 7 6	5 4 3 2 1
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 5-7); 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 labitat, distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor hebital distance better riffles divided by the width of the stream is a ratio of >35.
SCORE #\	20 19 18 17 16	15 14 13 12 🕅	10 9 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 erosion or bank failure absent or minimal; fittle potential for future problems <5% of bank affected.	Moderately stable; infrequent, small areas of crosion mostly healed over. 5-30% of bank in reach has areas of emision.	Moderately mustable; 30- 60 % of bank in reach has areas of ecosion; high crossion potential during floods	Unstable; many croded area faw areas frequent along straight sections and bends; obvious bank slongning, 60 100% of bank has crosional scars
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 3	2 (1) 0
SCORE <u>5</u> (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protective (score each hank) Note: determine left or right side by facing downstream	More than 90% of the streambank surfaces and immediate infarian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or moving 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 subble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of fore 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 has been removed to 5 centimeters or less in average stubble height
SCORE <u>J</u> (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
10. Riparian Vegetative Zone Width (some each bank riparian zone)	Width of riparian zone > 18 meters; human activities (i.e. parking lots, roadbeds, clear- cuts, lawas or crops) have not impacted zone	Width of siparian zone 12-18 meters; human activities have impacted zone only minimally	Width of riparian zone 6- 12 meters; imman activities have impacted zone a great deal.	Width of riparian zone of meters: little or no riparian vegetation due to human activities.
SCORE / (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE (RB)	RightBank 10 9	8 7 (6)	5 4 3	2 1 0

TOTAL SCORE



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Part of the Property Control	ADMINITION.		CAM GON	VET FUNN					
STREAM SURVEY AND STATION NUMBER:		≥001.5H	_		ASSESS	apr.	~ ~ =		,
	FIVENT	* £	\$ 7.47	<del></del>	DATE:	ono.	2-22-		ĺ
STATION LOCATION:		5/01d P	entonsvil	E.Rd.	TIME:	$\mathcal{N}_{i,m,k}$	09:45	10	
COUNTY:	WI	ा वृह् रेक्ट	<del></del>		STREAM	MILE	1.5	<del></del>	
WBID#HUC;	TNOS	13020	+	<del></del> :	STREAM	ORDER:	4		
WATERSHED GROUP #	-1				DRAINAC				
LATITUDE DECIDEG		875		<del>-,</del> :	ELEVATI				
LONGITUDE DECIDEG		3515	and the reserve	TOTAL .		ER PAGE			
ECOLOGICAL SUBREG		Secretary Secretary	1.32	-	uses qu	IAD		100 (21 ) . (21 ) W 100 000	*
PROJECTIPURPOSE	Name and district	CMPA SECTION CAPAGE		-			Vanda and American	Control Control Control	
SAMPLES OF LECTE Aquatic Life Assessed	(Macroinver		Fish	Algee	Other:		1000		
Type of benthic sample:			ANK DEND		OTHER_				
CHEMICALS YOUN	K		nation menior	i gonsen	Oluch.	***********			
FIELD MEASUREMEN								100000	
METERS USED: TV		and the second second second	HACLES CHEROLES		THE RESERVE AND A SECOND				
140	The second second		AND DESCRIPTION	* * * * * * * * * * * * * * * * * * *					
pH	1830	-8	តា .		ENGEAL ME	DOXYGEN	17 163		6-41
CONDUCTIVITY	1/03 2	Parallel S	m Sc	m) .	TIME	DOMIGEN	1102	CPM	(mg/L)
TEMPERATURE	782	2			OTHERS		4740		•
seem essistanting	1.12.00	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1			CINENS		<del></del>	لــنـــا	
Previous 48 hours Precip:	UNKNOWN	NONE	LITTLE	MODERATE	HEAVY	FLOODING	-		
Ambient Weather:	(SUNITY)	CLOUDY	BREEZY	RAIN	SNOW	AIR TEMP			
The state of the s	94,440	DC00001		TAPEN .	DIAMA	MANUAL SERVICE			
WATERSHED CHARAS	TERISTICS	App % of	Watershedio	bserved/			TO A CHARGE STATE OF THE		
UPSTREAM SURROUND				A CONTRACTOR OF THE SECOND SEC		75.000000000000000000000000000000000000		Towns of the second sec	
PASTURE 6	URBAN	. 5	RESID	POR K	7				
CROPS O	INDUSTRY	6	OTHER	58.4	<b>]</b>	17, 811.			
FOREST	MINING	O							
IMPACTS: rated S(ligit		, H(igh) magn		# not observ	ed			54 .c.\$.	
CAUSES	Flow Alter		SOURCES		The state of the s	Unknown	(9000)	\$X: +:	
Pestitides (0200) (Y) Metals (0500) (S)	Habitat All.		Point Source		0100) (52)	Municipal		<u> </u>	
Ammonia (0600) S	Thermal Att. Pathogens		Logging	n:Land Devel	2000)	Mining Read /bridg	(5000)	<u>Q</u>	
Chlorine (0700) (Y)	Of 6 grease		U/S Dam		800)	Urban Rund		<u> </u>	
Nutrients (0900) (	Unknown	(0000)	Riparien los		7600) II		dizetion (7700		
pH (1800) S	Station	(1100) M	Agriculture:	Row prop (	1000) [4		eedlot (1600)	0	
Organic Enrichment / Low	DO S	(1200)		ezing-ripanan	(1410) M	Dredging	(7200)	0	
Other:			Other:			200 Table 100 Table 1		Company of the company	
PHYSICAL STREAMIC		MICO TARREST	LENGTH O	ESTREAM A	REAMSSES	SED (m)			
SURROUNDING LAND U		The second second		en e non reading total	to be been and	The second			
ESTIMATE % RDB	LOB		RDB	LDB	<b>-</b>	ROB	LDB		
PASTURE 90	85	URBAN	<u> </u>	<u>Q</u>	RESID.	5	10		
CROPS 5	15	MOUSTRY		2	OTHER				
W CANOPY COVER: Est	<u> </u>	J WINNE	$\Box \mathcal{Q}$	$\Gamma C$	1				
M CANOPI COVER EST	musico:	_ Open(0.10)		ded(11-45)	Mostly Strad	ed(46-80)	Shaded(>80)		
Measu BANK HEIGHT (m): (L)	72		100000000000000000000000000000000000000	<del>-</del>	LB		RB_C		
BANK HEIGHT (m): L		SLIGHT		VATER MARK		5			
TYPE: SUDGE	MUD	SAND	GODERATE SET	EXCESSIVE NONE	BLANKET OTHER	geta	interninated	W	
TURBIDITY CLEAN	SLIGHT	MODERATE	HIGH	OPAQUE	Ander		, namualed	YOUN	
ALGAE PRESENT?	(NOME	SLIGHT	MODERATE	CHOKING	TYPE	·			
AQUATIC VEGET.	ROOTED	FLOATING	TVPF	_ AJON 8		**************	,		
ADDITIONAL COMMENT	3:(oil sheen, o	for, colors)	NUNE						

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#### STREAM SURVEY FORM

PHYSIC	CHARLES WERE HELD TO THE PROPERTY OF THE PARTY OF THE PAR							
	LESTREAM CH	ARACTERIS	nes teoma		100000000000000000000000000000000000000			
	0. 3		RUN	TPOOK		Staff Gaug	e/Bench Ht	
	450)			17	1	<b>一种发展的 新巴州东西</b>	gate fig.	10/01/
EPTH D		12		<b>↓</b> ⁄	4	VELOCITY	No. of	10 1+1
VIOTH (n	3)	2.6			J	FLOW	(CFS)	
(	ENGTH (m)	14			4	HABITAT A	SSESSME	NT SCORE# X
inight.	in sits i in first	<del>4.7</del>				RR#	ورداشا حامات	GP#
	Maria de la serie de la compansión de la co		**************************************			13539		SF#
radient	(sample reach):	Flat Low		igh Cascad	ie .			
ize (ctro	am width);	V. Small (ct.	m) \$mail}	.5.3m) Me	d (3-10m) La	me (10-25m)	Very Lm	(>25m)
	ATE (Complete							
				- Milagasii				
erticle (	Count - 100 mes	sured partic	es (mm).	inga salah sal Salah salah sa	Circle one:	(RIFFLE)	RUN	Now the second
e (mm)	description	abbreviation	Record measure	d particle size. I	Jse abbrev, below	to small eraise	X	
0.062	elthiny	el el	1.10	1			200 T 2 T 1 T 1 T 1	10.71
				<del>  </del>				
062-0.125		yfs	11-20		20.000			
25-250	fine vand	છ	21-30		J [.			1 1 1
25-0.60	med sond	<b>20</b> 6	81-40	awa a San	. 40 AND 400			T 1
130	coarse sand	CG.	41-50					1 15 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
A 200 S		::	51-60	<del>                                     </del>	<del>                                     </del>	1 1		1-1-
120	very coarse sand	(me navoj sep)			terrini by the			
0.84.0	gravel	(use equal size)	61-70					
256	cobble	(use actua) size)	71-80	1 1			* - 2. I	
6-4096	boulder	(use actual size)	81-90				1	
	Star of the	90 00033 1003 2		144		1 1 1		<del>                                     </del>
*#	bedrook	bdex	91-100	\$ <b>3</b>				
***	woody debrie	wood	and the second second second	7	1	1		
	•			***				
JBSTR	ATE(%)	(Visual estim	ates)					/
	~ान्ध्रम ∤		RUN	POOL			RIFFLE	RUN PROL
	A de la facilita				T. M. M.			
	1 (> 101)	5 %	<u>\</u> *		M (2.2.3)	(slick)	5 %	<u> </u>
DBBLE	(2.5-107)	10 %	***				O %	1 <b>X</b>
RAVEL	01250 5	10 %	96	/\ <b>*</b>	DETRITUS	(GROM)	0.96	96%
EDROC	k 15	337 W	*				o <b>%</b>	
AND		0 %	/%				S 8	
NAME OF	(gritty)				A MILLION TRUE	negati	<u> </u>	1 / 30 7
hotos/		l/Disc#	PPORTING (PS) Photo #ID	 	SUPPORTING,	₩ND.		NONEUPPORTING (N
Ф.		#ID		en dita berianin d	and the same and	and California Harris		14. Kin 17. Kin
TREAM	SKETCH (include	flow direction,	reach distanc	e, distance fo	om bridge, sar	npling points,	tribe, cutfal	<b>8</b> ,
			_		<del>-</del>	ing mengani sit		
CHILDRY I	icoess norman w	50:50//	1.1		1 -			
estock i	iccess, riparian ar	sa swy						
			Bridge					
		ea ewy	Bridge		<del>-</del>			
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		1 1	Bridge 7 Cur	·	+			, £.
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			7,0	1	7			of high pt.
			7,0	1	1		الل	of high pt.
			7,0	1	+	<b>^1</b>	side"	of high pt.
			7,0	1		1.54	side	of high pt.
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		1	7,0	1		Left	side '	of high pt.
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		四种(1)	7,0	111		Last	side in	of high pt. Juded in Juded in
		Biffe. > >	7,0	111		Lest	side in	of high pt.
		· 欧祖。 >	7,0	1 1 1		Lest	side of in	of high pt.  Judel in  Judel in  Judel 18  Judel 18  June 105
		-> eth. > -	7,0	111		Lest	side in Nocroin	of high pt.  Juded in  Juded to  Jud
		~ 四种"	7,0	1111		Left	side in Nacroin	of high pt.  Juded in  Juded to be  June 105  Sumples
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L COMP	tur of the second	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	7,0	1111		Lest	side not in processing the processin	of high pt.
L COMP	tur of the second	7、四种5、人	7,0	1 1 Page 2		Left	side in Nacroin	of high pt.  Judid in  Jud
	tur of the second	2. " BITAL! > ~	High ot. with 12	1 1 Page 2		Lest	side in Nocrois	of high pt.  Judil in  Jud
L Q WIN	tur of the second	2. " BITAL! > ~	High ot. with 12	1 1 Page 2		Lest	side in Noting	of high pt.  Judul in  Jud
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L COM	tur of the second	2. " BITAL! > ~	High ot. with 12	A A A Page 2		Last	side not in processing the processin	of high pt.  Judid in  Jud
L COM	tur of the second	2. " BITAL! > ~	High ot. with 12	7 1 Page 2		Left	side in hockery	of high pt.  Judid in  Jud
L Q WIN	tur of the second	2. " BITAL! > ~	High ot. with 12	1 1 Page 2		Lest	side in Nocrois	of high pt.  Judil in  Jud
L Q W	tur of the second	Run 1 1976. > - 1	High ot. with 12	1 1 1 Page 2		Lest	side in Nothing Flow	of high pt.  Judel in  Jud
L COMP	tur of the second	2. " BITAL! > ~	High ot. with 12	A 1 Page 2		Lest	side in Nocroin	of high pt.  Judid in  Jud
L Q WIN	tur of the second	Run 1 142 > -	High of with 12			Left	side in Not in Notoroil	of high pt.  Juded in  Jud
L COMP	tur of the second	Run 1 142 > -	High ot. with 12			Lest	side in Nocross	of high pt.  Judud in  Jud

