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

Prepared for

City of Franklin, Tennessee
109 3RD Avenue South
Franklin, Tennessee 37065
Attn: Ms. Crystal Bishop

February 11, 2011

Prepared by

Tetra Tech EM Inc.
712 Melrose Avenue
Nashville, Tennessee 37211

TABLE OF CONTENTS

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.

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	35º53.543'/ -86º50.846'	0.3	Moore's Elementary School	4a
Fivemile Creek	FMILE001.5WI	35º52.125'/ -86º50.109'	1.5	Old Peytonsville Road	4a
Watson Branch	WATSO000.6WI	35º54.562'/ -86º50.791'	0.6	South Royal Oaks Road	4a
Sharps Branch	SHARP000.7WI	35º55.384'/ -86º52.777'	0.7	11th Avenue at Highway 96 West	4a
Liberty Creek	LIBER000.7WI	35º55.743'/ -86º51.362'	0.7	Eddy Lane	5
Spencer Creek	SPENC000.8WI	35º56.61'/ -86º51.318'	0.8	McMahon Road and Franklin Road	5

*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

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

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	35º53.543'/ -86º50.846'	7.22.2010	8.58	621.4	74.91	7.61
FMILE001.5WI	Fivemile Creek	35º52.125'/ -86º50.109'	7.22.2010	8.30	483.3	78.20	7.10
WATSO000.6WI	Watson Branch	35º54.562'/ -86º50.791'	7.27.2010	8.63	756.1	76.51	6.89
SHARP000.7WI	Sharps Branch	35º55.384'/ -86º52.777'	7.27.2010	8.38	926.4	75.25	6.70
LIBER000.7WI	Liberty Creek	35º55.743'/ -86º51.362'	7.29.2010	8.05	577.0	77.45	6.28
SPENC000.8WI	Spencer Creek	35º56.61'/ -86º51.318'	8.3.2010	8.39	840.8	73.93	6.39

Notes:

mg/L	milligrams per liter
µS/cm	micro Siemens per centimeter
SU	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	**DATE SAMPLED:** 7.22.2010	**SAMPLE TYPE:** SQKICK
Total Number of Individuals in Sample = 202		

BIOMETRIC	VALUE	CALIBRATED SCORE[1]
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

[2]Not Impaired ≥32 *Slightly Impaired - 21-31* Moderately Impaired - 10-20 Severely Impaired <10

HABITAT ASSESSMENT SCORE = 96

[3]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
% CLINGERS - Percent clingers

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	**DATE SAMPLED:** 7.22.2010	**SAMPLE TYPE:** SQKICK
Total Number of Individuals in Sample = 201		

METRIC	VALUE	CALIBRATED SCORE[1]
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

[2]*Not Impaired ≥ 32* Slightly Impaired - 21-31 Moderately Impaired - 10-20 Severely Impaired <10

HABITAT ASSESSMENT SCORE = 83

[3]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
% CLINGERS - Percent clingers

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	**HUC NO:** TN05130204
WATERSHED GROUP: Harpeth River	**DATE SAMPLED:** 7.27.2010	**SAMPLE TYPE:** SQKICK

Total Number of Individuals in Sample = 206

METRIC	VALUE	CALIBRATED SCORE[1]
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 = 24

[2]Not Impaired ≥32 *Slightly Impaired - 21-31* Moderately Impaired - 10-20 Severely Impaired <10

HABITAT ASSESSMENT SCORE = 111

[3]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
% CLINGERS - Percent clingers

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	**DATE SAMPLED:** 7.27.2010	**SAMPLE TYPE:** SQKICK
Total Number of Individuals in Sample = 166		

METRIC	VALUE	CALIBRATED SCORE[1]
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

[2]Not Impaired ≥32 Slightly Impaired - 21-31 *Moderately Impaired - 10-20* Severely Impaired <10

HABITAT ASSESSMENT SCORE = 82

[3]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
% CLINGERS - Percent clingers

TABLE 3-Continued
ASSESSMENT SCORES AND RESULTS - LIBERTY CREEK

STATION NO: LIBER000.7WI	**STREAM:** Liberty Creek	**STREAM ORDER:** 2
LOCATION: Eddy Lane	**ECOREGION:** 71h	**HUC NO:** TN05130204
WATERSHED GROUP: Harpeth River	**DATE SAMPLED:** 7.29.2010	**SAMPLE TYPE:** SQKICK
Total Number of Individuals in Sample = 217		

METRIC	VALUE	CALIBRATED SCORE[1]
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

MACROINVERTEBRATE INDEX SCORE = 24

[2]Not Impaired ≥32 *Slightly Impaired - 21-31* Moderately Impaired - 10-20 Severely Impaired <10

HABITAT ASSESSMENT SCORE = 96

[3]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
% CLINGERS - Percent clingers

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	**DATE SAMPLED:** 8.3.2010	**SAMPLE TYPE:** SQKICK

Total Number of Individuals in Sample = 257

BIOMETRIC	VALUE	CALIBRATED SCORE[1]
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

[2]Not Impaired ≥32 *Slightly Impaired - 21-31* Moderately Impaired - 10-20 Severely Impaired <10

HABITAT ASSESSMENT SCORE = 124

[3]*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
% CLINGERS - Percent clingers

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

Arnwine, D.H., J.I. Broach, L.K. Cartwright and G.M. Denton. 2000. Tennessee Ecoregion Project. Tennessee Department of Environment and Conservation, Division of Water Pollution Control, Nashville, TN.

Gorman, O.T., and J.R. Karr. 1978. Habitat structure and stream fish communities. Ecology. 59:507-515.

Griffith, G.E., J.M. Omernik and S. Azevedo. 1997. Ecoregions of Tennessee. NHREEL, Western Ecological Division, U.S. Environmental Protection Agency, Corvallis Oregon. EPA/600/R-97/022.

TDEC. 2010. The Known Exceptional Tennessee Waters and Outstanding National Resources Waters. Accessed via: http://environment-online.state.tn.us:7654/pls/enf_reports/. October.

Tennessee Department of Environmental Conservation (TDEC), Division of Water Pollution Control (WPC). 2006. Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys. October (Revised).

TDEC WPC. 2007. Rules of TDEC WPC Chapter 1200-4-4 Use Classifications for Surface Waters. October (Revised).

TDEC WPC. 2010a. Proposed Final Version Year 2010 303(d) List. August.

TDEC WPC. 2010b. Bacteriological and Fishing Advisories in Tennessee. August.

U.S. Department of Agriculture (USDA). 2008. Aerial imagery.

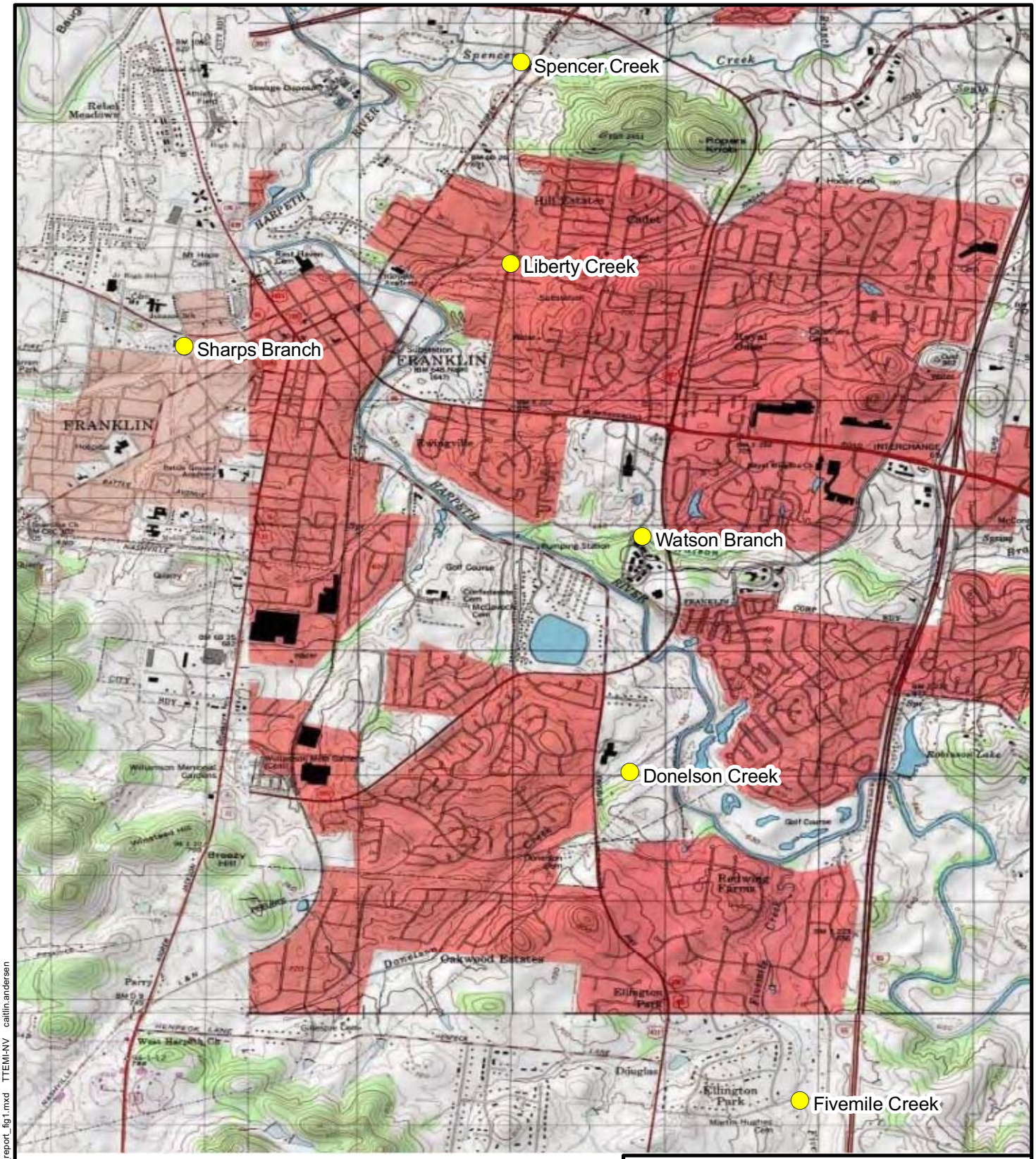
U.S. Geologic Service (USGS). 1979. 7.5 Minute Topographical Quadrangle Map, Spring Hill, Tennessee.

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



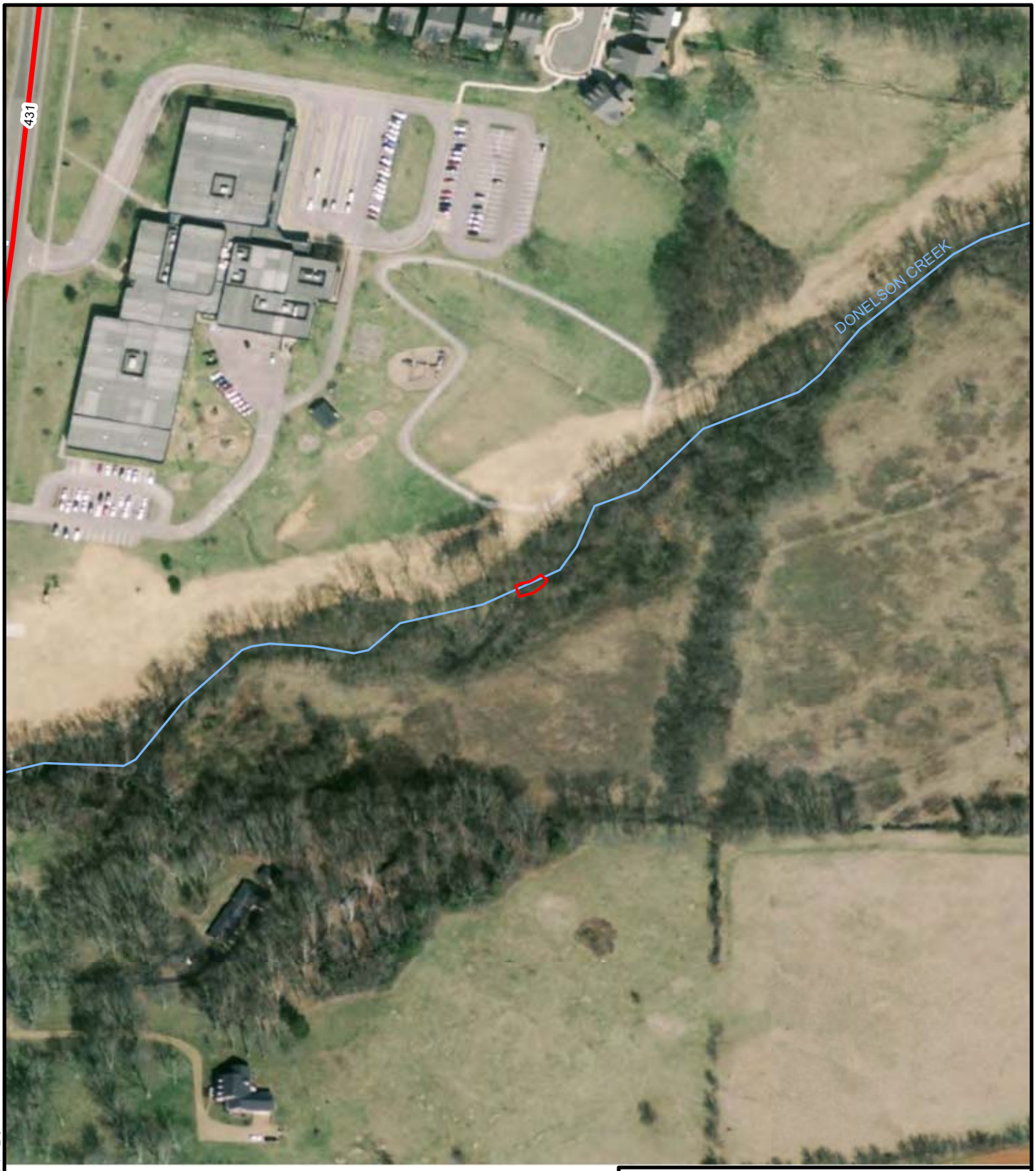
SOURCE: MODIFIED FROM USGS, FRANKLIN (1997), LEIPERS FORK (1981), BETHESDA (1982), AND SPRING HILL (1979), TENNESSEE QUADRANGLES.

CITY OF FRANKLIN
MACROINVERTEBRATE STREAM SURVEY

FIGURE 1
TOPOGRAPHIC MAP

TETRA TECH

2011-02-09 s:\cadd\s\127101\franklin_macro_report_fig1.mxd TTEMI-NV caitlin.andersen



Sample Reach

N
W E
S

0 100 200
Feet

SOURCE: MODIFIED FROM USDA, 2008.

