2014 / 2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE
TETRA TECH PROJECT NO. 103S3287

Prepared for

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1.0 INTRODUCTION

Tetra Tech, Inc. (Tetra Tech) has prepared this 2014/2015 Stream Monitoring Report for Williamson County, Tennessee in accordance with the proposals prepared by Tetra Tech on March 27, 2014, October 6, 2014, and February 24, 2015; and the Professional Services Contracts executed on April 14, 2015, October 31, 2014, and February 26, 2015. This report summarizes the project objectives, methods, results, and conclusions of the visual, chemical, and biological stream monitoring activities performed by the Williamson County Engineering Department (WCED) staff and Tetra Tech between June 2014 and May 2015.

The activities outlined in this report were performed in order to meet the monitoring requirements under the *National Pollution Discharge Elimination System (NPDES) General Permit for Small Municipal Separate Stormwater Sewer System (MS4), Permit No. TNS000000* (MS4 Permit) issued by the Tennessee Department of Environmental Conservation (TDEC), Division of Water Pollution Control (WPC) [TDEC WPC 2010]. The WCED will use the findings of the stream surveys to assess the current biological integrity and potential impact of nutrients on the selected streams. Additionally, the WCED intends to use the data collected in order to gauge the effectiveness of the County's MS4 program.

Four streams located within Williamson County, Tennessee – the Harpeth River, Little Harpeth River, Owl Creek, and Rutherford Creek - were chosen for sampling and surveying based on their listing on the *Proposed Final Version Year 2014 303(d) List* [303(d) List], dated October 2014, and prepared by the TDEC WPC (TDEC WPC 2014). The Harpeth River and the Little Harpeth River are located within the Harpeth River Watershed. In the northern portion of Williamson County, the Harpeth River (HUC Number TN05130204016-1000) is listed on the 303(d) List due to impairment from total phosphorous and low dissolved oxygen as a result of municipal point source discharges from the MS4 area. In the southern portion, the Harpeth River (TN05130204009-3000) is listed due to impairment from low dissolved oxygen and loss of biological integrity as a result of pasture grazing. The Little Harpeth River (TN05130204021-2000) is listed as impaired due to alteration in stream-side or littoral vegetative cover from pasture grazing and discharges from the MS4 area.

Owl Creek is located within the Cheatham Reservoir Watershed. Owl Creek (TN05130202007-0900 and 0920) is impaired for total phosphorous, loss of biological integrity due to siltation, and alteration due to stream side or littoral vegetative cover from discharges from the MS4 area. Rutherford Creek is located in the Duck River Watershed. Rutherford Creek (TN06040003034-3000) is impaired for nitrate-nitrite, total phosphorous, and loss of biological integrity due to siltation from pasture grazing and discharges from the MS4 area.

The stream reaches surveyed are located within the Outer Nashville Basin of the Interior Plateau (71h) of Tennessee (Griffith et al. 1998, Arnwine et al. 2000), except for Harpeth River at Arno Road which his located within the Inner Nashville Basin of the Interior Plateau (71i). The Interior Plateau extends from southern Indiana and Ohio to northern Alabama. The Outer Nashville Basin consists primarily of rolling hills with 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 Inner Nashville Basin is less hilly and lower elevation than the Outer Nashville Basin. The streams are lower gradient and often flow across large areas of limestone outcrops, which are common in the Inner Nashville Basin. The soils are shallow and lower in phosphorous (Arnwine et al. 2000).

The stream monitoring activities were divided into two parts: Section2: Chemical and Biological Sampling, and Section 3: Visual Stream Assessments (VSAs). The methods and results for each sampling event are outlined in the respective sections. A discussion of the results is included in Section 4.0. References for this report are included in Section 5.0. Tables 1 through 3 are included in the report text. Figures, additional tables, field sheets, photographs, and laboratory results are included in the appendices.

2.0 CHEMICAL AND BIOLOGICAL SAMPLING

2.1 METHODS

Chemical and biological sampling was performed by WCED personnel under the direction of Mr. Michael Scott, Williamson County Stormwater Coordinator, between June 18, 2014 and October 28, 2014. Limited field sampling, data analysis, and report preparation were completed by Ms. Amy Tolley, a Tetra Tech Biologist. The specific sampling sites within the stream reaches were chosen based on their accessibility from public land such as roadways or parks. The stream sampling sites are depicted on Figures 1 through 12 in Appendix A. The sampling site names, station numbers, latitude and longitude, 303(d) List assessment category designations, watershed location, and Tennessee Ecoregion location are listed below in Table 1: Chemical and Biological Stream Sampling Site Locations.

TABLE 1: CHEMICAL AND BIOLOGICAL STREAM SITE SAMPLING LOCATIONS

Site Name	Station Number	Latitude/ Longitude	303(d) List Assessment Category*	Watershed	Tennessee Ecoregion/ Stream Reach Drainage Area (square miles)
Harpeth at Sneed Road	HARPE065.6WI	36.0291/ -86.9238	4a. EPA approved DO and nutrient TMDLs	Harpeth River	71h/ >2
Harpeth at Moran Road	HARPE068.3WI	36.0173/ -86.9001	4a. EPA approved DO and nutrient TMDLs	Harpeth River	71h/ >2
Harpeth at Old Natchez Trace Road	HARPE072.4WI	36.0084/ -86.9303	4a. EPA approved DO and nutrient TMDLs	Harpeth River	71h/ >2
Harpeth at Old Hillsboro Road	HARPE075.8WI	35.9932/ -86.9029	4a. EPA approved DO and nutrient TMDLs	Harpeth River	71h/ >2
Harpeth at Cotton Road	HARPE079.8WI	35.9681/ -86.9008	4a. EPA approved DO and nutrient TMDLs	Harpeth River	71h/ >2
Harpeth at Arno Road	HARPE097.6WI	35.8782/ -86.7910	4a. EPA approved DO and nutrient TMDLs	Harpeth River	71i/ >2
Little Harpeth at Vaughn Road	LHARP001.9WI	36.0485/ -86.9034	4a. Impaired, EPA approved pathogen, siltation/habitat, and organic enrichment alteration TMDLs	Harpeth River	71h/ >2
Little Harpeth at Hillsboro Road	LHARP004.6WI	36.0432/ -86.8658	4a. Impaired, EPA approved pathogen, siltation/habitat, and organic enrichment alteration TMDLs	Harpeth River	71h/ >2
Owl at Split Log Road	OWL004.78WI	35.9510/ -86.7275	5	Cheatham Reservoir	71h/ <2
Rutherford at Old Bethesda Road	RUTHE026.7WI	35.7509/ -86.8175	5. EPA approved siltation TMDL	Duck River	71h/ >2
Rutherford at Cross Keys Road	RUTHE028.6WI	35.7589/ -86.7893	5. EPA approved siltation TMDL	Duck River	71h/ >2

Notes:

* As defined in the *Proposed Final Version Year 2014 303(d) List* (TDEC WPC 2014):

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.

DO – Dissolved oxygen

EPA – United States Environmental Protection Agency

TMDL – Total maximum daily loads

Global Positioning System (GPS) points were collected at the top and bottom of the stream sampling reach. A field station number was assigned for each stream sampling reach following *Section I.I, Protocol B of the TDEC WPC, Quality System Standard Operating Procedure* (QSSOP) for Macroinvertebrate Stream Surveys, 2011(TDEC WPC 2011b), herein referred to as the Macroinvertebrate QSSOP.

Per the MS4 Permit, visual stream surveys (physical characterization surveys) and impairment inventories were completed at each stream sampling reach; biological sampling was performed for stream segments identified as being impaired for siltation and/or habitat alterations, where discharges from the MS4 have been identified as a source of impairment; and chemical sampling was performed on stream segments subject to TMDLs for parameters other than siltation, habitat alteration, or pathogens performed where discharges from the MS4 have been identified as a source of impairment. The methods used to perform the monitoring activities are outlined in the report sub-sections below. Table 2: Chemical and Biological Stream Monitoring Activity Outline identifies the specific sampling activities that were performed at each sampling location.

TABLE 2: CHEMICAL AND BIOLOGICAL STREAM SAMPLING OUTLINE					
Site Name	**Station Number**	**Physical Characterization Surveys and Impairment Inventories**	**Biological Sampling**	**Chemical Sampling**	
				Dissolved Oxygen	**Nutrients**
Harpeth at Sneed Road	HARPE065.6WI	X		X	X
Harpeth at Moran Road	HARPE068.3WI	X		X	X
Harpeth at Old Natchez Trace Road	HARPE072.4WI	X		X	X
Harpeth at Old Hillsboro Road	HARPE075.8WI	X		X	X
Harpeth at Cotton Road	HARPE079.8WI	X		X	X
Harpeth at Arno Road	HARPE097.6WI	X		X	X
Little Harpeth at Vaughn Road	LHARP001.9WI	X	X		
Little Harpeth at Hillsboro Road	LHARP004.6WI	X	X		
Owl at Split Log Road	OWL004.78WI	X	X		X
Rutherford at Old Bethesda Road	RUTHE026.7WI	X	X		X
Rutherford at Cross Keys Road	RUTHE028.6WI	X	X		X

2.1.1 Visual Physical Characterization Surveys and Impairment Inventories

Visual Physical Characterization Surveys and Impairment Inventories were performed at each of the 11 stream segments in general accordance with the U.S. Environmental Protection Agency's (EPA's) *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish – Second Edition* (Barbour, et al. 1999). Field personnel completed Physical Characterization/Water Quality Field Data Sheets to document physical characteristics of the stream including weather conditions, stream subsystem, stream origin, stream type, catchment area, watershed features, riparian vegetation, instream features, large woody debris, aquatic vegetation, water quality parameters, and substrate. The water quality data were collected using a YSI 556 multiparameter water quality meter and included temperature,

specific conductance, dissolved oxygen, and pH. Turbidity was measured using a Turbidimeter DRT-15CE – T.

Field personnel completed a Habitat Assessment Data Sheet for High Gradient Streams at each sampling site to document visual observations of the stream habitat and surrounding area. The following ten parameters were evaluated based on a score of 0 up to 20, with 20 being the highest quality rating:

- Epifaunal Substrate/Available Cover,
- Embeddness of Riffles,
- Velocity/ Depth Regime,
- Sediment Deposition,
- Channel Flow Status,
- Riparian Vegetative Zone Width,
- Channel Alteration,
- Frequency of Riffles,
- Bank Stability, and
- Vegetative Protection.

The 10 individual habitat scores from the Habitat Assessment Data Sheets were totaled for each sample reach 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 the Habitat Assessment guidelines for Region 71h and 71i in the Macroinvertebrate QSSOP. For Ecoregion 71h, a habitat assessment score of ≥127 for streams with a >2 square mile drainage area and a habitat assessment score of ≥132 for a headwater stream with a ≤2 square mile drainage area is considered capable of supporting a healthy benthic community (not impaired). For Ecoregion 71i high gradient streams, a habitat assessment score of ≥121 for streams with >2 square mile drainage area and a habitat assessment score of ≥119 for a headwater stream with a ≤2 square mile drainage area is considered not impaired. Each individual parameter was compared to the Regional Expectations for Individual Habitat Parameters in Ecoregion 71h and 71i as outlined in Appendix A of the Macroinvertebrate QSSOP. The Regional Expectations for Individual Habitat Parameters represent the values of 75% of reference stream conditions and may indicate impairment of a stream based on an individual parameter regardless of the total HA score.

Please note, the Habitat Assessment Field Data Sheets used during the stream monitoring activities were obtained from the prior Macroinvertebrate QSSOP Revised October 2006 (TDEC 2006). The descriptions for ranking each parameter were changed slightly and Frequency of Riffles was replaced by Frequency of Reoxygenation Zones on the field data sheet included in the 2011 Macroinvertebrate QSSOP. However, we do not feel that the discrepancy alters the findings of the habitat assessment. WCED personnel included reoxygenation zones in determination of the frequency of riffles. The scores were compared to the most recent habitat assessment guidelines and Regional Habitat Expectations in the 2011 Macroinvertebrate QSSOP.

2.1.2 Chemical Stream Sampling

Field Methods

Chemical stream sampling for dissolved oxygen and/or nutrients was performed at nine stream sampling locations on the Harpeth River, Owl Creek, and Rutherford Creek (see Table 2). One duplicate sample was collected. The chemical sampling activities were performed in general accordance with the TDEC WPC Quality System Standard Operating Procedure for Chemical and Bacteriological Sampling of Surface Water, 2011 (TDEC WPC 2011a), here-in referred to as the Chemical QSSOP.

Chemical sample collection was performed upon arrival at each sampling site prior to other stream sampling activities. The field crew collected chemical samples in the approximate center of the stream reach in the thalweg. The sample containers were stored in a cooler packed with ice then picked up by a courier for delivery to the laboratory.

Laboratory Analysis

Laboratory analysis was performed by ESC Lab Sciences of Mount Juliet, Tennessee according to the *Williamson County Stream Monitoring Plan* dated December 2013. Samples collected for monitoring of nutrient levels were analyzed for ammonia nitrogen as N by EPA Method 350.1; nitrate + nitrite by EPA Method 353.2; total suspended solids by Standard Method 2540 D-2011; total Kjeldahl nitrogen by EPA Method 351.2; dissolved organic carbon by Standard Methods 5310 B-2011 or total organic carbon by EPA Method 9060A; and total phosphorus by EPA Method 365.4. Samples collected for monitoring of nutrient levels and dissolved oxygen levels were also analyzed for carbonaceous biochemical oxygen demand 5-day (CBOD5) by Standard Methods 5210 B-2011.

2.1.3 Biological Stream Sampling

Field Methods

Biological stream sampling was performed at two sampling reaches on the Little Harpeth River, one sampling reach on Owl Creek, and two sampling reaches on Rutherford Creek (See Table 2). The biological sampling activities were performed in general accordance with the Macroinvertebrate QSSOP. Deviations from the QSSOP are documented in this report.

Stream Survey Forms were completed and included documentation of stream characteristics and water quality parameters similar to those recorded on the Physical Characterization/Water Quality Field Data Sheets previously discussed. Additional stream and watershed data were compiled and entered on the Stream Survey Forms by WCED personnel at the office utilizing the Williamson County GIS Mapping System (Williamson County 2014).

Benthic macroinvertebrate sampling was performed generally following Section I.I, Protocol G of the Macroinvertebrate QSSOP for Semi-quantitative Riffle Kick sampling (SQKICK) as is recommended for riffle streams larger than 1 meter wide in Ecoregion 71h. Sampling was performed using a one-meter square kick net with 500-micron mesh. Three kicks were performed downstream to upstream at three separate riffles within the sampling reach. 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 1,000 milliliter (mL) high-density polyethylene bottles, preserved with ethyl alcohol, and labeled. Each of the five sites met the guidelines for comparison to the Macroinvertebrate QSSOP reference database; therefore, upstream or watershed references were not required.

Laboratory Sorting and Analysis

Tetra Tech personnel delivered the samples to a laboratory subcontractor for sorting following Section I.I, Protocol I, of the Macroinvertebrate QSSOP and taxonomic analysis following Section I.I, Protocol J. 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:

- Ephemeroptera, Plecoptera, and Trichoptera (EPT) Richness;
- Taxa Richness;
- Percent Oligochaete and Chironomids (Percent OC);
- EPT Abundance Excluding *Cheumatopsyche* spp. (Percent EPT-Cheum);
- North Carolina Biotic Index (NCBI);
- Percent Tennessee Nutrient Tolerant Organisms (TNUTOL); and
- Percent Clingers.

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

The biometric values were equalized by assigning a 0, 2, 4, or 6 to each value based on comparison to the applicable Biocriteria Tables for Ecoregion 71h, located in Appendix A: *Ecoregion Reference Information* following Section I.I, Protocol K of the Macroinvretebrate QSSOP.

Biological Condition Determination

Tetra Tech totaled the seven equalized biometric scores to obtain the Tennessee Macroinvertebrate Index Score (TMI Score) of each site, and then compared to the Index Score Ratings for Ecoregion 71h in order to estimate the biological condition of the sample reach. For Ecoregion 71h, a TMI Score of greater than or equal to 32 is considered as passing biocriteria guidelines.

2.2 RESULTS

The results of the chemical and biological stream monitoring activities are summarized below. The findings are representative of conditions within the stream reach at the time of the field activities and are not intended to fully quantify water quality conditions in the streams.

2.1.1 Visual Physical Characterization and Impairment Inventory Results

The sampling reach characteristics recorded during the visual physical characterization surveys and results of the habitat assessments for the eleven sampling sites are summarized below. Water quality parameters collected during the field activities are discussed in Section 3.2 and included in Table 4 in Appendix B. A graph presenting the Habitat Assessment Scores is included as

Figure 13 in Appendix A. Copies of the Physical Characterization/Water Quality Field Data Sheets, Stream Survey Forms, and Habitat Assessment Field Data Sheets are included in Appendix C. Photograph documentation of each site showing upstream and downstream conditions is included in Appendix D.

Harpeth River at Sneed Road

The Harpeth River at Sneed Road sampling site was located downstream of a bridge on Sneed Road in an area of agricultural row crops and residential development. The stream reach has been channelized. A large log jam was observed above the bridge. The riparian area consisted of primarily hardwood and shrubs. The stream sampling reach was approximately 115 feet wide and was mostly unshaded due to its width. The average depth of the reach was 3.6 feet and it consisted of pools and runs; no riffles were present. The substrate was predominantly boulder and cobble. Rooted emergent vegetation, primarily water willow, and attached algae were observed near the banks. Sampling was performed during high water conditions due to recent rains.

The HA Score for the sampling reach of Harpeth River at Sneed Road was 115, which is considered not capable of supporting a healthy benthic community (impaired). Frequency of riffles and vegetative protection for both stream banks were ranked as poor by WCED and Tetra Tech personnel. Velocity/depth regime and bank stability for both banks were ranked as marginal. Epifaunal substrate/available cover, embeddedness, sediment deposition, and channel alteration are ranked suboptimal. Channel flow status and riparian vegetative zone width were ranked optimal. Epifaunal substrate/available cover, embeddedness, velocity/depth regime, sediment disposition, channel flow status, and riparian vegetative zone width scores were within the regional expectations when compared to the ratings for 75 percent of the Ecoregion 7h reference streams with a greater than 2 square mile drainage area.

Harpeth River at Moran Road

The Harpeth River at Moran Road sampling site was located downstream of a bridge on Moran Road with predominantly agricultural row crops to the south and a golf course to the north. The stream banks were covered with hardwood trees and shrubs with grasses and row crops (corn) beyond. Approximately 40 percent of the reach contained rooted emergent vegetation, water willow. The stream sampling reach was approximately 84 feet wide and was partly shaded. The depth of the reach was between 2 to 4 feet and consisted of mostly runs. The substrate consisted

of a mix of bedrock, boulder, cobble, and gravel.

The HA Score for the sampling reach of Harpeth River at Moran Road is 155, which is considered to be supporting. Riparian vegetative zone width of the left bank is ranked as marginal. Epifaunal substrate/available cover, sediment deposition, channel alteration, and vegetative zone width of the right bank are ranked as suboptimal. Embeddedness, velocity/depth regime, frequency of riffles, and bank stability of both banks are ranked as optimal. All of the individual parameters, except the riparian vegetative zone width of the left bank, were within the Ecoregion 71h regional expectations for reference streams with greater than 2 square miles drainage area.

Harpeth River at Old Natchez Trace Road

The Harpeth River at Old Natchez Trace Road sampling site was located to east of Old Natchez Trace Road in a rural area of the county that consisted of agricultural row crop, wooded, and residential land. The stream reach was 87 feet wide and mostly unshaded due to the width. The average depth of the reach was one foot and there was a mix of riffles, runs, and pools. The substrate was predominantly gravel and cobble. The riparian area consisted of primarily hardwood trees. Rooted emergent vegetation, primarily water willow, was near the banks.

The HA Score for the sampling reach of Harpeth River at Old Natchez Trace Road was 151, which is considered capable of supporting a healthy benthic community (not impaired). Frequency of riffles was ranked as marginal. Epifaunal substrate/available cover, sediment deposition, channel flow status, and bank stability, vegetative protection, and riparian vegetative zone wide of both banks were ranked as suboptimal. Embeddedness, velocity/depth regime, and channel alteration were ranked as optimal. All of the individual parameters, except frequency of riffles and channel flow status, were within the Ecoregion 71h regional expectations for reference streams with greater than 2 square miles drainage area.

Harpeth River at Old Hillsboro Road

The Harpeth River at Old Hillsboro Road sampling site was located downstream of a bridge on Old Hillsboro Road (Highway 45) in an area of agricultural row crop and wooded land. The stream reach had been channelized and a large bar of rocks was located across the stream sampling reach. The riparian area consisted primarily of hardwood tress. Some rooted emergent vegetation was observed. The stream sampling reach was approximately 153 feet wide and was

mostly unshaded due to its width. The average depth of the reach was 3 feet and it consisted of primarily pool habitat. The substrate consisted of predominantly cobble, boulder, and bedrock. A small amount of rooted emergent vegetation was present.