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# HABITAT ASSESSMENT DATA SHEET- HIGH GRADIENT STREAMS (FRONT)

STREAM NAME			LOCATION	old Peytonsu	ille Rel
	NILEOOLSUI		ECOREGIC		`s'.
LAT 35° 52. (2		50.109'W	WATERSH	ED GROUP Harleth	River
MBID/HIIC 03	1302040105	99.50	INVESTIGAT	ORS CRICKYA TWELLER	Talillesbly
FORM COMPLETED	BY CBishop		DATE 7/22/10	TIME 1.15 AM) PM	
Habitat Parameter	Condition Category	es se se			
	Optimal	Suboptimal		Marginal	Poor
i. Epitaunal Substrate/Available Cover	Greater film 70% of substrate favorable for epifannal colonization and fish cover; mix of anage, submerged logs undercot banks, cobble or offier 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 o well-suited for colonization p adequate liabil maintenance o presence of ad substrate in the newfall, but no for colonizatio high end of se	ofential; at for f populations; ditional o from of it yet prepared n (may rate at	20-40% mix of stable liabitat; availability less than desirable; substrate frequently disturbed or removed	Less than 20% stable babitat; 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
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble particles are 25 surrounded by	5-50%	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 3	20 19 18 17 16	15 14 13	12 11	10 9 8 7 6	5 4 (3) 2 1
3. Velocity/Depth 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 present (if fast missing score I regimes).	sliallow is	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
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low—gradient streams) of the bottom affected by sediment deposition	Some new inco formation, mos gravel, sand or 5-30% (20-50% gradient) of the affected; slight pools	tly from fine sediment; 6 for low- bottom	Moderate deposition of new gravel, sand 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 12	20 19 18 17 16	15 14 13	12 11	10 9 8 7 6	5 4 3 2 1
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills> 75° available chann channel substra	el; or 25 % of	Waters 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 7	20 19 18 17 16	15 14 13	12 11	10 9 8 7 6	5 4 3 2 1

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# HABITAT ASSESSMENT DATA SHEET-HIGH GRADIENT STREAMS (BACK)

Iabitat Parameter	OOISWI Date	(		
iamar rarameter		Suboptimal	Marginal	Poor
. Channel	Optimal  Channelization or designing	Some channelization present,	Channelization may be	Banks shored with gabion o
Meration	absent or minimal; stream with normal pattern.	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	extensive; embankments or shoring structures, present on both banks; and 40 to 80% of siteam reach channelized and disropted.	cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
scorie II	20 19 18 17 16	15 14 13 12 (11)	10 9 8 7 6	5 4 3 2 1
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 5-7); variety of habitat is key. In streams where riffles are continuous, placement of	Occurrence of stiffes 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 habita distance between riffles divided by the width of the atream is a ratio of >35.
	boulders or other large, natural obstruction is important.			
SCORE 12	20 19 18 17 16	15 14 13 🕅 11	10 9 8 7	5 4 3 2 1
Bank Stability (score each bank)  Note: determine left or right sule by facing downstream.	Banks stable, evidence of crosion or bank failure absent or minimal; fittle 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 heak in reach has areas of crosion; high crosion potential during floods	Unstable; many eroded are "raw" areas frequent along straight sections and bends obvious bank sloughing; 6 100% of bank has erosions scars.
SCORE 3 (LB)	Left Bank 10 9	8 2 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 Protective (score each hank) 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; elimost 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 subble 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 cover by vegetation; disruption is streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height
SCORE Z (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
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riperian zone > 18 meters; human activities (i.e. parking lots, roadbeds, clear-cuts, lawns or crops) have not	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 (LB)	impacted zone Left Bank 10 9	1 8 7 6	5 4 3	2 1 0

TOTAL SCORE

83

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#### STREAM SURVEY FORM

STREAM SURVEY (INFO	RMATION							
STATION NUMBER:	MATS	000006	WI.		ASSESSO	RS:		Jullaustby
STATION LOCATION:	S. Royal		હતે.	. 4	TIME:		09.40	
COUNTY:	Williamso	1		•	STREAM O		2.6	•
WBID#HUC: WATERSHED GROUP#		130204			DRAINAGI	EAREA		
LATITUDE DECIDEG	35.90			•	ELEVATIO GAZETTEI	Car Mari		
LONGITUDE DECIDES ECOLOGICAL SUBREGIO		1651	ZVACZNICZ Z Z		USGS QU	22.2 (2.1)		
PROJECT/PURPOSE:		100 410				Serve Drawn Area State State		
SAMPLES COLLECTED Aquatic Life Assessed	Macroinverte	rates)	Fish	Algae	Other:			
Type of benthic sample: B			NK DENDY	SURBER	OTHER_			
CHEMICALS YOR N								
METERS USED: 7/4								A
And the second s	age ster	angkatanang belat 1990 at Sang ang angkatan	f :		erio per erresor Linea de l'interna		7 220	( 6)
pH	38,63	SU	mskem	<b>\</b>	DISSOLVED	OXYGEN	04:40	mg/L)
CONDUCTIVITY TEMPERATURE	76.51		(OF)	)	OTHERS			
and the second second	Lagran Carrier	<b>~</b>			. Design	FLOODING	0-	
Previous 48 hours Precip: Ambient Weather:	CYMNUS (	CLOUDY	BREEZY	MODERATE	HEAVY	AIR TEMP	10°	F
							NAME OF TAXABLE PARTY.	
WATERSHED CHAPAC UPSTREAM SURROUNDS			Vaterisies) (): ()	Selved V				
PASTURE 75	URBAN	6	RESID	75	]			
CHOPS: 5	MOUSTRY	್ದರ	OTHER	<u> </u>	j			
IMPACTS: rated S(light	Mining ), M(colerate);	H(lat) meani	ude.: Blank	not observe	M.		100	
CAUSES	Flow Alter	(1500) AA	SOURCES Point Source	100	100)	Unknown Wunicipal	(2000) /	
Pesticides (0200) M Metals (0500) H	Habitet Alt. Thermal Att		Logging	and delenged 🙋	000) 📏	Mining	(5000)	7
Ammonia (0600) \	Pathogens Oil & grease	(1700)	Construction U/S Dam	Land Devel (	3200) M 800) \	Road /bridge Urban Runo		
Chlorine (0700) Nutrients (0900)	Unknown	(0000) 🔪	Riparian los	<b>6</b>	7600) //\	Bank destal	lization (770)	X
pH (1000) Organic Enrickment / Low		1100) S 1200) S		Row crop (1 azing-riparian		Intensive Fr	ediol (1600) (7200)	
Other:	Libert Williams Consequence	312.	Other:			white the		
PHYSICALISTREAMICH		iics) — Sal	EENGTH O	STREAM AT	EAWSEE	SED/m/		
SURROUNDING LAND US ESTIMATE % RDB	LDB		RDB	LDB		RDB	LDB	
PASTURE ZO	Q	URBAN	20	10	RESID	60	90	
POREST O	100	MOUSTRY	8	8	OTHER	0_	<del>LO ,</del>	
% CANGRY COVER: Est	mated:	Open(0-10)	Farty Sha	ded(11-45)	Mostly Shad	ed(46-80)	Shaded(>80)	
Measu	ted:	U/5	D/S	ATER MARK	LB	6.5m	RB	
BANK HEIGHT (m):(	MONE	STIGHT (	MODERATE	EXCESSIVE	BLANKET	هم اندین بر اسیتمس		- <del></del>
TYPE: SUDGE	COLO !	GAND	SIT	NONE	OTHER	G	intaminated	Y or N
TURBIDITY CLEAN	MONE	MODERATE SLIGHT	HIGH MODERATE	OPAQUE CHOKING	TYPE			
AQUATIC VEGET.	ROOTED	FLOATING	TYPE		7150			
ADDITIONAL COMMENT	s:(OI sneen, od	or, colors)			·			<del></del>

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#### STREAM SURVEY FORM

PHYSIC	ALSTREAM CH	ARAGIERIS	nes/coma	SORVE   FORM			
	1		RUN POC	IL ]	Staff Gauge	/Bench Ht 💢	
DEPTH (	m(in)	1.15			VELOCITY (	FS) 0.2	平(++/s)
WICH (	r)	1.27	<b>├</b>	ا النج		CFS) —	/
REACH L	ENGTH (m)	111.3				SESSMENT SCO	RE#
Gradient	(sample reach):	Flat (LOW	Mode. High	Cescade	RR#	GP#	
	am width);	V. Small (<1.	5m) Small (1.5.3m	) Med (3-10m) La	inge (10-25m)	Very Lrg (>25m)	a reason of
SUBSTR	ATE (Complete	eitrerpartic	Beountoresum	te Substate (%)			
	Count-100 mea			Circle one:	(RIFFLE)	RUN	
size (mm) =0.062	description cittalay	abbrevietien ei	140	e size. Use abbrev, below	for smaller sizes.	1 1	
0.062-0.125		yfs	11,20			20 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
0.125.250	fine sand	fe	21-90				<del>-1</del>
0.25-0.60 0.5-1.0	medicand coarse cand	ins.	81-40 41-50			That Year	
1.0-2.0	very coarse sand	(use pate) sca)	51-60				
2.0-64.0	gravel	(use adual sza)	81-70		1 1 1		
64-286	cobble	(use actual size)	71-80				
256-4096	boulder	(use actual size)	81-90				
***	bedrook woody debris	bdex wood	91-100			1 1	
	minorities in	1002					
SUBSTR/	TE(%)	(Visual estim					
PART 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	i a arimini l		RUN FOOI			FFLE RUN	POOL
COBBLE	( (2 10 ) D 5.10 )	0 %		A SLAY	(slick)	0 * /	% %
GRAVEL		30 %	<del></del>	% SILT	CPOM -	15 % \ O %	* *
BEDROCK	ζ	O %	*	% MUCK-MUD	(FPOM)	15 %	
SAND	(gritty)	30 %	<u></u>	MARL (shell	frags.)	0 %	96
STREAM	USESUPPORT		WATER WITHORAY	M MOTER	gar Agar Mg	•	
CLASSIF				POSTED FOR:	Baderiological /	Add die	
Dom. H2C	Supply	ind. H2O Supp			Do Not Consum		<del></del>
TIER INTE	RJI	Navigation	Salah Salah		Precedimenty		<del></del>
Trout		Nat. Repr?	303 D		Figh Tissue Ad	lvis.:	
	STATUS; PORTING(F5)	PARTIALLY SUI				•	200
interest	Continuo(ra)	rainiputi our	LOVING (LC)	SOPPORTING B	UT THREATENED	(TH) NONSURI	PORTING (NS)
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#/0		#/D				and the same title and the	
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### HABITAT ASSESSMENT DATA SHEET-HIGH GRADIENT STREAMS (FRONT)

STREAM NAME	Watson Branch	LOCATIO	IN S. Royal Oaks Blue	
STATION# WA	150000.6WI	ECOREG		
LAT 35' 54.50	62' া N LONG -86'.	50.791' • WATERS	HED GROUP Health ZN	,es
WBID/HUC 05	302040105	INVESTIGA		Z
FORM COMPLETED	BY Coiship	DATE 7/27	10TIME 11,00 AM PM	
Habitat Parameter	Condition Category	ografication of the control of the c		
	Optimal	Suboptimal	Marginal	Poor
I. Epifaunal Substrate/Available Cover	Greater than 70% of substrate favorable for epifanual 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 habital well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the from of newfall, but not yet prepared for colonization (may rate at high end of scale)	availability less than desirable, substrate frequently disturbed or removed	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking
SCORE X	20 19 18 17 16	15 14 13 12 11	10 9 7 6	5 4 3 2 1
2. Embeddedness	Grayel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of riche 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 13	20 19 18 17 16	15 14 (3) 12 11	10 9 8 7 6	5 4 3 2 1
3. Velocity/Depth 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 regimes present (if fast-shallow is missing score lower than 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 12	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 bottom affected by sediment deposition	Some new increase in bar formation, mostly from gravel, sand or fine sediment 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools	(50-80% for low-gradient) of the bottom affected; sediment	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 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
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.		Very little water in channel and mostly present as standing pools.
SCORE 9	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1