CITY OF FRANKLIN
MACROINVERTEBRATE STREAM SURVEY

FIGURE 2
SITE LOCATION MAP
DONELSON CREEK

TETRA TECH

2011-02-09 s:\cadd\st\127101\franklin_macro_report_fig2.mxd TTEMI-NV caitlin.andersen

Sample Reach

N
W E
S

0 100 200
Feet

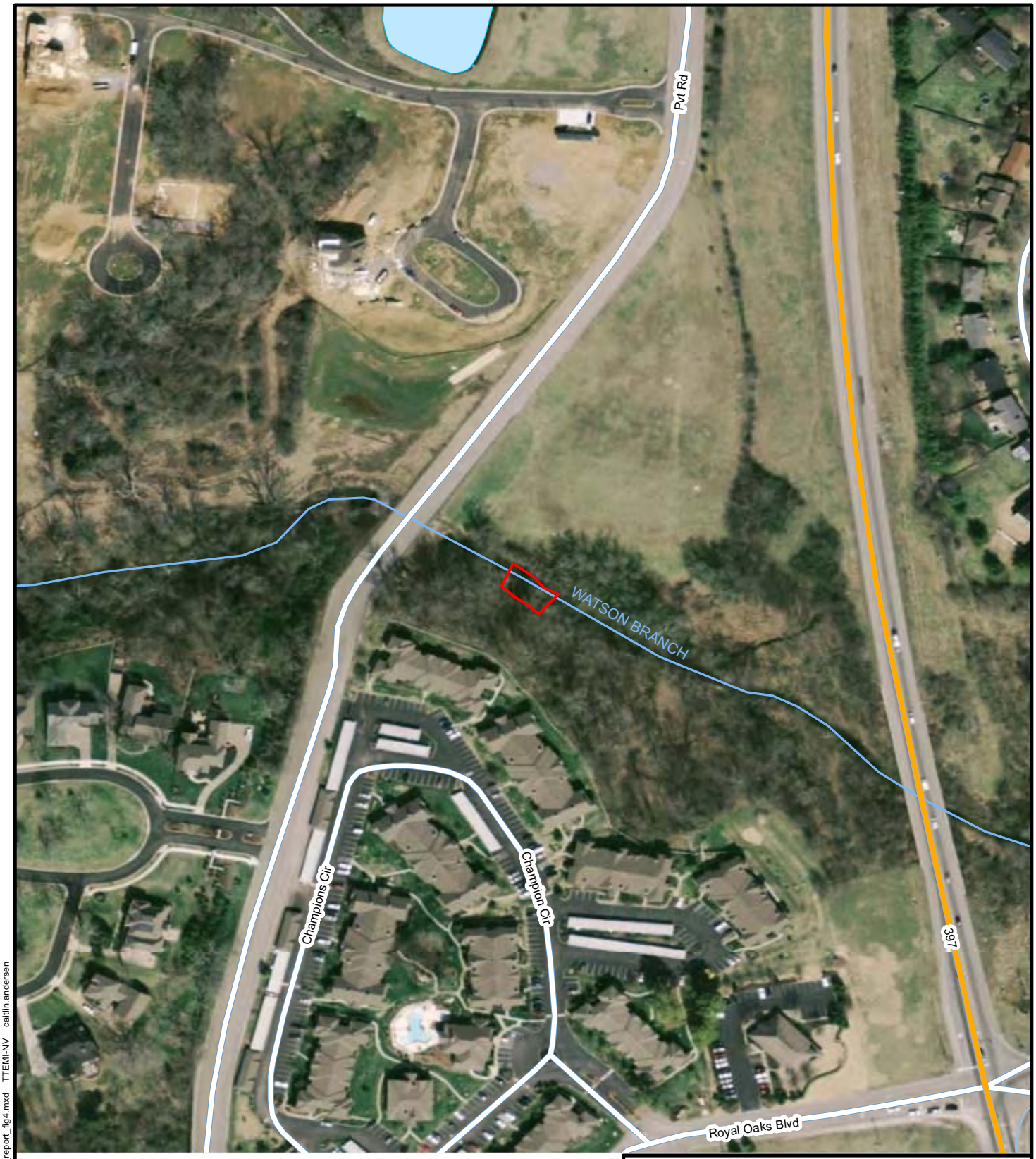
SOURCE: MODIFIED FROM USDA, 2008.

CITY OF FRANKLIN
MACROINVERTEBRATE STREAM SURVEY

FIGURE 3
SITE LOCATION MAP
FIVEMILE CREEK

TETRA TECH

2011-02-09 s:\cadd\s\127101\franklin_macro_report_fig3.mxd TTEMI-NV caitlin.andersen



Sample Reach

N
W E
S

0 100 200
Feet

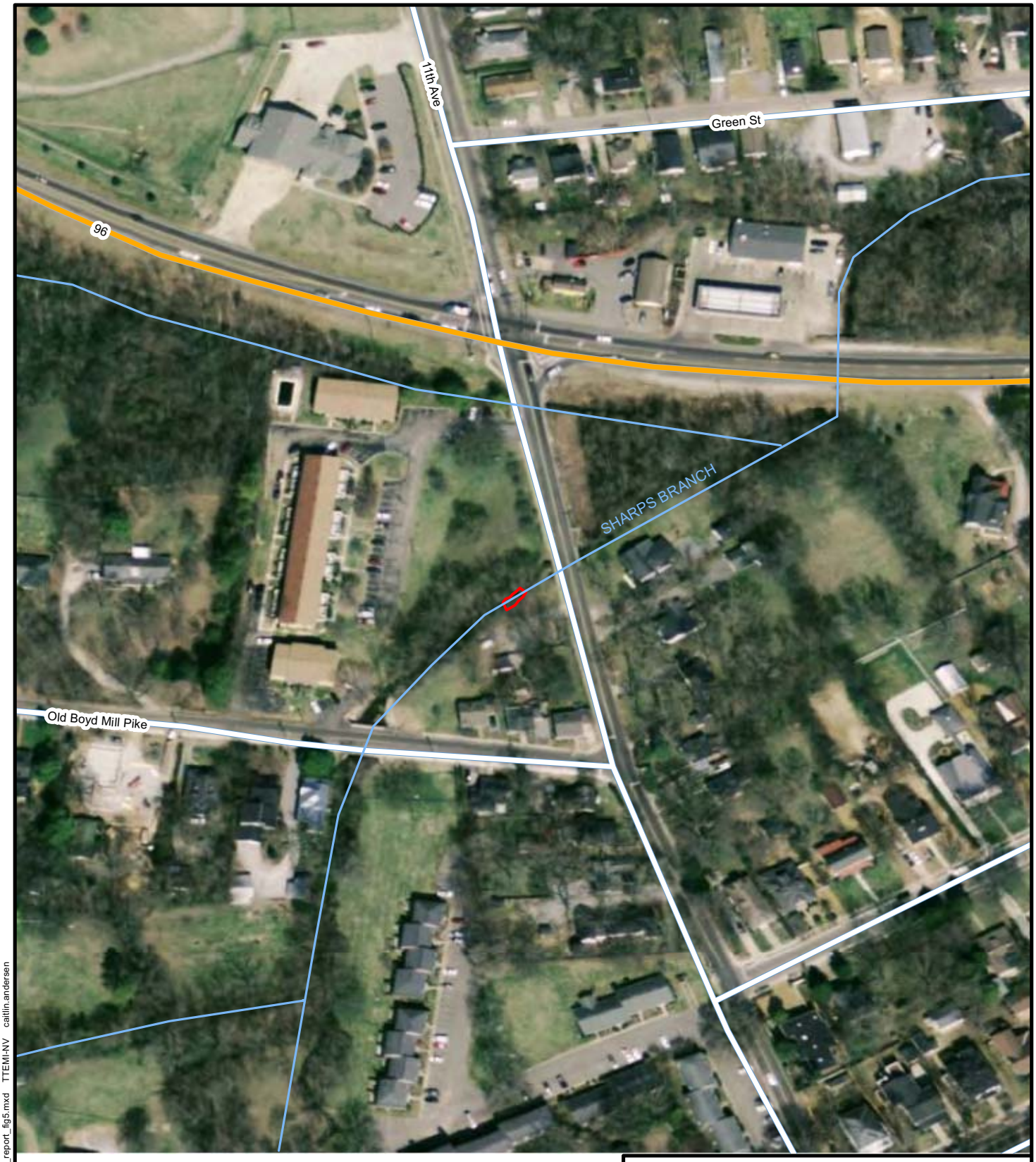
SOURCE: MODIFIED FROM USDA, 2008.

CITY OF FRANKLIN
MACROINVERTEBRATE STREAM SURVEY

FIGURE 4
SITE LOCATION MAP
WATSON BRANCH

TETRA TECH

2011-02-09 s:\cadd\s\127101\franklin_macro_report_fig4.mxd TTEMI-NV caitlin.andersen



Sample Reach

N
W E
S

0 100 200 Feet

SOURCE: MODIFIED FROM USDA, 2008.

CITY OF FRANKLIN
MACROINVERTEBRATE STREAM SURVEY

FIGURE 5
SITE LOCATION MAP
SHARPS BRANCH

TETRA TECH

2011-03-02 s:\cadd\s\127101\franklin_macro_report_fig5.mxd TTEMI-NV caitlin.andersen

Sample Reach

N
W E
S

0 100 200
Feet

SOURCE: MODIFIED FROM USDA, 2008.

CITY OF FRANKLIN
MACROINVERTEBRATE STREAM SURVEY

FIGURE 6
SITE LOCATION MAP
LIBERTY CREEK

TETRA TECH

2011-02-09 s:\cadd\s\127101\franklin_macro_report_fig6.mxd TTEMI-NV caitlin.andersen

Sample Reach

N
W
E
S

0 100 200
Feet

SOURCE: MODIFIED FROM USDA, 2008.

CITY OF FRANKLIN
MACROINVERTEBRATE STREAM SURVEY

FIGURE 7
SITE LOCATION MAP
SPENCER CREEK

TETRA TECH

2011-02-09 s:\cadd\s\127101\franklin_macro_report_fig7.mxd TTEMI-NV caitlin.andersen

APPENDIX B – RESUMES

Amy M. Tolley

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
Tetra Tech EMI
712 Melrose Avenue
Nashville, TN 37211
(615) 254-4559

Dana Lingle, Project Manager
Tetra Tech EMI
712 Melrose Avenue
Nashville, TN 37211
(615) 254-4559

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 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

DANA M. LINGLE

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 20th 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

STREAM SURVEY FORM

STREAM SURVEY INFORMATION

STATION NUMBER:	DONEL000.3WI	ASSESSORS:	CB, JW, JW
STREAM NAME:	Donelson Creek	DATE:	7/22/10
STATION LOCATION:	Moore's Elem. School	TIME:	13:30pm
COUNTY:	WI	STREAM MILE:	0.3
WBID/HUC:	TN05130204	STREAM ORDER:	2
WATERSHED GROUP #	21	DRAINAGE AREA	-
LATITUDE DEC/DEG	35.892383	ELEVATION (ft):	-
LONGITUDE DEC/DEG	-86.84793	GAZETTEER PAGE	-
ECOLOGICAL SUBREGION:	71h	USGS QUAD	-
PROJECT/PURPOSE:			

SAMPLES COLLECTED

Aquatic Life Assessed: (Macroinvertebrates) Fish Algae Other:

Type of benthic sample: BIORECON SQ KICK SQ BANK DENDY SURBER OTHER _____

CHEMICALS Y or (N)

FIELD MEASUREMENTS

METERS USED: Troll 9000

pH	8.59	SU	DISSOLVED OXYGEN	7.6006	PPM (mg/L)
CONDUCTIVITY	162.4	UMHOS (mScm)	TIME	13:30	
TEMPERATURE	74.91°F	°C (°F)	OTHERS		

Previous 48 hours Precip: UNKNOWN (NONE) LITTLE MODERATE HEAVY FLOODING

Ambient Weather: SUNNY (CLOUDY) BREEZY RAIN SNOW AIR TEMP: 90°F

WATERSHED CHARACTERISTICS (App % of watershed observed)

UPSTREAM SURROUNDING LAND USE: (estimated %)

PASTURE	5	URBAN	5	RESID	60
CROPS	5	INDUSTRY	0	OTHER	0
FOREST	5	MINING	0		

IMPACTS: rated S(light), M(oderate), H(igh) magnitude. Blank = not observed

CAUSES					SOURCES				
Pesticides	(0200)	H	Flow Alter.	(1500) M	Point Source: Indust	(0100)		Unknown	(9000) S
Metals	(0500)	H	Habitat Alt.	(1600) M		(2000)		Municipal	(2000) M
Ammonia	(0600)	S	Thermal Alt.	(1400) S	Logging	(2000)		Mining	(5000)
Chlorine	(0700)	M	Pathogens	(1700) S	Construction/Land Devel	(3200)	H	Road /bridge	(3100) S
Nutrients	(0900)	M	Oil & grease	(1900) M	U/S Dam	(6600)		Urban Runoff	(4000) M
pH	(1000)	S	Unknown	(0000)	Riparian loss	(7000)	M	Bank destabilization	(7700) S
Organic Enrichment / Low D.O.		M	Siltation	(1100) M	Agriculture: Row crop	(1000)	S	Intensive Feedlot	(1600)
Other:				(1200)	Livestock grazing-riparian	(1410)	S	Dredging	(7200)
					Other:				

PHYSICAL STREAM CHARACTERISTICS

LENGTH OF STREAM AREA ASSESSED (m): 8

SURROUNDING LAND USE:

ESTIMATE % RDB LDB

	RDB	LDB		RDB	LDB		RDB	LDB
PASTURE	10	0	URBAN	5	20	RESID.	75	70
CROPS	0	0	INDUSTRY	0	0	OTHER	0	0
FOREST	10	10	MINING					

% CANOPY COVER: Estimated: X Open(0-10) Partly Shaded(11-45) (Mostly Shaded(46-80)) Shaded(>80)

Measured: ____ U/S 10 D/S 80 LB 80 RB 80

BANK HEIGHT (m): 5 HIGH WATER MARK (m): 6

SEDIMENT DEPOSITS: NONE SLIGHT (MODERATE) EXCESSIVE BLANKET

TYPE: SLUDGE (MUD) SAND SILT NONE OTHER _____ Contaminated Y or N

TURBIDITY: (CLEAR) SLIGHT MODERATE HIGH OPAQUE

ALGAE PRESENT? NONE SLIGHT (MODERATE) CHOKING TYPE _____

AQUATIC VEGET. ROOTED FLOATING TYPE NONE

ADDITIONAL COMMENTS: (oil sheen, odor, colors) NONE

STREAM SURVEY FORM

PHYSICAL STREAM CHARACTERISTICS (cont.)