The HA Score for the sampling reach of Harpeth River at Old Hillsboro Road is 111, which is considered to be not supporting. Frequency of riffles is ranked poor. Epifaunal substrate, velocity/depth regime, bank stability for both stream banks, and vegetative protection of both stream banks are ranked as marginal. Embeddedness, sediment deposition, channel alteration, and riparian vegetative zone width of both banks are ranked as suboptimal. Channel flow status is ranked as optimal. Sediment deposition, channel flow status, and riparian vegetative zone width were within the Ecoregion 71h regional expectations for reference streams with greater than 2 square miles drainage area.

Harpeth River at Cotton Road

The Harpeth River at Cotton Road sampling site was located downstream of a bridge on Cotton Road in an area of residential development and wooded land with some agriculture. The riparian area consisted of primarily hardwood trees and shrubs. The stream sampling reach was approximately 73 feet wide and was partly shaded. The average depth of the reach was 3 feet and it consisted of primarily pools. The substrate was a mix of bedrock, boulder, cobble, and gravel. A small amount of algae and submergent vegetation was observed.

The HA Score for the sampling reach of Harpeth River at Cotton Road is 127, which is considered supporting. The velocity/depth regime and frequency of riffles are ranked poor. Channel alteration and epifaunal substrate/available cover are ranked as marginal. Embeddedness, sediment deposition, channel flow status, and riparian vegetative zone width are ranked as suboptimal. Bank stability and vegetative protection of both banks are ranked as optimal. Embeddedness, sediment deposition, channel flow status, bank stability, vegetative protection, and riparian vegetative zone width were within the Ecoregion 71h regional expectations for reference streams with greater than 2 square miles drainage area.

Harpeth River at Arno Road

The Harpeth River at Arno Road sampling site was located downstream of a bridge on Arno Road in an area of residential development and agricultural and wooded land with some agriculture. This is the sampling reach located within Ecoregion 71i. The riparian area consisted of primarily

hardwood trees. The stream sampling reach was approximately 55 feet wide and was partly shaded. The average depth of the reach was 1.8 feet and it consisted of a mix of pools, riffles, and runs. The substrate was primarily gravel with some cobble; heavy silt (20 percent) covered the stream bottom. Approximately 25 percent of the reach contained rooted emergent vegetation, water willow, which at one point narrowed the stream width to approximately 10 feet.

The HA Score for the sampling reach of Harpeth River at Arno Road is 157, which is considered supporting. Epifaunal substrate/available cover, sediment deposition, channel flow status, channel alteration, and bank stability and riparian vegetative zone width of both banks are ranked as sub-optimal. Embeddedness, velocity/depth regime, frequency of riffles, and vegetative protection of both banks are ranked as optimal. All of the individual parameters, except channel alteration, were within the Ecoregion 71i regional expectations for reference streams with greater than 2 square miles drainage area.

Little Harpeth River at Vaughn Road

The Little Harpeth River at Vaughn Road sampling site was located within Warner Park and flowed beneath the Vaughn Road Bridge. The surrounding area also consisted of residences and pasture land. The stream riparian was covered with hardwood trees and shrubs with agricultural and wooded land beyond to the east and south and mowed grass beyond the north and west. The stream reach was shaded. The average stream reach width was 36 feet. The average depth was 1.5 feet and it consisted of mainly pools. The substrate was primarily gravel and cobble with a heavy amount of silt (30 percent). Several sand bars were located within the sampling reach.

The HA Score for the sampling reach of the Little Harpeth River at Vaughn Road is 145, which is considered supporting. Epifaunal substrate cover and sediment deposition are ranked as marginal. Embeddedness, velocity/depth regime, channel flow status, and riparian vegetative zone width of both banks are ranked as sub-optimal. Channel alteration, bank stability of both banks, and vegetative protection of both banks are ranked as optimal. Velocity/depth regime, channel flow status, channel alteration, bank stability, vegetative protection, and riparian vegetative zone width were within the Ecoregion 71h regional expectations for reference streams with greater than 2 square miles drainage area.

Little Harpeth River at Hillsboro Road

The Little Harpeth River at Hillsboro Road sampling site was located within residential and

wooded area and flowed beneath the Hillsboro Road Bridge. This portion of the stream was channelized below the bridge. The stream riparian appeared to have been previously cut and was covered with shrubs and grasses, mostly invasive species. The stream was mostly shaded. The average stream reach width was 30 feet. The average depth was 1.3 feet and it consisted of an almost even mix of pools, runs, and riffles. The substrate was primarily boulder with some bedrock and gravel and approximately 10 percent silt. Two sand bars were located within the reach.

The HA Score for the sampling reach of Little Harpeth at Hillsboro Road is 124, which is considered non-supporting. Vegetative protection of both stream banks is ranked as poor. Riparian vegetative zone width of both stream banks is ranked as marginal. Epifaunal substrate/available cover, embeddedness, velocity/depth regime, and channel flow status are suboptimal. Sediment deposition is ranked as optimal. Epifaunal substrate/available cover, sediment deposition, channel flow status, channel alteration, frequency of riffles, and bank stability were within the Ecoregion 71h regional expectations for reference streams with greater than 2 square miles drainage area.

Owl Creek at Split Log Road

The Owl Creek at Split Log Road sampling site was located within a wooded area south of Split Log Road. This was the only sampling reach with a drainage area less than 2 square miles. The stream riparian consisted of predominantly hardwood trees. Pasture land was located approximately 15 feet to the west. The stream was mostly shaded. The average stream reach width was 9 feet and was not fully covered by water. The average depth was 4 inches and it consisted of a mix of riffles, runs, and pools. The substrate was primarily bedrock, boulder, and cobble.

The HA Score for the sampling reach of Owl Creek at Split Log Road is 133, which is considered to be supporting. Bank stability of the left bank is ranked as poor. Sediment deposition, vegetative protection of the left bank, and vegetative zone width of the right bank are ranked as marginal. Velocity depth regime, channel alteration, and vegetative protection of the right bank are ranked as sub-optimal. Epifaunal substrate/available cover, embeddedness, channel flow status, frequency of riffles, bank stability of the right bank, and riparian vegetative zone width of the left bank are ranked as optimal. All of the individual parameters, except sediment deposition, channel alteration, bank stability, and vegetative protection of the left bank, and riparian

vegetative zone width of the right bank, were within the Ecoregion 71h regional expectations for reference streams with less than 2 square miles drainage area.

Rutherford Creek at Old Bethesda Road

The Rutherford Creek at Old Bethesda Road sampling site was located southwest of the intersection of Smithson Road and Old Bethesda-Duplex Road downstream of Smithson Road. The stream reach was located within an area of agricultural row crop and pasture with a few scattered residences. The stream riparian consisted of predominantly shrubs, invasive species, with some hardwood trees. Pasture land was located approximately 20 feet to the west and Smithson Road with pasture or row crops were located approximately 15 feet to the east. The stream was partly shaded. The average stream reach width was 28 feet. The average depth was 7 inches and it consisted of a mix of riffles, runs, and pools. The substrate was primarily bedrock and gravel. Several sand and gravel bars were located within the reach. A small amount of algae was observed on the substrate.

The HA Score for the sampling reach of Rutherford Creek as Old Bethesda Road is 133, which is considered supporting. Sediment deposition and channel flow status are ranked marginal. Epifaunal substrate cover, embeddedness, velocity/depth regime, bank stability of both banks, and vegetative protection of both banks is ranked suboptimal. Channel alteration and frequency of riffles are ranked optimal. All of the individual parameters, except sediment deposition, channel flow status, and riparian vegetative zone width, were within the Ecoregion 71h regional expectations for reference streams with greater than 2 square miles drainage area.

Rutherford Creek at Cross Keys Road

The Rutherford Creek at Cross Keys Road sampling site was located an area of predominately pasture land with some wooded land downstream from a bridge over Cross Keys Road. The stream reach riparian consisted of shrubs with some hardwood trees and the stream reach was mostly shaded. The average stream reach width was 24 feet. The average depth was 6 inches and it consisted of a primarily pool habitat. The substrate was primarily bedrock and a small amount of algae was observed.

The HA Score for the sampling reach of Rutherford at Cross Keys Road is 159, which is considered supporting. Epifaunal substrate cover, velocity/depth regime, sediment deposition, channel flow status, vegetative protection of the right bank, and riparian vegetative zone width of

the both banks are ranked suboptimal. Embeddedness, channel alteration, frequency of riffles, bank stability of both banks, and vegetative protection of the left bank are ranked optimal. All of the individual parameters were within the Ecoregion 71h regional expectations for reference streams with greater than 2 square miles drainage area.

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.

2.1.2 Water Quality and Chemical Sampling Results

The water quality results and chemical sampling results are summarized below. The water quality results and chemical sampling results are presented in Table 4 in Appendix B. The water quality parameters were recorded on the Physical Characterization/Water Quality Field Data Sheets and Stream Survey Forms included in Appendix C. The laboratory analytical reports are included in Appendix E.

Water quality sampling was performed in-situ during the field activities at the eleven sampling sites. The pH values at the sampling sites ranged from 7.29 to 8.18 standard units and were indicative of neutral to slightly basic conditions. Water temperatures at the Harpeth River and Little Harpeth River sites, which were sampled in June, July, and September 2014, were between 23.15^{o} to 25.5^{o} Celsius; and water temperatures at Owl Creek and Rutherford Creeks sites, sampled in late October 2014, were between 15.3^{o} to 17.6^{o} Celsius. Dissolved oxygen levels varied slightly between the sites and ranged from 6.11 milligrams per liter (mg/L) and 10.09 mg/L; dissolved oxygen levels were generally lower in the Harpeth River sites. Conductivity varied at the sites and ranged from 0.228 milliSiemens per centimeter (mS/cm) to 0.562 mS/cm. Turbidity levels at the Harpeth River sites ranged from 7.5 nephelometric turbidity units (NTU) to 14 NTU; and at the Little Harpeth River, Rutherford Creek, and Owl Creek sites ranged from 2.5 NTU to 4.45 NTU.

Chemical sampling was performed at the nine sampling sites on the Harpeth River, Owl Creek, and Rutherford Creek. Sampling to assess nutrient levels was performed at all nine chemical sampling sites. One duplicate sample was collected at Harpeth at Old Natchez Trace Road.

Ammonia Nitrogen as N was below the laboratory detection limit (BDL) of 0.25 milligrams per liter (mg/L) at all nine sites. Nitrate + Nitrite detections ranged from 0.30 to 1.2 mg/L with the two highest detections of 1.2 mg/L at Harpeth River at Sneed Road and Rutherford Creek at Old Bethesda. Total Kjeldahl Nitrogen was BDL at Harpeth River on Sneed Road and Harpeth River at Moran Road and at the Owl Creek and Rutherford Creek sampling sites. Total Kjeldahl Nitrogen detections ranged from 0.26 to 0.48 mg/L at the remaining sampling sites. Total phosphorus detections ranged from 0.29 to 0.65 mg/L. Suspended Residue ranged between 9.1 and 14.0 at the Harpeth River sampling sites; was 3.5 mg/L at the Owl Creek sampling site; was 3.7 at the Rutherford at Cross Keys Road sampling site; and was BDL at the Rutherford at Old Bethesda Road sampling site. Total Organic Carbon ranged between 1.5 and 2.9 mg/L at the sampling sites.

Sampling to assess dissolved oxygen levels was also performed at the six Harpeth River sampling sites and included analysis of dissolved organic carbon and $CBOD_5$. Dissolved Organic Carbon ranged between 1.8 and 2.4 mg/L. $CBOD_5$ was detected at 16.0 mg/L at the Harpeth at Sneed Road sampling site; and was BDL at the remaining sites.

2.1.3 Biological Sampling Results

Biological (macroinvertebrate) sampling was performed at the five sampling sites on the Little Harpeth River, Owl Creek, and Rutherford Creek. The results are summarzied below. The biological sampling results are presented in Tables 5A – 5E in Appendix B and represented graphically in Figures 14 through 21 in Appendix A. Copies of the laboratory reports are included in Appendix E.

Little Harpeth River at Vaughn Road

The TMI Score for the sampling reach of Little Harpeth at Vaughn Road is 28, which is considered to fail the biocriteria guidelines. For Ecoregion 71h, a TMI Score of greater than or equal to 32 is considered as passing biocriteria guidelines. Based on comparison of the biometric values to the Biocriteria Table for the Ecoregion 71h, Percent EPT-Cheum and Percent TNUTOL are moderately impaired; Taxa Richness, EPT Richness, and NCBI are slightly impaired; and Percent OC and Percent Clingers are not impaired.

Little Harpeth River at Hillsboro Road

The TMI Score for the sampling reach of Little Harpeth at Hillsboro Road is 28, which is

considered to fail the biocriteria guidelines. Based on comparison of the biometric values to the Biocriteria Table for the ecoregion, Percent EPT-Cheum and Percent TNUTOL are moderately impaired; Taxa Richness, EPT Richness, and NCBI are slightly impaired; and Percent OC and Percent Clingers are not impaired.

Owl Creek at Split Log Road

The TMI Score for the sampling reach of Owl Creek at Hillsboro Road is 14, which is considered to fail the biocriteria guidelines. Based on comparison of the biometric values to the Biocriteria Table for the ecoregion, Percent EPT-Cheum and Percent Clingers are severely impaired; Taxa Richness, EPT Richness, TNUTOL, and NCBI are slightly impaired; and Percent OC is not impaired.

Rutherford Creek at Old Bethesda Road

The TMI Score for the sampling reach of Rutherford Creek at Old Bethesda Road is 32, which passes the biocriteria guidelines. Based on comparison of the biometric values to the Biocriteria Table for the ecoregion, Percent Clingers is slightly impaired; Taxa Richness, Percent OC, and Percent EPT – Cheum are moderately impaired; and EPT Richness, NCBI, and Percent TNUTOL are not impaired.

Rutherford Creek at Cross Keys Road

The TMI Score for the sampling reach of Rutherford at Cross Keys Road is 28, which is considered to fail the biocriteria guidelines. Based on comparison of the biometric values to the Biocriteria Table for the ecoregion, Percent EPT-Cheum and Percent Clingers are slightly impaired; Taxa Richness, NCBI, and Percent TNUTOL are moderately impaired; and EPT Richness and Percent OC are not impaired.

3.0 VISUAL STREAM ASSESSMENTS

3.1 METHODS

Visual Stream Assessments (VSAs) were performed at twenty-three (23) outfall locations by WCED personnel under the direction of Mr. Scott, between March 18, 2015 and May 15, 2015. Limited field assistance, data analysis, and report preparation were completed by Amy Tolley, of Tetra Tech. The 23 outfall locations were located on the four streams listed on the 303d List for impairment in Williamson County, the Harpeth River, Little Harpeth River, Owl Creek, and Rutherford Creek. The outfall locations were selected by WCED and included four (4) reference locations. The VSAs were performed by locating each outfall and making observations of the stream corridor at a minimum of 50 feet upstream and 50 feet downstream from the outfall point. The VSA Site locations are outlined in Table 3 below.

Prior to the field activities, Tetra Tech prepared field maps using aerial photography showing each outfall location and approximate visual observation boundaries (100-foot corridor) for use by WCED personnel. The field maps also include smaller insets of topographic maps, National Wetland Inventory (NWI) mapping, and an aerial photograph of the vicinity to aid the field personnel in identifying environmental conditions and location accessibility. Copies of the field maps are included in Appendix A.

TABLE 3: VISUAL STREAM ASSESSMENT LOCATIONS			
VSA Site Number	**Outfall Location**	**Stream Location**	**Physical Location**
1	36.0288, -86.9239	Harpeth River	Sneed Road
2	36.0172, -86.8999	Harpeth River	Moran Road
3	36.0080, -86.9309	Harpeth River	Old Natchez Trace Road
4	35.9967, -86.9355	Harpeth River	Old Natchez Trace Road/Lawrence Road
5	35.9680, -86.9007	Harpeth River	Cotton Lane
6	36.0489, -86.9037	Little Harpeth River	Vaughn Road
7	35.7502, -86.8179	Rutherford Creek	Smithson Road
8	35.7523, -86.8163	Rutherford Creek	Old Bethesda-Duplex Road
9	35.7541, -86.8108	Rutherford Creek	Old Bethesda-Duplex Road
10	35.7581-86.8022	Rutherford Creek	Bethesda-Duplex Road
11	35.7580, -86.7974	Rutherford Creek	Mosley Road
12	35.7596, -86.7919	Rutherford Creek	Cross Keys Road
13	35.7587, -86.7891	Rutherford Creek	Cross Keys Road/Comstock Road
14	35.7571, -86.7731	Rutherford Creek	Cross Keys Road
15	35.7543. -86.7682	Rutherford Creek	Cross Keys Road
16	35.7524, -86.7638	Rutherford Creek	Cross Keys Road
17	35.7541. -86.7561	Rutherford Creek	Pulltight Hill Road
18	35.7562, -86.7489	Rutherford Creek	Mt. Zion Road
19	35.9537, -86.7195	Owl Creek	Split Log Road
20	35.9526, -86.7284	Owl Creek	Pleasant Hill Road at Split Log Road
21	35.9456, -86.7301	Owl Creek	Pleasant Hill Road
22	35.9384, -86.7306	Owl Creek	Vernon Road
23	35.9364, -86.7302	Owl Creek	Whistler Cove

The VSAs were performed in general accordance with the Stream Corridor Assessment (SCA) Survey protocol developed by the Watershed Restoration Division of the Maryland Department of Natural Resources. The SCA was developed in order to quickly identify a variety of environmental concerns within a watershed's stream network. Although the SCA is not intended to be a scientific endeavor that would replace any biological and or chemical analysis or other detailed survey data, it does provide for a methodology of rapid examination of the watershed and problems that reside therein.

The SCA has four main objectives:

1. Provide a list of observable environmental problems present within a stream system and along its riparian corridor;

2. Provide sufficient information on each problem so that a preliminary determination of both the severity and correctability of a problem can be made;

3. Provide sufficient information so that restoration efforts can be prioritized; and

4. Provide a quick assessment of both in-and near-stream habitat conditions so that comparative assessments can be made of the condition of different stream segments.

Following the SCA protocol, WCED personnel made visual observations to identify any of the following environmental conditions at each VSA location:

- Channel Alteration
- Erosion Site
- Exposed Pipes
- Pipe Outfalls
- Fish Barrier
- Inadequate Buffer
- In/Near Stream Construction
- Trash Dumping
- Unusual Condition or Comment
- Representative Site.

For each environmental condition identified, a field data sheet, supplied in the SCA protocol report, was completed. Multiple data sheets may have been completed each site and for the same type of environmental condition. For example, if two fish barriers were identified at the VSA location, a separate data sheet would be completed for each. Each environmental condition, and therefore, each field data sheet, was assigned a number to correspond to the VSA location (1 through 23) followed by the corresponding number of the environmental condition at each location (1, 2, 3). The environmental condition number was assigned (1, 2, 3…) as a problem was identified and the numbering was not prioritized in any way. Additionally, photographs were taken of the VSA locations and environmental conditions observed. Copies of the VSA field data sheets are included in Appendix C. Photographic documentation is included in Appendix D.

Each data sheet includes a general description and location of the environmental condition observed and includes a severity, correctability, and accessibility rating. The severity rating is based on how bad a specific problem is relative to other problems in the same category. A rating of 1 to 5 is assigned, with 5 being the most severe problem and 1 being assigned for minor problems. The correctability rating is a relative measure of how easily the field personnel believe it would be to correct a specific problem. A severity rating of 1 to 5 is assigned, with 1 being for

minor problems and a 5 being for major restoration problems. The accessibility rating is a relative measure of how difficult it is to reach a specific problem site. An accessibility rating of 1 to 5 is assigned with 1 being for a site that is easily accessible, both by car or on foot; a 5 is assigned for sites that are difficult to reach both on foot and by a vehicle. Some of the ratings were modified during the writing of the report once the data from VSAs could be compared.

The data collected during the VSAs will be used to prioritize stream segments for additional monitoring, management, or restoration efforts within the watershed according to the severity of the problem, effort required and cost to cure the problem, and accessibility to the problem area.

3.2 RESULTS

The results of the VSAs and recommended repairs are summarized below. Prioritization of the identified conditions is also outlined. Figures showing the VSA site locations are provided in Appendix A. Copies of the VSA field data sheets are included in Appendix C. Photographic documentation is included in Appendix D. The findings are representative of conditions within the stream reach at the time of the field activities and are not intended to fully quantify water quality conditions in the streams.

3.2.1 VSA Site Conditions and Recommendations

VSA Site 1 - Harpeth River at Sneed Road

An Unusual Condition and erosion were identified at Harpeth River at Sneed Road, VSA Site 1. Torrent flow debris was observed upstream above the bridge support piling and abutment. The debris is visible on historical aerial imagery viewed on GoogleEarth since at least 2011. The river depth appears to be shallow directly above the bridge. Torrent debris fields are a direct result of channelization and bank and shoreline erosion during high watershed flow events. Continued buildup of this material will have a negative effect on the structural integrity of the bridge during moderate to high river flow. Debris build up reduces the laminar flow through the structure and may induce significant turbulence increasing overall erosion of the river and bank destabilization. The condition was rated severe (2), with good correctability rating (2), and good access rating (2).

Moderate erosion of the river banks was also observed in the reach below the bridge road

crossing. The average area of exposed bank height is six feet. The condition's severity was rated minor (4) with a poor correctability (4) and accessibility (4) ratings.

Prolonged accumulation of torrent debris can be prevented by monitoring of the Sneed Road Bridge and the material can be removed as needed by the appropriate County department.