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# HABITAT ASSESSMENT DATA SHEET- HIGH GRADIENT STREAMS (BACK)

labitat Parameter				
	Optimal	Suboptimal	Marginal	Poor
. Channel Meratina	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 of cement, over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
score 12	20 19 18 17 16	15 14 13 😥 11	10 9 8 7 6	5 4 3 2 1
f. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent, ratio of distance between riffles divided by width of the stream <7:1 (generally 5-7); 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 habita distance between riffles divided by the width of the stream is a ratio of >35.
SCORE X	20 19 18 17 16	15 14 13	10 9 8 7	5 4 3 2 1
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 <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 are "raw" areas frequent along straight sections and bende obvious bank slonghing, 6 100% of bank has erosions scars
SCORE 4 (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 Protective (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 cover by vegetation, disruption is reambank vegetation has been removed to 5 centimeters or less in average stubble height
SCORE 7 (LB)	Left Bank 10 9	8 /7) 6	5 4 3	2 1 0
SCORE_S_(RB)	Right Bank 10 9	8 7 6	(5) 4 3	2 1 0
10. Riparian Vegeiztive 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 ciparian 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 < meters: little or no riparia vegetation due to human activities.
SCORE 4 (LB)	Left Bank 10 9	8 7. 6	5 (4) 3	2 1 0

TOTAL SCORE



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311	KEAM SUKVET FURM			
WATERSHED GROUP # LATITUDE DECIDES -86.87961 ECOLOGICAL SUBREGION: -716 PROJECTIPURPOSE: SAMPLES COLLECTED	ัด <b>น</b> ฯ	ASSESSORS: DATE: TIME: STREAM MILE: STREAM ORDER: DRAINIAGE AREA ELEVATION (fi): GAZETTEER PAGE USGS QUAD	CBiho 12/10 13/30 0,7	
CHEMICALS YOUN' FIELD WEASUREMENTS  METERS USED: Troll 9000  PH S.38 E 7.75.25 UNITE	Fish Algae BANK DENDY SURBER  W (nS/c~) C F)	Other: OTHER DISSOLVED GXYGEN TIME OTHERS	6.704 mm (mg) 13:30 PM Turb O.1	4)
UPSTREAM SURROUNDING LAND USE: (estimated pasture UPRAN 50		HEAVY FLOODING SNOW AIR TEMPS	92°F	
CROPS O INDUSTRY 25 FOREST O MINING O IMPACTS: rated S(light) Micderate), H(igh) mage CAUSES Flow Atter (1500) M Pastingles (0200) M Habitat All (1800) M Impact (0500) H Thermal Att (1800) H Ammonia (0500) Rathogens (1700) M	SOURCES Point Source Indust (0	Unknown 100) \   Wunkipel 100) \   Winng	(9030)   H (2000)   H (5000)   U	
Chlorine (0700) S Oli & gresse (1900) H Nittients (0900) H Uniconem (0000) pH (1900) 5 Siterior (1100) M Oliganic Enrictment Jow D.O. (1200) Oliganic Enrictment Jow D.O. (1200) Oliganic Enrictment Jow D.O. (1200) SURROUNDING LAND USE :	U/S Dam (8)	900) Urban Rundf 900) H Bank destabl 900) Untersive Fee 1410) Dredging	(4900) H vetion (7,709) M	
ESTIMATE % RDB LDB  PASTURE			LDB 40 5 Shaded(>80) tis	
BANK HEIGHT (m): M  SEDIMENT DEPOSITS: NOVE SLIGHT  TYPE SUDGE MUD SLIGHT  TURBIDITY CLEAY) SLIGHT MODERATE  ALGAE PRESENT? NOVE SUGHT  ACUATIC VEGET. ROOTED FLOATING	HIGH WATER MARK MODERATE EXCESSIVE NOME HIGH OFFICIE MODERATE OHOKING TYPE	(m): 1,5 BLANKET OTHER Con	iaminatéd Y or N	
ADDITIONAL COMMENTS: (oil sheen, odor, colors)	glass and p	nan lifter s lastic	uch as.	

State of TN

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10/12/2006

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			HM SUKY	er ( . 1 . 0. 1 /21.1				
PHYSICALSTREAMS		NCS (cont.) IRUN	ROOL /					
DEPTH DEC IN	13A	2.5 11	TOOL /		VELOCIT	ge/Bench Ht Y (FS)	0.39	CH/<
WIDTH (m)	1,5 m	1,50	X	1	FLOW	(CFS)	المحري الم	2112)
REACH LENGTH (m)	3.4 m	5.2m		1	HABITAT	ASSESSME	NT SCORE	82
			and the first	•	RR#		GP#	
Gradient (sample reach			gh_Casced			ore some and		
Size (stream width) : SUBSTRATE (Comple	V. Small (<1.				21ge (1U-25r	n) Very Lrg	(>25m)	
Particle Count - 100 m			SULTH CE SUL	Circle one:	RIFFLE	RUN		CONTRACTOR OF STREET
size (nim) description		Record measure	particle size. L				2.7.	<del>````</del>
=0.062 ditabley	d	1-10			A LOVE AND THE COLUMN			
0.052-0.125 very line sund 0.125-250 fine band	vfs. fo	11-20 21-50			1-4-			
0.25-0.60 med send	ms	31-40			i iz	100 A 30 To 30		
0.6 1.0 coase cand	06	41-50			1. (1.5%)			
1.0-2.0 very coarse sand 2.0-54.0 gravel	(use ectual size)	51-60 81-70		enter a constant	1-1-			**.
64-256 cobble	(use actual size)	71-80			1 1	<del>                                     </del>	1 1	
256-4096 boulder	(use actual size)	81-90						
bedrock	bdex wood	91-100						
woody debrie	Angria		<u> </u>		<del></del>	<del></del>		
SUBSTRATE(%)	(Visual estim	175.52		* .				4
BOULDER (> 10")	RIFFLE S	RUN %	POOL	CLAY	(slick)	RIFFLE %		POOL
COBBLE (2,5-10")	5 %	<b>₹</b>	- <del>/ %</del>	SLT	(chink)	10 %		7%
GRAVEL (0.1-2.5")	40 %		*	DETRITUS		5 %		%
BEDROCK SAND (gritty)	3/2 %	<b>X</b>	**	MUCK-MUI MARL (she)		5 %		>%
Ourth (Surth)	بصيوب با		~~	diame fano	ii riceMark		30	
STREAMUSESURED	NEW YORK	WATER WITH	IDRAWL NO	TEO	Medical.	and the state		
CLASSIFIED FOR:		nde.	POST	ED FOR:	Baderiologi			
Dom. H2O Supply TIER IMIER II	Ind. FI2O Sup Navigation	ØV.			Do Not Con Preceptions			
Farmer in a tenant in a								
Trout>>	Net Repr?	2150E		e de la compansión de l	Fish Tissu		resident society.	2.4
Trout >> SUPPORT STATUS;	Net. Repr?				Fish Tissu	e Advis.		4
	Net. Repr?	CECOSTROPP	$\supset$	SVPPORTNG,	Fish Tissu	e Advis.	NONSURPOR	ing (NS)
SUPPORT STATUS; FULLYSUPPORTING(FS)	Net. Repr?	PPORTING (PS)	)	Súpportng,	FISH TISSU	e Advis.		ine (NE)
SUPPORT STATUS; FULLYSUPPORTING(FS) Photos # Yor N F	Nat. Rep?  PARTIALLY SU  COLUDISC #  #110	PPORTING (PS) Photo #4D			Eist Tibbu BUT THREATE WID	e'Advie. NED (TH)	NONSUPPOR	ine (NS)
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SUPPORT STATUS; FULLY SUPPORTING (FS) Photos A Gr N F #ID STREAM SKETCH (Including Street Street) Street St	Mat. Rept?  #ARTIALLY SU  coll/Disc #  #/ID.  de flow direction;	Photo #ID Reach distance	, distance fro	III bildge, sa	FIST THEOUT THE FATE WILD	eAdvis.	NONSURPORT	
SUPPORT STATUS; FULLY SUPPORTING (FS) Photos A Gr N F #ID STREAM SKETCH (Including Street Street) Street St	Mat. Rept?  #ARTIALLY SU  coll/Disc #  #/ID.  de flow direction;	Photo #ID Reach distance	, distance fro	III bildge, sa	FIST THEOUT THE FATE WILD	e'Advie. NED (1H)	NONSURPORT	

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## HABITAT ASSESSMENT DATA SHEET-HIGH GRADIENT STREAMS (FRONT)

STREAM NAME	Sharps Branch		LOCATION 115 AVER 96W					
	<u>AZPOOO.7WI</u>		ECOREGION 7/h					
LAT 35° 55.		52.777 W	WATERSHED GROUP Harpeth River					
WBID/HUC 051			INVESTIGATORS CB/5/10/D DATE 7/27/0 TIME 1.30 AM 2MD					
Habitat Parameter	BY C.Bishop		DATE	TIME 1.30 AM (FM)	<u> </u>			
	Condition Category							
Angles Kanadanakan ligada	Optimal	Suboptimal		Marginal	Poor			
L. Epifaunal Substrate/Available Cover	Greater than 70% of substrate favorable for epifanual colonization and fish cover; mix of snage, submerged logs undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/mage that are not new fall and not transient)	40-70% mix of well-suited for colonization produced the maintenance of admixtance of admixtance of admixtance of admixtance of the newfall, but no for colonization high end of see	full nearial; at for l'populations; litional from of t yet prepared a (may rate at	20-40% mix of stable 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 8	20 19 18 17 16	15 14 13	12 11	10 9 (8) 7 6	5 4 3 2 1			
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, couble particles are 25 nurounded by	-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 8	20 19 18 17 16	15 14 13	12 11	10 9 (8) 7 6	5 4 3 2 1			
3. Velocity/Depth Regime	All finer 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 present (if fast- missing score la regimes).	aliallow is	Only 2 of the 4 habitat regimes present (if first- shallow or slow-shallow are missing, score low)	Dominated by I velocity/depth regime (usually slow-deep)			
score 10	20 19 18 17 16	15 14 13	12 11	i0 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 bottom affected by sediment deposition.	Some new incar formation, most gravel, sand or. 5-30% (20-50% gradient) of the affected; slight pools	ly from fine sediment, i for low- bottom	Moderate deposition of new gravel, sand 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 7	20 19 18 17 16	15 14 13	12 11	10 9 8 7 6	5 4 3 2 1			
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills> 759 available chann channel substra	el; or 25 % of	Waters 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 12	20 19 18 17 16	15 14 13	(12) 11	10 9 8 7 6	5 4 3 2 1			

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## HABITAT ASSESSMENT DATA SHEET- HIGH GRADIENT STREAMS (BACK)

	000.7WI Date	( )		
Habitat Parameter				<del>7</del>
	Optimal	Suboptimal	Marginal	Poor
6. Cliannel 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., diedging, (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 cement, over 80% of fine stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
score 12	20 19 18 17 16	15 14 13 (12) 11	10 9 8 7 6	5 4 3 2 1
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 5-7); 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 habites distance between riffles divided by the width of the stream is a ratio of >35.
score 3	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 (3) 2 1
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 exosion 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 crosion potential during floods	Unstable, many croiled area "raw" areas frequent along straight sections and bends; obvious bank alonghing, 61 100% of bank has crosional scars
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE (Ø (RB)	Right Bank 10 9	8 7 (6)	5 4 3	2 1 0
9. Vegetative Protective (score each bank) Note: defermine left or right side by facing duwnstream	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, indenstry 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 subble 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 the streambank vegetation has been removed to 5 centimeters or less in average stubble height
SCORE 3 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 5 (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 ripatian zone 12-18 meters; human activities have impacted zone only minimally	Width of riparian zone 6- 12 meters; imman activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 3	2 /1 0

TOTAL SCORE

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STEEAMISURVEYANT	ORVATION	UITCAMS	PRVETFURM		10.51	
STATION NUMBER: STREAM NAME STATION LOCATION: COUNTY: WEIDWHUC: WATERSHED GROUP & LATITUDE DECIDED	Libera Eddy Wh Dollforn	130204 L River	302)	ASSESSORS DATE: TIME: STREAM MILL STREAM ORD DRAINAGE A ELEVATION ()	7/2 09:00 0: 0: REA	14/5W 14/0 1
LONGITUDE DECIDEG ECOLOGICAL SUBREGIPER POSE:  SAMPLES COLUECTE Aquatic Life Assessed  Type of Sentine sample:	Macrohyerteb	362' 686, 8°	Algae NDY SURBER	GAZETTEER I USGS QUAD Other OTHER		
CHEMICALE * (A.M.) IFIELD MEASUREMENT METERS USED:						
PH CONDUCTIVITY TEMPERATURE	8.05 577.0 77.45°	SO (OF		Dissolved ox Time Others	1GEN 6.2	79 m(mg/L)
Previous 48 hours Precip: Ambient Weather:	STHINY C	IONE LITTLE LOUDY BREEZY	MODERATE RAIN	10 may 2003020 11 mg 4.00	eding 87%	
WATERSHED CHARAS UPSTREAM SURROUNDS PASTURE CROPS GREST MARKETS TRACESTIGHT	UFRAN UFRAN MOUSTRY MINING	(estimated %) 40 Resid				
CAUSES  CAUSES  Pestocles (0200) #  Metals (0500) #  Ammonia (0500)  Chlorine (0700) //		100) S Point Sci 190) S Legging (99) Constitut	S me: Indust (0	Uriki 100) bikini 100) Minn	(2000) (Heji	H.
Varience ((2000)     id (1900)   S Prochic Enrichment / Low D Phierr	10. S (12	90) Reparant 90) M Agricultun 90) Livestock Other:	10.00	900) H Bank	Fundi (4000) destablization (770 alve Feadlot (1600) glog (7200)	(g) //C
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ROPE CREST CANOPY COVER: Estin		NOUSTRY DEN(0-10) Party St	inded(f).isP	OTHER	= 40	
Meacur MKHEIGHT (m): •5 4 EDMENT DEPOSITS: IVPE: SUDGE	PB / 1.5 (	S DE HIGH SUGHY GODERATE	WATER MARK	Mostly Shaded(46-8 LB in): 5 m BLANKET	8) Shaded(>80) RB	
urbidity clear Ligae present? Quatic veget.	NONE SUR	SAND SEED GOERATE HIGH GODERATE AT GODERATE AT MICH TYPE	OFACUE	TYPE	Contaminated	¥ • <b>(N</b> )
dditional comments:	(oil sheen, odor, c	olore)				