	RIFFLE	RUN	POOL
DEPTH (in)	.02		
WIDTH (m)	1.5		
REACH LENGTH (m)	8		

Staff Gauge/Bench Ht: —
VELOCITY (FS) 0.71 (ft/s)
FLOW (CFS) —
HABITAT ASSESSMENT SCORE #: 96
RR# GP#

Gradient (sample reach): Flat (LW) Mode. High Cascade
Size (stream width): V. Small (<1.5m) Small (1.5-5m) Med (5-10m) Large (10-25m) Very Lrg (>25m)

SUBSTRATE (Complete either particle count or estimate Substrate (%))

Particle Count - 100 measured particles (mm). Circle one: (RIFFLE) RUN

size (mm)	description	abbreviation	Record measured particle size. Use abbrev. below for small particles.
<0.062	silt/clay	cl	1-10
0.062-0.125	very fine sand	vfs	11-20
0.125-.250	fine sand	fs	21-30
0.25-0.50	med sand	ms	31-40
0.5-1.0	coarse sand	cs	41-50
1.0-2.0	very coarse sand	(use actual size)	51-60
2.0-64.0	gravel	(use actual size)	61-70
64-256	cobble	(use actual size)	71-80
256-4096	boulder	(use actual size)	81-90
---	bedrock	bdrk	91-100
---	woody debris	wood	

SUBSTRATE (%) (Visual estimates)

	RIFFLE	RUN	POOL
BOULDER (> 10")	20 %	%	%
COBBLE (2.5-10")	5 %	%	%
GRAVEL (0.1-2.5")	5 %	%	%
BEDROCK	50 %	%	%
SAND (gritty)	5 %	%	%

	RIFFLE	RUN	POOL
CLAY (slick)	5 %	%	%
SILT	5 %	%	%
DETRITUS (FPOM)	5 %	%	%
MUCK-MUD (FFOM)	80 %	%	%
MARL (shell frags.)	0 %	%	%

STREAM USE SUPPORT: WATER WITHDRAWL NOTED

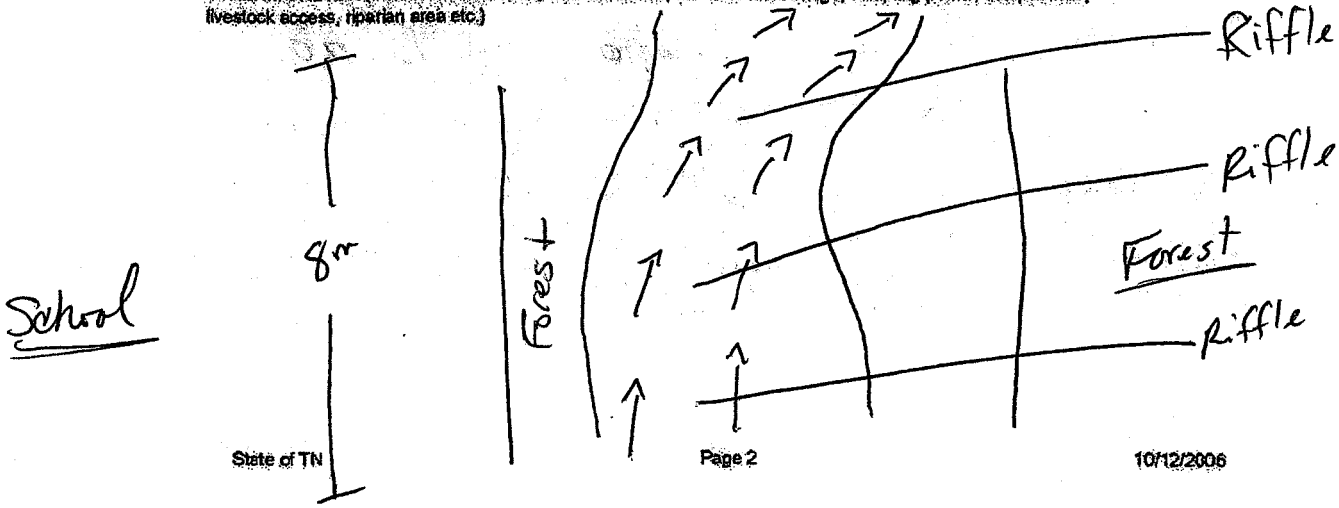
CLASSIFIED FOR:
Dom. H2O Supply
Ind. H2O Supply
TIER I/TIER II
Navigation
Trout >>
Nat. Rep.? 3030

POSTED FOR:
Bacteriological Advis.
Do Not Consume
Precautionary
Fish Tissue Advis.:

SUPPORT STATUS:
FULLY SUPPORTING (FS) PARTIALLY SUPPORTING (PS) SUPPORTING, BUT THREATENED (TH) NONSUPPORTING (NS)

Photos ? (Y) or N Roll/Disc # Photo #ID #/ID
#/ID #/ID

STREAM SKETCH (include flow direction, reach distance, distance from bridge, sampling points, tribs, outfalls, livestock access, riparian area etc.)



HABITAT ASSESSMENT DATA SHEET- HIGH GRADIENT STREAMS (FRONT)

STREAM NAME	DONELSON CREEK	LOCATION	Moores Elementary School
STATION #	DONEL000.3 WI	ECOREGION	71h
LAT	35° 53.549' N	LONG	-86° 50.846' W
WBID/HUC	05130209010S	INVESTIGATORS	CBishop JWeller JWithby
FORM COMPLETED BY	CBishop	DATE	7/22/10 TIME 1.30 AM (PM)

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient)	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the from of newfall, but not yet prepared for colonization (may rate at high end of scale)	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 cobble provides diversity of niche space.	Gravel, cobble and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 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 (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 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 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	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 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% of the available channel; or 25 % of channel substrate 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 10	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1

HABITAT ASSESSMENT DATA SHEET- HIGH GRADIENT STREAMS (BACK)

Station ID ANEL000.3WI Date 7/22/10

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 or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 15	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 habitat; distance between riffles divided by the width of the stream is a ratio of >35.
SCORE 11	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 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 area; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars
SCORE 1 (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
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 covered by vegetation; disruption of streambank vegetation is very high; 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 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 riparian zone > 18 meters; human activities (i.e. parking lots, roadbeds, clear-cuts, lawns or crops) have not impacted zone	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 1 (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

TOTAL SCORE (93) 96

STREAM SURVEY FORM

STREAM SURVEY INFORMATION

STATION NUMBER:	FWIE001.5WTT	ASSESSORS:	CB, JW, JW
STREAM NAME:	FIVEMILE6	DATE:	7-22-10
STATION LOCATION:	001.5 Old Peytonsville Rd.	TIME:	09:45
COUNTY:	WI	STREAM MILE:	1.5
WBID/HUC:	TN051302 04	STREAM ORDER:	4
WATERSHED GROUP #	1	DRAINAGE AREA	—
LATITUDE DEC/DEG	35.86875	ELEVATION (ft):	—
LONGITUDE DEC/DEG	-86.83515	GAZETTEER PAGE	—
ECOLOGICAL SUBREGION:	71h	USGS QUAD	—
PROJECT/PURPOSE:			

SAMPLES COLLECTED

Aquatic Life Assessed: (Macroinvertebrates) Fish Algae Other:

Type of benthic sample: BIORECON (SQ KICK) SQ BANK DENDY SURBER OTHER

CHEMICALS Y or (N)

FIELD MEASUREMENTS

METERS USED: Troll 9000

pH	8.30	SU	DISSOLVED OXYGEN	7.102	RAW (mg/L)
CONDUCTIVITY	493.3	UMHOS (mS cm)	TIME	0945	
TEMPERATURE	78.2	°C (°F)	OTHERS		

Previous 48 hours Precip: UNKNOWN (NONE) LITTLE MODERATE HEAVY FLOODING

Ambient Weather: (SUNNY) CLOUDY BREEZY RAIN SNOW AIR TEMP:

WATERSHED CHARACTERISTICS — Appx. % of watershed observed

UPSTREAM SURROUNDING LAND USE: (estimated %)

PASTURE	80	URBAN	5	RESID	15
CROPS	0	INDUSTRY	0	OTHER	
FOREST	0	MINING	0		

IMPACTS: rated S(light), M(oderate), H(igh) magnitude. Blank = not observed

CAUSES		Flow Alter. (1500)	M	SOURCES		Unknown (9000)	
Pesticides (0200)	M	Habitat Alt. (1600)	H	Point Source: Indust (0100)	M	Municipal (2000)	S
Metals (0500)	S	Thermal Alt. (1400)	S	Logging (2000)	O	Mining (5000)	O
Ammonia (0600)	S	Pathogens (1700)	M	Construction/Land Devel (3200)	H	Road /bridge (3100)	M
Chlorine (0700)	M	Oil & grease (1900)	S	U/S Dam (6000)	O	Urban Runoff (4000)	S
Nutrients (0900)	M	Unknown (0000)		Riparian loss (7600)	H	Bank destabilization (7700)	M
pH (1000)	S	Siltation (1100)	M	Agriculture: Row crop (1900)	H	Intensive Feedlot (1600)	O
Organic Enrichment / Low D.O.	S	(1200)		Livestock grazing-riparian (1410)	M	Dredging (7200)	O
Other:				Other:			

PHYSICAL STREAM CHARACTERISTICS — LENGTH OF STREAM AREA ASSESSED (m): 4

SURROUNDING LAND USE:

ESTIMATE % RDB LDB

	RDB	LDB		RDB	LDB		RDB	LDB
PASTURE	90	85	URBAN	0	0	RESID.	5	10
CROPS	5	5	INDUSTRY	0	0	OTHER	0	0
FOREST	0	0	MINING	0	0			

% CANOPY COVER: Estimated: X Open(0-10) Party Shaded(11-45) Mostly Shaded(46-80) Shaded(>80)

Measured: U/S 15 D/S 15 LB 0 RB 0

BANK HEIGHT (m): (L) 3 (R) 1.5 HIGH WATER MARK (m): 3.5

SEDIMENT DEPOSITS: NONE (SLIGHT) MODERATE EXCESSIVE BLANKET

TYPE: SLUDGE (MUD) SAND (SILT) NONE OTHER Contaminated Y or (N)

TURBIDITY: (CLEAR) SLIGHT MODERATE HIGH OPAQUE

ALGAE PRESENT? (NONE) SLIGHT MODERATE CHOKING TYPE

AQUATIC VEGET. ROOTED FLOATING TYPE NONE NONE

ADDITIONAL COMMENTS: (oil sheen, odor, colors)

STREAM SURVEY FORM

PHYSICAL STREAM CHARACTERISTICS (cont.)

	RIFFLE	RUN	POOL
DEPTH (in)	.5		
WIDTH (m)	2.6		
REACH LENGTH (m)	4		

Staff Gauge/Bench Ht: —
VELOCITY (FS) 1.0 (ft/s)
FLOW (CFS) —
HABITAT ASSESSMENT SCORE #: 83
RR# GP#

Gradient (sample reach): Flat Low Mode High Cascade
Size (stream width): V. Small (<1.5m) Small (1.5-3m) Med (3-10m) Large (10-25m) Very Lrg (>25m)

SUBSTRATE (Complete either particle count or estimate substrate (%))

Particle Count - 100 measured particles (mm). Circle one: (RIFFLE) RUN

size (mm)	description	abbreviation
<0.062	silt/clay	cl
0.062-0.125	very fine sand	vfs
0.125-.250	fine sand	fs
0.25-0.50	med sand	ms
0.5-1.0	coarse sand	cs
1.0-2.0	very coarse sand	(use actual size)
2.0-64.0	gravel	(use actual size)
64-256	cobble	(use actual size)
256-4096	boulder	(use actual size)
---	bedrock	bdrk
---	woody debris	wood

Record measured particle size. Use abbrev. below for smaller sizes.

1-10										
11-20										
21-30										
31-40										
41-50										
51-60										
61-70										
71-80										
81-90										
91-100										

SUBSTRATE (%) (Visual estimates)

	RIFFLE	RUN	POOL
BOULDER (> 10")	5 %	%	%
COBBLE (2.5-10")	10 %	%	%
GRAVEL (0.1-2.5")	75 %	%	%
BEDROCK	%	%	%
SAND (gritty)	0 %	%	%

	RIFFLE	RUN	POOL
CLAY (slick)	5 %	%	%
SILT	0 %	%	%
DETRITUS (CPOM)	0 %	%	%
MUCK-MUD (FPOM)	0 %	%	%
MARL (shell frags.)	0 %	%	%

STREAM USE SUPPORT

WATER WITHDRAWL NOTED

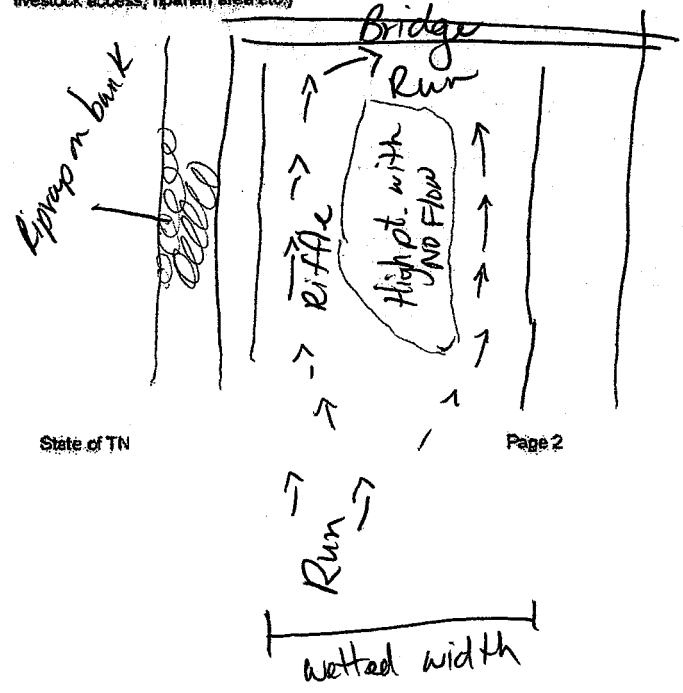
CLASSIFIED FOR:
Dom. H2O Supply N/A
Ind. H2O Supply N/A
TIER II/TIER III N/A
Navigation N/A
Trout >> N/A
Nat. Repr? ~~APPR~~ 3030

POSTED FOR:
Bacteriological Advis. N/A
Do Not Consume N/A
Precautionary N/A
Fish Tissue Advis. N/A

SUPPORT STATUS:
FULLY SUPPORTING (FS) PARTIALLY SUPPORTING (PS) SUPPORTING, BUT THREATENED (TH) NONSUPPORTING (NS)

Photos? Y or N Roll/Disc # Photo #ID #/ID
#/ID #/ID

STREAM SKETCH (include flow direction, reach distance, distance from bridge, sampling points, tribs, outfalls, livestock access, riparian area etc.)



Left side of high pt. Not included in Macroinvertebrate & Flow samples

HABITAT ASSESSMENT DATA SHEET- HIGH GRADIENT STREAMS (FRONT)

STREAM NAME	FIVE MILE CREEK	LOCATION	old Peytonsville Rd
STATION #	FMILE001.5UI	ECOREGION	71h
LAT 35° 52.125' N	LONG -86° 50.109' W	WATERSHED GROUP	Harpeth River
WBID/HUC	05130204010S	INVESTIGATORS	CBishop JKeller DWilloughby
FORM COMPLETED BY	CBishop	DATE 7/22/10 TIME 9.15 (AM) PM	

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient)	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the from of newfall, but not yet prepared for colonization (may rate at high end of scale)	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 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 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 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 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 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 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	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 Statns	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.	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

HABITAT ASSESSMENT DATA SHEET- HIGH GRADIENT STREAMS (BACK)

Station ID FMILE001.5WI Date 7/22/10

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 or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 11	20 19 18 17 16	15 14 13 12 (11)	10 9 8 7 6	5 4 3 2 1
7. Frequency of Riffles (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 habitat; distance between riffles divided by the width of the stream is a ratio of >35.
SCORE 12	20 19 18 17 16	15 14 13 (12) 11	10 9 8 7	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; 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 area; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars
SCORE 3 (LB)	Left Bank 10 9	8 (7) 6	5 4 (3)	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 (7) 6	5 4 3	2 1 0
9. Vegetative 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 covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height
SCORE 2 (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 riparian zone > 18 meters; human activities (i.e. parking lots, roadbeds, clear-cuts, lawns or crops) have not impacted zone	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 (1) 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 (1) 0

TOTAL SCORE 83

STREAM SURVEY FORM

STREAM SURVEY INFORMATION

STATION NUMBER:	WAT50000606 E	ASSESSORS:	Tweller, Willoughby
STREAM NAME:	Watson Branch	DATE:	7/27/10
STATION LOCATION:	S. Royal Oaks Rd.	TIME:	09.40 AM
COUNTY:	Williamson	STREAM MILE:	0.6
WBID#/HUC:	TN05130204	STREAM ORDER:	3
WATERSHED GROUP #	1	DRAINAGE AREA	—
LATITUDE DEC/DEG	35.90936	ELEVATION (ft):	—
LONGITUDE DEC/DEG	-86.84651	GAZETTEER PAGE	—
ECOLOGICAL SUBREGION:	71h	USGS QUAD	—