VSA Site 2 - Harpeth River at Moran Road

VSA Site 2, Harpeth River at Moran Road has an inadequate riparian buffer on the right bank. The mowed residential lawn is located beyond an approximate 10-foot right bank riparian buffer. The condition was given a minor severity rating (4) with moderate correctability (3), relatively good access (2), and low potential for construction of a wetland (5). Bank stabilization and establishment of a wider riparian buffer along the reach would help to lessen the in-stream impacts. Community education and outreach can be used to encourage residents to establish wider riparian buffers on their land.

VSA Site 3 - Harpeth River at Old Natchez Trace Road

VSA Site 3, Harpeth River at Old Natchez Road, was selected by WCED as a representative site. The reach exhibits nominal bank erosion with riffle and pool habitat. Macroinvertebrate substrata, shelter for fish, velocity and depth, and channel flow were ranked optimal by WCED staff; embeddedness, bank vegetation, and bank condition were ranked suboptimal; and channel alteration, sediment deposition, and riparian vegetation were ranked as marginal. Of note, the riparian buffer on the west river bank is less than 50 feet wide due to the presence of Old Natchez Trace Road.

VSA Site 4 - Harpeth River at Old Natchez Trace and Lawrence Roads

An inadequate buffer was observed at VSA Site 4, Harpeth River at Old Natchez Trace and Lawrence Roads between the edge of the road pavement and the river channel. Old Natchez Trace Road runs along this section of the Harpeth River for approximately 0.65 mile. Some areas of the river bank along the road are less than 15 feet wide, including this VSA site. At the site, the river banks exhibit significant down-cutting and erosion. The banks are scoured and steep with an approximate 8-foot drop down to the river. An electrical transmission line crosses over the stream at the VSA site and some riparian vegetation may have been removed during its placement. The apparent continued bank erosion and overall bank condition increases sedimentation into the river and decreases biological habitat and vegetative cover.

The inadequate buffer condition was given a low correctability rating (4) and good access rating (2). The site is not a candidate for potential wetland construction. This condition is rated moderately severe (3). The road conditions can be assessed by the appropriate County department with ongoing monitoring as needed. River bank repair and stabilization activities will help to reduce erosion and further bank destabilization. Storm water controls can be put into place to reduce flow rates over the river bank that may further damage riparian vegetation and increase bank erosion. A wider riparian area would be beneficial; however, may not be possible due to the proximity of the roads. The density of the existing riparian may be increased by planting additional vegetation to help stabilize the existing bank. Some vegetation has recently been planted along the roadway. The proximity to the road and electrical transmission line that crosses the river should be considered when selecting vegetation for the river bank. For maximum benefits, maintenance of the vegetation should be coordinated with the owner of the transmission line.

VSA Site 5 - Harpeth River at Cotton Lane

Harpeth River at Cotton Lane Figure 5, exhibits down cutting erosion within the channel below the bridge. The average exposed bank height is six feet. Recent clearing was observed along one area of the bank; the cleared area was covered with a small amount of hay. An electrical line was observed above the river along Cotton Lane. Pasture is located beyond the left bank and a residential lawn is located beyond the right bank. The severity of the erosion condition was rated moderate (4) with low correctability (4), and good access (2).

Steep banks may be further eroded away with torrent flow. Stabilization of the river banks and reestablishment of riparian vegetation will help to decrease erosion. The choice of riparian vegetation should take into account concerns associated with the bridge and electrical line.

VSA Site 6 - Little Harpeth River at Vaughn Road

VSA Site 6, Little Harpeth River at Vaughn Road was selected by WCED as a representative site. Macroinvertebrate substrata, shelter for fish, and channel flow were rated as optimal by WCED staff; embeddedness, channel alteration, velocity and depth, bank vegetation, bank condition, and riparian vegetation were rated as suboptimal; and sediment deposition was rated as marginal. The riparian area is greater than 50 feet on both banks.

VSA Sites 7, 8, 9, and 10 - Rutherford Creek at Smithson Road, Old Bethesda-Duplex Road, and Bethesda-Duplex Road

An inadequate buffer exists at these four VSA Sites on Rutherford Creek. The distance between the road and the creek bank is less than 10 feet in most areas and is less than 5 feet at VSA Sites 8 and 9. Down-cutting of the creek banks has occurred over time with the steep banks being up to 15 feet high in most areas. VSA Site 7 was given a moderate severity rating (3). VSA Site 10 was given a minor severity rating (4). Inadequate buffer conditions at VSA Sites 8 and 9 are rated severe (2). Correctability potential is low (4 or 5) due to the presence of the roads, but with good access (1 or 2). Potential wetland construction ranges from poor to good at the different sites (2, 3, or 4).

The roads along Rutherford Creek in these areas can be assessed by the appropriate County department with ongoing monitoring as needed. Any stormwater that runs off road surfaces or sheet flow from natural or manmade surfaces may increase the slope erosion and thusly cause a failure of the road surface. Along with slope failure, there will be a sharp increase in torrent debris which will have an impact of resources downstream. Through community outreach and education, landowners along Rutherford Creek can be encouraged to increase riparian buffers along the creek.

VSA Site 7 on Smithson Road was also identified as an erosion site. The creek banks exhibit significant down-cutting and erosion. The apparent continued bank erosion and overall bank condition increases sedimentation into the creek and decreases biological habitat and vegetative cover. The erosion condition was rated severe (2) with a low correctability potential (4) and good access (2). Creek bank repair and stabilization activities would be beneficial. A wider riparian area would be beneficial; however, may not be possible due to the proximity of the road. The density of the existing riparian may be increased by planting additional vegetation to help further stabilize the existing banks.

At VSA Site 8, a 16-inch, corrugated metal stormwater pipe was observed in the side of the left creek bank that carries stormwater from the properties across Old Bethesda-Duplex Road. The pipe outfall may contribute to bank erosion at the site. The pipe was given a minor severity rating (5), with good correctability (1), and good access.

Additionally, significant channel alteration was observed at VSA Sites 8 and 9. Only minimum

erosion and minor under cutting of the banks was observed at these Sites. The conditions were given a low severity rating (4) with least correctability potential (5), but good access (1).

VSA Site 11 - Rutherford Creek at Mosley Road

An inadequate buffer exists at VSA Site 11, Rutherford Creek and Moseley Road, in the area adjacent to the east of the bridge and to the west of the bridge. The creek is surrounded by pasture and residential lawn. Additionally, it appears that erosion has exposed both Mosley Road bridge abutments. The severity of the condition is rated as moderate (3), with good access (1) and correctability (1), which are dependent on the private landowner. This site has good accessibility for the establishment of a riparian buffer to the west of the bridge that would help reduce agricultural runoff to the creek; however, would require cooperation of the land owner.

VSA Sites 12, 14, 15, and 16 - Rutherford Creek at Cross Key Road

VSA Sites 12, 14, 15, and 16 located along Cross Keys Road have inadequate buffers on both sides of the creek. The buffer widths are less than 25 feet at all sites. At VSA Sites 12, 14, and 15, the buffers of the left bank are 5 feet or less due to mowed lawns, roads, or pastures. The severity ratings at VSA Sites 12, 14, and 16 are moderately severe (3); and at VSA Site 15 is the most severe (1) due to the presence of cattle in the creek and significant bank erosion. The correctability ratings were good (2) at all except for VSA 15, which was rated poor (4) due to the proximity to agricultural buildings and paved driveway of a private land owner. Access was rated good at the sites (1 or 2).

The surrounding area consists primarily of close-cut residential lawns and pastures. Riparian vegetation may be established along bridges and County road easements; however, the majority of the land is privately owned. Through community outreach and education, landowners along Rutherford Creek can be encouraged to increase riparian buffers along the creek.

At VSA Site 14, an exposed, 8-inch iron pipe was identified across Rutherford Creek within the creek channel near the bridge. The pipe was approximately one foot above the stream flow level at the time. The pipe appeared to be a potential water pipe and no evidence of leaks was observed; therefore, it was given a low severity rating (4). Correctability was rated poor (4) since the piping likely supplies water nearby residences; and access was rated good (1). Debris build-up was noted at the pipe and additional build up and torrent debris during high flow events are a

risk to the pipe integrity. If viable, the pipe owner can redirect this pipe to a more appropriate location depending on use.

The channel has been straightened on the northern side of Cross Keys Road and was identified as a channel alteration condition for VSA Site 14. The condition was given a minor severity rating (4). The correctability rating for the channelization is low (5) since the stream channel would need to altered significantly to restore natural sinuosity. Access was rated good (1). A stream restoration project would likely be required to mitigate channelization and the lack of riparian buffer at this site.

A cattle gate was observed on the downstream side of the bridge at VSA Site 14, to prevent any livestock from exiting the northern pasture than runs parallel to Cross Keys Road. A cattle gate was also observed at VSA Site 16 attached to the roadway guard rails to retain livestock; therefore, the presence of cattle in the creek is likely. At VSA Site 15, cattle gates were constructed on the upstream and downstream portions of the Cross Key culvert bridge. An additional cattle gate was observed upstream from the bridge. Evidence of cattle entering the creek was observed. The presence of cattle in the creek at VSA Site 15 was rated severe (2), with a moderate correctability potential (3) and good access (1). Correctability was rated 3 since it would be up to the landowner to ensure that cattle are kept out of the creek. Cattle gates in the creeks reduce natural flow during moderate flow events. Additionally, nutrient run off from agricultural operations increases available nitrogen and phosphorous in streams and degrades water quality. Community outreach and education could be used to encourage landowners to keep cattle out of creek. The Natural Resources Conservation Service (NRCS) would be a good partner in working with agricultural landowners.

Erosion that appears to have been created by agricultural operations in the surrounding area was observed at VSA Site 15 with additional erosion from stormwater runoff. A partial fish barrier was observed in the creek because of head cutting due to erosion. The erosion condition and fish barrier were rated moderately severe (3). Correctability of the fish barrier and erosion conditions were rated good (2) with good access (2). The fish barrier can be corrected by returning the stream channel at barrier to grade; however, if erosion problems are not corrected, routine maintenance may be required. The project could be performed by the County or local volunteer or non-profit group with landowner permission.

At VSA Site 16, a 20-inch, concrete stormwater outfall pipe was observed in the bank of Rutherford Creek on the eastern side of Cross Key Road. Stormwater discharges directly into the creek from the pipe. No evidence of discharges other than stormwater was observed at the pipe. Minor erosion was observed beneath the pipe; however, its integrity appears to be intact. The presence of the pipe was rated as least severe (5); correctability was rated moderate (3); and access was rated good (1).

VSA Site 13 - Rutherford Creek at Cross Keys Road and Comstock Road

VSA Site 13, Rutherford Creek at Cross Keys Road and Comstock Road was chosen as a representative site by WCED. Over half of the site categories were rated as suboptimal and riparian vegetation was rated as poor. An inadequate condition was documented on both stream banks between Cross Keys Road and Rutherford Creek. The buffer width on the left is 10 feet and the buffer on the right is 15 feet. The inadequate buffer condition was given a severity rating of 3, correctability of 1, and access of 1. The site has good potential for future wetland construction (2). The creek has been channelized at the bridge and along Cross Keys Road and was rated low severity (4), worst correctability (5), and good access (1). A fish barrier was observed and consists of a concrete or rock slab that may be an exposed foundation associated with the box culvert or utility line encasement. The fish barrier was rated severe (2) with best correctability (1), and good access (1).

Armoring the creek bank upstream and downstream may reduce the amount of bank erosion. The fish barrier may be from a natural formation and any changes to the formation could pose a danger to the road infrastructure above. The County, non-profit group, or a volunteer group could easily access the site to build up and stabilize the stream bed to the level of the slab.

VSA Site 17 - Rutherford Creek at Pulltight Hill Road

An inadequate buffer was identified on both sides of the creek at VSA Site 17, Rutherford Creek at Pulltight Road. The creek crosses through private pastures and residences in this area with only low-cut vegetation on the banks. The creek bank is utilized in livestock grazing activity. The condition was rated severe (2) due to the presence of livestock, with correctability rating of fair (3), and access rating good (2). There is a moderate potential (3) of wetlands being established at the site due to private ownership. Nutrient run off from agricultural operations increases available nitrogen and phosphorous in streams and degrades water quality. The establishment of a vegetated buffer will help decreasing the volume of sediment transport and

potentially increase water quality. Community outreach and education or incentive programs could be used to encourage landowners to keep livestock out of creek and to increase riparian buffer areas on their properties.

Rutherford Creek is conveyed into an elliptical corrugated metal pipe for approximately 200 feet passing below two improved driveways. The pipe is damaged causing debris blockage within the piped channel and is a fish barrier. The channel alteration was given a moderate severity rating (3), poor correctability rating (4), and good access rating (2). The damage to the pipe at the creek was recorded as an unusual condition with a high severity rating (2), poor correctability (5), and good access (2). The fish barrier was rated severe (1), with poor correctability (5) and poor access (4) due to its position within the pipe. The corrugated metal pipe appears to have been constructed improperly due to the lack of removing bedrock deforming the pipe and thusly reducing flow. This section of pipe can be removed and replaced, and the pipe channel smoothed, with any obstructions removed that will have an effect on the slope of the pipe. Because this section of stream appears to be outside of the right of way, the work could possibly be done by volunteers or a non-profit with the cooperation of the owner.

Erosion was observed in the form of downcutting due to the pipe outfall and lack of sufficient vegetation to retain soils. The average exposed bank height is four feet. The erosion condition was given a moderate severity rating (3), with good correctability (2), and good access (2).

VSA Site 18 - Rutherford Creek at Mt. Zion Road

VSA Site 18 has an inadequate buffer on both sides of the creek channel to the east of Mt. Zion Road. This portion of the creek is intermittent and was dry at the time of the survey. The creek banks appear to be mowed as part of the residential lawn that the creek flows through. The riparian buffer is wider on the west side of Mt. Zion Road. The severity is rated moderate (3), correctability is good (2) and access is good (1). Potential wetland creation is good (2).

A 24-inch corrugated metal pipe acts as a road culvert for the creek beneath Mt. Zion Road that conveys headwaters of Rutherford Creek collected from the east. The creek bed has been blocked by rip rap beneath the pipe. The side slopes of Mt Zion Road are steep creating an approximate drop of 24 inches from the invert to the creek bed below. The condition was rated severe (1), with correctability poor (4), and good access (1).

Although the upper portions of the creek are vegetated, the pipe used to convey surface water runoff will increase the level of erosion of the downstream side of Mt. Zion Road crossing. A simple spillway or increasing the depth of the pipe matching natural grade may assist in reducing erosion around the structure while allowing downstream flow. Community outreach and education can encourage landowners to increase riparian areas on their properties.

VSA Site 19 - Owl Creek at Split Log Road

VSA Site 19 has an inadequate creek buffer on the City of Brentwood City side. The downstream stream corridor, to the southeast, appears to be well vegetated. There was an abundance of algae observed across the stream bed. WCED gave the site a moderate severity rating (3), good correctability (2), and good access (1). The potential for the creation of wetlands was low (4). Community outreach and education can encourage landowners to increase riparian areas on their properties, decrease use of fertilizers, and decrease agricultural inputs.

VSA Site 20 - Owl Creek at Pleasant Hill Road and Split Log Road

VSA Site 20 has an inadequate stream buffer on both sides of the creek east of Pleasant Hill Road. The creek flows through pasture land to the east. The site was given a moderate severity rating (3), with good correctability (2), and good access (1). Community outreach and education may encourage landowners to increase riparian buffers on their land.

VSA Site 21 - Owl Creek at Pleasant Hill Road

Owl Creek along Pleasant Hill Road was chosen as a representative site by WCED. Ten representative categories were ranked as suboptimal. The other three, channel velocity embeddedness, and velocity and depth scores, were rated optimal. Side slopes on either side of Pleasant Hill Road and on the upstream and downstream sides of the box culvert crossing are steep. These side slopes appear to be well vegetated.

VSA Site 22 - Owl Creek at Vernon Road

VSA Site 22 has an inadequate buffer on both sides of the creek which consists of mowed residential lawns. The inadequate buffer was given a high severity rating (1), with moderate correctability, good access (1), and good potential for wetland construction (2). An excessive amount of algae was observed in the creek and is likely associated with fertilizer use. The algae was documented as an unusual condition with a moderate severity rating (3), good correctability (1), and good access (1).

Erosion was observed in the form of downcutting along the creek banks due to lack of an inadequate riparian buffer. The erosion was rated with severe (2) due to a fish barrier condition discussed below, good correctability (1) and good access (1).

The road culverts at the creek were blocked by debris, algae, and sedimentation creating a fish barrier. Sedimentation in front of two of the culverts has stopped creek flow through the culverts during normal or low flow conditions. The fish barrier was rated severe (1), with good correctability (2), and good access (1).

The fish barrier and water flow blockages can be resolved by removal of sediments and blockages at the road culverts. Community outreach and education can encourage landowners to increase riparian areas on their properties, decrease use of fertilizers, and decrease agricultural inputs.

A concrete stormwater pipe outfall was observed on the right bank of the creek. No abnormal conditions were observed in association with the pipe outfall which was given a minor severity rating (5), good correctability rating (1), and good access rating (1).

VSA Site 23 - Owl Creek at Whistler Cove

VSA Site 23 has an inadequate buffer on both sides of the creek channel to the west of Whistler Cove. The creek banks appear to be mowed as part of the residential lawn that the creek flows through. The riparian buffer is wider on the east side of Whistler Cove. The severity is rated minor (5), correctability is good (1), and access is good (2). Potential wetland creation is moderate (3). Community outreach and education can be used to encourage landowners to increase riparian areas on their properties.

3.2.2 Priority Mitigation Sites

The intent of the Visual Stream Assessment is not only to document conditions within the stream that can negatively impact the watershed health and quality, but also to prioritize the conditions based on severity and potential to be corrected in order to develop a plan for mitigation actions within the watershed that will best utilize County, community, government, and non-profit group resources. The following paragraphs outline the conditions identified during the survey that are prioritized for mitigation in the near future due to their severity and/or correction potential.

VSA Site 1 – Harpeth River at Sneed Road – Removal of accumulated debris at the Sneed Road bridge can be performed by the appropriate County department, and the bridge can be monitored on an on-going basis for future debris build up, particularly after high flow events.

VSA Sites 7, 8, 9, and 10 - Rutherford Creek at Smithson Road, Old Bethesda-Duplex Road, and Bethesda-Duplex Road - Correctability of the inadequate buffer conditions was rated low due to the proximity to county roads. Due to the severity of the inadequate buffer conditions, these sites, particularly VSA Site 8 and Site 9, should be prioritized for grant funding opportunities or restoration projects by volunteers or non-profit groups.

VSA Site 14 – Rutherford Creek at Cross Keys Road – Potential mitigation of the exposed pipe across the stream bed should be reviewed and possibly performed by a volunteer group or non-profit with the cooperation of the owner.

VSA Sites 14, 15, 16, 17 – Rutherford Creek at Cross Keys Road and Pulltight Road - livestock activity or potential livestock activity was observed in Rutherford at these sites. Targeted outreach and education and potential incentives to the landowners may be used to discourage livestock in streams.

VSA Sites 13 and 15 – Rutherford Creek at Cross Keys Road – Fish barriers were observed at these two VSA sites that are moderate to severe conditions that have good potential for correction and good accessibility. With cooperation of the land owners, County personnel, local volunteer groups, or non-profit groups could perform the work within one day. It should be noted, however, that due to existing erosion conditions at the sites, mitigation measures may need to be monitored and maintained.

VSA Site 17 – Rutherford Creek at Pulltight Road – The bottom of a corrugated metal pipe that runs beneath two driveways was observed to be damaged at this site. Debris is built up at the damaged area inside the pipe. The damage is also altering stream flow and is a fish barrier. The condition was given a low correctability rating. With assistance from a volunteer group or non-profit group, the pipe could possibly be repaired or replaced in coordination with the property owner.

VSA Site 18 – Rutherford Creek at Mt. Zion Road – channel alteration was observed at this site that is a severe condition; however, will likely require heavy equipment to mitigate. Correction would likely take one to three days.

VSA Site 19 – Owl creek at Split Log Road – Excessive levels of algae were observed at this site. A stream walk can be performed to search for point sources of algal growth in the stream. Targeted outreach and education can be performed in this vicinity to discourage the use of fertilizers.

VSA Site 22 – Owl Creek at Vernon Road – Excessive algae was observed in Owl Creek at this location that appears to be caused by application of fertilizer on the surrounding land. Removal of sedimentation and stones at the road culvert would help to reestablish creek flow. The task would likely take one day and require heavy machinery. A stream walk can be performed to identify point sources of increased algal growth in the stream. Targeted outreach and education can be performed for the landowners in the vicinity to discourage the use of fertilizers and placing materials in the stream that block flow.

VSA Site 4 - Harpeth River at Old Natchez Trace and Lawrence Roads - The inadequate buffer condition was given a low correctability rating and is rated moderately severe; however, should be assessed by the appropriate County department in the near future with ongoing monitoring. This portion of the river should be prioritized for grant funding opportunities or restoration projects by volunteers or non-profit groups. The owner of the transmission line can also be contacted to discuss minimizing vegetation removal at the site and other sites within the County.