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		and the second	STR	EAM SURI	EY FORM		Mark Comment	2.	*==	
PHYSIC	ALESTRE AMERICA	ARAGTERIST	is (cons)							
		RIFFLE	RUN'	POOL		Staff Gau	ge/Bench Ht		7	
DEPTH &	# (iv)	11n		-	]	VELOCIT	Y (FS)	_435	0.25	ft/s)
WIDTH (n		1.5			]	FLOW	(CFS)			
REACH L	ENGTH (m)	2.9		1	]		ASSESSME		96	
						RR#	-	GP#		
	(sample reach):		£ 20 1	igh Cesca		1	20 24	2.20.4		
Size (ctro	am width):	V. Small (<1.5				arge (10-25n	n) Very Lrg	(>25m)	The state of the s	
SUBSTR	ATE (Complete	eluei barrel	expuntable	<b>FUNATES</b>						
	Count - 100 me				Circle one:	RIFFLE	ノ RUN		<u>G</u>	
size (mm) =0.062	description	abbyeviation of	recom meneure	g particle size.	Jee abbrev, belou	V for smaller etc	<b>61</b>	640) 8 <b>1</b> 500 (8 <b>1</b> 50)	• **	
0.062-0:125	eltelsy very inc sand	vfs	11-20			A CANAGE			* .	
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0.25-0.50	med send	ms	81-40			1.4				
0.5-1.0	coarse sand	65	41-50			3 3 3 3 3 3 3	1 1		•	
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SUBSTR	ATE(%)	(Visual estim		-			minum en	imitate a	****	
naturer	N. A. WANG	RIFFLE 10 %	RUN S	POOL *	CLAY	(slick)	RIFFLE %		POOL	
BOULDES COBBLE		10 %	- 3			(SALAN)	→ % *		— % — %	
GRAVEL	0.1-2.51	10 %	- 4	1		(GPOM)	6 9		- %	
BEDROC	K	(O) %	- %		MUCK-MUI	) (FPOM)	O %	- %	%	
SAND	(gritty)	10 🛠	*	*	MARL (she	litrags.)	0 %	- %	96	
Name and district			navieti i i		Alak					
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State	of TN		pool	Page 2		) : Sa	mple (	ecotion 10112	/2006	

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### HABITAT ASSESSMENT DATA SHEET-HIGH GRADIENT STREAMS (FRONT)

STREAM NAME			LOCATION				
STATION# LIB			ECOREGIO				
LAT 35' 55.743		51.362'W	WATERSH		Nes		
WBID/HUC O	51302040105		INVESTIGATORS COTTON TWELLET JUTTHING WHY				
FORM COMPLETED	BY <βishal		DATE 7/29/10	TIME 4.00 /(AM) PM			
Habitat Parameter	Condition Category	andre grande de la companya de la c La companya de la co					
	Optimal	Suboptimal		Marginal	Pour		
I. Epitaunal Substrate/Available Cover	Greater than 70% of substrate favorable for entitional colonization and flich cover; mix of snage, submerged logs underent bunks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snage that are not new fall and not transient)	well-suited for colonization padequate habi maintenance of presence of an substrate in the newfall, but n	oftential; fat for of populations; iditional to from of or yet prepared on (may rate at	20-40% mix of stable habitat; svailability less than desirable; substrate frequently disturbed or removed	Less than 20% stable habitat is buint; lack of habitat is obvious; substrate unstable or lacking		
score 12	20 19 18 17 16	15 14 13	3 (12)11	10 9 8 7 6	5 4 3 2 1		
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobbl particles are 2 surrounded by	5-50% Tine sediment.	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 /O	20 19 18 17 16	15 14 1	3 12 11	10 9 8 7 6	5 4 3 2 1		
3. Velocity/Depth Regime	All four velocity/depth regimes present (alow-deep, slow-shellow, fast-deep, fast- shallow) (Slow is<0.3m/s deep is >0.5m)	Only 3 of the present (if fas missing score regimes).	t-shallow is	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 /O	20 19 18 17 16	15 14 1	3 12 11 (	10 9 8 7 6	5 4 3 2 1		
4. Sediment Deposition	Little or no culargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition	5-30% (20-50 gradient) of th	stly from r fine sediment, % for low-	Moderate deposition of new gravel, sand or fine sediment on old and new bare; 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 13	20 19 18 17 16	15 14 1	3 12 11	10 9 8 7 6	5 4 3 2 1		
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills> 7 available chan channel substi	5% of the inel; or 25 % of ate is exposed.	Waters 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 1Z	20 19 18 17 16	15 14 13	3 (12) 11	10 9 8 7 6	5 4 3 2 1		

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## HABITAT ASSESSMENT DATA SHEET-HIGH GRADIENT STREAMS (BACK)

Habitat Parameter	000 7WI Date			
\$350 miles	Optimal	Suboptimal	Marginal	Poor
-	Opinal	- San Optimus	14444 Breat	
6. Channel Alteration	Chamelization 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 may be extensive; embankments or shoring structures, present on both banks; and 40 to 80% of stream reach channelized and	Banks shored with gabion of cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
17	20 19 18 17 16	channelization is not present	disrupted.	5 4 3 2 1
SCORE /	20 19 18 17 16	15 14 15 (12) 11	,10 9 8 7 b	3 4 3 2 1
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 5-7); 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 rifile 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 habited distance between riffles divided by the width of the stream is a ratio of >35.
score 7	20 19 18 17 16	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 erosion or bank failure absent or unumal; little potential for future problems <5% of bank affected.	Moderately stable; infrequent, arnall 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 neess of crossion; high crossion potential during floods	Unstable, many eroded area "raw" areas frequent along straight sections and bends; obvious bank sloughing, 60 100% of bank has erosional scars
SCORE 5 (LB)	Left Bank 10 9	8 7 6	(5) 4 3	2 1 0
SCORE_5_(RB)	Right Bank 10 9	8 7 6	(3) 4 · 3	2 1 0
9. Vegetative Protective (score each hank) Note: determine left or right side by facing downstream	More than 90% of the streambank surfaces and immediate rigarian 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 subblie 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 remptaing	Less than 50% of the streambank surfaces cover by vegetation; disruption of streambank vegetation has very high; vegetation has been removed to 5 centimeters or less in average stubble height
SCORE 4 (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
IO. Riparian Vegetative Zone Width (score each hank riparian zone)	Width of ciparian zone > 18 meters; human activities (i.e. parking lots, roadbeds, clear- cuts, lawns or crops) have not	Width of ciparian 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 riparien zone <6 meters: little or no riparien vegetation due to human activities.
SCORE ( (LB)	impacted zone Left Bank 10 9	8 7 6	5 4 3	2 /1 0
ATLANTA I LLADI	I LEUE DILLE AV -			

TOTAL SCORE



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#### STREAM SURVEY FORM

STREAMSU	RVEYINEC	RMATION			TETTOR					
STATION NU STREAM NAI STATION LO COUNTY: WBID#HUC: WATERSHEE LATITUDE DI LONGITUDE ECOLOGICAI PROJECTIPU	MBER: ME: CATION: GROUP # COIDEG DECIDEG SUBREGIO RPOSE:	SPEN McMah William TAV Harpe 350 4	th Rive	Franklin P		ASSESS DATE: TIME: STREAM STREAM DRAINAG ELEVATI USGS QU	MILE: ORDER; SE AREA ON (M); SER PAGE	Jwelle 8/03 11:10 14:th	T. Twilloug	hby
SAMRUES OF Aquatio Life A Type of benthi CHEMICALS A FIELD MEAS METERS USE	reesed reemple: Bid G(N) U(REVIEN)			Figh BANK DEND	Algae Y GURBER	Other OTHER				
PH CONDUCTIVITY TEMPERATURE			9 8 3 <b>(</b> )	(of)	)	DISSOLVE TIME OTHERS	D OXYGEN	6.30	W-C-110	
Previous 48 ho Ambient West		ENNIA NIKMONAM	CLONDA	LITTLE BREEZY	MODERATE RAIN	HEAVY SNOW	FLOODING AIR TEMP:		· .	
WATERSHE	CHARACT	ERISTICS 1	ADD % OF	watershed of	served)					
UPSTREAM S PASTURE CROPS FOREST	URROUNDIN 15 5 10	G LAND US! Ufban Industry Mining	(estimated 50	RESID OTHER	_0 _20					
IMPACTS: 1	ated S(light)	M(oderate),	H(igh) magn	itude. Blank	= not observ	ed		3	\$1450 <u>8</u> 5	
CAUSES Pesticides (02	90): H	Flow After. Habitet All.	(1500) H	SOURCES	e america a	· · · · · · · · · · · · · · · · · · ·	Unknown	(9000)	3.	
Metals (05)		Thermal Att		Point Source Leading		0100) <b>S</b> 2000)	Municipal Manag	(2000)	H	
Ammonia (06			(1700) H		Land Devel		Road /bridge	(5000)	SLISS -	
Chlorine (07)		Oil & grease		U/S Dam	(E	800)	Urban Runo		A	
190) amelituvi 1901) Ha			(00003)	Ripanan tos		760O H	Bank destab	meation (774)	9 H	
pH (190 Organic Enrich			(1106) H (1200) H	Agriculture:	Row crop ( ezing-liparian	(DOD) M		edlot (1600	NO.	
Other:		en e	**************************************	Other:	क्रामी-भिक्षांसा	(1410) (v/	Dredging	(7200)	<u> </u>	
PHYSICALIS	REMICHA	RACTERIS	ngs.		STREAMAI	EAUSSES	SEDIMI.		The state of	
SURROUNDIN	g land use			પ્રાથમ ક્ષેત્રમાં જેવી	Now Property and the	erioda i entralistra i			survey of the su	
ESTIMATE % I	RDB:	LDB	4	RDB	LDB		RDB	LDB		
Anna Santan	50	50	URBAN	35	. 35	RESID	.15	15		
CROPS	0	<u>_Q</u>	MOUSTRY	0	0	OTHER	0		*	
FOREST CANOPY CO		0	MINING		0					
M CHNGHT CC	Measure		Open(0.10)	Party Shad	led(11-45) (	Mostly Shad	ed(46-80)	Shaded(>80)	ent <sup>er</sup>	
BANK HEIGHT		**	U/S	D/S_	ATER MARK	1860		RB	· ·	1
SEDIMENT DE		MONE	SLIGHT	MODERATE	EXCESSIVE	BLANKET	$\omega$	<del></del>	-	
TYPE	SLUDGE	Min	SAND	CONTRACT OF THE PARTY OF THE PA	NONE	OTHER	Cal	ntaminated	YON	
TURBIDITY C		(SLIGHT)	MODERATE	HIGH	OPAQUE	A and a second		attacks and also seed by	. 90	
ALGAE PRESE	· · · · · · · · · · · · · · · · · · ·	· ·	SLIGHT	MODERATE	CHOKING	TYPE				
AQUATIC YES			FLOATING	TYPE	<u></u>					
ADDITIONAL C	~ mwcn 12:(	ui sneen, odd	x, colore)	¥	·					

Division of Water Pollution Control QSSOP for Macroinvertebrate Stream Surveys Revision 4 Effective Date: October 2006 Appendix B: Page 9 of 12