PROJECT/PURPOSE:

SAMPLES COLLECTED

Aquatic Life Assessed: (Macroinvertebrates) Fish Algae Other:

Type of benthic sample: BIORECON (SQ KICK) SQ BANK DENDY SURBER OTHER _____

CHEMICALS: Y or (N)

FIELD MEASUREMENTS

METERS USED: Troll 9000

pH	8.63	SU	DISSOLVED OXYGEN	6.892	(mg/L)
CONDUCTIVITY	756.1	(mS/cm)	TIME	09:40	
TEMPERATURE	76.51	(°F)	OTHERS		

Previous 48 hours Precip: UNKNOWN (NONE) LITTLE MODERATE HEAVY FLOODING

Ambient Weather: (SUNNY) (CLOUDY) BREEZY RAIN SNOW AIR TEMP: 90°F

WATERSHED CHARACTERISTICS (Approx. % of watershed observed)

UPSTREAM SURROUNDING LAND USE: (estimated %)

PASTURE	15	URBAN	5	RESID	75
CROPS	0	INDUSTRY	0	OTHER	0
FOREST	5	MINING	0		

IMPACTS: rated S(light), M(oderate), H(eavy) magnitude. Blank = not observed

CAUSES				SOURCES					
Pesticides	(0200)	M	Flow Alter. (1500)	M	Point Source: Indust.	(0100)		Unknown	(9000)
Metals	(0500)	H	Habitat Alt. (1800)	S	Logging	(2000)		Municipal	(2000)
Ammonia	(0600)		Thermal Alt. (1400)		Construction/Land Devel	(3200)	M	Mining	(5000)
Chlorine	(0700)		Pathogens (1700)		U/S Dam	(6600)		Road /bridge	(3100) H
Nutrients	(0900)		Oil & grease (1900)	M	Riparian loss	(7600)	M	Urban Runoff	(4000) H
pH	(1000)		Unknown (0000)		Agriculture: Row crop	(1000)		Bank destabilization	(7700)
Organic Enrichment / Low D.O.			Siltation (1100)	S	Livestock grazing-riparian	(1410)		Intensive Feedlot	(1600)
Other:					Other:			Dredging	(7200)

PHYSICAL STREAM CHARACTERISTICS — LENGTH OF STREAM AREA ASSESSED (m): 11.3

SURROUNDING LAND USE:

ESTIMATE %	RDB	LDB		RDB	LDB		RDB	LDB
PASTURE	20	0	URBAN	20	10	RESID	60	90
CROPS	0	0	INDUSTRY	0	0	OTHER	0	0
FOREST	0	10	MINING	0	0			

% CANOPY COVER: Estimated: X Open(0-10) (Party Shaded(11-45)) Mostly Shaded(46-80) Shaded(>80)

Measured: U/S D/S LB RB

BANK HEIGHT (m): (L) 4m (R) 1m HIGH WATER MARK (m): 6.5m

SEDIMENT DEPOSITS: NONE SLIGHT (MODERATE) EXCESSIVE BLANKET

TYPE: SLUDGE (MUD) (SAND) (SILT) NONE OTHER _____ Contaminated Y or N

TURBIDITY: (CLEAR) SLIGHT MODERATE HIGH OPAQUE

ALGAE PRESENT? (NONE) SLIGHT MODERATE CHOKING TYPE _____

AQUATIC VEGET. (ROOTED) FLOATING TYPE _____

ADDITIONAL COMMENTS: (oil sheen, odor, colors)

STREAM SURVEY FORM

PHYSICAL STREAM CHARACTERISTICS (cont.)

	RIFFLE	RUN	POOL
DEPTH (m) (in)	1.15		
WIDTH (m)	1.27		
REACH LENGTH (m)	11.3		

Staff Gauge/Bench Ht: —
VELOCITY (FS) 0.24 (ft/s)
FLOW (CFS) —
HABITAT ASSESSMENT SCORE #: 111
RR#: GP#:

Gradient (sample reach): Flat (Low) Mode. High Cascade
Size (stream width): V. Small (<1.5m) (Small (1.5-3m)) Med (3-10m) Large (10-25m) Very Lrg (>25m)

SUBSTRATE (Complete either particle count or estimate Substrate (%))

Particle Count - 100 measured particles (mm). Circle one: (RIFFLE) RUN

size (mm)	description	abbreviation	Record measured particle size. Use abbrev. below for smaller sizes.
<0.062	silt/clay	si	1-10
0.062-0.125	very fine sand	vfs	11-20
0.125-.250	fine sand	fs	21-30
0.25-0.50	med sand	ms	31-40
0.5-1.0	coarse sand	cs	41-50
1.0-2.0	very coarse sand	(use actual size)	51-60
2.0-64.0	gravel	(use actual size)	61-70
64-256	cobble	(use actual size)	71-80
256-4096	boulder	(use actual size)	81-90
---	bedrock	bdrk	91-100
---	woody debris	wood	

SUBSTRATE (%) (Visual estimates)

	RIFFLE	RUN	POOL
BOULDER (> 10")	0 %	%	%
COBBLE (2.5-10")	10 %	%	%
GRAVEL (0.1-2.5")	30 %	%	%
BEDROCK	0 %	%	%
SAND (gritty)	30 %	%	%

	RIFFLE	RUN	POOL
CLAY (slick)	0 %	%	%
SILT	15 %	%	%
DETRITUS (CPOM)	0 %	%	%
MUCK-MUD (FPOM)	15 %	%	%
MARL (shell frags.)	0 %	%	%

STREAM USE SUPPORT

WATER WITHDRAWL NOTED

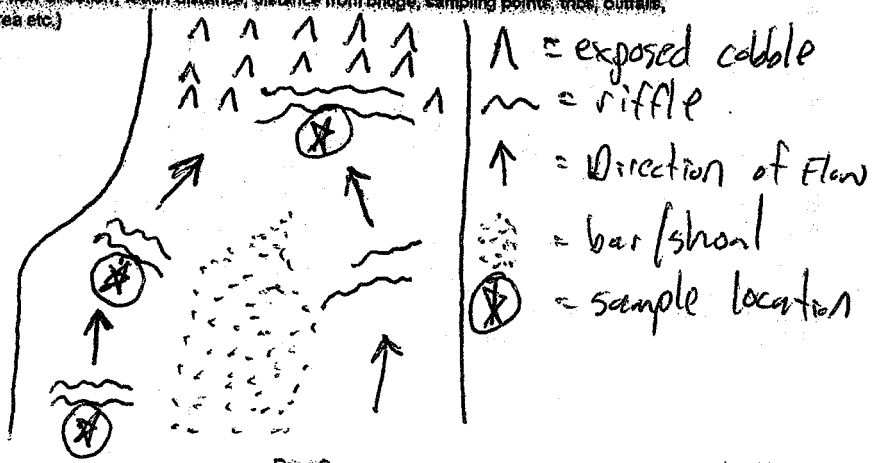
CLASSIFIED FOR:
Dom. H2O Supply
Ind. H2O Supply
TIER II/TIER III
Navigation
Trout >>
Nat. Repr? 303 D

POSTED FOR:
Bacteriological Advis.
Do Not Consume
Precaut/Ionary
Fish Tissue Advis.:

SUPPORT STATUS:
FULLY SUPPORTING (FS) PARTIALLY SUPPORTING (PS) (SUPPORTING, BUT THREATENED (TH)) NONSUPPORTING (NS)

Photos ? Y or N Roll/Disc #: Photo #ID: W/ID:
W/ID: W/ID:

STREAM SKETCH (include flow direction, reach distance, distance from bridge, sampling points, tribs, outfalls, livestock access, riparian area etc.)



HABITAT ASSESSMENT DATA SHEET- HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Watson Branch	LOCATION S. Loyal Oaks Blvd
STATION # WATS0000.6WI	ECOREGION 71h
LAT 35° 54.562' N LONG -86° 50.791' W	WATERSHED GROUP Harpeth River
WBID/HUC 05130204010S	INVESTIGATORS Jweller, Swilloughby
FORM COMPLETED BY Cushing	DATE 7/27/10 TIME 11.00 AM PM

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient)	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the from of newfall, but not yet prepared for colonization (may rate at high end of scale)	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 10	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 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 76% surrounded by fine sediment.
SCORE 13	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 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	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 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.	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 9	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1

HABITAT ASSESSMENT DATA SHEET- HIGH GRADIENT STREAMS (BACK)

Station ID WATS0000.601 Date 7/27/10

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 or 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 (12) 11	10 9 8 7 6	5 4 3 2 1
7. Frequency of Riffles (or bends) 12	Occurence 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.	Occurence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >35.
SCORE X	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 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 area; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional 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 covered by vegetation; disruption of streambank vegetation is very high; 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 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 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 4 (LB)	Left Bank 10 9	8 7 6	5 (4) 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 (7) 6	5 4 3	2 1 0

TOTAL SCORE 103

111

STREAM SURVEY FORM

STREAM SURVEY INFORMATION

STATION NUMBER:	SHARP000.7WE	ASSESSORS:	CBishop
STREAM NAME:	Sharps Branch	DATE:	7/27/10
STATION LOCATION:	11th Ave at 96W	TIME:	13:30
COUNTY:	Williamson	STREAM MILE:	0.7
WBID#/HUC:	TN05130204	STREAM ORDER:	2
WATERSHED GROUP #:	1	DRAINAGE AREA:	=
LATITUDE DEC/DEG:	35.92306	ELEVATION (ft):	=
LONGITUDE DEC/DEG:	-86.87961	GAZETTEER PAGE:	=
ECOLOGICAL SUBREGION:	71b	USGS QUAD:	=
PROJECT/PURPOSE:			

SAMPLES COLLECTED

Aquatic Life Assessed: (Macroinvertebrates) Fish Algae Other:

Type of benthic sample: BIORECON (SQ KICK) SQ BANK DENDY SURBER OTHER

CHEMICALS Y or N: N

FIELD MEASUREMENTS

METERS USED: Troll 9000

pH	8.38	SU	DISSOLVED OXYGEN	6.704	PPM (mg/L)
CONDUCTIVITY	275.25	UMHOS (mS/cm)	TIME	13:30 PM	
TEMPERATURE	926.4	°C (°F)	OTHERS	Turb 0.1	

Previous 48 hours Precip: UNKNOWN (NONE) LITTLE MODERATE HEAVY FLOODING

Ambient Weather: (SUNNY) (CLOUDY) BREEZY RAIN SNOW AIR TEMP: 92°F

WATERSHED CHARACTERISTICS: ADD % OF WATERSHED OBSERVED

UPSTREAM SURROUNDING LAND USE: (estimated %)

PASTURE	0	URBAN	50	RESID	25
CROPS	0	INDUSTRY	25	OTHER	0
FOREST	0	MINING	0		

IMPACTS: rated S(light), M(oderate), H(igh) magnitude. Blank = not observed

CAUSES:				SOURCES			
Pesticides (0200)	M	Flow Alter. (1500)	M	Point Source: Indust. (0100)		Unknown (9000)	
Metals (0500)	H	Habitat Alt. (1600)	M	Logging (2000)		Municipal (2000)	H
Ammonia (0600)		Thermal Alt. (1400)	H	Construction/Land Devel (3200)	M	Mining (5000)	
Chlorine (0700)	S	Pathogens (1700)	M	U/S Dam (8600)		Road /bridge (3100)	H
Nutrients (0900)	H	Oil & grease (1900)	H	Riparian loss (7600)	H	Bank destabilization (7709)	M
pH (1000)	S	Unknown (0000)		Agriculture: Row crop (1000)		Intensive Feedlot (1600)	
Organic Enrichment / Low D.O.		Siltation (1100)	M	Livestock grazing-riparian (1410)		Dredging (7200)	
Other:		(1200)		Other:			

PHYSICAL STREAM CHARACTERISTICS: LENGTH OF STREAM AREA ASSESSED (m): 3.6

SURROUNDING LAND USE:

ESTIMATE %	RDB	LDB		RDB	LDB		RDB	LDB
PASTURE	0	0	URBAN	50	50	RESID	40	40
CROPS	0	0	INDUSTRY	10	10	OTHER	0	0
FOREST	0	0	MINING	0	0			

% CANOPY COVER: Estimated: X Open(0-10) Partly Shaded(11-45) (Mostly Shaded(46-80)) Shaded(>80)

Measured: U/S D/S LB RB

BANK HEIGHT (m): M HIGH WATER MARK (m): 1.5

SEDIMENT DEPOSITS: NONE (SLIGHT) MODERATE EXCESSIVE BLANKET

TYPE: SLUDGE (MUD) SAND (SILT) NONE OTHER Contaminated Y or N

TURBIDITY: (CLEAR) SLIGHT MODERATE HIGH OPAQUE

ALGAE PRESENT? (NONE) SLIGHT MODERATE CHOKING TYPE

AQUATIC VEGET. (NONE) ROOTED FLOATING TYPE

ADDITIONAL COMMENTS: (oil sheen, odor, colors) lots of human litter such as glass and plastic

STREAM SURVEY FORM

PHYSICAL STREAM CHARACTERISTICS (cont.)

	RIFFLE	RUN	POOL
DEPTH (in)	1in	2.5 in	
WIDTH (m)	1.5m	1.5m	
REACH LENGTH (m)	3.4m	5.2m	

Staff Gauge/Bench Ht: –
VELOCITY (FS) 0.39 (ft/s)
FLOW (CFS) –
HABITAT ASSESSMENT SCORE #: 82
RR# GP#

Gradient (sample reach): Flat (Low) Mode. High Cascade
Size (stream width): V. Small (<1.5m) (Small (1.5-5m)) Med (5-10m) Large (10-25m) Very Lrg (>25m)

SUBSTRATE (Complete either particle count or estimate subsrate (%))

Particle Count - 100 measured particles (mm). Circle one: (RIFFLE) RUN

size (mm)	description	abbreviation	Record measured particle size. Use abbrev. below for smaller sizes.
<0.062	silt/clay	cl	1-10
0.062-0.125	very fine sand	vfs	11-20
0.125-.250	fine sand	fs	21-30
0.25-0.50	med sand	ms	31-40
0.5-1.0	coarse sand	cs	41-50
1.0-2.0	very coarse sand	(use actual size)	51-60
2.0-64.0	gravel	(use actual size)	61-70
64-256	cobble	(use actual size)	71-80
256-4096	boulder	(use actual size)	81-90
---	bedrock	bdrx	91-100
---	woody debris	wood	

SUBSTRATE (%) (Visual estimates)

	RIFFLE	RUN	POOL
BOULDER (> 10")	0 %	%	%
COBBLE (2.5-10")	5 %	%	%
GRAVEL (0.1-2.5")	40 %	%	%
BEDROCK	0 %	%	%
SAND (gritty)	30 %	%	%

	RIFFLE	RUN	POOL
CLAY (slick)	5 %	%	%
SILT	10 %	%	%
DETRITUS (CPOM)	5 %	%	%
MUCK-MUD (FPOM)	5 %	%	%
MARL (shell frags.)	0 %	%	%

STREAM USE SUPPORT WATER WITHDRAWL NOTED

CLASSIFIED FOR:		POSTED FOR:	
Dom. H2O Supply	Ind. H2O Supply		Bacteriological Advis.
TIER II/TIER III	Navigation		Do Not Consume
Trout >>	Nat. Repr? 303D		Precautionary
			Fish Tissue Advis.:

SUPPORT STATUS:
FULLY SUPPORTING (FS) (PARTIALLY SUPPORTING (PS)) SUPPORTING, BUT THREATENED (TH) NONSUPPORTING (NS)

Photos ? Y or N Roll/Disc # Photo #ID #/ID
#/ID #/ID

STREAM SKETCH (include flow direction, reach distance, distance from bridge, sampling points, tribs, outfalls, livestock access, riparian area etc.)