The remainder of the conditions documented consist primarily of inadequate buffers, channel alterations, and erosion issues that are a result of the predominant agricultural and residential use and road infrastructure in the watersheds. On-going community outreach programs, along with partnering with government agencies, such as the NRCS, volunteer groups, universities, and non-profit groups are strategies that will be explored.

4.0 CONCLUSIONS

The HA Scores indicated that all of the stream sample reaches, except three, were identified as capable of supporting a healthy benthic community (not impaired). The three sampling reaches that were identified as non-supporting were Harpeth at Sneed Road, Harpeth at Old Hillsboro Road, and Little Harpeth at Hillsboro Road.

The in-situ water quality and chemical sampling results were similar for all of the sampling sites. However, Harpeth River at Sneed Road was the only sampling site with detections of $CBOD_5$. Higher water temperatures were measured in the Harpeth River and Little Harpeth River sites sampled between June and September than for the Owl Creek and Rutherford Creek sites sampled in October. Suspended residue and turbidity were generally higher at the Harpeth River sampling sites. No apparent correlations were identified between the water quality and chemical sampling results and respective TMI or HA Scores.

Only one of the stream sample reaches, Rutherford Creek at Old Bethesda Road, was determined to have a TMI score considered to pass the biocriteria guidelines. The two Little Harpeth sample reaches and Rutherford Creek at Cross Keys Road had TMI scores of 28, just below the passing criteria of TMI 32. Owl Creek had a TMI score of 14.

The findings of the stream monitoring activities were expected based on the inclusion of stream sampling reaches on the 303(d) List. 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.

The Williamson County Engineering Department intends to use the findings of this survey to steer the direction and development of goals for the County's MS4 program to meet the TMDLs for pollutants established for these streams within the County's jurisdiction. The information collected during the surveys provides insight into the current health and condition of these streams and potential sources of impact. The data will be used to assist in interpreting trends in impairment over time. From these trends in water quality and biological integrity, the County will have a greater amount of information to base their decisions regarding stormwater management.

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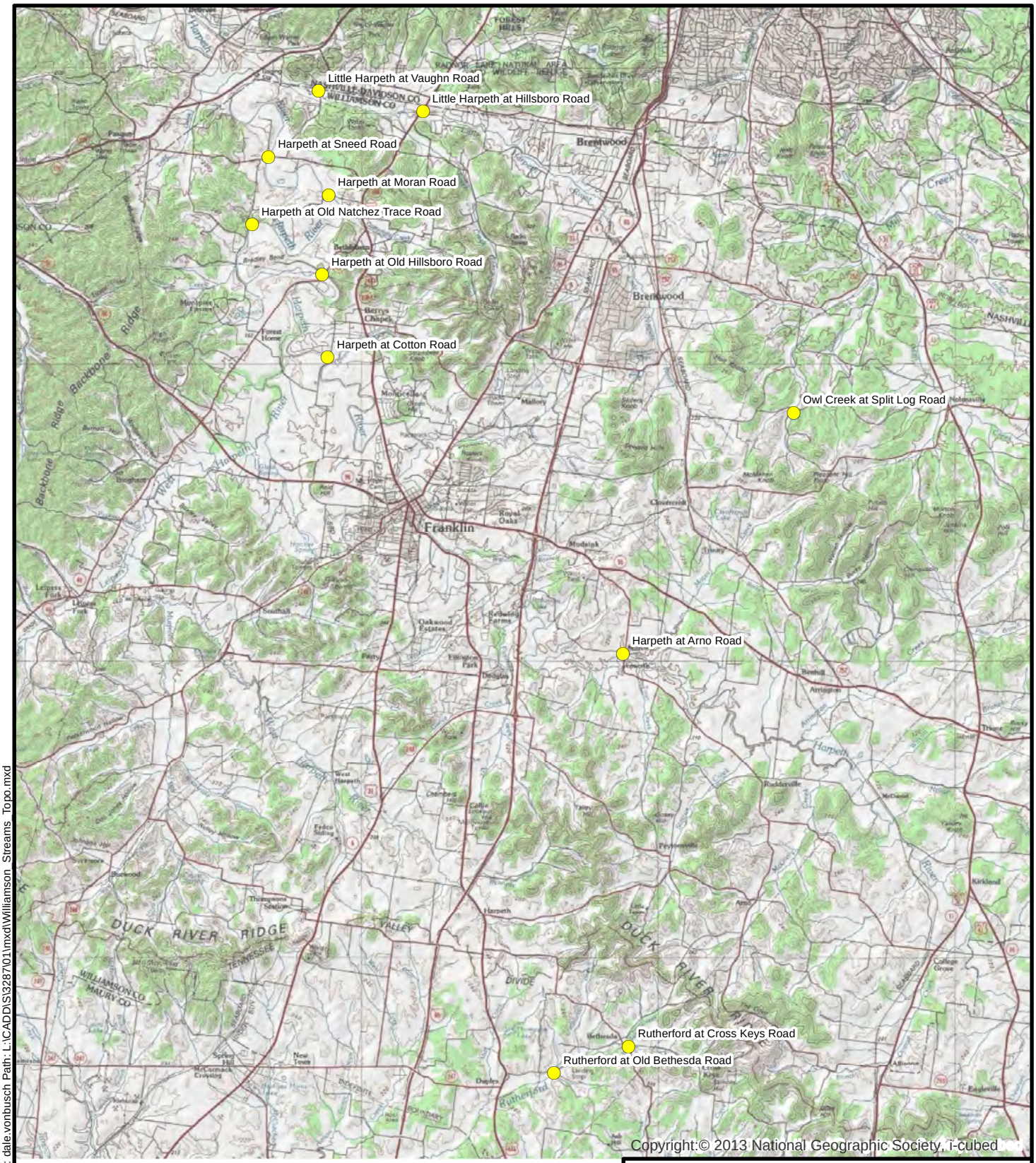
APPENDIX A – FIGURES



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- Sampling Locations

N
W E
S

0 7,500 15,000
Feet

SOURCE: MODIFIED FROM USGS, 100K SERIES QUADRANGLES.

2014/2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 1
CHEMICAL AND BIOLOGICAL SAMPLING LOCATIONS

TETRA TECH

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Sample Reach

N
W E
S

0 100 200
Feet

SOURCE: BING MAPS HYBRID IMAGERY 2010-2012.

2014/2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 2
CHEMICAL SAMPLING SITE LOCATION
HARPETH AT SNEED ROAD

TETRA TECH

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Sample Reach

N
W E
S

0 100 200
Feet

SOURCE: BING MAPS HYBRID IMAGERY 2010-2012.

2014/2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 3
CHEMICAL SAMPLING SITE LOCATION
HARPETH AT MORAN ROAD

TETRA TECH

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Sample Reach

N
W E
S

0 100 200
Feet

SOURCE: BING MAPS HYBRID IMAGERY 2010-2012.

2014/2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 4
CHEMICAL SAMPLING SITE LOCATION
HARPETH AT OLD NATCHEZ TRACE ROAD

TETRA TECH

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Sample Reach

N
W
E
S

0 100 200
Feet

SOURCE: BING MAPS HYBRID IMAGERY 2010-2012.

2014/2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 5
CHEMICAL SAMPLING SITE LOCATION
HARPETH AT OLD HILLSBORO ROAD

TETRA TECH

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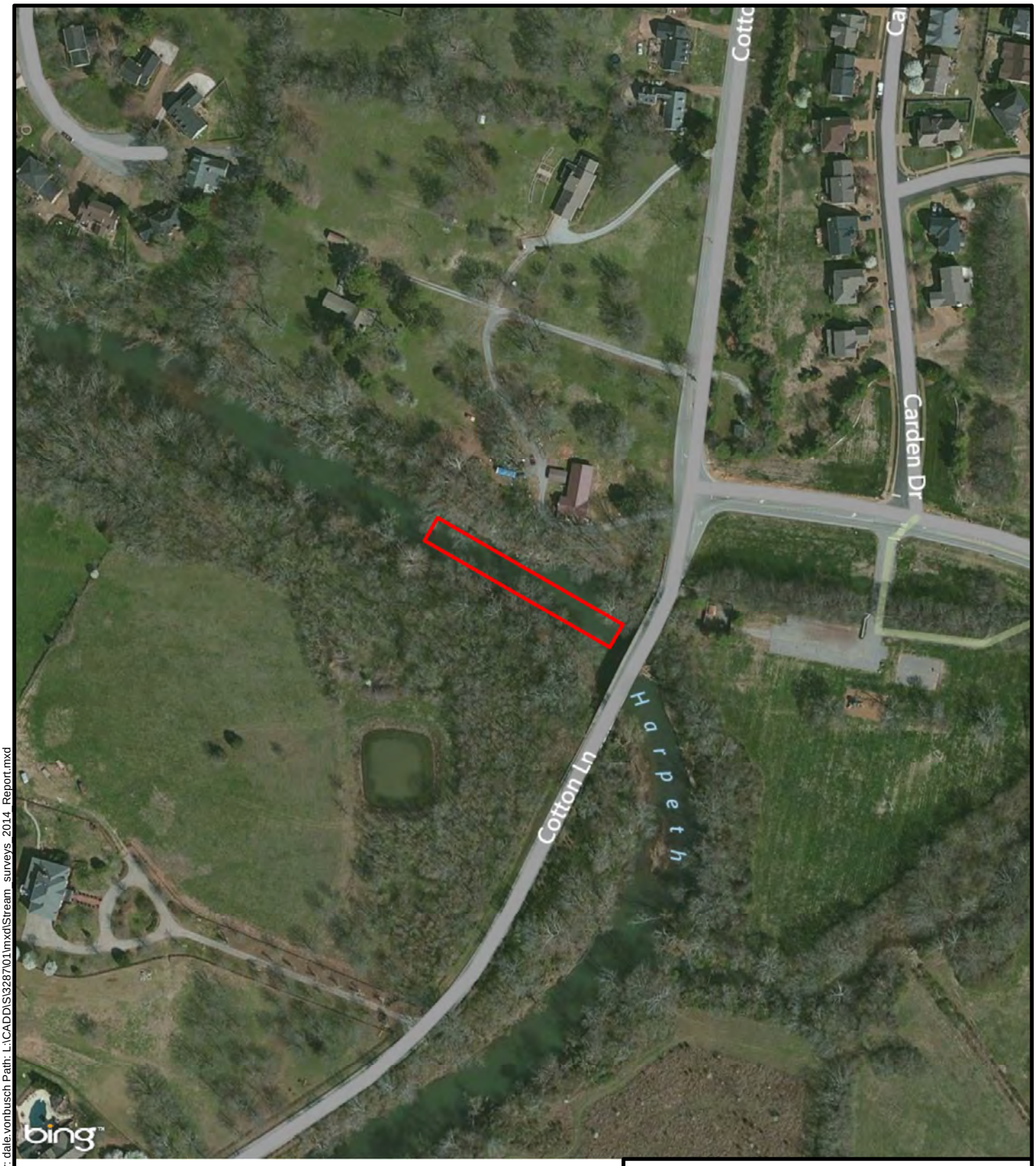

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Sample Reach

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W E
S

0 100 200
Feet

SOURCE: BING MAPS HYBRID IMAGERY 2010-2012.

2014/2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 6
CHEMICAL SAMPLING SITE LOCATION
HARPETH AT COTTON ROAD

TETRA TECH

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Sample Reach

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W E
S

0 100 200
Feet

SOURCE: BING MAPS HYBRID IMAGERY 2010-2012.

2014/2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 7
CHEMICAL SAMPLING SITE LOCATION
HARPETH AT ARNO ROAD

TETRA TECH

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Sample Reach

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S

0 100 200
Feet

SOURCE: BING MAPS HYBRID IMAGERY 2010-2012.

2014/2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 8
BIOLOGICAL SAMPLING SITE LOCATION
LITTLE HARPETH AT VAUGHN ROAD

TETRA TECH

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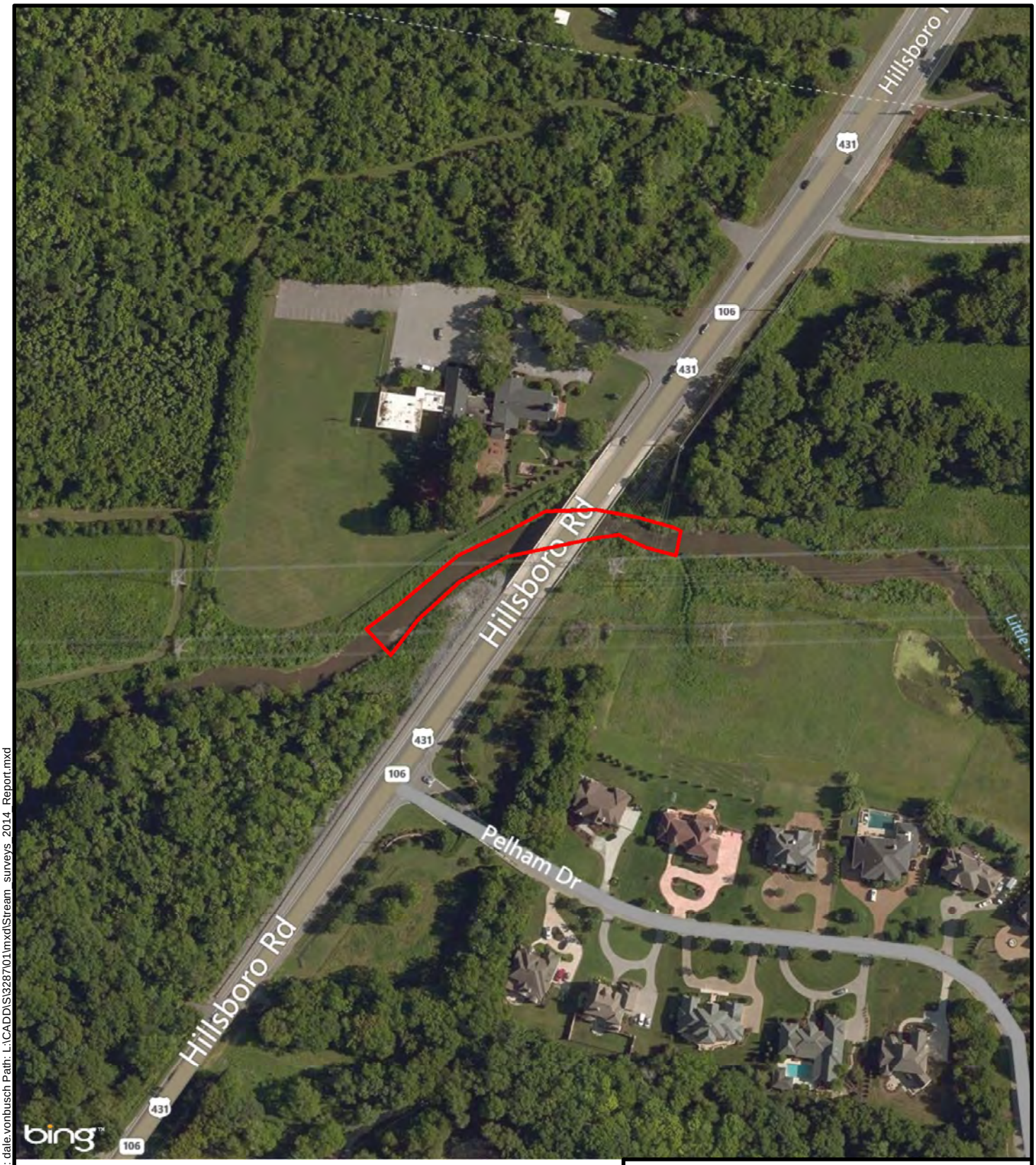

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Sample Reach

N
W E
S

0 100 200
Feet

SOURCE: BING MAPS HYBRID IMAGERY 2010-2012.

2014/2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 9
BIOLOGICAL SAMPLING SITE LOCATION
LITTLE HARPETH AT HILLSBORO ROAD

TETRA TECH

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Sample Reach

N
W E
S

0 100 200
Feet

SOURCE: BING MAPS HYBRID IMAGERY 2010-2012.

2014/2015 STREAM MONITORING REPORT WILLIAMSON COUNTY, TENNESSEE

FIGURE 10
BIOLOGICAL SAMPLING SITE LOCATION
OWL CREEK AT SPLIT LOG ROAD

TETRA TECH

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Sample Reach

N
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S

0 100 200
Feet

SOURCE: BING MAPS HYBRID IMAGERY 2010-2012.

2014/2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 11
BIOLOGICAL SAMPLING SITE LOCATION
RUTHERFORD AT OLD BETHESDA ROAD

TETRA TECH

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Sample Reach

N
W E
S

0 100 200
Feet

SOURCE: BING MAPS HYBRID IMAGERY 2010-2012.

2014/2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 12
BIOLOGICAL SAMPLING SITE LOCATION
RUTHERFORD AT CROSS KEYS ROAD

TETRA TECH

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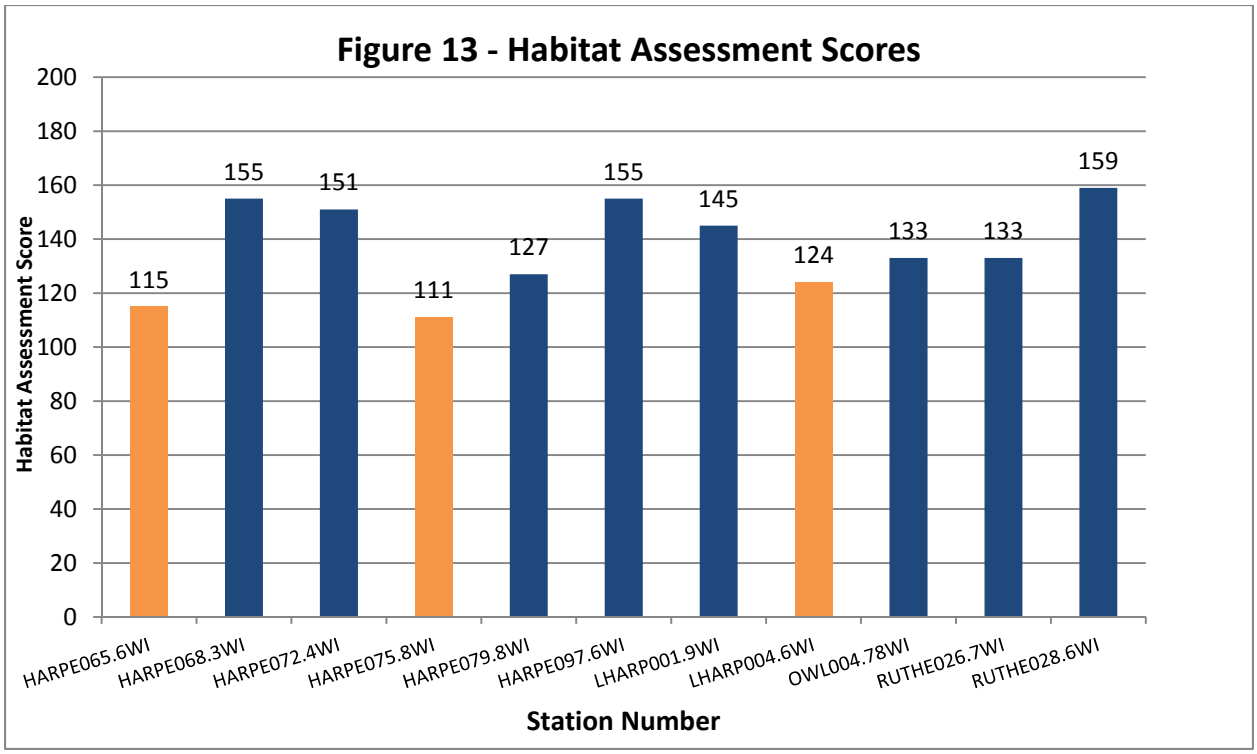
Figure 13 - Habitat Assessment Scores
Habitat Assessment Score
200
180
160
140
120
100
80
60
40
20
0
115
155
151
111
127
155
145
124
133
133
159
HARPE065.6WI
HARPE068.3WI
HARPE072.4WI
HARPE075.8WI
HARPE079.8WI
HARPE097.6WI
LHARP001.9WI
LHARP004.6WI
OWL004.78WI
RUTHE026.7WI
RUTHE028.6WI
Station Number