### STREAM SURVEY FORM

	PHYSICAL STREAM OF				A CONTRACTOR OF THE PROPERTY O
	DEPTH (m)		OOL	Staff Gauge/Bench VELOCITY (FS)	HE (EL/s)
	WOTH (ii)	3.0		FLOW (CFS)	D. 62 (+4/5)
·	REACH LENGTH (m)	3.9		HABITAT ASSESSI	MENT SCORE# 101
			<del></del>	RR#	GP# 127
	Gradient (sample reach):		the same of the sa		No. of the contract of
	Size (ctream width):	V. Small (<1.5n) Small (1.5		inge (10-25m) Very L	rg (≥25m)
	SUBSTRATE (Complete Particle Count - 100 me	e either particle count or est			
	size (mim) description	Abbrevision Record measured p	Circle one:	(RIFFLE) RUN	
	<0.082 sittley	a 1-10			
	0.062-0.125 very line sand	vfs 11-20			
	0.125-250 fine sand 0.25-0.50 med sand	fy 21-30 ms 31-40			
	0.54.0 coase and	66 41-50		S A COMPANY DAMAGE	
	1.0-2.0 very coarse sand	(use action acre) 51-60			
	2.0-64.0 gravel	(une actue) sze) 81-70	The second		
	64-256 cobble	(use actual size) 7.1-80 (use actual size) 81-80		1-1-1-	
	256-4096 boulder bedrock	(see actual size) 81-90 bdex 91-100			
	bedrock woody debris	wood	Art Breeze Constant		
	**	•			<del></del>
	SUBSTRATE (%)	(Visual estimates)			
	BOULDER (> 10)		30 % GLAY	(slick) O	RUN POOL
	COBBLE (2.5.10°)	To the Committee of the	16 % SLT	(SIGN)	% 20 %
	GRAVEL (0.1-2-5')	20 % X %	5 % DETRITUS	(CPGM)	* * 6 %
	BEDROCK		20 % MUCK-MUE		% O %
	SAND (gritty)	0 */	S % MARL (shell	Iffings)	%/ <b>%</b> O %
	Dom. H2O Supply THER BYTHER JB TROUT >> SUPPORT STATUS; FULLY SUPPORTERS (15)	Ind. 120 Supply Nevigation Nat. Rep.7: 3035 PARTIALLY SUPPORTING (PS)	Supporting,	Do Not Consume Presudonary Fish Tissue Advis.:	NONEUPPORTING (NS)
	Photos (Y) or N Ro	oll/Disc# Photo#ID #/D		#/ID	
	STREAM SKETCH (include	e flow direction, reach distance, o	listance from bridge, sar	nolina points tribs ou	falls.
	livestock access, riparian a		and an experience of the second	and complete produces and a second problems	12//Wit
_	FLOW				
	-				
[ ]	\	FLOW			
		FLO		•	
					* ************************************
	Pool	DRÝ -	DID-RAP		
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0 7			******		campling location
0 7	~ 150 Ft		**************************************		campling location
0			**************************************	··· -	
0 7			Page 2 FLo	··· -	campling locations  Fles 10/12/2006 ing a

Division of Water Pollution Control QSSOP for Macroinvertebrate Stream Surveys Revision 4 Effective Date: October 2006 Appendix B: Page 4 of 12

# HABITAT ASSESSMENT DATA SHEET-HIGH GRADIENT STREAMS (FRONT)

STREAM NAME	SPENCERCE	HK 1	LOCATION	1 Frankly Rd/A	1c Mahon Rd
STATION#	SPENCOOD. 8WI		ECOREGIO		
LAT 350 56	610' N LONG -86'	251.318'W	WATERSH	ED GROUP Hupeth 1	wer
WBID/HUC 05		4	INVESTIGAT		logithy
FORM COMPLETED			DATE 8/4/NO	TIME ( / do AM) PM	
Habitat Parameter	Tweller Condition Category	1			
	Optimal	Suboptimal		Marginal	Poor
L. Epifaunal Substrate/Available Cuver	Greater than 70% of substrate favorable for epifannal colonization and fish cover; mix of snaga, submerged logs undercut banks, coloble 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 well-suited for colonization por adequate habits maintenance of ade substrate in the newfall, but no for colonization high end of sca	full stential; st for spopulations; litional stoon of t yet prepared s (may rate at	20-40% mix of stable 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
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cabble provides diversity of niche space.	Gravel, couble particles are 25 surrounded by	-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 12	20 19 18 17 16	14 13	(12) 11	10 9 8 7 6	5 4 3 2 1
3. Velocity/Depth Regime	All from 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 present (if fast- missing score le regimes).	ai wollada	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 14	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 bottom affected by sediment deposition	Some new incre- formation, most gravel, sand or: 5-30% (20-50% gradient) of the affected; slight pools	ly from fine sediment; for low- bottom	Moderate deposition of new gravel, sand 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 17 16	15 14 13	12 (11)	10 9 8 7 6	5 4 3 2 1
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills> 759 available chann channel substra	el; or 25 % of	Waters 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 12	20 19 18 17 16	15 14 13	<u>(12)</u> 11	10 9 8 7 6	5 4 3 2 1

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# HABITAT ASSESSMENT DATA SHEET-HIGH GRADIENT STREAMS (BACK)

Station ID SIENC	COO. 8WI Date	6/3/10		
Habitat Parameter				
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging ábsent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; swidence 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 cement, over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
score 13	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1
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 5-7); 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 lubita 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 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 duyastream.	Banks stable; evidence of crosion 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 crossion potential during floods	Unstable; many eroded are "xaw" areas frequent along straight sections and bends obvious bank sloughing; 6 100% of bank has erosiona scars
SCORE (CLB)	Left Bank 10 9	8 7 (6)	5 4 3	2 1 0
SCORE X (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protective (score each hank) Note: determine left or right side by facing downstream	More than 90% of the streambank surfaces and immediate rigarian zone covered by native vegetation, including trees, inderstory 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 shibble 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 cover by vegetation; disruption of streambank vegetation has been removed to 5 centimeters or less in average stubble height
SCORE_S_(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
Io. Riparian Vegefative Zone Width (score each bank riparian zone)	Width of riparian zone > 18 meters; human activities (i.e. parking lots, roadbeds, clearcuts, lawas or crops) have not impacted zone	Width of siparian 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 ripariar vegetation due to human activities.
SCOREZ(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 MAN



APPENDIX D – PHOTOGRAPHIC DOCUMENTATION



Description:	View of the Donelson Creek sampling reach facing downstream.



<b>Description:</b>	View of the Donelson Creek sampling reach facing upstream.



<b>Description:</b>	View of the Fivemile Creek sampling reach facing downstream.



<b>Description:</b>	View of the Fivemile Creek sampling reach facing upstream.



Description:	View of the Watson Branch sampling reach facing downstream.



<b>Description:</b>	View of the Watson Branch sampling reach facing upstream.



<b>Description:</b>	View of the Sharps Branch sampling reach facing downstream.



<b>Description:</b>	View of the Sharps Branch sampling reach facing upstream.



Description:	View of the Liberty Creek sampling reach facing downstream.



Description:	View of the Liberty Creek sampling reach facing upstream.



<b>Description:</b>	View of the Spencer Creek sampling reach facing downstream.



<b>Description:</b>	View of the Spencer Creek sampling reach facing upstream.



APPENDIX E - ANALYTICAL RESULTS AND CHAINS OF CUSTODY

IW6.000OSTAW	φ	7 23	44	<b>−</b>
IWT009AAH2	<del>-</del>		84	1
SPENC000.8W1		8		
LIBER000.6WI			15	<del>-</del>
FMILE001.5WI		ю		
DONEI000'3MI	7		20	4
F.F.G. CL		FC FC FC	90 90	SC CG P
T.V.	6.1	6.12 6.6 6.48 7.58	8.84 3.4 2.46	7.03
SPECIES	PLATYHELMINTHES Turbellaria Tricladida Dugesiidae Girardia sp. MOLLUSCA Bivalvia Veneroida Corbiculidae	Corbicula sp. Sphaeriidae Pisidium sp. Sphaerium sp. Gastropoda Mesogastropoda	Physella sp. Physella sp. Pleuroceridae Elimia sp. ANNELIDA Oligochaeta Tubificida	Lumbricidae Lumbriculidae Lumbriculidae Hirudinea Rhynchobdellida Glossiphoniidae ARTHROPODA Crustacea

IW6.0000STAW			വ	Ŋ	α	
IWT009AAH2	6	-	Ø			
SPENC000.8W1			~		ო დ	
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DONEI000'3MI		Ŋ	0	30	4	
C C					555	
F.F.G.	SH CG CG	Ð	HS	000 000 000 000	SC SC FC FC	P P P P P P P P P P P P P P P P P P P
T.V.	7.85	7.87	2.6	6.1 4.51 1.2 7.41	3.45 3.45 3.45 3.45 3.45	7.78 6.1 9
SPECIES	Isopoda Asellidae Lirceus sp. Amphipoda	Crangonycudae Crangonyx sp. <b>Decapoda</b> Cambaridae	Orconectes sp. Insecta Collembola Ephemeroptera	Baetidae  Baetis sp.  Diphetor sp.  Caenidae  Caenis sp.	Heptageniidae  Maccaffertium sp.  Stenacron sp.  Stenonema sp.  Isonychiidae  Isonychia sp.	Calopterygidae Calopteryx sp. Coenagrionidae Hemiptera Corixidae

IW6.000OSTAW	c	7				30	<sub>∞</sub>									22								_			9	
IWT009AAH2						7										28											22	
SPENC000.8W1				~		186	38				6					2				4								
LIBER000.6WI						24	24						7			2		2							7		15	_
EMILE001.5WI						12	147		_							9				_								
DONEI000'3MI	<del>-</del>					44	16				46				7	7				_	_					_	_	
c				$\mathbf{C}\mathbf{\Gamma}$	$\mathbf{C}\mathbf{\Gamma}$	$C\Gamma$	$\mathbf{C}\mathbf{\Gamma}$		$C\Gamma$	$\mathbf{C}\mathbf{\Gamma}$	$C\Gamma$				$C\Gamma$	$C\Gamma$				$C\Gamma$								$\mathbf{C}\mathbf{\Gamma}$
F.F.G.	<u>d</u> 6	7	Ь	Ъ	$\mathbf{FC}$	$\mathbf{FC}$	FC	ΡΙ	ΡΙ	FC	FC			CG	$\mathbf{SC}$	$\mathbf{SC}$	Ь	Ь	$\mathbf{SC}$	$\mathbf{sc}$	Ь			Ь	CC	FC	Ь	$\mathcal{G}$
	9	<b>c</b>	6.5	5.16	4	6.22	4.3	4	6.22		2.76			9	5.93	5.1	4.6	89.6		2.35	<b>∞</b>			7.2	9.63	4.09	4.5	5.78
SPECIES	Microvelia sp.	Knagovena sp. <b>Megaloptera</b>	Corydalidae	Corydalus sp. Trichoptera	Hydropsychidae	Cheumatopsyche sp.	Hydropsyche sp.	Hydroptilidae	Hydroptila sp.	Philopotamidae	Chimarra sp.	Coleoptera	Curculionidae	Elmidae	Dubiraphia sp.	Stenelmis sp.	Hydrophilidae	Tropisternus sp.	Psephenidae	Psephenus sp.	Staphylinidae	Diptera	Chironomidae	Ablabesmyia sp.	Chironomus sp.	Cladotanytarsus sp.	Conchapelopia sp.	Cricotopus sp.

IW6.000OSTAW	F F	т то	206 20 4 7.77% 21.84% 4.91 70.39%
IWT004AAH2	~ ~	Ν	166 13 1 43.37% 1.20% 6.17 80.72% 19.28%
SPENC000.8W1			257 10 5 0.00% 94.94% 5.61 75.88%
LIBER000.6WI	- 0 0 V C - 4 -	1 73	217 24 4 20.74% 23.96% 6.60 31.80% 28.57%
FMILE001.5WI	8		201 15 9 1.00% 88.56% 4.61 13.93%
DONEI000°3MI		<b>← ←</b>	202 20 6 7.92% 70.79% 4.73 57.92%
J C	CL	CC	
F.F.G.	SC SH CG CG FC FC	P FC FC SH SH SH	
J. Y.	6.4 6.5 7.3 7.3 5.89 6.52 6.76 8.1	7.6 7.57 3.5 4 4.9 9.64 7.33	
SPECIES	Cryptochironomus sp. Phaenopsectra sp. Polypedilum sp. Rheocricotopus sp. Rheotanytarsus sp. Stictochironomus sp. Tanytarsus sp. Culicidae Anopheles sp.	Empididae Hemerodromia sp. Simuliidae Simulium sp. Tipulidae Limonia sp.	TOTAL NO. OF ORGANISMS TOTAL NO. OF TAXA EPT %OC %EPT NCBI %NUTOL % CLINGERS

T.V. = tolerance values range from 0 for organisms very intolerant of organic wastes to 10 for organisms very tolerant of organic wastes F.F.G. = Functional feeding group Legend (added by Tetra Tech):