4th sample due to lack of individuals collected in first 3 kicks

HABITAT ASSESSMENT DATA SHEET- HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Sharps Branch		LOCATION 11th Ave @ 96W	
STATION # SHARP000.7WI		ECOREGION 71h	
LAT 35° 55.384' N LONG -86° 52.777'W		WATERSHED GROUP Harpeth River	
WBID/HUC 05130204010S		INVESTIGATORS C Bishop	
FORM COMPLETED BY C. Bishop		DATE 7/27/10 TIME 1.30 AM (PM)	

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient)	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the from of newfall, but not yet prepared for colonization (may rate at high end of scale)	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, 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 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 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 10	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	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> 75% of the available channel; or 25 % of channel substrate 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 12	20 19 18 17 16	15 14 13 (12) 11	10 9 8 7 6	5 4 3 2 1

HABITAT ASSESSMENT DATA SHEET- HIGH GRADIENT STREAMS (BACK)

Station ID SHARP000.7WI Date 7/27/10

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 or 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 (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 habitat; 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
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60 % of bank in reach has areas of erosion; high erosion potential during floods	Unstable; many eroded area; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars
SCORE 6 (LB)	Left Bank 10 9	8 7 (6)	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 (6)	5 4 3	2 1 0
9. Vegetative 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 covered by vegetation; disruption of streambank vegetation is very high; 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 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 1 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 (1) 0
SCORE 1 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 (1) 0

TOTAL SCORE (82)

STREAM SURVEY FORM

STREAM SURVEY INFORMATION

STATION NUMBER: LIBER000.7NI
STREAM NAME: Liberty Creek
STATION LOCATION: Eddyville
COUNTY: Williamson
WBID#/HUC: TN05130204
WATERSHED GROUP #: Harpeth River
LATITUDE DEC/DEG: 35°55.743' (35.92905)
LONGITUDE DEC/DEG: -86°57.362' (-86.85603)
ECOLOGICAL SUBREGION: 71h
PROJECT/PURPOSE:

ASSESSORS: CB/JW/SW
DATE: 7/29/10
TIME: 0900
STREAM MILE: 0.7
STREAM ORDER: 2
DRAINAGE AREA: —
ELEVATION (ft): —
GAZETTEER PAGE: —
USGS QUAD: —

SAMPLES COLLECTED

Aquatic Life Assessed: Macroinvertebrates Fish Algae Other:
Type of benthic sample: BIORECON (SQ KICK) SQ BANK DENDY SURBER OTHER
CHEMICALS Y or (N)

FIELD MEASUREMENTS

METERS USED: YSI 95D

pH	8.05	SU	DISSOLVED OXYGEN	6.279	PPM (mg/L)
CONDUCTIVITY	577.0	UMHOS (mScm)	TIME	09:00	
TEMPERATURE	77.45°F	°F (°C)	OTHERS		

Previous 48 hours Precip: UNKNOWN (NONE) LITTLE MODERATE HEAVY FLOODING
Ambient Weather: (SUNNY) CLOUDY BREEZY RAIN SNOW AIR TEMP: 87°F

WATERSHED CHARACTERISTICS (Approx. % of watershed observed)

UPSTREAM SURROUNDING LAND USE: (estimated %)

PASTURE	—	URBAN	40	RESID	60
CROPS	—	INDUSTRY	—	OTHER	—
FOREST	—	MINING	—		

IMPACTS: rated S(light), M(oderate), H(igh) magnitude. Blank = not observed

CAUSES				SOURCES			
Pesticides (0200)	H	Flow Alter. (1500)	M	Point Source: Indust. (0100)		Unknown (9000)	
Metals (0500)	M	Habitat Alt. (1600)	S	Logging (2000)		Municipal (2000)	H
Ammonia (0600)		Thermal Alt. (1400)	S	Construction/Land Devel (3200)		Mining (5000)	
Chlorine (0700)	M	Pathogens (1700)		U/S Dam (6600)		Road /bridge (3100)	M
Nutrients (0900)	H	Oil & grease (1900)	H	Riparian loss (7900)	H	Urban Runoff (4000)	H
pH (1900)	S	Unknown (0099)		Agriculture: Row crop (1000)		Bank destabilization (7700)	M
Organic Enrichment / Low D.O.	S	Siltation (1100)	M	Livestock grazing-riparian (1410)		Dredging (7200)	
Other:		(1200)		Other:			

PHYSICAL STREAM CHARACTERISTICS — LENGTH OF STREAM AREA ASSESSED (m): 240

SURROUNDING LAND USE:

ESTIMATE % RDB	RDB	LDB		RDB	LDB		RDB	LDB
PASTURE	—	—	URBAN	100	60	RESID	—	40
CROPS	—	—	INDUSTRY	—	—	OTHER	—	—
FOREST	—	—	MINING	—	—			

% CANOPY COVER: Estimated: X Open(0-10) Partly Shaded(11-45) Mostly Shaded(46-80) Shaded(>80)
Measured: U/S D/S LB RB

BANK HEIGHT (m): .5 LDB / 1.5 RDB HIGH WATER MARK (m): 5m

SEDIMENT DEPOSITS: NONE SLIGHT (MODERATE) EXCESSIVE BLANKET
TYPE: SLUDGE (MUD) SAND SILT NONE OTHER Contaminated Y or (N)
TURBIDITY: CLEAR (SLIGHT) MODERATE HIGH OPAQUE

ALGAE PRESENT? NONE SLIGHT (MODERATE) CHOKING TYPE
AQUATIC VEGET. (ROOTED) FLOATING TYPE
ADDITIONAL COMMENTS: (oil sheen, odor, colors)

STREAM SURVEY FORM

PHYSICAL STREAM CHARACTERISTICS (cont.)

	RIFFLE	RUN	POOL
DEPTH avg (in)	1in		
WIDTH (m)	1.5		
REACH LENGTH (m)	2.9		

Staff Gauge/Bench Ht: —
VELOCITY (FS) 0.25 (ft/s)
FLOW (CFS) —
HABITAT ASSESSMENT SCORE #: 96
RR# GP#

Gradient (sample reach): Flat (Low) Mode. High Cascade

Size (stream width): (V. Small (<1.5m)) Small (1.5-3m) Med (3-10m) Large (10-25m) Very Lrg (>25m)

SUBSTRATE (Complete either particle count or estimate substrate (%))

Particle Count - 100 measured particles (mm). Circle one: (RIFFLE) RUN

size (mm)	description	abbreviation	Record measured particle size. Use abbrev. below for smaller sizes.
<0.062	silt/clay	sl	1-10
0.062-0.125	very fine sand	vfs	11-20
0.125-.250	fine sand	fs	21-30
0.25-0.50	med sand	ms	31-40
0.5-1.0	coarse sand	cs	41-50
1.0-2.0	very coarse sand	(use actual size)	51-60
2.0-64.0	gravel	(use actual size)	61-70
64-256	cobble	(use actual size)	71-80
256-4096	boulder	(use actual size)	81-90
---	bedrock	bdrx	91-100
---	woody debris	wood	

SUBSTRATE (%) (Visual estimates)

	RIFFLE	RUN	POOL
BOULDER (> 10")	10 %	— %	— %
COBBLE (2.5-10")	10 %	— %	— %
GRAVEL (0.1-2.5")	10 %	— %	— %
BEDROCK	60 %	— %	— %
SAND (gritty)	10 %	— %	— %

	RIFFLE	RUN	POOL
CLAY (slick)	0 %	— %	— %
SILT	0 %	— %	— %
DETRITUS (FPOM)	0 %	— %	— %
MUCK-MUD (FPOM)	0 %	— %	— %
MARL (shell frags.)	0 %	— %	— %

STREAM USE SUPPORT

WATER WITHDRAWL NOTED

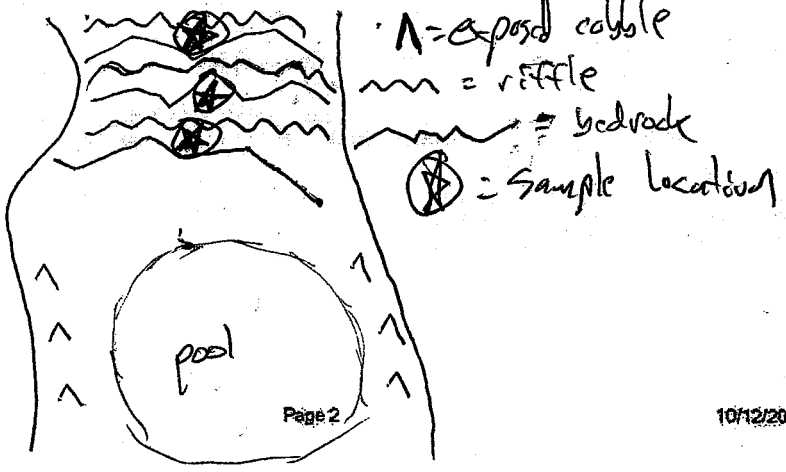
CLASSIFIED FOR:
Dom. H2O Supply
Ind. H2O Supply
TIER I/TIER II
Navigation
Trout >>
Nat. Res? 303D

POSTED FOR:
Bacteriological Advis.
Do Not Consume
Precautionary
Fish Tissue Advis.

SUPPORT STATUS:
FULLY SUPPORTING (FS) PARTIALLY SUPPORTING (PS) SUPPORTING, BUT THREATENED (TH) NONSUPPORTING (NS)

Photos ? Y or N Roll/Disc # Photo #ID #/ID
#/ID #/ID

STREAM SKETCH (include flow direction, reach distance, distance from bridge, sampling points, tribs, outfalls, livestock access, riparian area etc.)



HABITAT ASSESSMENT DATA SHEET- HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Liberty Creek		LOCATION Eddy Ln	
STATION # LIBER000.7WI		ECOREGION 71h	
LAT 35° 55.743' N	LONG -86° 51.362' W	WATERSHED GROUP Harpeth River	
WBID/HUC 05130204010S		INVESTIGATORS C Bishop, JWeller, JWilloughby	
FORM COMPLETED BY C Bishop		DATE 7/29/10 TIME 9:00 (AM) PM	

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient)	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the from of newfall, but not yet prepared for colonization (may rate at high end of scale)	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 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 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 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 (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 10	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	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 13	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.	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

HABITAT ASSESSMENT DATA SHEET- HIGH GRADIENT STREAMS (BACK)

Station ID UBER000.7WI Date 7/29/10

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 or 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 (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 habitat; 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 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 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	(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 covered by vegetation; disruption of streambank vegetation is 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
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone > 18 meters; human activities (i.e. parking lots, roadbeds, clear-cuts, lawns or crops) have not impacted zone	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 1 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 (1) 0
SCORE 1 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 (1) 0

TOTAL SCORE 96

STREAM SURVEY FORM

STREAM SURVEY INFORMATION

STATION NUMBER: SPENC000.8 WJE / Spencer
STREAM NAME:
STATION LOCATION: McMahon Rd. / Franklin Pk
COUNTY: Williamson
WBID/HUC: TN
WATERSHED GROUP #: Harpeth River
LATITUDE DEC/DEG: 35° 56.610' (35.9435)
LONGITUDE DEC/DEG: -86° 51.318' (-86.8553)
ECOLOGICAL SUBREGION: 71h
PROJECT/PURPOSE:

ASSESSORS: JWeller, JWilloughby
DATE: 8/03/18
TIME: 11:10 AM
STREAM MILE: 0.8
STREAM ORDER: 4th
DRAINAGE AREA: —
ELEVATION (ft): —
GAZETTEER PAGE: —
USGS QUAD: —

SAMPLES COLLECTED

Aquatic Life Assessed: (Macroinvertebrates) Fish Algae Other:
Type of benthic sample: BIORECON (SQ KICK) SQ BANK DENDY SURBER OTHER
CHEMICALS: Y or (N)

FIELD MEASUREMENTS

METERS USED: Troll 9000

pH	8.39 SU	DISSOLVED OXYGEN	6.393 (mg/L) ppm
CONDUCTIVITY	840.8 (µS/cm)	TIME	09:00 AM
TEMPERATURE	73.93 °F (°C)	OTHERS	

Previous 48 hours Precip: UNKNOWN (NONE) LITTLE MODERATE HEAVY FLOODING
Ambient Weather: (SUNNY) CLOUDY BREEZY RAIN SNOW AIR TEMP:

WATERSHED CHARACTERISTICS (Appr. % of watershed observed)

UPSTREAM SURROUNDING LAND USE: (estimated %)

PASTURE	15	URBAN	50	RESID	20
CROPS	5	INDUSTRY	0	OTHER	0
FOREST	10	MINING	0		

IMPACTS: rated S(light), M(oderate), H(igh) magnitude. Blank = not observed

CAUSES				SOURCES			
Pesticides (0200)	H	Flow Alter. (1500)	H	Point Source: Indust (0100)	S	Unknown (9000)	
Metals (0500)	H	Habitat Alt. (1600)	H	Logging (2000)		Municipal (2000)	H
Ammonia (0600)	M	Thermal Alt. (1400)	M	Construction/Land Devel (3200)	H	Mining (5000)	
Chlorine (0700)	H	Pathogens (1700)	H	U/S Dam (8800)		Road /bridge (3100)	H
Nutrients (0900)	H	Oil & grease (1800)	H	Riparian loss (7600)	H	Urban Runoff (4000)	H
pH (1900)	M	Unknown (0000)		Agriculture: Row crop (1000)	M	Bank destabilization (7700)	H
Organic Enrichment / Low D.O.		Siltation (1100)	H	Livestock grazing-riparian (1410)	M	Intensive Feedlot (1600)	
Other:		(1200)	H	Other:		Dredging (7200)	S

PHYSICAL STREAM CHARACTERISTICS — LENGTH OF STREAM AREA ASSESSED (m): 49

SURROUNDING LAND USE:

ESTIMATE % RDB

	RDB	LDB		RDB	LDB		RDB	LDB
PASTURE	50	50	URBAN	35	35	RESID	15	15
CROPS	0	0	INDUSTRY	0	0	OTHER	0	0
FOREST	0	0	MINING	0	0			

% CANOPY COVER: Estimated: ✓ Open(0-10) Party Shaded(11-45) (Mostly Shaded(46-80)) Shaded(>80)
Measured: U/S D/S LB 60 RB
BANK HEIGHT (m): 1m HIGH WATER MARK (m): 3m

SEDIMENT DEPOSITS: NONE SLIGHT (MODERATE) EXCESSIVE BLANKET
TYPE: SLUDGE MUD SAND (SILT) NONE OTHER Contaminated Y or (N)
TURBIDITY: CLEAR (SLIGHT) MODERATE HIGH OPAQUE
ALGAE PRESENT? (NONE) SLIGHT MODERATE CHOKING TYPE
AQUATIC VEGET. ROOTED FLOATING TYPE
ADDITIONAL COMMENTS: (oil sheen, odor, colors)

STREAM SURVEY FORM

PHYSICAL STREAM CHARACTERISTICS (cont.)