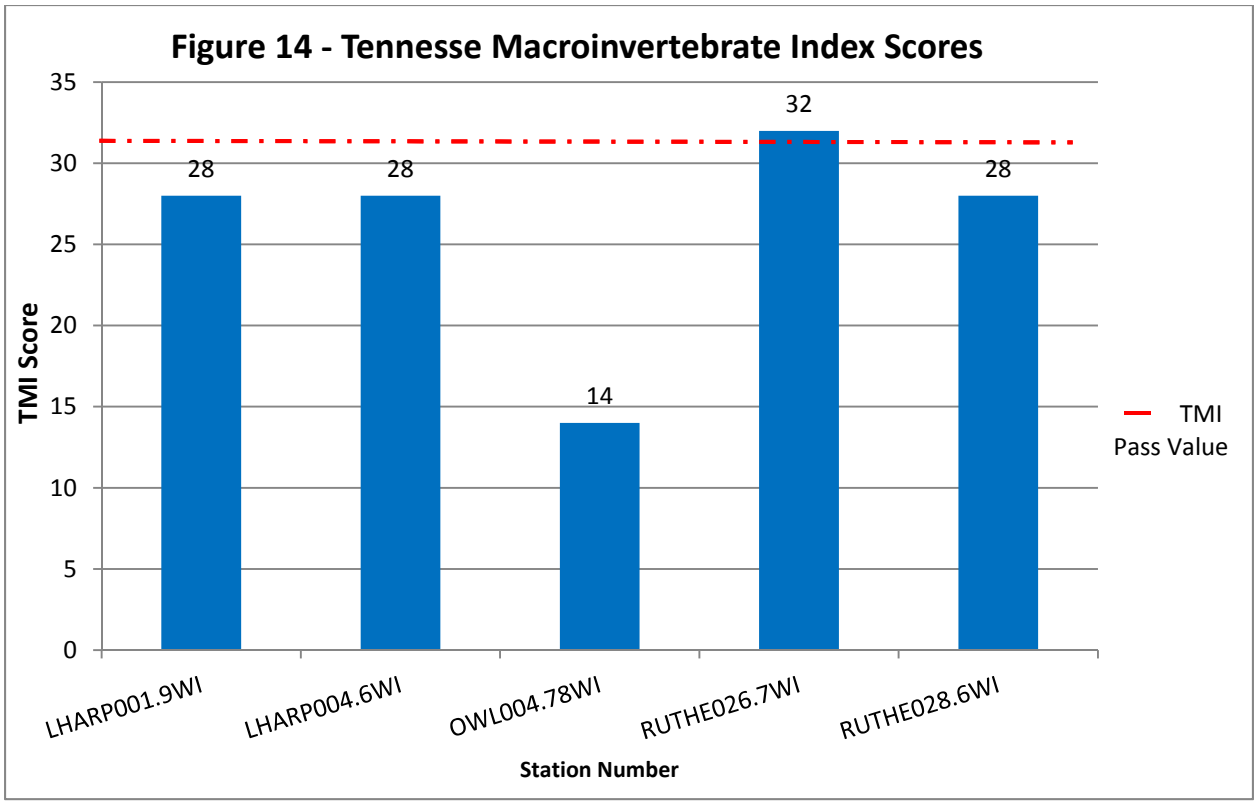
Figure 14 - Tennesse Macroinvertebrate Index Scores
TMI Score
35
30
25
20
15
10
5
0
28
28
14
32
28
LHARP001.9WI
LHARP004.6WI
OWL004.78WI
RUTHE026.7WI
RUTHE028.6WI
Station Number
TMI
Pass Value

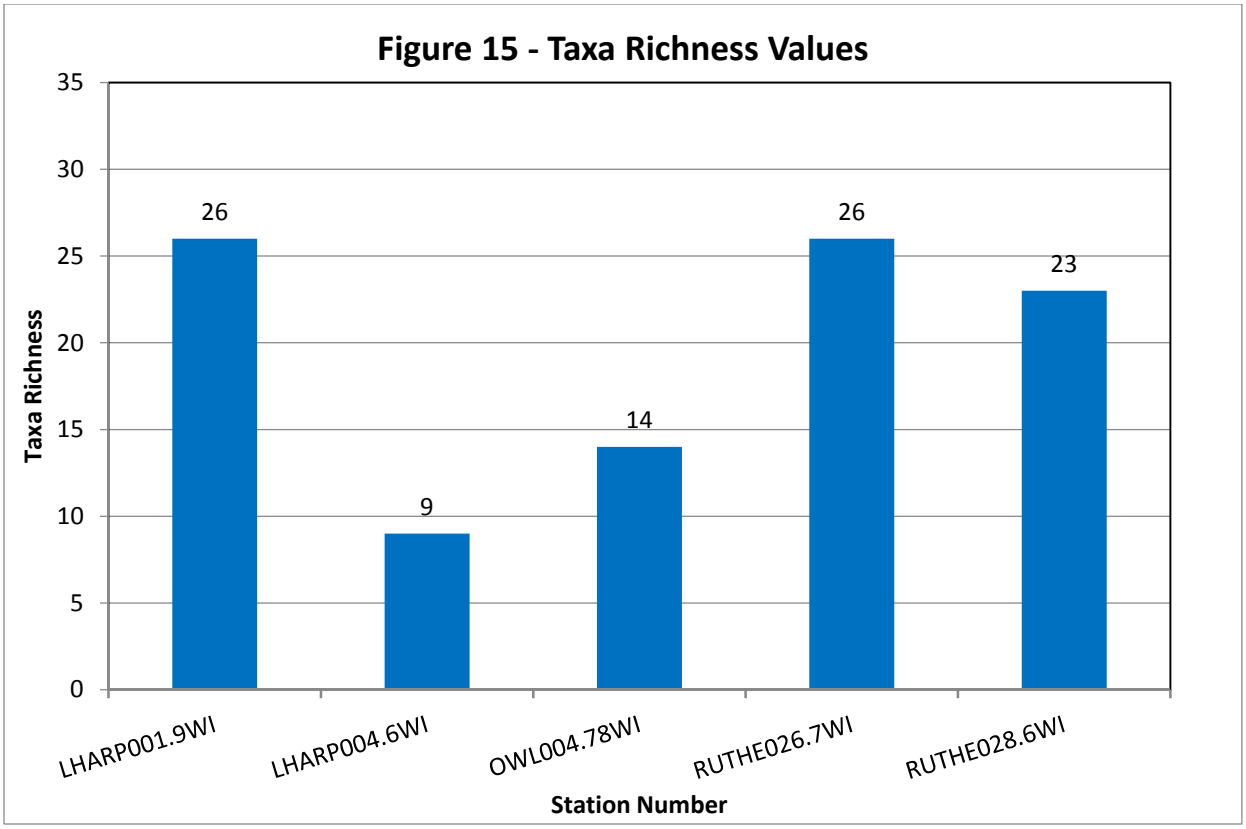
Figure 15 - Taxa Richness Values
Taxa Richness
35
30
25
20
15
10
5
0
26
9
14
26
23
LHARP001.9WI
LHARP004.6WI
OWL004.78WI
RUTHE026.7WI
RUTHE028.6WI
Station Number

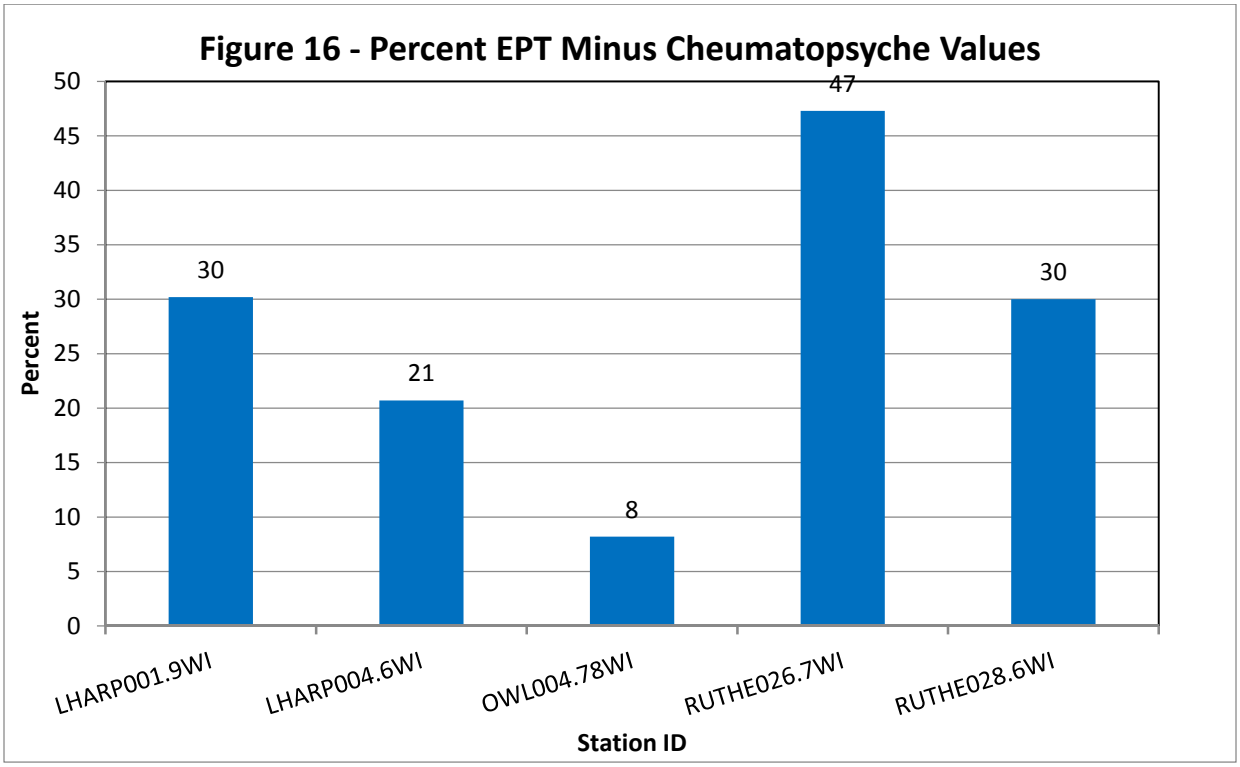
Figure 16 - Percent EPT Minus Cheumatopsyche Values
Percent
50
45
40
35
30
25
20
15
10
5
0
30
21
8
47
30
LHARP001.9WI
LHARP004.6WI
OWL004.78WI
RUTHE026.7WI
RUTHE028.6WI
Station ID

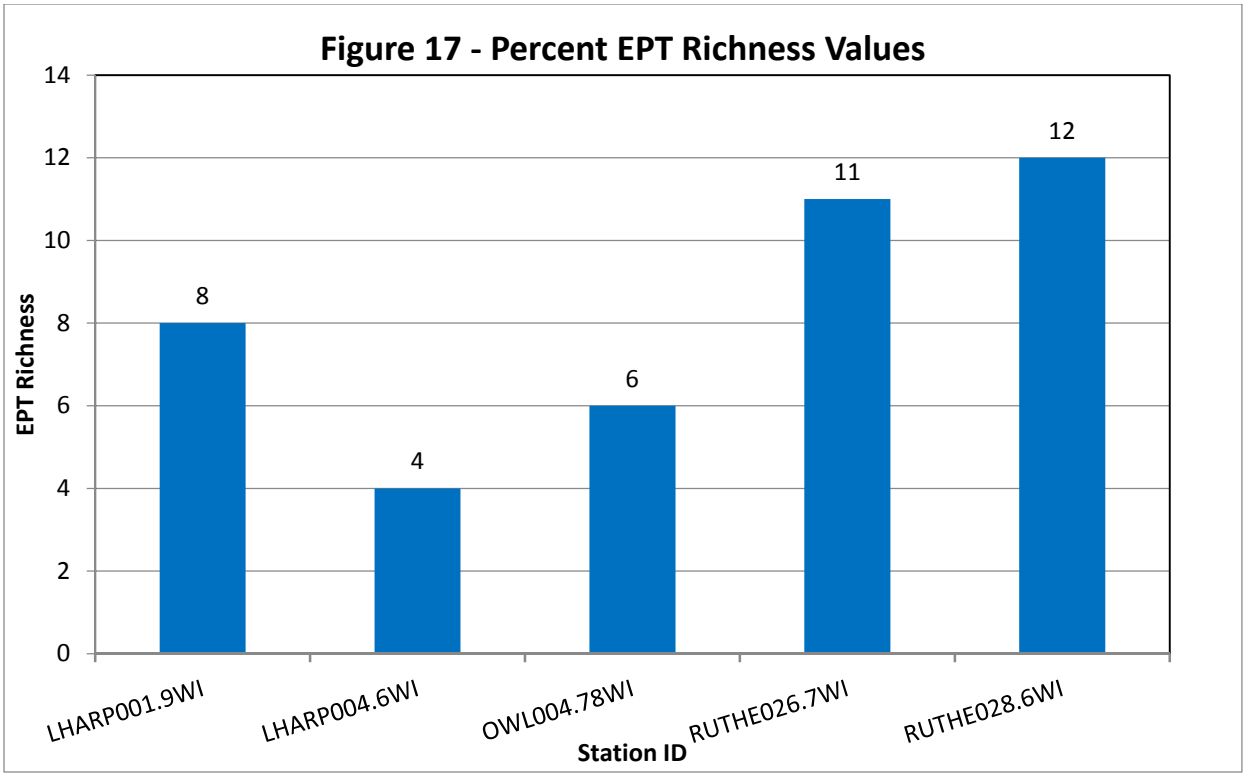
Figure 17 - Percent EPT Richness Values
EPT Richness
14
12
10
8
6
4
2
0
8
4
6
11
12
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LHARP004.6WI
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RUTHE026.7WI
RUTHE028.6WI
Station ID

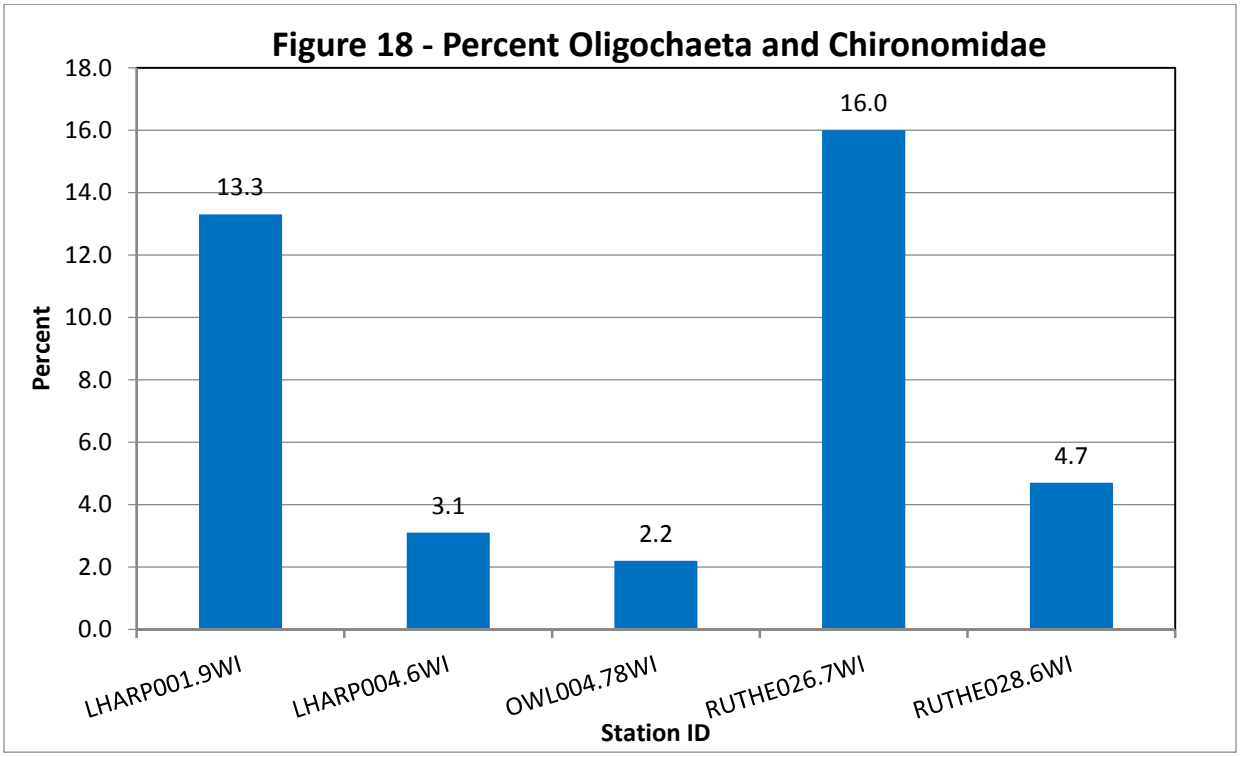
Figure 18 - Percent Oligochaeta and Chironomidae
Percent
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
13.3
3.1
2.2
16.0
4.7
LHARP001.9WI
LHARP004.6WI
OWL004.78WI
RUTHE026.7WI
RUTHE028.6WI
Station ID

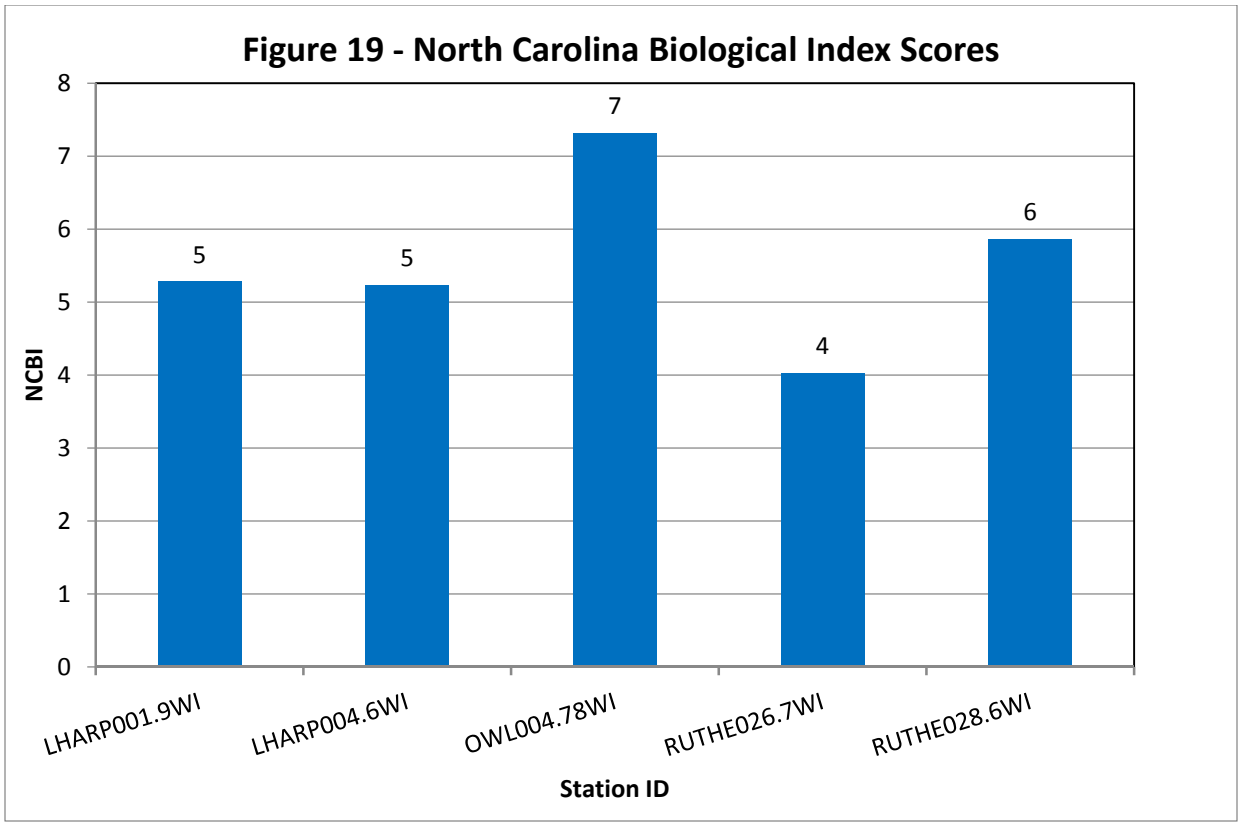
Figure 19 - North Carolina Biological Index Scores
NCBI
8
7
6
5
4
3
2
1
0
5
5
7
4
6
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LHARP004.6WI
OWL004.78WI
RUTHE026.7WI
RUTHE028.6WI
Station ID

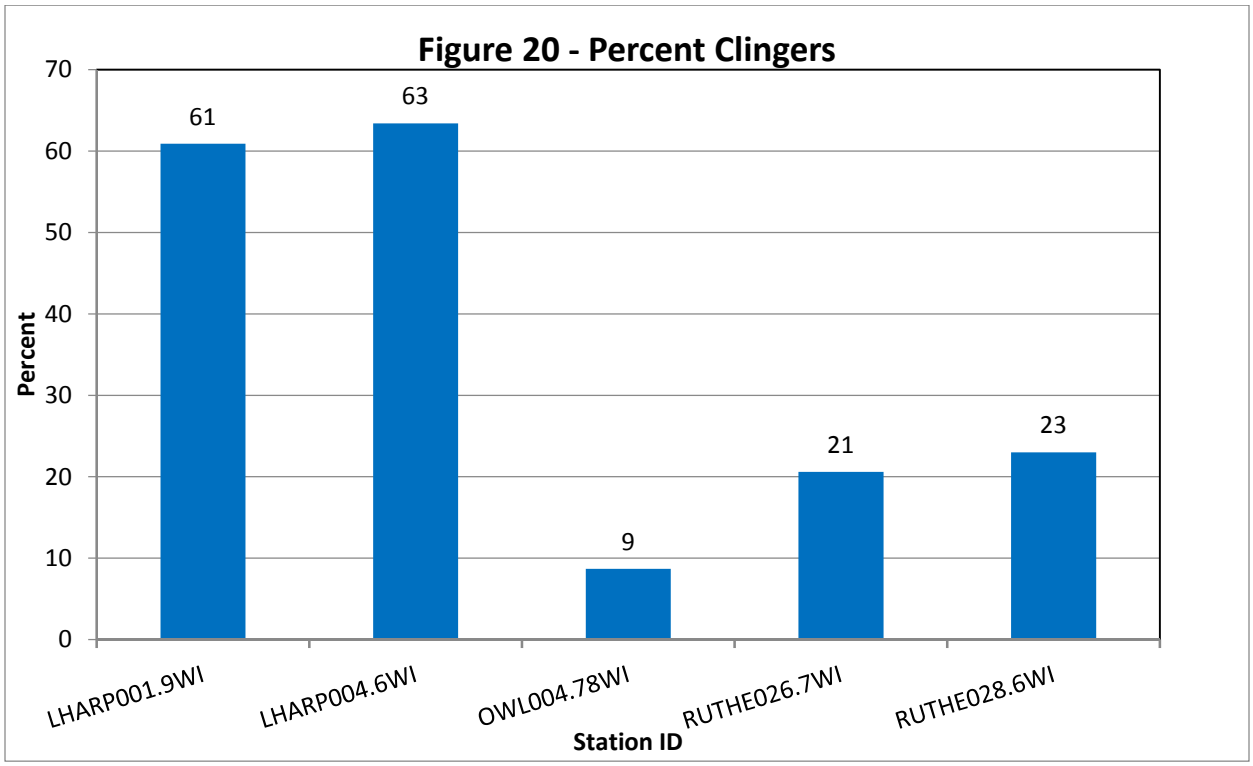


Figure 20 - Percent Clingers
Percent
70
60
50
40
30
20
10
0
61
63
9
21
23
LHARP001.9WI
LHARP004.6WI
OWL004.78WI
RUTHE026.7WI
RUTHE028.6WI
Station ID