T.V. F.F.G. CL

CG = collector/gatherer FC = Filtering/collectors, SC = Scrapers SH = Shredders

P = Predators PI = Piercer

CL = Clingers sp = species

IWT.-009AAHS

SPENC000.8W1

LIBER000.6WI

FMILE001.5WI

DONEI000'3MI

IW6.000OSTAW

# PENNINGTON & ASSOCIATES, INC.

570 East 10th Street \* Cookeville, TN 38501\*Phone (931) 526-6038\* Fax (931) 528-4167

Porject No.:
(03512710)
- 10
(Include Matrix and Point of Sample)
T

Pennington and Associates, Inc.-SOP-benchic macroinvertebrates

# Biological Analysis

STATE OF INESSEE - ENVIRONMENTAL LABORATORIES Please Print Legibly	NES (ME	*Scheo	Biological Amalysis "Schedule must be arranged in advance for all tests (815) 252-5327
Project/Site No. FMILE (001, 5	Screening Bloassays	Chronic Bioassays /	Branch Lab Number
المارية	(Cannot be used for permitting)	Chronic Cd	Chain of Çustody (sign full name)
Count	48 hr Static Screening Cd	Log Number	1. Collected by COSNOO
Description Macromyloxte brates	Log Number	LCS0 @ 24 hrs /	30
JOLS Depth	LCNO @ 24 hrs	LC50 @ 48 hrs /	al 6 4.
Collection Date 7/33/10 Time 9:15 am	LCSQQ 48 hrs	1.C50 @ 72 hrs /	4
J. Aishu	48 hr Static Screening Pp	LC50 @ 96 hry	
Sampling Agency City, of Frank In	Log Number	Sunival	M
Billing Cade J	LCSD @ 24 hrs	NOAEC/	Delivered to Pennington assoc Sac Attorn
If Priority, Cate Needed	LC50 @ 48 krs	LOAEQ	Date
Send Report to		Reproduction	3. Received by
Crustal bishane Lanklintnan	Acute Bioaskays	NØAEC	Date Time
	48 hr Static Definitive Cd	LOAEC	Delivered to
Contact Hazard	Log Number	/ 1025	Date
Oate Reported By	LC50 @ 24 hrs	/ Chronic Pp	4. Recid in Lab by
Reviewed By	LC50 @ 48 tirs	Log Number	Date Time
Reviewed by	NOAEC	LC50 @ 24 hrs	Lagged in by:
BIOLOGICAL SURVEYS	LOAEC	LCS0 @ 48 hrs	Date Time
Macroinvertahrate Recon	AR he Static Malinitive Day	ICEO & Tohns	Additional Information
Ranid Rioassessment (State SOP)	I co Number	1C50 (0.96 hrs	1. Abbrox. volume of semple 200 ± 20% indiv.
		100 G 000 L	3
Illiensive Suivey - Suivei	1050 (2.5 ms	\$ 100 CO	
intensive Survey - Denay	LCSU @ 48 hrs	ACSO (1) 144 ms	
Fish Population Recon	NOAEC /	L&FO @ 168 hrs	3. Others present at collection 3 Wellex & 5 Will Walnut
Fish Population Intensive	LOAEC /	Surviçai	
Fish Tissue Collection	96 hr Stalic Definitive Cd	NOABÇ	
Chlorophyll Analysis	Log Number /	LOAEC	time at this point O
Log Number	LC50 @ 24 hrs/	Growth	
Chlorophylla	LC50 @ 48 hrs	NOAEC \	5. Field collection procedure, handling and/or
Pheophyton	LC50 @ 721/fs	LOAEC	preservation of this sample (A) (culvo)
SPECIAL STUDIES	LC50 @ 96/hrs	1025	
(Please Specify)	NOAEC /		
	LOAEC /	Chlonne Residual	6. Mode of transportation to lab Cour
	96 hr Static Definitive Pp		
	Log Number	Lab Parameters	7. SampleDower sealed by
	LC54 @ 24 hrs	Hall	
	LC#0 @ 48 hirs	Cond.	8. Date earnplercoulli resaled
	1,650 @ 72 hrs	0.0	9. Remarks Sorted Debyis
	ACSO @ 96 hrs	Temp.	
	/ NOAEC		
	/ LOAEC		
PH:3010 (rev 1/96)			RDA 1627



									Attock														¥	<b>-</b>			A	ppe	end	ix I	B: 1	Pag	ge 1	11 c	of 1	2				
Biological Analysis "Schedule must be arranged in advance for all tests (815) 282-5327	Branch Lab Number	Chain of Custody (sign full name)	1. Collected by C. D. Shop	Date 8/30/10 Time	ď	Date 8/30/10 Time		Date 8-30-15 Time 72:45	haton Assoc Cee	Times	3. Received by	Date Time:	Dalivered to	Date Time	A. Recid in Lab by	Date Time	Logged in by	Date Time:	Additional Information	1. Approx. volume of sample 200 ± 20% indiv.	٤		3. Others present at collection $5 wellength 4 5 will people$	0	4. Number of other samples collected at same	time at this point $\mathcal{C}$		5. Field collection procedure, handling and/or	preservation of this sample (A) (Culvo)			6. Mode of transportation to tab Cour		7. Samplercooker sealed by		8. Oale earnplarcopier sealed	19. Remarks Sorted Dobris			
atog.	Chronic Bioassays /	Chronic Cd	Log Number	LC50 @ 24 hrs /	LC50 @ 48 hrs /	1C50 @ 72 hrs /	1C50 @ 96 hry	Survival	NOAEC/	LOAEQ	Reproduction	NJØAEC	LOAEC	7 1025	/Chronic Pp	Log Number	LC50 @ 24 hrs	LCSD @ 48 hrs	LC50 @ 72 hrs	LC50 @ 96 hrs	LC50 @ 120 hrs	C50 @ 144 hrs	L&50 @ 168 hrs	Survigal	NOABÇ	LOAEC	Growth	NOAEC	LOAEC	1025		Chlorine Residual		Lab Parameters	五	Cond.	0.0	Temp.		
ves (AB)	Screening Bioassays	(Cannot be used for permitting)	48 hr Sfatic Screening Cd	Log Number	LCX0.@ 24 hrs	LC50/00 48 hrs	48 hr Static Screening Pp	Log Number	LCSO @ 24 hrs	LC50 @ 48 kms		Acute Bioaskays	48 hr Static Definitive Cd	Log Number	LC50 @ 24 hrs	LC50 @ 48 hrs	NOAEC / /	LOAEC	48 hr Static Definitive Pp	Log Number	LCS0 @ 24 hrs /	LCSO @ 48 hrs /	NOAEC /	LOAEC /	96 hr Static Definitive Cd	Log Number /	LC50 @ 24 hrs/	LC50 @ 48 hrs	LC50 @ 72 y/s	LC50 @ 96/krs	NOAEC /	LOAEC /	96 hr Static Definitive Pp	Log Nifmber	LC54 @ 24 hrs	LC#0 @ 48 hrs	(\$50 @ 72 hrs	/_C50 @ 96 hrs	NOAEC	
STATE OF INESSEE - ENVIRONMENTAL LABORATORIES Please Print Legibly	Project/Site No. SHIRP (VOD), 7	Project Name Shavos (Argura	ľ	Description Macrolhuexte brates	000 7 Depth	0/1/C/L at	A. Shao	Sampling Agency (1, L. of Frank In	3	If Priority, Date Needed	Send Report to	Crustal bishane Lianklintnon	T 1 1	Contact Hazard	Date Reported By	Reviewed By	Reviewed by	BIOLOGICAL SURVEYS	X Macroinvertebrate Recon	Rapid Bloassessment (State SOP)	Intensive Survey - Surber	Intensive Survey - Dendy	Fish Population Recon	Fish Population Intensive	Fish Tissue Collection	Chlorophyll Analysis	Log Number	Chlorophyli a	Pheophyton	SPECIAL STUDIES	(Please Specify)									

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Biolog

STATE OF INESSEE - ENVIRONMENTAL LABORATORIES	ues (Age)		Biological Analysis
Please Print Legibly		"Sche	"Schedule must be arranged in advance for all tests (615) 262-6327
Projectisite No. LIBORODO, 10	Screening Bioassays	Chronic Bioassays /	Branch Lab Number
Project Name   Dexty Oxeg	(Cannot be used for permitting)	Chronic Cd /	Chain of Çustody (sign full name)
٥	48 hr Static Screening Gd	Log Number	1. Collected by C D'S IND
Description / Macyco muchebrates	Log Number	LC50 @ 24 hrs /	Date 8/30// 0 Trime
000 6 0 0 oth	LCKO @ 24 hrs	1.C50 @ 48 hrs /	Α.
Collection Date 7/29/10 Time 9:00am	LC5 <b>\@</b> 48 hrs	LC50 @ 72 hrs /	Date 8/30/10 Time
) Asshap	48 hr Static Screening Pp	1C50 @ 96 hry	77
Sampling Agency (L.L. of Franklin	Log Number	Sunival /	1245
Billing Code	LCSD @ 24 hrs	NOAEC/	Delivered to Poning to ASSCC Seo Atto
If Priority, Date Needed	LC50 @ 48\prs	LOAEG	
Send Report to		Reproduction	3. Received by
Crustal bishane Lanklintnon	Acute Bioassays	NØAEC	Date
	48 hr Static Delinitive Cd	LOAEC	Delivered to
Contact Hazard	Log Number	/ 1025	Date
Date Reported By	LC50 @ 24 hrs	/ Chronic Pp	4. Recid in Lab by
Reviewed By	LC50 @ 48 hrs	Log Number	Daite Time
Reviewed by	MOAEC	LC50 @ 24 hrs	Logged in by
BIOLOGICAL SURVEYS	LOAEC	LC50 @ 48 hrs.	Date
Macroinvertebrate Recon	48 hr Static Definitive Pp	LC50-09-72 hrs	Additional information
Rapid Bioassessment (State SOP)	Log Number	LCS0 @ 96 hrs	1. Approx. volume of semple 200 ± 20% indw.
Intensive Survey - Surber	LCS0 @ 24 hrs	LC50 @ 120 hrs	1
Intensive Survey - Dendy	LC50 @ 48 hrs	LC50 @ 144 hrs	
Fish Population Recon	NOAEC /	L&50 @ 168 tms	3. Others present at collection $5  \mathrm{Welley} \notin 5  \mathrm{Will Blankby}$
Fish Population Intensive	LOAEC /	Survigi	r 0
Fish Tissue Collection	96 hr Stalic Definitive Cd	NOABÇ	4. Number of other samples collected at same
Chlorophyll Analysis	Log Number /	LOAEC	time at this point O
Log Number	LC50 @ 24 hrs/	Growth.	
Chiorophyllia	LC50 @ 48 hr\$	NOAEC \	5. Fleid collection procedure, handling and/or
Pheophyton	LC60 @ 72 1∕fs	LOAEC	preservation of this sample (A 1 Culvo)
SPECIAL STUDIES	LC50 @ 96/hrs	1025	
(Please Specify)	NOAEC /		
	LOAEC /	Chlorine Residual	6. Mode of transportation to lab Cour
	96 hr Static Definitive Pp		
	Log Namber	Lab Parameters	7. Sempleronner sealed by
	LC59/@ 24 hrs	Hd	
	LCSO @ 48 hrs	Cond.	8. Oate earnplatcooler sealed
	L650 @ 72 hrs	0.0	9. Remarks Shifted Denis
	CS0 @ 96 hrs	Temp.	
	NOAEC		
•	LOAEC		

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6. Mode of transportation to lab Cour

B. Oate eamplercomer se

96 hr. Static Definitis Log Namber LCG @ 24 hrs LCG @ 26 hrs LCG @ 96 hrs NOAEC

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STATE OF INESSEE - ENVIRONMENTAL LABORATORIES AND Discon Driver London