	RIFFLE	RUN	POOL
DEPTH (in)	4.1 in		
WIDTH (m)	3.0		
REACH LENGTH (m)	3.9		

Staff Gauge/Bench Ht: —
VELOCITY (FS) 0.62 (ft/s)
FLOW (CFS) —
HABITAT ASSESSMENT SCORE #: 124
RR# GP#

Gradient (sample reach): Flat Low (Mode.) High Cascade
Size (stream width): V. Small (<1.5m) Small (1.5-3m) (Med (3-10m)) Large (10-25m) Very Lrg (>25m)

SUBSTRATE (Complete either particle count or estimate Substrate (%))

Particle Count - 100 measured particles (mm). Circle one: (RIFFLE) RUN

size (mm)	description	abbreviation
<0.062	silt/clay	cl
0.062-0.125	very fine sand	vfs
0.125-.250	fine sand	fs
0.25-0.50	med sand	ms
0.5-1.0	coarse sand	cs
1.0-2.0	very coarse sand	(use actual size)
2.0-64.0	gravel	(use actual size)
64-256	cobble	(use actual size)
256-4096	boulder	(use actual size)
---	bedrock	bdrk
---	woody debris	wood

Record measured particle size. Use abbrev. below for smaller sizes.

1-10																			
11-20																			
21-30																			
31-40																			
41-50																			
51-60																			
61-70																			
71-80																			
81-90																			
91-100																			

SUBSTRATE (%) (Visual estimates)

	RIFFLE	RUN	POOL
BOULDER (> 10")	20 %	%	30 %
COBBLE (2.5-10")	50 %	%	10 %
GRAVEL (0.1-2.5")	20 %	%	5 %
BEDROCK	5 %	%	20 %
SAND (gritty)	0 %	%	5 %

	RIFFLE	RUN	POOL
CLAY (slick)	0 %	%	10 %
SILT	5 %	%	20 %
DETRITUS (FPOM)	0 %	%	0 %
MUCK-MUD (FFOM)	0 %	%	0 %
MARL (shell frags.)	0 %	%	0 %

STREAM USE SUPPORT: WATER WITHDRAWL NOTED

CLASSIFIED FOR: None

Dom. H2O Supply	Ind. H2O Supply		
TIER II/TIER III	Navigation		
Trout >>	Nat. Rep.? 3031		

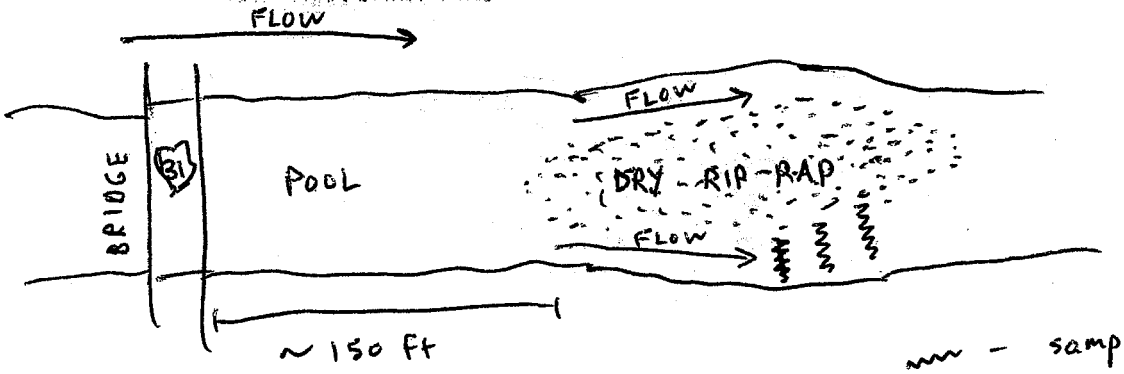
POSTED FOR:

Bacteriological Advis.	
Do Not Consume	
Precautionary	
Fish Tissue Advis.:	

SUPPORT STATUS:
FULLY SUPPORTING (FS) PARTIALLY SUPPORTING (PS) SUPPORTING, BUT THREATENED (TH) NONSUPPORTING (NS)

Photos ? Y or N Roll/Disc # Photo #ID #/ID
#/ID #/ID

STREAM SKETCH (include flow direction, reach distance, distance from bridge, sampling points, tribs, outfalls, livestock access, riparian area etc.)



~~~ - sampling locations

FLOW → - Riffles
Rapidly - moving moving
~~~

HABITAT ASSESSMENT DATA SHEET- HIGH GRADIENT STREAMS (FRONT)

STREAM NAME	SPENCER CREEK	LOCATION	Franklin Rd/McMahon Rd
STATION #	SPENC000.8WI	ECOREGION	71h
LAT	35° 56.610' N LONG -86° 51.318' W	WATERSHED GROUP	Harpeth River
WBID/HUC	05130204010S	INVESTIGATORS	JWeller JWilloughby
FORM COMPLETED BY	[redacted]	DATE 8/3/10 TIME	11:00 AM PM

JWeller

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient)	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the from of newfall, but not yet prepared for colonization (may rate at high end of scale)	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 cobble provides diversity of niche space.	Gravel, cobble and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 12	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 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 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 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	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 11	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.	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

HABITAT ASSESSMENT DATA SHEET- HIGH GRADIENT STREAMS (BACK)

Station ID SPENC000.8WI Date 8/3/10

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 or 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 habitat; distance between riffles divided by the width of the stream is a ratio of >35.
SCORE 13	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 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 area; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars
SCORE 6 (LB)	Left Bank 10 9	8 7 (6)	5 4 3	2 1 0
SCORE 8 (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 covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height
SCORE 5 (LB)	Left Bank 10 9	8 7 6	(5) 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 (6)	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone > 18 meters; human activities (i.e. parking lots, roadbeds, clear-cuts, lawns or crops) have not impacted zone	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 7 (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 124

APPENDIX D – PHOTOGRAPHIC DOCUMENTATION

Photographic Documentation
City of Franklin, Tennessee
Macroinvertebrate Stream Survey

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

Photographs taken by City of Franklin personnel between July 22 and August 3, 2010.

Photograph Number 1

Photographic Documentation
City of Franklin, Tennessee
Macroinvertebrate Stream Survey

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

Photographs taken by City of Franklin personnel between July 22 and August 3, 2010.

Photograph Number 2

Photographic Documentation
City of Franklin, Tennessee
Macroinvertebrate Stream Survey

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

Photographs taken by City of Franklin personnel between July 22 and August 3, 2010.

Photograph Number 3

Photographic Documentation
City of Franklin, Tennessee
Macroinvertebrate Stream Survey

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

Photographs taken by City of Franklin personnel between July 22 and August 3, 2010.

Photograph Number 4

Photographic Documentation
City of Franklin, Tennessee
Macroinvertebrate Stream Survey

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

Photographs taken by City of Franklin personnel between July 22 and August 3, 2010.

Photographic Documentation
City of Franklin, Tennessee
Macroinvertebrate Stream Survey

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

Photographs taken by City of Franklin personnel between July 22 and August 3, 2010.

Photographic Documentation
City of Franklin, Tennessee
Macroinvertebrate Stream Survey

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

Photographs taken by City of Franklin personnel between July 22 and August 3, 2010.

Photographic Documentation
City of Franklin, Tennessee
Macroinvertebrate Stream Survey

Description:	View of the Sharps Branch sampling reach facing upstream.

Photographs taken by City of Franklin personnel between July 22 and August 3, 2010.

Photographic Documentation
City of Franklin, Tennessee
Macroinvertebrate Stream Survey

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

Photographs taken by City of Franklin personnel between July 22 and August 3, 2010.

Photograph Number 9

Photographic Documentation
City of Franklin, Tennessee
Macroinvertebrate Stream Survey

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

Photographs taken by City of Franklin personnel between July 22 and August 3, 2010.

Photographic Documentation
City of Franklin, Tennessee
Macroinvertebrate Stream Survey

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

Photographs taken by City of Franklin personnel between July 22 and August 3, 2010.

Photographic Documentation
City of Franklin, Tennessee
Macroinvertebrate Stream Survey

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

Photographs taken by City of Franklin personnel between July 22 and August 3, 2010.

APPENDIX E – ANALYTICAL RESULTS AND CHAINS OF CUSTODY

BENTHIC MACROINVERTEBRATES COLLECTED FROM FRANKLIN, TN (TETRA TECH),8/31/10.

SPECIES	T.V.	F.F.G.	CL	DONEI000.3WI	FMILE001.5WI	LIBER000.6WI	SPENC000.8W1	SHARP00-.7WI	WATSO000.6WI
PLATYHELMINTHES									
Turbellaria									
Tricladida									
Dugesiidae	**6.1**								
Girardia sp.	**7.23**			2				1	6
MOLLUSCA									
Bivalvia									
Veneroida									
Corbiculidae									
Corbicula sp.	**6.12**	**FC**					2		23
Sphaeriidae	**6.6**	**FC**							
Pisidium sp.	**6.48**	**FC**							1
Sphaerium sp.	**7.58**	**FC**			3				
Gastropoda									
Mesogastropoda									
Physidae									
Physella sp.	**8.84**	**CG**				15			
Pleuroceridae	**3.4**								
Elimia sp.	**2.46**	**SC**		20				34	44
ANNELIDA									
Oligochaeta		**CG**							
Tubificida									
Lumbricidae	**10**	**SC**		14		1		48	1
Lumbriculida									
Lumbriculidae	**7.03**	**CG**							6
Hirudinea		**P**							
Rhynchobdellida									
Glossiphoniidae		**P**						1	
ARTHROPODA									
Crustacea									

SPECIES	T.V.	F.F.G.	CL	DONEI000.3WI	FMILE001.5WI	LIBER000.6WI	SPENC000.8W1	SHARP00-.7WI	WATSO000.6WI
Isopoda									
Asellidae		**SH**							
Lirceus sp.	**7.85**	**CG**						19	
Amphipoda	**7.4**	**CG**							
Crangonyctidae									
Crangonyx sp.	**7.87**	**CG**		5				1	
Decapoda									
Cambaridae	**7.5**								
Orconectes sp.	**2.6**	**SH**		2	3	7		6	5
Insecta									
Collembola							1		
Ephemeroptera									
Baetidae	**6.1**	**CG**							
Baetis sp.	**4.51**	**CG**		30	7	3			5
Diphetor sp.	**1.2**			3	1				
Caenidae		**CG**							
Caenis sp.	**7.41**	**CG**			1	1			
Heptageniidae	**1.5**	**SC**							
Maccaffertium sp.	**3.45**	**SC**	**CL**				3		
Stenacron sp.	**3.58**	**SC**	**CL**	4	8		8		2
Stenonema sp.	**3.45**	**SC**	**CL**		1				
Isonychiidae		**FC**							
Isonychia sp.	**3.45**	**FC**			1				
Odonata									
Calopterygidae		**P**							
Calopteryx sp.	**7.78**	**P**				10			
Coenagrionidae	**6.1**	**P**							
Hemiptera									
Corixidae	**9**	**PI**			7	1			
Veliidae	**6**	**P**							

SPECIES	T.V.	F.F.G.	CL	DONEI000.3WI	FMILE001.5WI	LIBER000.6WI	SPENC000.8W1	SHARP00-.7WI	WATSO000.6WI
Microvelia sp.	**6**	**P**		1					
Rhagovelia sp.	**6**	**P**							2
Megaloptera									
Corydalidae	**6.5**	**P**							
Corydalus sp.	**5.16**	**P**	**CL**				1		
Trichoptera									
Hydropsychidae	**4**	**FC**	**CL**						
Cheumatopsyche sp.	**6.22**	**FC**	**CL**	44	12	24	186	2	30
Hydropsyche sp.	**4.3**	**FC**	**CL**	16	147	24	38		8
Hydroptilidae	**4**	**PI**							
Hydroptila sp.	**6.22**	**PI**	**CL**		1				
Philopotamidae		**FC**	**CL**						
Chimarra sp.	**2.76**	**FC**	**CL**	46			9		
Coleoptera									
Curculionidae						2			
Elmidae	**6**	**CG**							
Dubiraphia sp.	**5.93**	**SC**	**CL**	2					
Stenelmis sp.	**5.1**	**SC**	**CL**	7	6	5	5	28	57
Hydrophilidae	**4.6**	**P**							
Tropisternus sp.	**9.68**	**P**				5			
Psephenidae		**SC**							
Psephenus sp.	**2.35**	**SC**	**CL**	1	1		4		
Staphylinidae	**8**	**P**		1					
Diptera									
Chironomidae									
Ablabesmyia sp.	**7.2**	**P**							1
Chironomus sp.	**9.63**	**CG**				7			
Cladotanytarsus sp.	**4.09**	**FC**		1					
Conchapelopia sp.	**4.5**	**P**		1		15		22	6
Cricotopus sp.	**5.78**	**CG**	**CL**			1			

BENTHIC MACROINVERTEBRATES COLLECTED FROM FRANKLIN, TN (TETRA TECH),8/31/10.

SPECIES	T.V.	F.F.G.	CL	DONEI000.3WI	FMILE001.5WI	LIBER000.6WI	SPENC000.8W1	SHARP00-.7WI	WATSO000.6WI
Cryptochironomus sp.	**6.4**	**P**						1	1
Phaenopsectra sp.	**6.5**	**SC**	**CL**			1			
Polypedilum sp.	**5.69**	**SH**			2	6		1	1
Rheocricotopus sp.	**7.3**	**CG**				2			
Rheotanytarsus sp.	**5.89**		**CL**			7			
Stictochironomus sp.	**6.52**	**CG**				1			
Tanytarsus sp.	**6.76**	**FC**				4			
Culicidae	**8.1**	**FC**							
Anopheles sp.	**8.58**	**FC**				1			
Empididae	**7.6**	**P**							
Hemerodromia sp.	**7.57**	**P**							1
Simuliidae	**3.5**	**FC**	**CL**						
Simulium sp.	**4**	**FC**	**CL**	1				2	1
Tipulidae	**4.9**	**SH**							
Limonia sp.	**9.64**	**SH**				1			
Tipula sp.	**7.33**	**SH**		1		73			5
TOTAL NO. OF ORGANISMS				**202**	**201**	**217**	**257**	**166**	**206**
TOTAL NO. OF TAXA				**20**	**15**	**24**	**10**	**13**	**20**
EPT				**6**	**9**	**4**	**5**	**1**	**4**
%OC				**7.92%**	**1.00%**	**20.74%**	**0.00%**	**43.37%**	**7.77%**
%EPT				**70.79%**	**88.56%**	**23.96%**	**94.94%**	**1.20%**	**21.84%**
NCBI				**4.73**	**4.61**	**6.60**	**5.61**	**6.17**	**4.91**
%NUTOL				**57.92%**	**13.93%**	**31.80%**	**75.88%**	**80.72%**	**70.39%**
% CLINGERS				**59.90%**	**87.56%**	**28.57%**	**98.83%**	**19.28%**	**47.57%**

Legend (added by Tetra Tech): 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

SPECIES	T.V.	F.F.G.	CL	DONEI000.3WI	FMILE001.5WI	LIBER000.6WI	SPENC000.8W1	SHARP00-.7WI	WATSO000.6WI

CG = collector/gatherer
FC = Filtering/collectors,
SC = Scrapers
SH = Shredders
P = Predators
PI = Piercer
CL = Clingers
sp = species

CHAIN -OF CUSTODY

NO.

PENNINGTON & ASSOCIATES, INC.