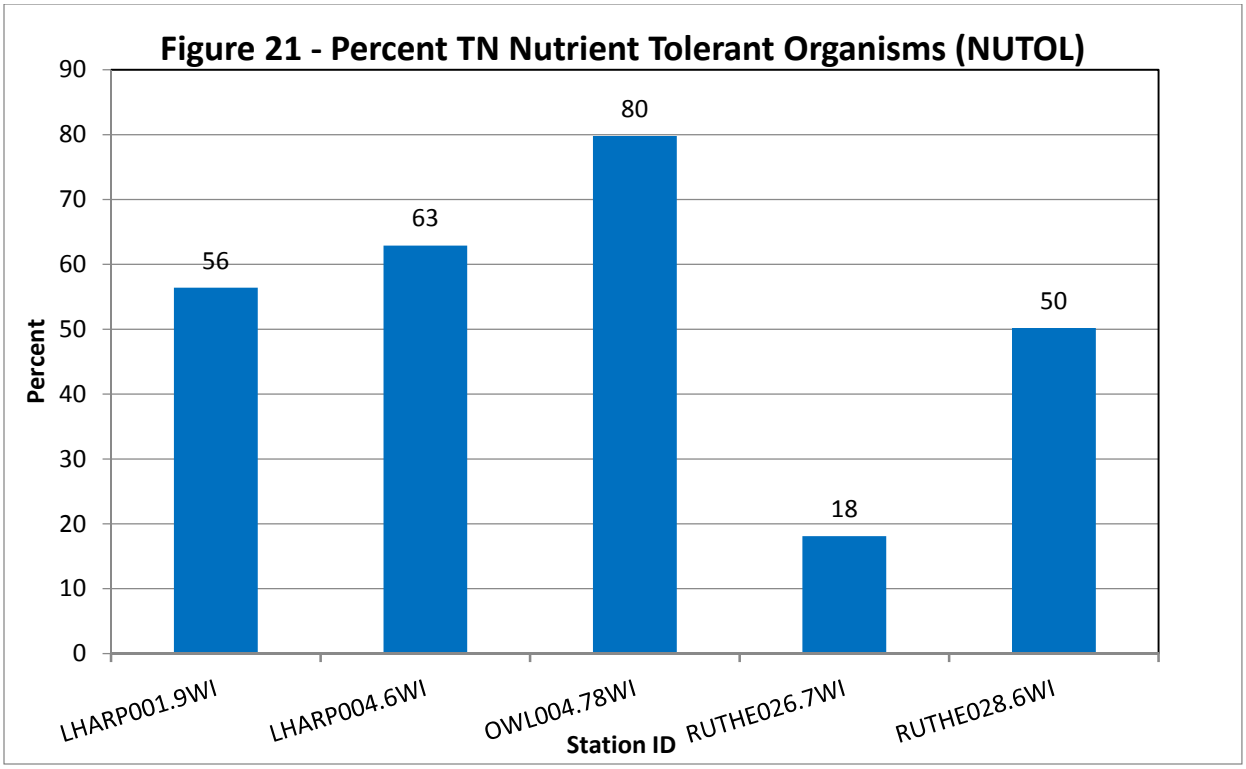
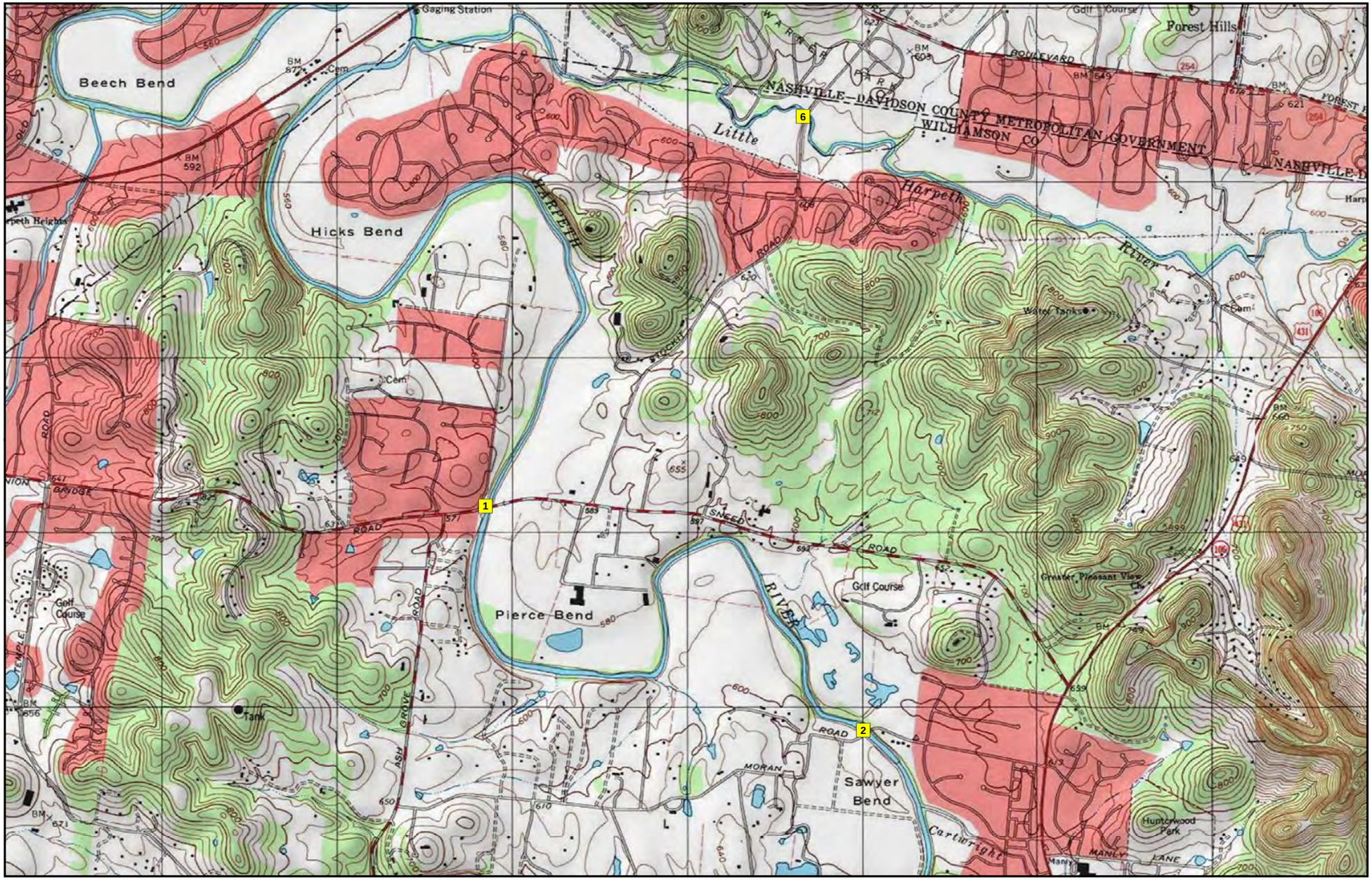
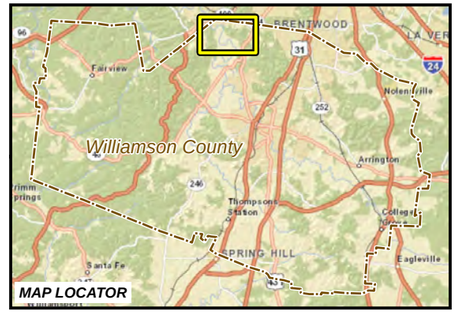


Figure 21 - Percent TN Nutrient Tolerant Organisms (NUTOL)
Percent
90
80
70
60
50
40
30
20
10
0
56
63
80
18
50
LHARP001.9WI
LHARP004.6WI
OWL004.78WI
RUTHE026.7WI
RUTHE028.6WI
Station ID





NOTES:

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Map Sources:
USGS Topographic 7.5 min Quadrangle,
Bellevue, TN 1997.

LEGEND

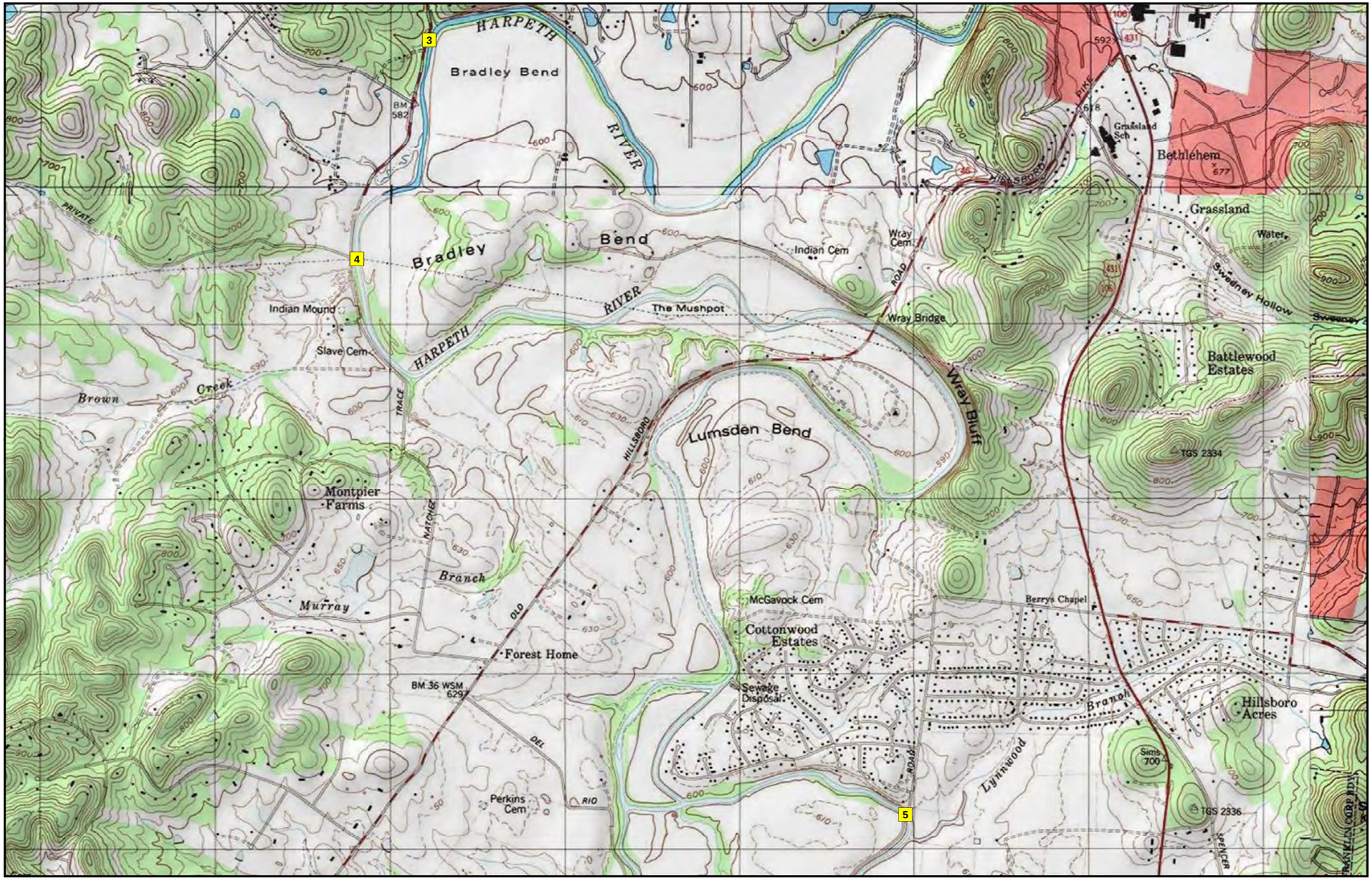
- VSA Site Location

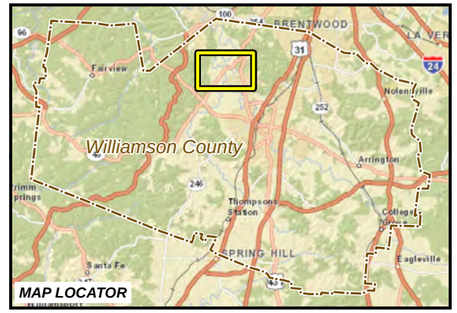
2014/2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 22
VSA SITE LOCATIONS
ON HARPETH AND LITTLE HARPETH RIVERS

TETRA TECH

Date: 9/14/2015 User: dale.vonbusch Path: L:\CADD\S\3287\01\002\mxd\topo_map_harpeth_little_harpeth.mxd





NOTES:

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Feet

Map Sources:
USGS Topographic 7.5 min Quadrangles,
Bellevue, TN 1997 & Leipers Fork, TN 1981.

LEGEND

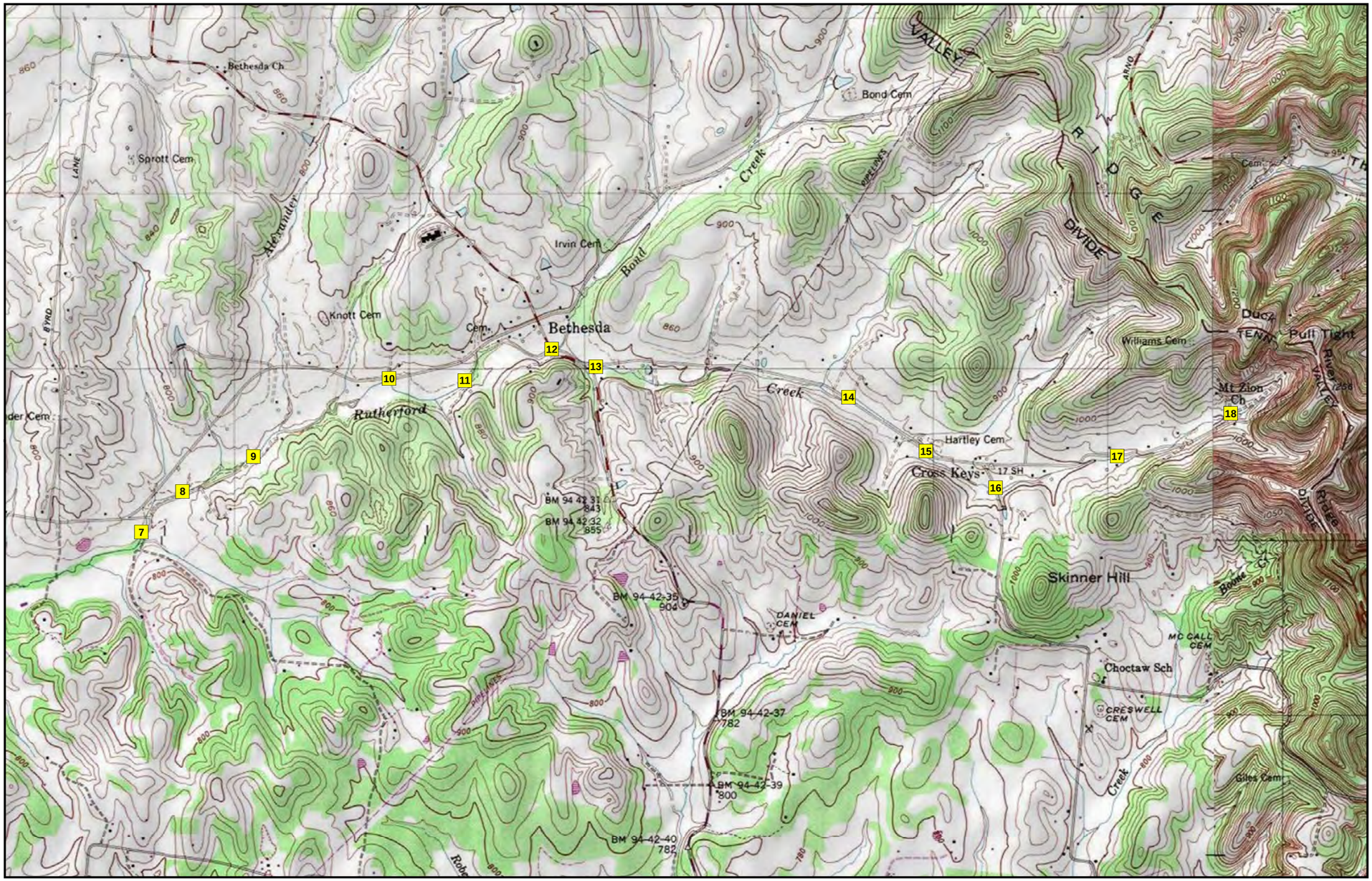
- VSA Site Location

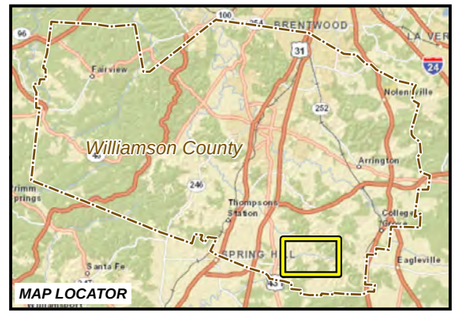
2014/2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 23
VSA SITE LOCATIONS
ON HARPETH RIVER

TETRA TECH

Date: 9/14/2015 User: dale.vonbusch Path: L:\CADD\S\3287\01\002\mxd\topo_map_harpeth.mxd





NOTES:

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Map Sources:
USGS Topographic 7.5 min Quadrangles,
Bethesda, TN 1982 & College Grove, TN 1981
& Rally Hill, TN 1981 & Chapel Hill, TN 1980.

LEGEND

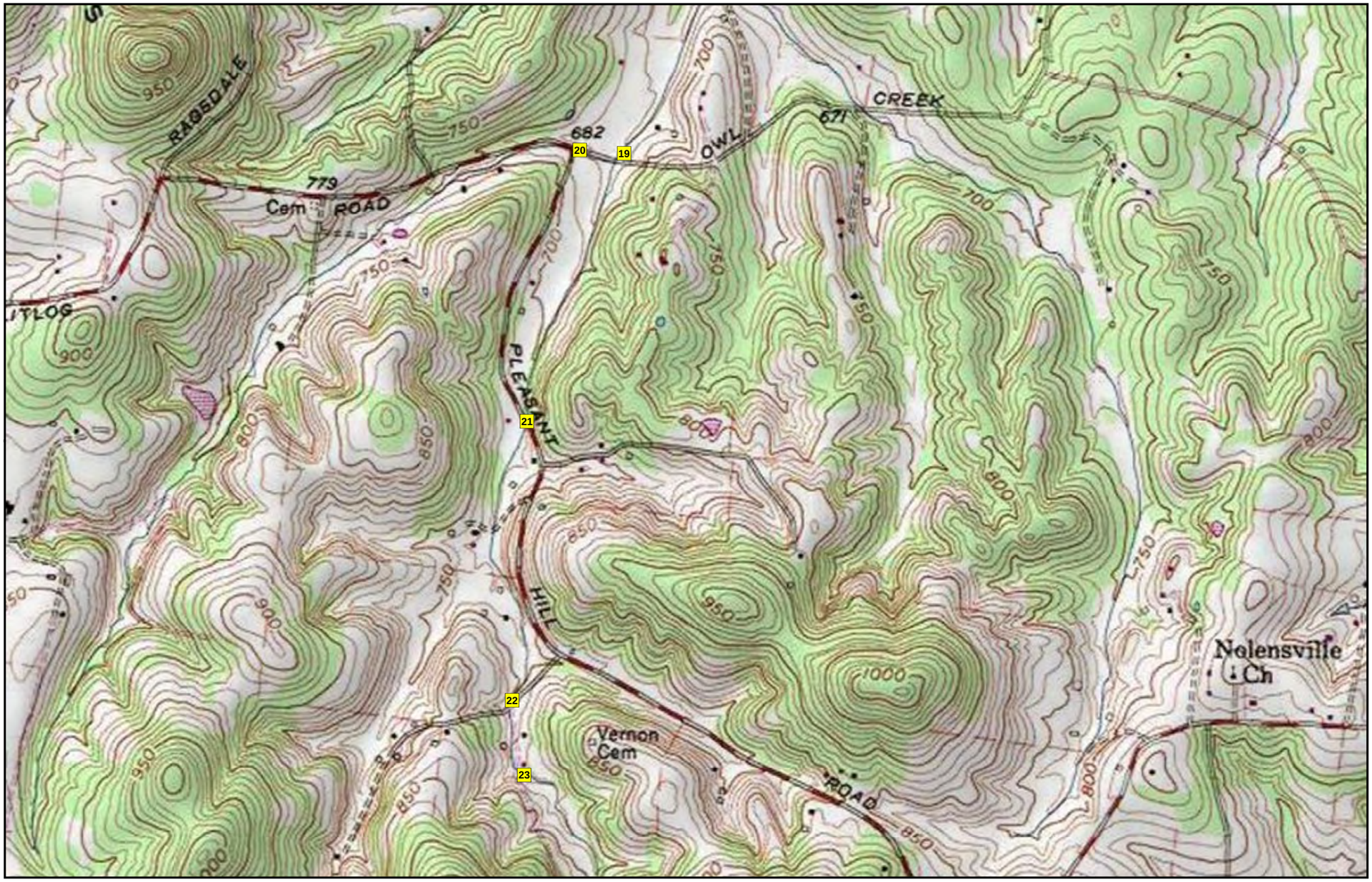
- VSA Site Locations

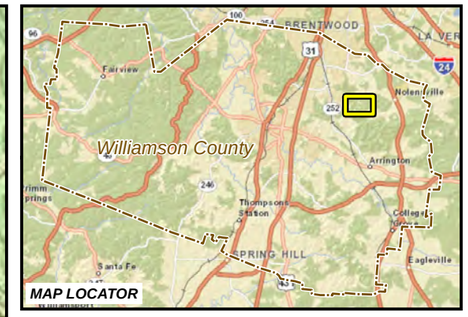
2014/2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 24
VSA SITE LOCATIONS
ON RUTHERFORD CREEK

TETRA TECH

Date: 9/14/2015 User: dale.vonbusch Path: L:\CADD\S\3287\01\002\mxd\topo_map_rutherford.mxd





NOTES:

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Map Sources:
USGS Topographic 7.5 min Quadrangle,
Nolensville, TN 1981.