		٠		
Please Print Legibly		#25ch#	"Schedule must be arranged in advance for all tests (615) 262-6327	
Projectifite No. SPENCODO.8	Screening Bioassays	Chronic Bioassays /	Branch Lab Number	
	(Cannot be used for permitting)	Chronic Cd /	Chain of Çustody (sign full name)	
1008	48 hr Static Screening Cd	Log Number	1. Collected by C Distrop	
Description Macon Mettebrate	Log Mumber	LC50 @ 24 hrs /	Date 8/30//0 Time	
	LONG 24 hrs	LC56 @ 48 hrs /	A. Tolley	
Collection Date 9/3/10 Time 9:00 am	LCSOND 48 hrs	LC80 @ 72 hrs /	Date 8/30/10 Time	
Sampler's name (Pfint) C A Stud	48 hr Static Screening Pp	LC50 @ 98 hry	2. Received by Onn Dollan	
70 27	Log Number	Survival /	_	
C.	LCSO @ 24 hrs	NOAEC/	Delivered to Pontrata Assc See A	差
If Priority, Date Needed	LCSD @ 48\pre	LOAEG		
Send Report to		Reproduction	3. Received by	
Crustal bishane Lianklintnian	Acute Bioastays	NØAEC	Date Time	
	48 hr Static Definitive Cd	LOAEC	Delivered to	
Contact Hazard	Log Number	) (225	Date Time	
Date Reported By	LC50 @ 24 hrs	/ Chronic Pp	4. Rec'd in Lab by	
Reviewed By	LC50 @ 48 hrs	Log Number	Date Time	
Reviewed by	NOAEC	LC50@ 24 hrs	Lagged in by	
BIOLOGICAL SURVEYS	LOAEC	LC50 @ 48 brs	Date	
Macroinvertebrate Recon	48 hr Static Definitive P.b.	LC50.@ 72 hrs	Additional Information	
Rapid Bloassessment (State SOP)	Log Number	TC20 @ Behrs	1. Approx. volume of sample 200 ± 20% indiw.	
Intensive Survey - Surber	LC50 @ 24 hrs /	LC50 @ 120 hrs	2. Nearest town or city Franklin . TN	
Intensive Survey - Dendy	LCS0 @ 48 hrs	ACSO @ 144 hrs		
Fish Population Recon	NOAEC	L&50 @ 168 tms	3. Others present at collection 5 Welley & 5 Will Bughb	3
Fish Population Intensive	LOAEC /	Survice	0	<b>-</b>
Fish Tissue Collection	96 hr Stalic Definitive Cd	NOABÇ	4. Number of other samples collected at same	
Chlorophyll Analysis	Log Number /	LOAEC	time at this point O	
Log Number	LC50 @ 24 hrs/	Growth		
Chiorophylia	LC50 @ 48 hrs	NOAEC	S. Field collection procedure, handling and/or	
Pheophyton	LC50 @ 721/fs	LOAEC	preservation of this sample A (eu/no)	
SPECIAL STUDIES	LC50 @ 96/hrs	1025		
(Please Specify)	NOAEC /			
		The state of the s	A 15 15 15 15 15 15 15 15 15 15 15 15 15	

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OF INESSEE - ENVIRONMENTAL LABORATORIES	JES (ALL)		Biological Analysis	
Stream, County Stream, 2	Screening Bioassavs	Chronic Bioassavs /	VS / Branch Lab Number	
<b>\</b> /^	(Cannot be used for permitting)	Chronic Cd	Chain of Çustody (sign full name)	
3	48 hr Static Screening Cd	Log Number	1. Collected by C D'Shop	
nvextebia	Log Number	LC50 @ 24 hrs /	Date 8/30//0 Time	
Mile (000,3 Depth	LCSO @ 24 hrs	1C50 @ 48 hrs /	रिशिक	
0//20/10	1.CSO/@ 48 hrs	LC80 @ 72 hrs /		
10 (F	d Spring Screening Pp	1.050 @ 96 hrg/	2. Received by Long Dollars	
4	Log Number	Survival	\$	
5	LCSO @ 24 hrs	NOAEC/	Delivered to Peninator Assoc - Attack	7
ly, Date Needed	1.C50 @ 48\prs	LOAEQ		
eport to		Reproduction	3. Received by	
Stal wishing Lanklintnon	Acute Bioastays	NØAEC	Date	
1	48 hr Static Definitive Cd	LOAEC	Dalivered to	
Hazard	Log Number	1535	Date	
sponed By	LC50 @ 24 hrs	/ Chronic Pp	4. Recid in Lab by	
ed 8v	LC50 @ 48 hrs	Log Number	Dake Time	
od be	NOAEC	LC50 @ 24 hrs	Logged in by	
OLOGICAL SURVEYS	LOAEC	LCSO @ 48 hrs	Date Time	
croinvertebrate Recon	48 hr Static Definitive Pp	LC50-@ 72 hrs	Additional Information	
pid Bioassessment (State SOP)	Log Number	LC50 @ 96 hrs	1. Approx. volume of sample 200 ± 20% indiv.	
ensive Survey - Surber	LC50 @ 24 hrs	LC50 @ 120 hrs	\\ \.	
ensive Survey - Dendy	LC50 @ 48 hrs	LC50 @ 144 hrs		
th Population Recon	NOAEC	L&50 @ 168 hrs	3. Others present at collection 3 Welley & 3 Will Stuthbu	
th Population Intensive	LOAEC	Survital	C 0	_
th Tissue Collection	96 hr Static Definitive Cd	NOABÇ	4. Number of other samples collected at same	
lorophyll Analysis	Log Number /	LOAEC	time at this point O	
Number	LC50 @ 24 hrs/	Growth		
niorophyli a	LC50 @ 48 hrs	NOAEC	5. Field collection procedure, handling and/or	
heophyton	LC50 @ 72 1/18	LOAEC	preservation of this pample (A) (201/20)	
ECIAL STUDIES	LCS0 @ 96Arrs	1025		
ease Specify)	NOAEC /			
	LOAEC /	Chlorine Residual	6. Mode of transportation to lab Cour	
	96 hr Static Definitive Pp		,	
	Log Nimber	Lab Parameters	7. Samplercooler seated by	
	LCSI @ 24 hrs	Ho		
	LC#0 @ 48 hrs	Cond.	8. Oate eample/cooler sealed	
	550 @ 72 hrs	0.0	9. Remarks Sorted delovis	
	ACSO @ 96 hrs	Temp.		
	NOAEC			
	/ LOAEC			
) (rev 1/96)			RDA 1627	

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Analysis
Biological

STATE OF INESSEE - ENVIRONMENTAL LABORATORIES Please Print Legibly	ves (AF	BUUK.	Biological Analysis "Schedule must be arranged in advance for all tests [615] 262-5327
Project/Site No. IN 17 1SO 0000 6	Screening Bioassays	Chronic Bioassays /	Branch Lab Number
Project Name Watson Branch	(Cannot be used for permitting)	Chronic Cd /	Chain of Çustody (sign full name)
(0	48 hr Static Screening Cd	rog Number	1. Collected by C. Cishoo
ro inverter	Log Number	LC50 @ 24 hrs	Date 8/30//0 Time
, Co Depth	LC 60 @ 24 hrs	LC50 @ 48 hrs /	ed 6 A. Toller
Collection Date 7/27/10Time 9:45 am	LCSQ 48 hrs	LC50 @ 72 hrs /	Date 8/3040 Time
int C. Asshup	48 hr Static Screening Pp	LC50 @ 96 hry	
Sampling Agency City, of Frank (in	Log Number	Survival	Date 8-37-10 Time (2145
Billing Cade J	LCSD @ 24 hrs	NOAEC/	Delivered to Pennington Assoc - Attack
If Priority, Date Needed	LCSD @ 48\ms	LOAEQ	
Send Report to		Reproduction	3. Received by
Crustal bishace Lanklintnon	Acute Bioassays	NØAEC	Date
	48 hr Static Delinitive Cd	LOMEC	Dativered to
Contact Hazard	Log Number	/ 1025	Date Time
Date Reported By	LC50 @ 24 hrs	/Chronic Pp	4. Rec'd in Lab by
Reviewed By	LC50 @ 48 hrs	Log Number	Date
Reviewed by	NOAEC	LC50 @ 24 hrs	Logged in by
BIOLOGICAL SURVEYS	LOAEC	LCSO @ 48 hrs	Date Time
X Macroinvertebrate Recon	48 hr Static Definitive Pp	LC50.@ 72 hrs	Additional Information
Rapid Bioassessment (State SOP)	Log Number	LC50 @ 96 hrs	1. Approx. volume of sample 200 ± 20% indiv.
Intensive Survey - Surber	LC50 @ 24 hrs /	LC50:@ 120 hrs	2. Negrest town or city Franklin TN
Intensive Survey - Dendy	LCS0 @ 48 hrs /	LC50 @ 144 hrs	
Fish Population Recon	NOAEC	Lago @ 168 tms	3. Others present at collection $5  \mathrm{Welley}  4  \mathrm{SWill Bushby}$
Fish Population Intensive	LOAEC /	Survival	C 0
Fish Tissue Collection	96 hr Stalic Definitive Cd	NOABÇ	4. Number of other samples collected at same
Chlorophyll Analysis	Log Number	LOAEC	time at this point O
Log Number	LC50 @ 24 hrs/	Growth	
Chlorophyll a	LC50 @ 48 hrs	NOAEC	5. Field collection procedure, handling and/or
Pheophyton	LC50 @ 721/s	LOAEC	preservation of this sample (4 (euly.o)
SPECIAL STUDIES	LC50 @ 96/hrs	10.255	
(Please Specify)	NOAEC /		
	LOAEC/	Chlorine Residual	6. Mode of transportation to lab Cox
	96 hr Static Definitive Pp		
	Log Number	Lab Parameters	7. Samplarodoka: sealed by
	LC5/@ 24 hrs	五	
	LC#0 @ 48 hrs	Cond.	8. Oate eemptercount sealed
	L650 @ 72 hrs	D.O.	9. Remarks Soy and Debris
	LC50 @ 96 hrs	Темр.	
	/ NOAEC		
	/ LOAEC		

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Biological Analysis "Schedule must be arranged in advance for all tests (815) 282-6327	Chronic Bioassays / Branch Lab Number		Log Number / 1. Collected by C OS/NOD	LC50 @ 24 hrs / Date 8/30// 0 Time	1.050 @ 48 hrs /   Delivered to A. Tolley	0708/8 ated /	1.050 @ 36 hry 2. Received by Chm 2000	Survival / Date 8-30-13 Time / 245	1	LOAE9 Date Time	Reproduction 3. Received by	NgAEC Date Time	AOAEC Delivered to	/ IC25 Date Time	Chronic Pp. 4. Recd in Lab by	Log Number Date Time	LCS0 @ 24 hrs Logged in by	LC50 @ 48 hrs. Date Time	LC50 @ 72 hrs Additional Information	LCSO @ 96 hrs 1. Approx. volume of sample 200 ± 20% ind W.	LCS0 @ 120 hrs 2. Nearest town of city From Kin TN	μc50@144hrs	1850 @ 188 tire 3. Others present at collection 5 Welley & 5 Will Black		4. Number of other s	LOAEC   time at this point C	/	NOAEC. \ 5. Field collection procedure, handling and/or	LOAEC preservation of this sample $A   colvol$	1025		Chibrine Residual 6. Mode of transportation to lab Cox		ab Parameters 7. Semple cooler sealed by	¥0	Cond. 8. Date semple/cooler sealed	D.O.   19. Remarks ,	Temp. 11 Gample Kesidul	74	The same of the sa
<b>&amp;</b>	Screening Bioassays		48 hr Static Screening Cd	Lbg Number	LOSO @ 24 hrs	LCSO 48 hrs	48 hr Static Screening Pp	Log Number	LCSO @ 24 hrs	LC50 @ 48\prs		Acute Bioaskays	48 hr Static Definitive Cd	Log Number	LC50 @ 24 hrs	LC50 @ 48 hrs	NOAEC //	LOAEC	48 hr Static Definitive P.p.\	Log Number	LC50 @ 24 hrs	LC50 @ 48 hrs	NOAEC /	LOAEC /	96 hr Static Definitive Cd	Log Number	LC50 @ 24 hrs/	LC50 @ 48 hrs	LC50 @ 721/fs	1050 @ 96/ns	NOAEC /		96 hr Static Definitive Pp		115					
STATE OF INESSEE - ENVIRONMENTAL LABORATORIES Please Print Legibly	Project/Site No. L/ H T SO (200, 6	a 501	٦	Aver	Stream Mile 600.6 Depth	10	7	t to	Billing Code J Care	If Priority, Date Needed	Send Report to	Crustal bishone Lanklintnon		Contact Hazard	Date Reported By	Reviewed By	Reviewed by	BIOLOGICAL SURVEYS	X Macroinvertebrate Recon	Rapid Bioassessment (State SOP)	Intensive Survey - Surber	Intensive Survey - Dendy	Fish Population Recon	Fish Population intensive	Fish Tissue Collection	Chlorophyll Analysis	Log Number	Chiorophyll a	Pheophytan	SPECIAL STUDIES	(Please Specify)									