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

Project Name: City of Franklin

Porject No.: 1035127101

Project Location: Franklin, TN

Samplers (signature): See Attached

Sampling Date: Various

Sample ID	Date	Time	COMP	GRAB	Sample Description (Include Matrix and Point of Sample)	# of Containers	Requested Parameters
FMILE001.5	7-22-10	0915			See Remarks	1	
SHARP000.7	7-27-10	1330				1	
LIBER 000.6	7-29-10	0900				1	
SPENC 000.8	8-3-10	0900				1	
DONEL 000.3	7-22-10	1330				1	
WATSO 000.6	7-29-10	0945				1	

Remarks: Collected by SA-KICK & Sorted to subsamples containg 200+/- 20% organisms. Analyze using Quality System Standard Operating Procedure for Macroinvertebrate Stream Survey, TDEC, WPC, Oct. 2000. Identify to genus. Provide Metrics

Relinquished by	Date/Time
Amy M. Talley	8-31-10
Received by	Date/Time
Relinquished by	Date/Time
Received by	Date/Time
Relinquished by	Date/Time
Received by	Date/Time
Relinquished by	Date/Time
Received by	Date/Time
Relinquished by	Date/Time
Received by	Date/Time
Relinquished by	Date/Time
Received by	Date/Time

Pennington and Associates, Inc.-SOP-benchic macroinvertebrates

8-31-10

STATE OF TENNESSEE - ENVIRONMENTAL LABORATORIES

Please Print Legibly

Biological Analysis

**Schedule must be arranged in advance for all tests (615) 262-5327

Project/Site No.	FMILE001.5
Project Name	Five Mile Creek
Station No.	001.5 County WI
Description	Macroinvertebrates
Stream Mile	001.5 Depth
Collection Date	7/22/10 Time 9:15 am
Sampler's name (Print)	C Bishop
Sampling Agency	City of Franklin
Billing Code	
If Priority, Date Needed	
Send Report to	Crystal.bishop@franklintn.gov
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
  - Chlorophyll a
  - Pheophyton
- [ ] SPECIAL STUDIES

(Please Specify)

Screening Bioassays

(Cannot be used for permitting)

48 hr Static Screening Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs

48 hr Static Screening Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs

Acute Bioassays

48 hr Static Definitive Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- NOAEC
- 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 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- NOAEC
- LOAEC

96 hr Static Definitive Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- NOAEC
- LOAEC

Chronic Bioassays

Chronic Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- Survival
- NOAEC
- LOAEC
- Reproduction
- NOAEC
- LOAEC
- IC25

Chronic Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- LC50 @ 120 hrs
- LC50 @ 144 hrs
- LC50 @ 168 hrs
- Survival
- NOAEC
- LOAEC
- Growth
- NOAEC
- LOAEC
- IC25

Chlorine Residual

Lab Parameters
- pH
- Cond.
- D.O.
- Temp.

Branch Lab Number

Chain of Custody (sign full name)

1. Collected by C Bishop
   Date 8/30/10 Time
   Delivered to A. Tollen
   Date 8/30/10 Time
2. Received by Amy Zelley
   Date 8-30-10 Time 12:45
   Delivered to Pennington Assoc. - See Attached
   Date Time
3. Received by
   Date Time
   Delivered to
   Date Time
4. Rec'd in Lab by
   Date Time
   Logged in by
   Date Time

Additional Information

1. Approx. volume of sample 200 ± 20% indiv.
2. Nearest town or city Franklin, TN
3. Others present at collection J Weller & J Willoughby
4. Number of other samples collected at same time at this point 0
5. Field collection procedure, handling and/or preservation of this sample Alcohol
6. Mode of transportation to lab Car
7. Sample/cooler sealed by
8. Date sample/cooler sealed
9. Remarks Sorted Debris

PH-3010 (rev 1/96)

RDA 1527

STATE OF TENNESSEE - ENVIRONMENTAL LABORATORIES

Please Print Legibly

Biological Analysis

**Schedule must be arranged in advance for all tests (615) 262-6327

Project/Site No.	SHARP 000.7
Project Name	Sharps Branch
Station No.	000.7 County WI
Description	Macroinvertebrates
Stream Mile	000.7 Depth
Collection Date	7/27/10 Time 1:30pm
Sampler's name (Print)	C. Bishop
Sampling Agency	City of Franklin
Billing Code	
If Priority, Date Needed	
Send Report to	Crystal.bishop@franklintn.gov
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
  - Chlorophyll a
  - Pheophyton
- [ ] SPECIAL STUDIES

(Please Specify)

Screening Bioassays

(Cannot be used for permitting)

48 hr Static Screening Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs

48 hr Static Screening Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs

Acute Bioassays

48 hr Static Definitive Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- NOAEC
- 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 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- NOAEC
- LOAEC

96 hr Static Definitive Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- NOAEC
- LOAEC

Chronic Bioassays

Chronic Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- Survival
- NOAEC
- LOAEC
- Reproduction
- NOAEC
- LOAEC
- IC25

Chronic Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- LC50 @ 120 hrs
- LC50 @ 144 hrs
- LC50 @ 168 hrs
- Survival
- NOAEC
- LOAEC
- Growth
- NOAEC
- LOAEC
- IC25

Chlorine Residual

Lab Parameters
- pH
- Cond.
- D.O.
- Temp.

Branch Lab Number

Chain of Custody (sign full name)

1. Collected by C Bishop
   Date 8/30/10 Time
   Delivered to A. Tolley
   Date 8/30/10 Time
2. Received by Crystal Bishop
   Date 8-30-10 Time 12:45
   Delivered to Pennington Assoc. -See Attached
   Date Time
3. Received by
   Date Time
   Delivered to
   Date Time
4. Rec'd in Lab by
   Date Time
   Logged in by
   Date Time

Additional Information

1. Approx. volume of sample 200 ± 20% indiv.
2. Nearest town or city Franklin, TN
3. Others present at collection J Weller & J Willoughby
4. Number of other samples collected at same time at this point 0
5. Field collection procedure, handling and/or preservation of this sample Alcohol
6. Mode of transportation to lab Car
7. Sample/cooler sealed by
8. Date sample/cooler sealed
9. Remarks Sorted Debris

PH-3010 (rev 1/96) RDA 1527

STATE OF TENNESSEE - ENVIRONMENTAL LABORATORIES

Please Print Legibly

Biological Analysis

**Schedule must be arranged in advance for all tests (615) 262-6327

Project/Site No.	LIBERO00.6
Project Name	Liberty Creek
Station No.	000.6 County WI
Description	Macroinvertebrates
Stream Mile	000.6 Depth
Collection Date	7/29/10 Time 9:00am
Sampler's name (Print)	C. Bishop
Sampling Agency	City of Franklin
Billing Code	
If Priority, Date Needed	
Send Report to	Crystal.bishop@franklintn.gov
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
  - Chlorophyll a
  - Pheophyton

SPECIAL STUDIES

(Please Specify)

Screening Bioassays (Cannot be used for permitting)
48 hr Static Screening Cd
Log Number
LC50 @ 24 hrs
LC50 @ 48 hrs
48 hr Static Screening Pp
Log Number
LC50 @ 24 hrs
LC50 @ 48 hrs

Acute Bioassays
48 hr Static Definitive Cd
Log Number
LC50 @ 24 hrs
LC50 @ 48 hrs
NOAEC
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 hrs
LC50 @ 72 hrs
LC50 @ 96 hrs
NOAEC
LOAEC
96 hr Static Definitive Pp
Log Number
LC50 @ 24 hrs
LC50 @ 48 hrs
LC50 @ 72 hrs
LC50 @ 96 hrs
NOAEC
LOAEC

Chronic Bioassays
Chronic Cd
Log Number
LC50 @ 24 hrs
LC50 @ 48 hrs
LC50 @ 72 hrs
LC50 @ 96 hrs
Survival
NOAEC
LOAEC
Reproduction
NOAEC
LOAEC
IC25
Chronic Pp
Log Number
LC50 @ 24 hrs
LC50 @ 48 hrs
LC50 @ 72 hrs
LC50 @ 96 hrs
LC50 @ 120 hrs
LC50 @ 144 hrs
LC50 @ 168 hrs
Survival
NOAEC
LOAEC
Growth
NOAEC
LOAEC
IC25
Chlorine Residual
Lab Parameters
pH
Cond.
D.O.
Temp.

Branch Lab Number	
Chain of Custody (sign full name)	
1. Collected by	C Bishop
Date	8/30/10 Time
Delivered to	A. Tolley
Date	8/30/10 Time
2. Received by	Amy Tolley
Date	8-30-10 Time 1245
Delivered to	Pennington Assoc. - See Attached
Date	Time
3. Received by	
Date	Time
Delivered to	
Date	Time
4. Rec'd in Lab by	
Date	Time
Logged in by	
Date	Time
Additional Information	
1. Approx. volume of sample	200 ± 20% indiv.
2. Nearest town or city	Franklin, TN
3. Others present at collection	J Weller & J Willoughby
4. Number of other samples collected at same time at this point	0
5. Field collection procedure, handling and/or preservation of this sample	Alcohol
6. Mode of transportation to lab	Car
7. Sample/cooler sealed by	
8. Date sample/cooler sealed	
9. Remarks	Sorted Debris

PH-3010 (rev 1/96)

RDA 1527

STATE OF TENNESSEE - ENVIRONMENTAL LABORATORIES

Please Print Legibly

Biological Analysis

**Schedule must be arranged in advance for all tests (615) 262-6327

Project/Site No.	SPENC000.8
Project Name	Spencer Creek
Station No.	000.8 County WI
Description	Macroinvertebrate
Stream Mile	000.8 Depth
Collection Date	8/2/10 Time 9:00 am
Sampler's name (Print)	C. Bishop
Sampling Agency	City of Franklin
Billing Code	
If Priority, Date Needed	
Send Report to	Crystal.bishop@franklintn.gov
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
  - Chlorophyll a
  - Pheophyton
- [ ] SPECIAL STUDIES
  - (Please Specify)

Screening Bioassays

(Cannot be used for permitting)

48 hr Static Screening Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs

48 hr Static Screening Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs

Acute Bioassays

48 hr Static Definitive Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- NOAEC
- 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 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- NOAEC
- LOAEC

96 hr Static Definitive Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- NOAEC
- LOAEC

Chronic Bioassays

Chronic Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- Survival
- NOAEC
- LOAEC
- Reproduction
- NOAEC
- LOAEC
- IC25

Chronic Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- LC50 @ 120 hrs
- LC50 @ 144 hrs
- LC50 @ 168 hrs
- Survival
- NOAEC
- LOAEC
- Growth
- NOAEC
- LOAEC
- IC25

Chlorine Residual

Lab Parameters
- pH
- Cond.
- D.O.
- Temp.

Branch Lab Number

Chain of Custody (sign full name)

1. Collected by C Bishop
   Date 8/30/10 Time
   Delivered to A. Tolley
   Date 8/30/10 Time
2. Received by Amy Dollens
   Date 8-30-10 Time 12:45
   Delivered to Pennington Assoc. - See Attached
   Date Time
3. Received by
   Date Time
   Delivered to
   Date Time
4. Rec'd in Lab by
   Date Time
   Logged in by
   Date Time

Additional Information

1. Approx. volume of sample 200 ± 20% indiv.
2. Nearest town or city Franklin, TN
3. Others present at collection J Weller & J Willoughby
4. Number of other samples collected at same time at this point 0
5. Field collection procedure, handling and/or preservation of this sample Alcohol
6. Mode of transportation to lab Car
7. Sample/cooler sealed by
8. Date sample/cooler sealed
9. Remarks Sorted debris

PH-3010 (rev 1/96)

RDA 1527

STATE OF TENNESSEE - ENVIRONMENTAL LABORATORIES

Please Print Legibly

Biological Analysis

**Schedule must be arranged in advance for all tests (615) 262-6327

Project/Site No.	DONEL000.3
Project Name	Donelson Branch
Station No.	000.3 County WI
Description	Macroinvertebrate
Stream Mile	000.3 Depth
Collection Date	7/22/10 Time 1:30pm
Sampler's name (Print)	C. Bishop
Sampling Agency	City of Franklin
Billing Code	
If Priority, Date Needed	
Send Report to	Crystal.bishop@franklintn.gov
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
  - Chlorophyll a
  - Pheophyton

SPECIAL STUDIES

(Please Specify)

Screening Bioassays (Cannot be used for permitting)	
48 hr Static Screening Cd	
Log Number	
LC50 @ 24 hrs	
LC50 @ 48 hrs	
48 hr Static Screening Pp	
Log Number	
LC50 @ 24 hrs	
LC50 @ 48 hrs	

Acute Bioassays	
48 hr Static Definitive Cd	
Log Number	
LC50 @ 24 hrs	
LC50 @ 48 hrs	
NOAEC	
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 hrs	
LC50 @ 72 hrs	
LC50 @ 96 hrs	
NOAEC	
LOAEC	
96 hr Static Definitive Pp	
Log Number	
LC50 @ 24 hrs	
LC50 @ 48 hrs	
LC50 @ 72 hrs	
LC50 @ 96 hrs	
NOAEC	
LOAEC	

Chronic Bioassays	
Chronic Cd	
Log Number	
LC50 @ 24 hrs	
LC50 @ 48 hrs	
LC50 @ 72 hrs	
LC50 @ 96 hrs	
Survival	
NOAEC	
LOAEC	
Reproduction	
NOAEC	
LOAEC	
IC25	
Chronic Pp	
Log Number	
LC50 @ 24 hrs	
LC50 @ 48 hrs	
LC50 @ 72 hrs	
LC50 @ 96 hrs	
LC50 @ 120 hrs	
LC50 @ 144 hrs	
LC50 @ 168 hrs	
Survival	
NOAEC	
LOAEC	
Growth	
NOAEC	
LOAEC	
IC25	
Chlorine Residual	
Lab Parameters	
pH	
Cond.	
D.O.	
Temp.	

Branch Lab Number	
Chain of Custody (sign full name)	
1. Collected by	C Bishop
Date	8/30/10 Time
Delivered to	A. Tolley
Date	8/30/10 Time
2. Received by	Amy Tolley
Date	8-30-10 Time 1245
Delivered to	Pennington Assoc. - Attached
Date	Time
3. Received by	
Date	Time
Delivered to	
Date	Time
4. Rec'd in Lab by	
Date	Time
Logged in by	
Date	Time
Additional Information	
1. Approx. volume of sample	200 ± 20% indiv.
2. Nearest town or city	Franklin, TN
3. Others present at collection	J Weller & J Willoughby
4. Number of other samples collected at same time at this point	0
5. Field collection procedure, handling and/or preservation of this sample	Alcohol
6. Mode of transportation to lab	Car
7. Sample/cooler sealed by	
8. Date sample/cooler sealed	
9. Remarks	Sorted debris

PH-3010 (rev 1/96)

RDA 1527

STATE OF TENNESSEE - ENVIRONMENTAL LABORATORIES

Please Print Legibly

Biological Analysis

**Schedule must be arranged in advance for all tests (615) 262-5327

Project/Site No.	WATSO 000.6
Project Name	Watson Branch
Station No.	000.6 County WI
Description	Macro invertebrate
Stream Mile	000.6 Depth
Collection Date	7/27/10 Time 9:45am
Sampler's name (Print)	C Bishop
Sampling Agency	City of Franklin
Billing Code	J
If Priority, Date Needed	
Send Report to	Crystal.bishop@franklintn.gov
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
  - Chlorophyll a
  - Pheophyton
- [ ] SPECIAL STUDIES

(Please Specify)

Screening Bioassays

(Cannot be used for permitting)

48 hr Static Screening Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs

48 hr Static Screening Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs

Acute Bioassays

48 hr Static Definitive Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- NOAEC
- 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 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- NOAEC
- LOAEC

96 hr Static Definitive Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- NOAEC
- LOAEC

Chronic Bioassays

Chronic Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- Survival
  - NOAEC
  - LOAEC
- Reproduction
  - NOAEC
  - LOAEC
- IC25

Chronic Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- LC50 @ 120 hrs
- LC50 @ 144 hrs
- LC50 @ 168 hrs
- Survival
  - NOAEC
  - LOAEC
- Growth
  - NOAEC
  - LOAEC
- IC25

Chlorine Residual

Lab Parameters
- pH
- Cond.
- D.O.
- Temp.