LEGEND

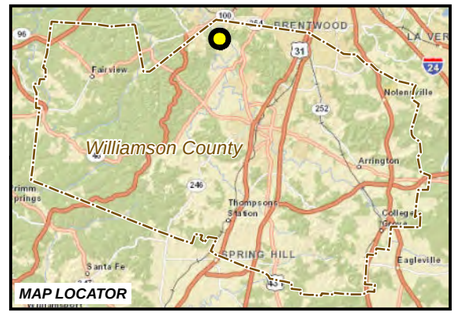
VSA Site Location

2014/2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 25
VSA SITE LOCATIONS
ON OWL CREEK

TETRA TECH

Date: 9/14/2015 User: dale.vonbusch Path: L:\CADD\S\3287\01\002\mxd\topo_map_owl.mxd



NOTES:

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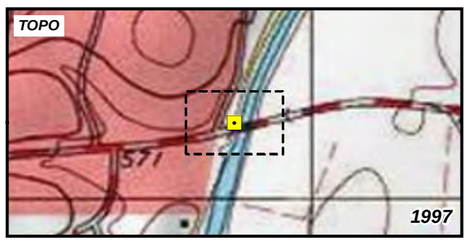
Feet

Map Sources:
ESRI Aerial Imagery 2010-2012, USGS Topographic 7.5 min Quadrangles, National Hydrology Dataset (NHD) 2015, National Wetlands Inventory, 2015.

LEGEND

- Visual Inspection Point
- 50-feet From Inspection Point



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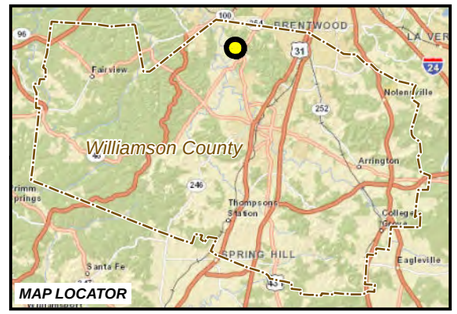
WILLIAMSON COUNTY, TENNESSEE

FIGURE 26
VSA SITE 1, HARPETH AT SNEED ROAD

TETRA TECH

Date: 3/17/2015 User: dale.vonbusch Path: L:\CADD\S\3287\01\002\mxd\Stream_visual_surveys_map_book.mxd



NOTES:

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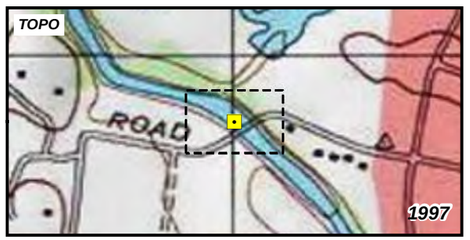
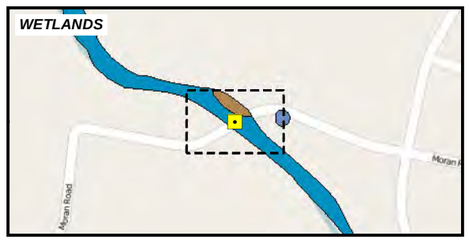
Feet

Map Sources:
ESRI Aerial Imagery 2010-2012, USGS Topographic 7.5 min Quadrangles, National Hydrology Dataset (NHD) 2015, National Wetlands Inventory, 2015.

LEGEND

- Visual Inspection Point
- 50-feet From Inspection Point



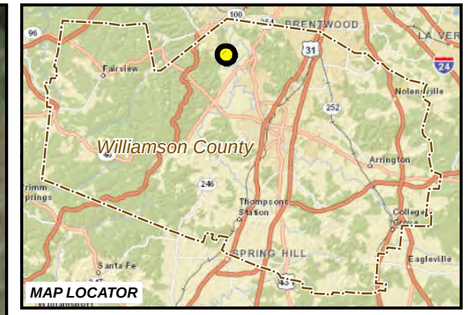


2014/2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 27
VSA SITE 2, HARPETH AT MORAN ROAD

TETRA TECH

Date: 3/17/2015 User: dale.vonbusch Path: L:\CADD\S\3287\01\002\mxd\Stream_visual_surveys_map_book.mxd



NOTES:

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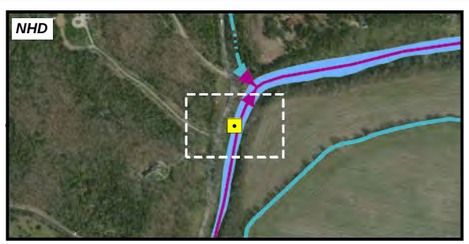
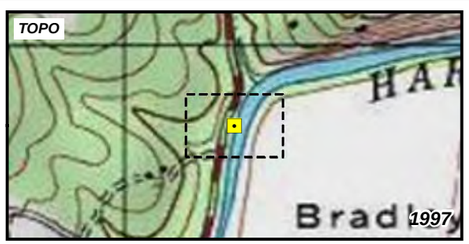
Feet

Map Sources:
ESRI Aerial Imagery 2010-2012, USGS Topographic 7.5 min Quadrangles, National Hydrology Dataset (NHD) 2015, National Wetlands Inventory, 2015.

LEGEND

- Visual Inspection Point
- 50-feet From Inspection Point





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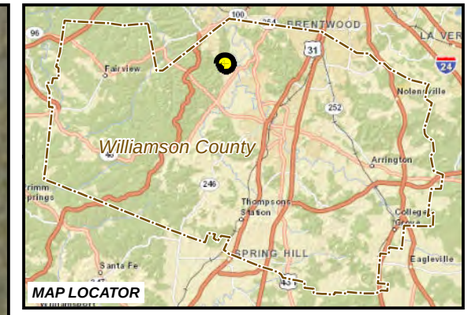
WILLIAMSON COUNTY, TENNESSEE

FIGURE 28
VSA SITE 3, HARPETH AT OLD NATCHEZ TRACE ROAD

TETRA TECH

Date: 3/17/2015 User: dale.vonbusch Path: L:\CADD\S\3287\01\002\mxd\Stream_visual_surveys_map_book.mxd



NOTES:

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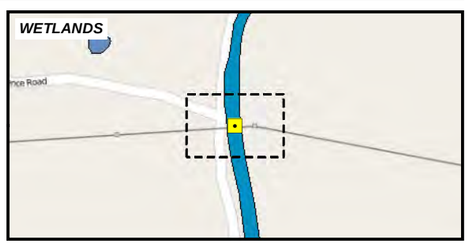
Map Sources:
ESRI Aerial Imagery 2010-2012, USGS Topographic 7.5 min Quadrangles, National Hydrology Dataset (NHD) 2015, National Wetlands Inventory, 2015.

LEGEND

- Visual Inspection Point
- 50-feet From Inspection Point

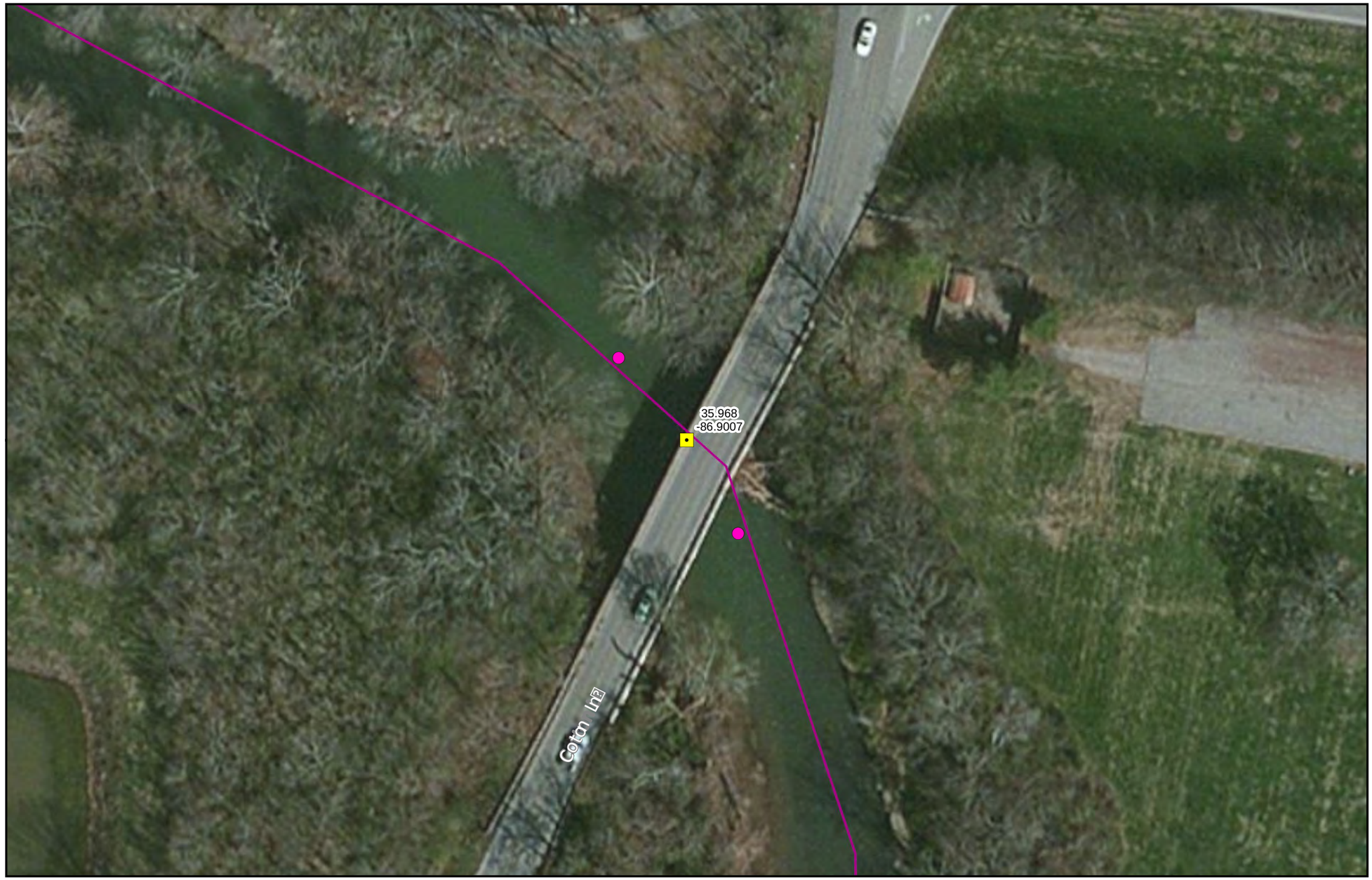


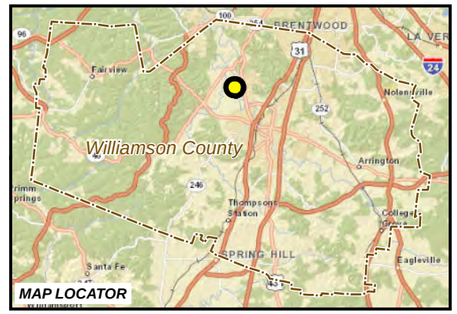
2014/2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 29
VSA SITE 4, HARPETH AT OLD NATCHEZ TRACE ROAD/ LAWRENCE ROAD

TETRA TECH

Date: 3/17/2015 User: dale.vonbusch Path: L:\CADD\S\3287\01\002\mxd\Stream_visual_surveys_map_book.mxd





NOTES:

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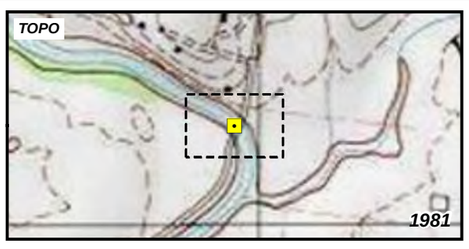
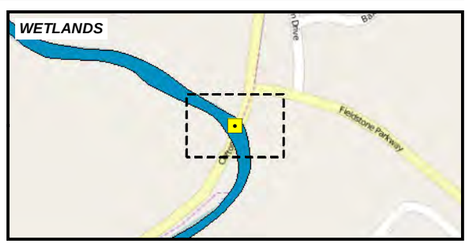
Map Sources:
ESRI Aerial Imagery 2010-2012, USGS Topographic 7.5 min Quadrangles, National Hydrology Dataset (NHD) 2015, National Wetlands Inventory, 2015.

LEGEND

- Visual Inspection Point
- 50-feet From Inspection Point



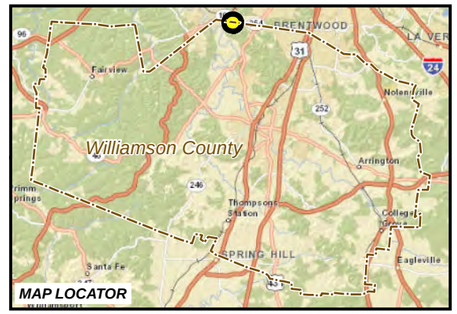


2014/2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 30
VSA SITE 5, HARPETH AT COTTON LANE

TETRA TECH

Date: 3/17/2015 User: dale.vonbusch Path: L:\CADD\S\3287\01\002\mxd\Stream_visual_surveys_map_book.mxd



NOTES:

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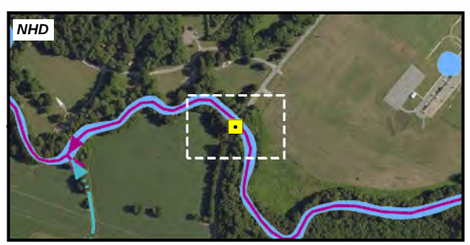
Map Sources:
ESRI Aerial Imagery 2010-2012, USGS Topographic 7.5 min Quadrangles, National Hydrology Dataset (NHD) 2015, National Wetlands Inventory, 2015.

LEGEND

- Visual Inspection Point
- 50-feet From Inspection Point

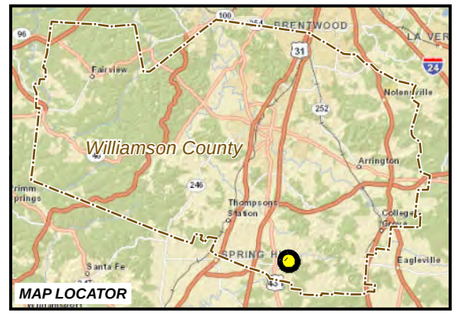


2014/2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 31
VSA SITE 6, LITTLE HARPETH AT VAUGHN ROAD

TETRA TECH

Date: 3/17/2015 User: dale.vonbusch Path: L:\CADD\S\3287\01\002\mxd\Stream_visual_surveys_map_book.mxd



NOTES:

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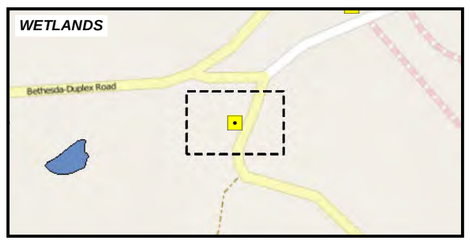
Feet

Map Sources:
ESRI Aerial Imagery 2010-2012, USGS Topographic 7.5 min Quadrangles, National Hydrology Dataset (NHD) 2015, National Wetlands Inventory, 2015.

LEGEND

- Visual Inspection Point
- 50-feet From Inspection Point

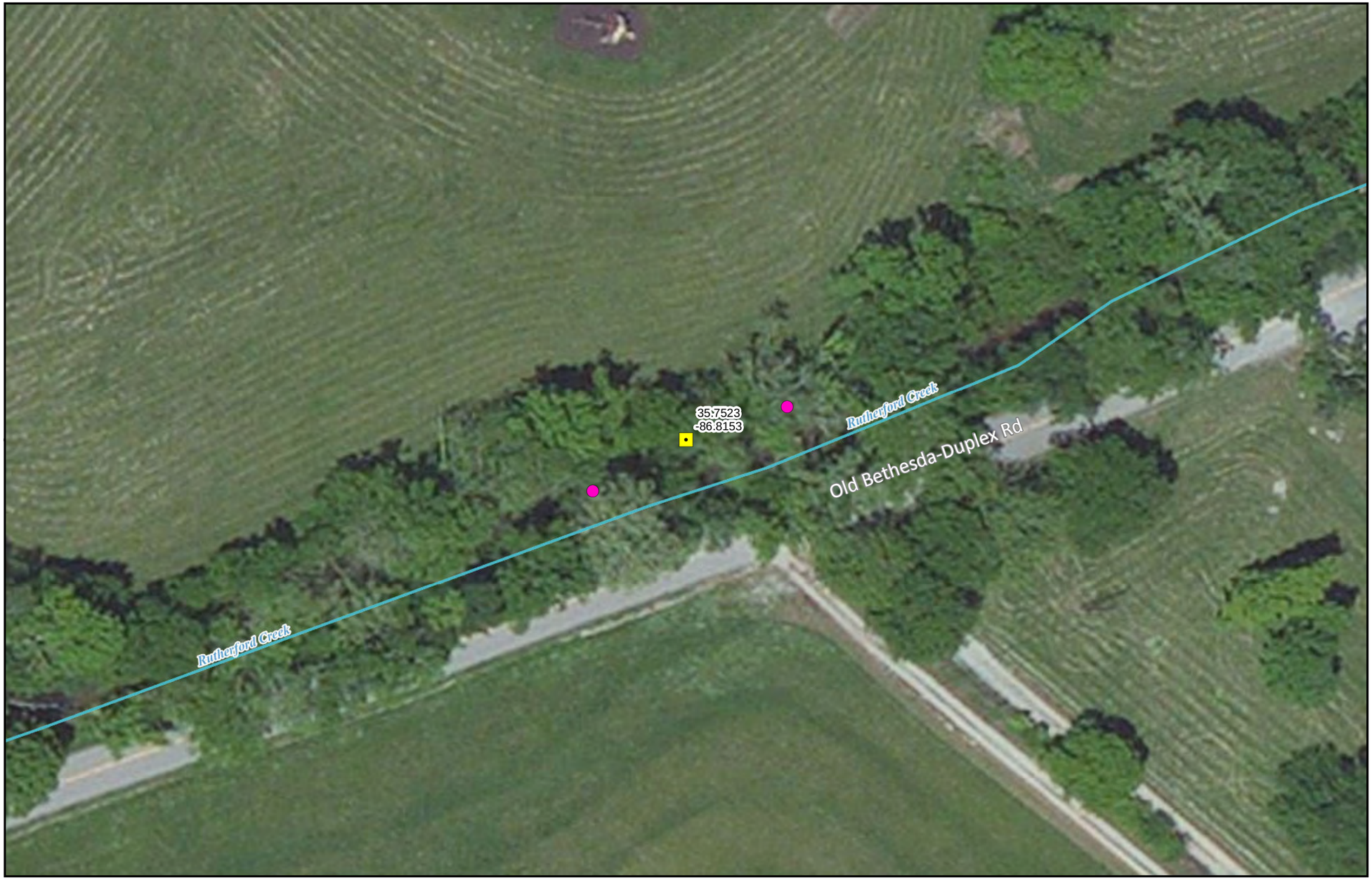


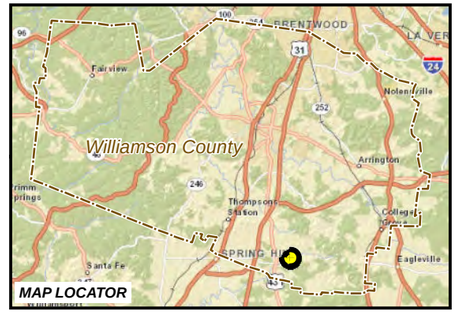
2014/2015 STREAM MONITORING RPOERT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 32
VSA SITE 7, RUTHERFORD CREEK AT SMITHSON ROAD

TETRA TECH

Date: 3/17/2015 User: dale.vonbusch Path: L:\CADD\S\3287\01\002\mxd\Stream_visual_surveys_map_book.mxd





NOTES:

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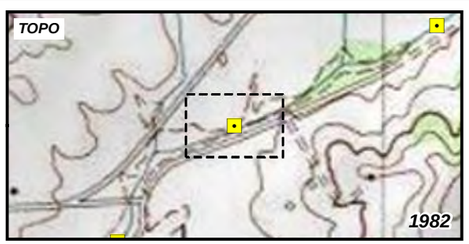
Feet

Map Sources:
ESRI Aerial Imagery 2010-2012, USGS Topographic 7.5 min Quadrangles, National Hydrology Dataset (NHD) 2015, National Wetlands Inventory, 2015.