Biological Analysis

STATE OF INESSEE - ENVIRONMENTAL LABORATORIES CALL Please Print Legibly

Please Print Legibly		Sche	"Schedule must be arranged in advance for all tests (815) 262-5327
Project/Site No. (70 NE), 000.3	Screening Bioassays	Chronic Bioassays /	Branch Lab Number
Project Name 100 nelson (3 canch	(Cannot be used for permitting)	Chronic Cd /	Chain of Çustody (sign full name)
Station No. 000.3 County MI	48 hr Static Screening Cd	Log Number /	1. Collected by C D'S NOD
Description (Nac 10 in vertebrate	Log Number	LC50 @ 24 hrs /	Date 8/30// 0 Time
O#O	்ட்டிற்ற 24 hrs	LC50 @ 48 hrs /	
Collection Date 7/22/10 Time 1,30 AM	LCSOLO 48 hrs	LC50 @ 72 hrs /	Date 8/30/LO Time
(	48 hr Static Screening Pp	1C50 @ 36 hry	N Va
Sampling Agency (Lity of Frank II)	Log Number	Survival /	Date 8-2ら-(び Time /えyS
7	LCSD @ 24 hrs	NOAEC/	20
If Priority, Date Needed	LC50 @ 49 hrs	LOAEG	Date. Time
Send Report to		Reproduction	3. Received by
Constal bishone Lanklintnian	Acute Bioaskays	NØAEC	Date Time
, h	48 hr Static Delinitive Cd	LOAEC	Delivered to
Contact Hazard	Log Number	/ 1025	Date Time
Data Reported	LC50 @ 24 hrs	//Chronic Pp	4. Rec'd in Lab by
Reviewed By	LC50 @ 48 hrs	Log Number	Date Time
Reviewed by	NOAEC \	LC50 @ 24 hrs	Logged in by
BIOLOGICAL SURVEYS	LOAEC	LC50 @ 48 hrs	Date Time
Macroinvertebrate Recon	48 hr Static Definitive Pp	LC50 @ 72 hrs	Additional Information
Rapid Bioassessment (State SOP)	Lag Number	LCSO @ 96 hrs	1. Approx. volume of sample 200 ± 20% indiv.
Intensive Survey - Surber	LC50-@ 24 hrs /	LCS0 @ 120 hrs	2. Nearest town or city Franklin TN
Intensive Survey - Dendy	1050 @ 48 hrs	LC50 @ 144 hrs	
Fish Population Recon	NOAEC /	L&50 @ 168 ftrs	3. Others present at callection 5 Welley & 5 Will puglish
Fish Population Intensive	LOAEC /	Survigat	, 0
Fish Tissue Collection	96 hr Static Definitive Cd	NOABÇ	4. Number of other samples collected at same
Chlorophyll Analysis	Log Number	LOAEC	time at this point O
Log Number	LC50 @ 24 hrs/	Growth.	
Chlorophyll a	LC50 @ 48 hr	MOMEC	5. Field collection procedure, handling and/or
Pheophyton	LC50 @ 72 1/s	LOAEC	preservation of this sample (A ) e.u.n.o.
SPECIAL STUDIES	LC50 @ 96/hrs	10255	
(Please Specify)	NOAEC /		
	LOAEC /	Chlorine Residual	6. Mode of transportation to lab Cox
	96 hr Static Definitive Pp		
	Log Nymber	Lab Parameters	7. Sampletooxer sealed by
	LC54/@ 24 hrs	Hd	
	LC SO @ 48 hrs	Cond.	8. Date-earnplercouler seated
	U650 @ 72 hrs	D.O.	9. Remarks
	/CSO@ 96 hrs	Temp.	Gample residue
	/ NOAEC		
	/ LOAEC		
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### Biological Analysis

Biological Analysis "Schedule must be arranged in advance for all tests (615) 282-5327	Chronic Bioassays / Branch Lab Number	Γ	1. Collec	LCSG @ 24 hrs / Date \$/30// 0 Time	4	1.050 @ 72 hrs / Date 8/30/10 Time				LOAE9 Date Time	Reproduction 3. Received by	NØAEC Date Time	AOA €C Delivered to	/ IC25 Date Time	Chronic Pp 4. Recd in Lab by	Log Number Date Time	LC50 @ 24 hrs Logged in by	LCSO @ 48 hrs Date Time	LCS0.@ 72 hrs Additional Information	LCS0 @ 96 hrs 1. Approx. volume of sample 200 ± 20% ind W.	15	LC50 @ 144 hrs	Liken @ 168 hrs 3. Others present at collection $5  \text{Welley } \in 5  \text{Will Bughlau}$	Surhai	NOABC 4. Number of other samples collected at same	LOAEC time at this point O	Growth (	NOAEC \ 5. Fleid collection procedure, handling end/or	LOAEC preservation of this sample (A) (20)(20)	1C28		Chlorine Residual 6. Mode of transportation to lab (2017		Lab Parameters 7, samplerbooks sealed by		Cond. 8: Date-eample/coder-walled	D.O.   B. Remarks ,	Temp.   Gample Kesiaul	
ues (A)	Screening Bioassays	(Cannot be used for permitting)	48 hr Static Screening Cd	Log Number	LC 0 0 24 hrs	LOSON 48 hrs	48 hr Static Screening Pp	Log Number	LCSD @ 24 hrs	LCSO @ 48 kirs		Acute Bioaskays	48 hr Static Delinitive Cd	Log Number	LC50 @ 24 hrs	LC50 @ 48 hrs	MOAEC / /	LOAEC	48 hr Static Definitive Pp	Log Number	LC50 @ 24 hrs	LC50 @ 48 hrs	NOAEC /	LOAEC /	96 hr Static Definitive Cd	Log Number	LC50 @ 24 hrs/	LC50 @ 48 hr	LC50 @ 72 1/s	LC50 @ 99/hrs	NOAEC /	LOAEC /	96 hr Static Definitive Pp	Log Namber	LCSV@ 24 hrs	LC\$0 @ 48 hrs	L/50 @ 72 hrs	ACSO @ 96 hrs	NOAEC
STATE OF INESSEE - ENVIRONMENTAL LABORATORIES Please Print Lagibly	Project/Site No. 5PCNC 000.5	Project Name 50 eAcer ( Feek	0	Description Macroinvertebrate	000.9 Depth -	Collection Date 9/3/10 Time 9.00 A.M	Sampler's name (Print) C. A. Sluco	Sampiling Agency (J.L. of Frank (in	ŋ	If Priority, Date Needed	Sand Report to	Crustal bishane Lianklintnian		Contact Hazard	Date Reported	Reviewed By	Reviewed by	BIOLOGICAL SURVEYS	X Macroinvertebrate Recon	Rapid Bioassessment (State SOP)	Intensive Survey - Surber	Intensive Survey - Dendy	Fish Population Recon	Fish Population Intensive	Fish Tissue Collection	Chlorophyll Analysis	Log Number	Chiorophyli a	Pheophyton	SPECIAL STUDIES	(Please Specify)								

## Biological Analysis

STATE OF INESSEE - ENVIRONMENTAL LABORATORIES Please Print Lagibly	RIES (#)	ə4\2 <b>5</b>	Biological Analysis "Schedule must be arranged in advance for all tests (616) 252-5327
Project/Site No. L. (3GR 000.6	Screening Bioassays	Chronic Bioassays /	" Branch Lab Number
iberty Ci	(Cannot be used for permitting)	Chronic Cd /	ğ
Station No. OOO.6 County WI	48 hr Static Screening Cd	Log Number	ed to Disho
Description Macroinvertebrates	Log Number	LC50 @ 24 hrs	Date 8/30// 0 Time
Depth	LC 60 @ 24 hrs	LC50 @ 48 hrs	े में. किंदिय
Collection Date 7/29/10 Time 9,00 A.M.	LCSO @ 48 hrs	LC50 @ 72 hrs /	Date 8/3040 Time
C. A.shu	48 hr Static Screening Pp	1C50 @ 36 hry	vediby Class
Sampling Agency ( ), Lo of Frank (in	Log Number	Survival	Date 8-30-(2) Time (2:45
h	LCSD @ 24 hrs	NOAEC/	sred to
if Priority, Date Needed	LCS0 @ 48 kms	LOAEG	Date. Time
Send Report to		Reproduction	wed by
Crustal bishop Lanklintnon	Acute Bloaskays	NØAEC	Date Time
	48 hr Static Devinitive Cd	LOMEC	Dalivared to
Contact Hazard	Log Number	/ 1026	Date Time
Date Reported By	LC50 @ 24 hrs	/Chronic Pp	4. Rec'd in Lab by
Reviewed By	LC50 @ 48 hrs	Log Number	Date Time
Reviewed by	NOAEC	LC50 @ 24 hrs	Logged in by
BIOLOGICAL SURVEYS	LOAEC	LC50 @ 48 hrs	Date Time
Macroinvertebrate Recon	48 hr Static Definitive Pp\	LC50.00 72 hrs	Additional Information
Rapid Bioassessment (State SOP)	Log Number	LC50 @ 96 hrs	1. Approx. wolume of sample 200 ± 20% indiw.
Intensive Survey - Surber	LC50 @ 24 hrs	LCS0@ 120 hrs	2. Nearest town or city Franklin TN
Intensive Survey - Dendy	LC50 @ 48 hrs	LC50 @ 144 hrs	
Fish Population Recon	NOAEC /	LA 50 @ 168 hrs	3. Others present at collection 5 Wellex & 5 Will Walnum
Fish Population Intensive	LOAEC /	Survigal	, o
Fish Tissue Collection	96 hr Stalic Definitive Cd	NOABC	4. Number of other samples collected at same
Chlorophyll Analysis	Log Number /	LOAEC	time at this point.
Log Number	LC50 @ 24 hrs/	Growth	
Chierophyll a	LC50 @ 48 hp/	NOAEC	5. Field collection procedure, handling and/or
Pheophyton	LC50.@ 72.t/s	LOAEC	preservation of this sample (4 (60)(0)
SPECIAL STUDIES	LC50 @ 96hrs	1025	
(Please Specify)	NOAEC /		- 1
	LOAEC /	Chlorine Residual	5. Mode of transportation to lab (our
	96 hr Static Definitive Pp		
	Log Nikmber	Lab Parameters	7. Sample/cooker sealed by
	LC5/@ 24 hrs	Ha	
	LC#0 @ 48 hrs	Cond.	B. Date earnpler/cooler realest
	L650 @ 72 hrs	0.0	4
	LCSO @ 96 hrs	Temp.	Sample Kestaur
	/ NOAEC		A/L C. Am O. S.
	/ LOAEC		
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Analysis
Biological

ise Print Legibly			"Sch	"Schedule must be arranged in advance for all tasts (615) 262-6327
ct/8tte No. < LL A. P COO 7		Screening Bioassays	Chronic Bioassays	Branch Lab Number
ct Name Shalls Blanch	کے	(Cannot be used for permitting)	Chronic Cd /	Chain of Çustody (sign full name)
4 000		48 hr Static Screening Cd	Log Number	1: Collected by C OSPOD
1		Ag Mumber	LC50 @ 24 hrs /	8
17		LONG 24 hrs	LC50 @ 48 hrs /	red 6 4. Tolley
te 7/27/10	L	LCSQ 48 hrs	LCS0 @ 72 hrs /	Date 8/30/10 Time
P. P. Sha		48 hr Static Screening Pp	1.C50 @ 96 hry	2. Received by Jun Jos Len
1		Log Number	Sunival	Date 8-20-(to Time 7.12: 45
		LCSD @ 24 hrs	NOAEC/	ared to
ority, Date Needed	ı	LCSD @ 48 hrs	LOAEQ	Date. Time
Report to	L		Reproduction	3. Received by
weth history Cantintonal		Acute Bioaskays	NØAEC	Date Time
	ľ	48 hr Static Devinitive Cd	LOAEC	Delivered to
aci Hazard		Log Number	/ 1025	Date Time
Reported	·	LC50 @ 24 hrs	/Chronic Pp	4. Recid in Lab by
	<del>-</del>	LC50 @ 48 hrs	Log Number	Date Time
wed by	····	NOAEC /	LC50 @ 24 hrs	Logged in by
SIOLOGICAL SURVEYS		LOAEC	LC50 @ 48 hrs	Date Time
Macroinvertebrate Recon	Ľ	48 hr Static Definitive Pp	LC50-@ 72 hrs	Additional Information
Rapid Bioassessment (State SOP)	Ë	Log Number	LCSO (0) 96 hrs	1. Approx. volume of sample 200 ± 20% indw.
ntensive Survey - Surber		LC50 @ 24 hrs	LCS0 @ 120 hrs	2. Nearest town or only Franklin TN
ntensive Survey - Dendy	<u> </u>	LC50 @ 48 hrs /	CS0 @ 144 hrs	
Fish Population Recon	·····	NOAEC /	L&50 @ 168 hrs	3. Others present at optication 5 Wellex & 5 Will Bughby
Fish Population Intensive		LOAEC /	Survival	
Fish Tissue Collection		96 hr Static Definitive Cd	NOABC	4. Number of other samples collected at same
Chlorophyll Analysis	Ē	Log Number	LOAEC	time at this point C
ed Number		LC50 @ 24 hrs/	Growth	
Chlorophyll a		C50 @ 48 hp	NOAEC	5. Field collection procedure, handling and/or
Pheophyton	_	LC50@723/fs	LOAEC	preservation of this sample A \ CUNO
SPECIAL STUDIES	·=	C50 @ 95/hrs	1025	
Please Specify)		NOAEC /		
	1=	LOAEC /	Chlorine Residual	6. Mode of transportation to lab Cour
		96 hr Static Definitive Pp		
	Ē	og Nyfmber	Lab Parameters	7. Sampleropoler sealed by
	L==L	C54 @ 24 hrs	HG.	
		Cyfolog 48 hrs	Cond.	8. Cate eample/cooler geared
		650 @ 72 hrs	B.O.	9. Remarks
	<u>~</u>	C50 @ 96 hrs	Тетр.	Sample Residue
	$\leq$	NOAEC		
	_	LOAEC		一年 な 三意ない