Branch Lab Number

Chain of Custody (sign full name)

1. Collected by C Bishop
   Date 8/30/10 Time
   Delivered to A. Tolley
   Date 8/30/10 Time
2. Received by Amy Tolley
   Date 8-30-10 Time 12:45
   Delivered to Pennington Assoc - Attached
   Date Time
3. Received by
   Date Time
   Delivered to
   Date Time
4. Rec'd in Lab by
   Date Time
   Logged in by
   Date Time

Additional Information

1. Approx. volume of sample 200 ± 20% indiv.
2. Nearest town or city Franklin, TN
3. Others present at collection J Weller & J Willoughby
4. Number of other samples collected at same time at this point 0
5. Field collection procedure, handling and/or preservation of this sample Alcohol
6. Mode of transportation to lab Car
7. Sample/cooler sealed by
8. Date sample/cooler sealed
9. Remarks Sorted Debris

PH-3010 (rev 1/96) RDA 1527

STATE OF TENNESSEE - ENVIRONMENTAL LABORATORIES

Please Print Legibly

Biological Analysis

**Schedule must be arranged in advance for all tests (615) 262-6327

Project/Site No.	WATSO 000.6
Project Name	Watson Branch
Station No.	000.6
County	WI
Description	Macroinvertebrate
Stream Mile	000.6
Depth	
Collection Date	7/27/10
Time	9.45 AM
Sampler's name (Print)	C Bishop
Sampling Agency	City of Franklin
Billing Code	
If Priority, Date Needed	
Send Report to	crystal.bishop@franklintn.gov
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
  - Chlorophyll a
  - Pheophyton
- [ ] SPECIAL STUDIES

(Please Specify)

Screening Bioassays

(Cannot be used for permitting)

48 hr Static Screening Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs

48 hr Static Screening Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs

Acute Bioassays

48 hr Static Definitive Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- NOAEC
- 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 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- NOAEC
- LOAEC

96 hr Static Definitive Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- NOAEC
- LOAEC

Chronic Bioassays

Chronic Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- Survival
- NOAEC
- LOAEC

Reproduction
- NOAEC
- LOAEC
- IC25

Chronic Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- LC50 @ 120 hrs
- LC50 @ 144 hrs
- LC50 @ 168 hrs
- Survival
- NOAEC
- LOAEC

Growth
- NOAEC
- LOAEC
- IC25

Chlorine Residual

Lab Parameters
- pH
- Cond.
- D.O.
- Temp.

Branch Lab Number

Chain of Custody (sign full name)

1. Collected by C Bishop
   Date 8/30/10 Time
   Delivered to A. Tolley
   Date 8/30/10 Time
2. Received by
   Date 8-30-10 Time 1245
   Delivered to ~~Brentwood~~
   Date Time
3. Received by
   Date Time
   Delivered to
   Date Time
4. Rec'd in Lab by
   Date Time
   Logged in by
   Date Time

Additional Information

1. Approx. volume of sample 200 ± 20% indiv.
2. Nearest town or city Franklin, TN
3. Others present at collection J Weller & J Willoughby
4. Number of other samples collected at same time at this point 0
5. Field collection procedure, handling and/or preservation of this sample Alcohol
6. Mode of transportation to lab Car
7. Sample/cooler sealed by
8. ~~Date sample/cooler sealed~~
9. Remarks Sample Residue Not for Analysis

PH-3010 (rev 1/96) RDA 1527

STATE OF TENNESSEE - ENVIRONMENTAL LABORATORIES

Please Print Legibly

Biological Analysis

**Schedule must be arranged in advance for all tests (615) 262-6327

Project/Site No.	DONEL 000.3
Project Name	Donelson Branch
Station No.	000.3 County WI
Description	Macroinvertebrate
Stream Mile	000.3 Depth
Collection Date	7/22/10 Time 1,30PM
Sampler's name (Print)	C Bishop
Sampling Agency	City of Franklin
Billing Code	
If Priority, Date Needed	
Send Report to	Crystal.bishop@franklintn.gov
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
  - Chlorophyll a
  - Pheophyton
- [ ] SPECIAL STUDIES
  - (Please Specify)

Screening Bioassays
(Cannot be used for permitting)

48 hr Static Screening Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs

48 hr Static Screening Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs

Acute Bioassays

48 hr Static Definitive Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- NOAEC
- 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 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- NOAEC
- LOAEC

96 hr Static Definitive Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- NOAEC
- LOAEC

Chronic Bioassays

Chronic Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- Survival
- NOAEC
- LOAEC
- Reproduction
- NOAEC
- LOAEC
- IC25

Chronic Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- LC50 @ 120 hrs
- LC50 @ 144 hrs
- LC50 @ 168 hrs
- Survival
- NOAEC
- LOAEC
- Growth
- NOAEC
- LOAEC
- IC25

Chlorine Residual

Lab Parameters
- pH
- Cond.
- D.O.
- Temp.

Branch Lab Number

Chain of Custody (sign full name)

1. Collected by C Bishop
   Date 8/30/10 Time
   Delivered to A. Talley
   Date 8/30/10 Time
2. Received by Amy Talley
   Date 8-30-10 Time 1345
   Delivered to
   Date Time
3. Received by
   Date Time
   Delivered to
   Date Time
4. Rec'd in Lab by
   Date Time
   Logged in by
   Date Time

Additional Information

1. Approx. volume of sample 200 ± 20% indiv.
2. Nearest town or city Franklin, TN
3. Others present at collection J Weller & J Willoughby
4. Number of other samples collected at same time at this point 0
5. Field collection procedure, handling and/or preservation of this sample Alcohol
6. Mode of transportation to lab Car
7. ~~Sampler/cooler sealed by~~
8. ~~Date sampler/cooler sealed~~
9. Remarks Sample Residual Not for Analysis

PH-3010 (rev 1/96) RDA 1527

STATE OF TENNESSEE - ENVIRONMENTAL LABORATORIES

Biological Analysis

Please Print Legibly

**Schedule must be arranged in advance for all tests (615) 262-6327

Project/Site No.	SPENC000.8
Project Name	Spencer Creek
Station No.	000.8 County WI
Description	Macroinvertebrate
Stream Mile	000.8 Depth ———
Collection Date	8/3/10 Time 9:00AM
Sampler's name (Print)	C. Bishop
Sampling Agency	City of Franklin
Billing Code	
If Priority, Date Needed	
Send Report to	Crystal.bishop@franklintn.gov
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
  - Chlorophyll a
  - Pheophyton
- [ ] SPECIAL STUDIES

(Please Specify)

Screening Bioassays

(Cannot be used for permitting)

48 hr Static Screening Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs

48 hr Static Screening Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs

Acute Bioassays

48 hr Static Definitive Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- NOAEC
- 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 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- NOAEC
- LOAEC

96 hr Static Definitive Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- NOAEC
- LOAEC

Chronic Bioassays

Chronic Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- Survival
- NOAEC
- LOAEC
- Reproduction
- NOAEC
- LOAEC
- IC25

Chronic Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- LC50 @ 120 hrs
- LC50 @ 144 hrs
- LC50 @ 168 hrs
- Survival
- NOAEC
- LOAEC
- Growth
- NOAEC
- LOAEC
- IC25

Chlorine Residual

Lab Parameters
- pH
- Cond.
- D.O.
- Temp.

Branch Lab Number

Chain of Custody (sign full name)

1. Collected by C Bishop
   Date 8/30/10 Time
   Delivered to A. Tolley
   Date 8/30/10 Time
2. Received by
   Date 8-30-10 Time 12:45
   Delivered to
   Date Time
3. Received by
   Date Time
   Delivered to
   Date Time
4. Rec'd in Lab by
   Date Time
   Logged in by
   Date Time

Additional Information

1. Approx. volume of sample 200 ± 20% indiv.
2. Nearest town or city Franklin, TN
3. Others present at collection J Weller & J Willoughby
4. Number of other samples collected at same time at this point 0
5. Field collection procedure, handling and/or preservation of this sample Alcohol
6. Mode of transportation to lab Car
7. Sample/cooler sealed by ———
8. Date sample/cooler sealed ———
9. Remarks Sample Residue Not for Analysis

PH-3010 (rev 1/96) RDA 1527

STATE OF TENNESSEE - ENVIRONMENTAL LABORATORIES

Please Print Legibly

Biological Analysis

**Schedule must be arranged in advance for all tests (615) 262-6327

Project/Site No.	LIBER 000.6
Project Name	Liberty Creek
Station No.	000.6 County WI
Description	Macroinvertebrates
Stream Mile	000.6 Depth
Collection Date	7/29/10 Time 9.00 AM
Sampler's name (Print)	C Bishop
Sampling Agency	City of Franklin
Billing Code	
If Priority, Date Needed	
Send Report to	Crystal.bishop@franklintn.gov
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
  - Chlorophyll a
  - Pheophyton
- [ ] SPECIAL STUDIES

(Please Specify)

Screening Bioassays

(Cannot be used for permitting)

48 hr Static Screening Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs

48 hr Static Screening Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs

Acute Bioassays

48 hr Static Definitive Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- NOAEC
- 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 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- NOAEC
- LOAEC

96 hr Static Definitive Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- NOAEC
- LOAEC

Chronic Bioassays

Chronic Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- Survival
  - NOAEC
  - LOAEC
- Reproduction
  - NOAEC
  - LOAEC
  - IC25

Chronic Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- LC50 @ 120 hrs
- LC50 @ 144 hrs
- LC50 @ 168 hrs
- Survival
  - NOAEC
  - LOAEC
- Growth
  - NOAEC
  - LOAEC
  - IC25

Chlorine Residual

Lab Parameters
- pH
- Cond.
- D.O.
- Temp.

Branch Lab Number

Chain of Custody (sign full name)

1. Collected by C Bishop
   Date 8/30/10 Time
   Delivered to A. Tolley
   Date 8/30/10 Time
2. Received by Amy Tolley
   Date 8-30-10 Time 12:45
   Delivered to
   Date Time
3. Received by
   Date Time
   Delivered to
   Date Time
4. Rec'd in Lab by
   Date Time
   Logged in by
   Date Time

Additional Information

1. Approx. volume of sample 200 ± 20% indiv.
2. Nearest town or city Franklin, TN
3. Others present at collection J Weller & J Willoughby
4. Number of other samples collected at same time at this point 0
5. Field collection procedure, handling and/or preservation of this sample Alcohol
6. Mode of transportation to lab Car
7. Sample/cooler sealed by
8. Date sample/cooler sealed
9. Remarks Sample Residue Not for Analysis

PH-3010 (rev 1/96)

RDA 1527

STATE OF TENNESSEE - ENVIRONMENTAL LABORATORIES

Please Print Legibly

Biological Analysis

**Schedule must be arranged in advance for all tests (615) 262-6327

Project/Site No.	SHARP000.7
Project Name	Sharps Branch
Station No.	000.7 County WJ
Description	Macroinvertebrates
Stream Mile	000.7 Depth
Collection Date	7/27/10 Time 1.30 PM
Sampler's name (Print)	C Bishop
Sampling Agency	City of Franklin
Billing Code	
If Priority, Date Needed	
Send Report to	Crystal.bishop@franklintn.gov
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
  - Chlorophyll a
  - Pheophyton
- [ ] SPECIAL STUDIES (Please Specify)

Screening Bioassays (Cannot be used for permitting)

48 hr Static Screening Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs

48 hr Static Screening Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs

Acute Bioassays

48 hr Static Definitive Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- NOAEC
- 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 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- NOAEC
- LOAEC

96 hr Static Definitive Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- NOAEC
- LOAEC

Chronic Bioassays

Chronic Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- Survival
  - NOAEC
  - LOAEC
- Reproduction
  - NOAEC
  - LOAEC
- IC25

Chronic Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- LC50 @ 120 hrs
- LC50 @ 144 hrs
- LC50 @ 168 hrs
- Survival
  - NOAEC
  - LOAEC
- Growth
  - NOAEC
  - LOAEC
  - IC25

Chlorine Residual

Lab Parameters
- pH
- Cond.
- D.O.
- Temp.

Branch Lab Number

Chain of Custody (sign full name)

1. Collected by C Bishop
   Date 8/30/10 Time
   Delivered to A. Tolley
   Date 8/30/10 Time
2. Received by Amy Talley
   Date 8-30-10 Time 12:45
   Delivered to
   Date Time
3. Received by
   Date Time
   Delivered to
   Date Time
4. Rec'd in Lab by
   Date Time
   Logged in by
   Date Time

Additional Information

1. Approx. volume of sample 200 ± 20% indiv.
2. Nearest town or city Franklin, TN
3. Others present at collection J Weller & J Willoughby
4. Number of other samples collected at same time at this point 0
5. Field collection procedure, handling and/or preservation of this sample Alcohol
6. Mode of transportation to lab Car
7. Sample/cooler sealed by
8. Date sample/cooler sealed
9. Remarks Sample Residue Not for Analysis

PH-3010 (rev 1/96)

RDA 1527

STATE OF TENNESSEE - ENVIRONMENTAL LABORATORIES

Please Print Legibly

Biological Analysis

**Schedule must be arranged in advance for all tests (615) 262-6327

Project/Site No.	FMILE001.5
Project Name	Five Mile Creek
Station No.	001.5
County	WI
Description	Macroinvertebrate
Stream Mile	001.5
Depth	
Collection Date	7/22/10
Time	9:15 AM
Sampler's name (Print)	C Bishop
Sampling Agency	City of Franklin
Billing Code	
If Priority, Date Needed	
Send Report to	Crystal.bishop@franklintn.gov
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
  - Chlorophyll a
  - Pheophyton
- [ ] SPECIAL STUDIES

(Please Specify)

Screening Bioassays

(Cannot be used for permitting)

48 hr Static Screening Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs

48 hr Static Screening Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs

Acute Bioassays

48 hr Static Definitive Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- NOAEC
- 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 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- NOAEC
- LOAEC

96 hr Static Definitive Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- NOAEC
- LOAEC

Chronic Bioassays

Chronic Cd
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- Survival
  - NOAEC
  - LOAEC
- Reproduction
  - NOAEC
  - LOAEC
  - IC25

Chronic Pp
- Log Number
- LC50 @ 24 hrs
- LC50 @ 48 hrs
- LC50 @ 72 hrs
- LC50 @ 96 hrs
- LC50 @ 120 hrs
- LC50 @ 144 hrs
- LC50 @ 168 hrs
- Survival
  - NOAEC
  - LOAEC
- Growth
  - NOAEC
  - LOAEC
  - IC25

Chlorine Residual

Lab Parameters
- pH
- Cond.
- D.O.
- Temp.

Branch Lab Number

Chain of Custody (sign full name)

1. Collected by C Bishop
   Date 8/30/10 Time
   Delivered to A. Tolley
   Date 8/30/10 Time
2. Received by Amy Tolley
   Date 8-30-10 Time 12:45
   Delivered to
   Date Time
3. Received by
   Date Time
   Delivered to
   Date Time
4. Rec'd in Lab by
   Date Time
   Logged in by
   Date Time

Additional Information

1. Approx. volume of sample 200 ± 20% indiv.
2. Nearest town or city Franklin, TN
3. Others present at collection J Weller & J Willoughby
4. Number of other samples collected at same time at this point 0
5. Field collection procedure, handling and/or preservation of this sample Alcohol -- 70%
6. Mode of transportation to lab Car
7. ~~Sample/cooler sealed by~~
8. ~~Date sample/cooler sealed~~
9. Remarks Sample Residue Not for Analysis

PH-3010 (rev 1/96)

RDA 1527