LEGEND

- Visual Inspection Point
- 50-feet From Inspection Point

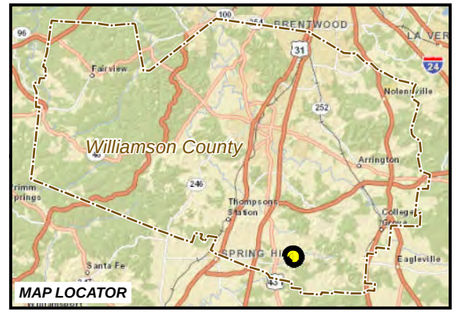


2014/2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 33
VSA SITE 8, RUTHERFORD CREEK AT OLD BETHESDA-DUPLEX ROAD

TETRA TECH

Date: 3/17/2015 User: dale.vonbusch Path: L:\CADD\S\3287\01\002\mxd\Stream_visual_surveys_map_book.mxd



NOTES:

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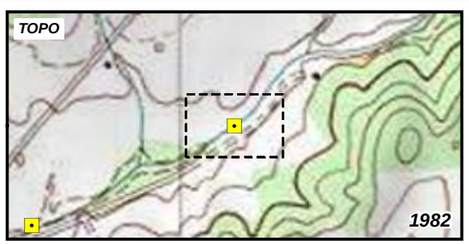
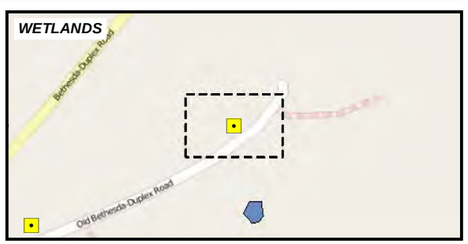
Feet

Map Sources:
ESRI Aerial Imagery 2010-2012, USGS Topographic 7.5 min Quadrangles, National Hydrology Dataset (NHD) 2015, National Wetlands Inventory, 2015.

LEGEND

- Visual Inspection Point
- 50-feet From Inspection Point



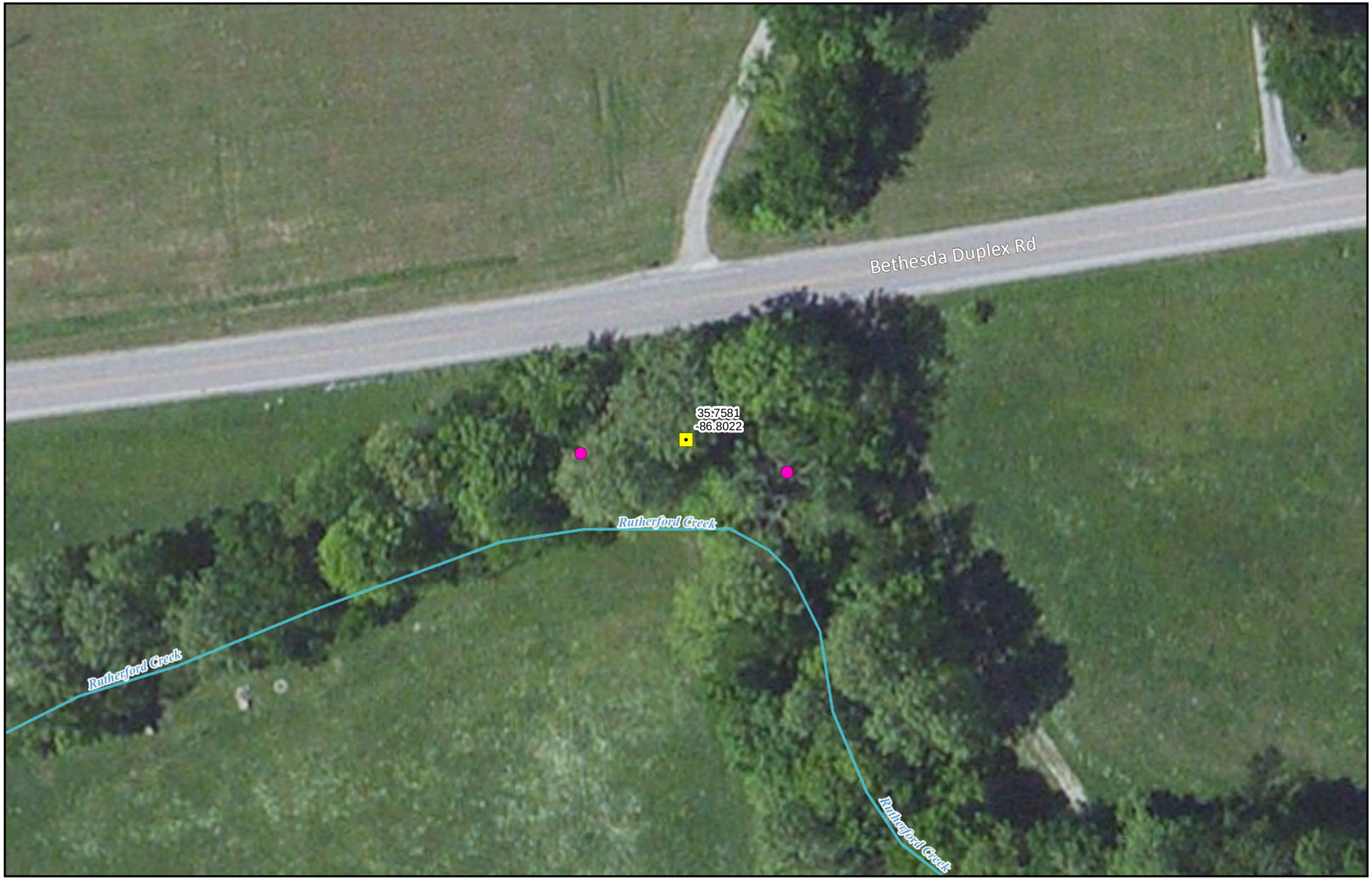


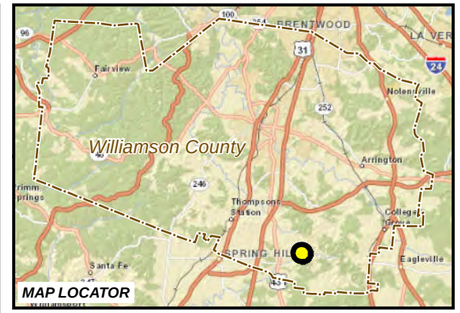
2014/2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 34
VSA SITE 9, RUTHERFORD CREEK AT OLD BETHESDA-DUPLEX ROAD

TETRA TECH

Date: 3/17/2015 User: dale.vonbusch Path: L:\CADD\S\3287\01\002\mxd\Stream_visual_surveys_map_book.mxd





NOTES:

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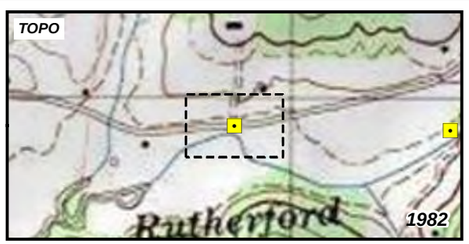
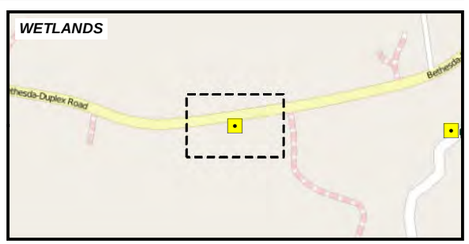
Feet

Map Sources:
ESRI Aerial Imagery 2010-2012, USGS Topographic 7.5 min Quadrangles, National Hydrology Dataset (NHD) 2015, National Wetlands Inventory, 2015.

LEGEND

- Visual Inspection Point
- 50-feet From Inspection Point





2014/2015 STREAM MONITORING RPEORT
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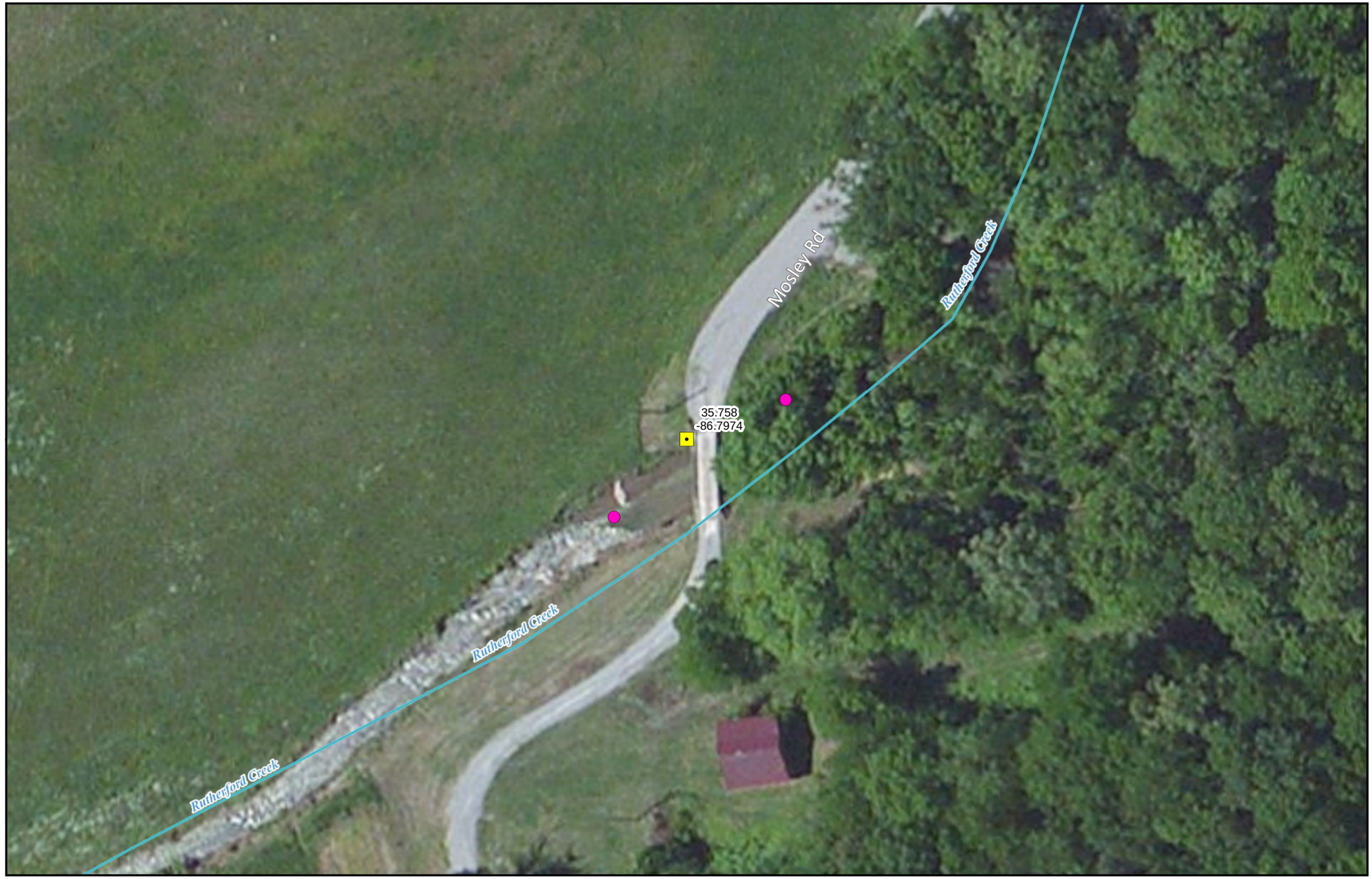
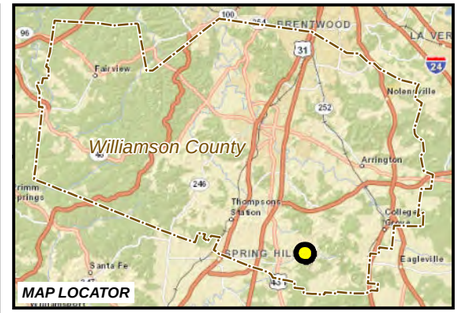
FIGURE 35
VSA SITE 10, RUTHERFORD CREEK AT BETHESDA-DUPLEX ROAD

TETRA TECH

Date: 3/17/2015 User: dale.vonbusch Path: L:\CADD\S\3287\01\002\mxd\Stream_visual_surveys_map_book.mxd





NOTES:

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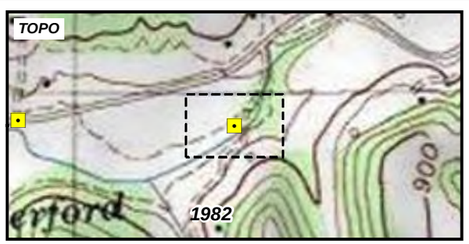
Feet

Map Sources:
ESRI Aerial Imagery 2010-2012, USGS Topographic 7.5 min Quadrangles, National Hydrology Dataset (NHD) 2015, National Wetlands Inventory, 2015.

LEGEND

- Visual Inspection Point
- 50-feet From Inspection Point



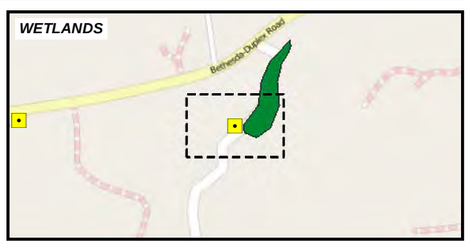


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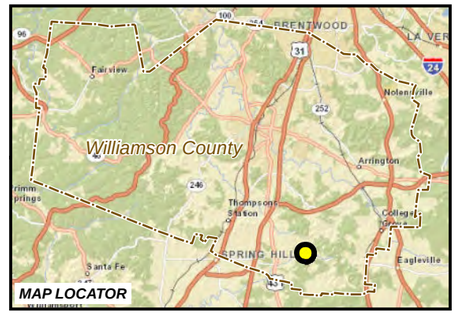
FIGURE 36
VSA SITE 11, RUTHERFORD CREEK AT MOSLEY ROAD

TETRA TECH

Date: 3/17/2015 User: dale.vonbusch Path: L:\CADD\S\3287\01\002\mxd\Stream_visual_surveys_map_book.mxd



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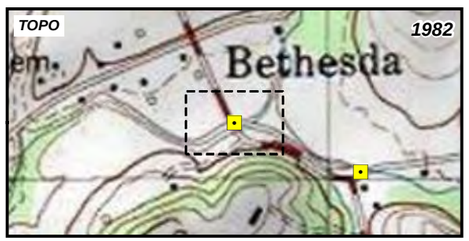
Map Sources:
ESRI Aerial Imagery 2010-2012, USGS Topographic 7.5 min Quadrangles, National Hydrology Dataset (NHD) 2015, National Wetlands Inventory, 2015.

LEGEND

- Visual Inspection Point
- 50-feet From Inspection Point

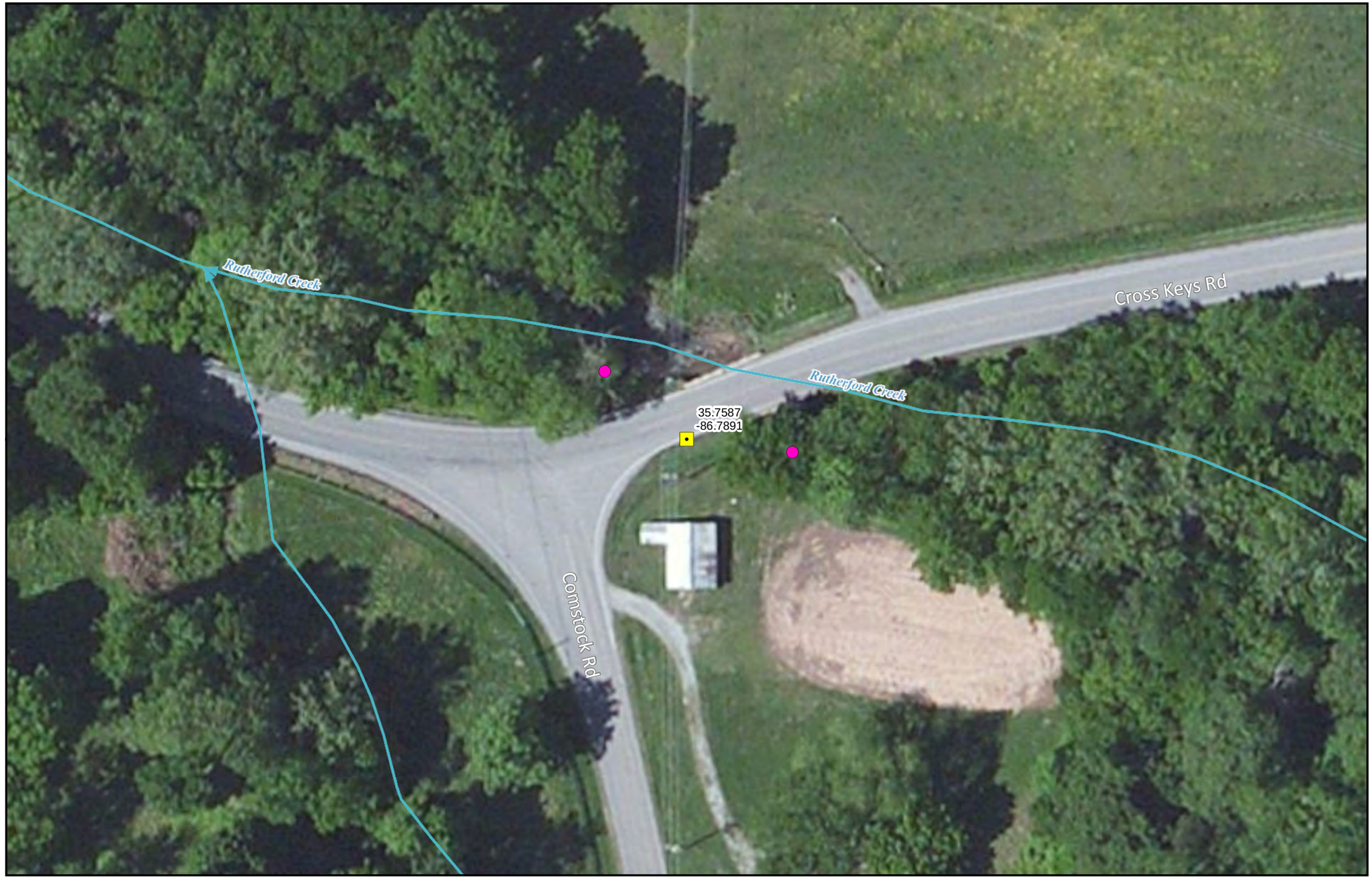


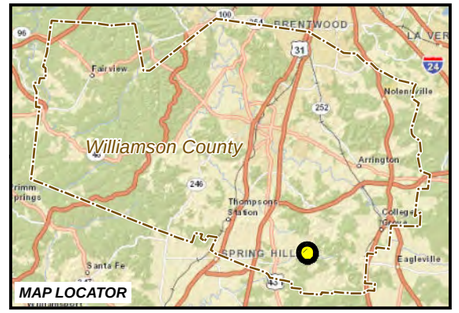
2014/2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 37
VSA SITE 12, RUTHERFORD CREEK AT CROSS KEYS ROAD

TETRA TECH

Date: 3/17/2015 User: dale.vonbusch Path: L:\CADD\S\3287\01\002\mxd\Stream_visual_surveys_map_book.mxd





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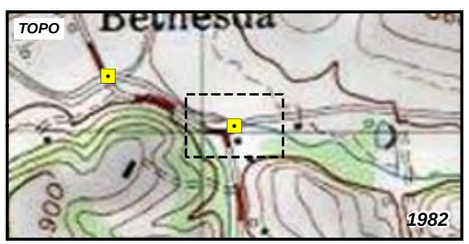
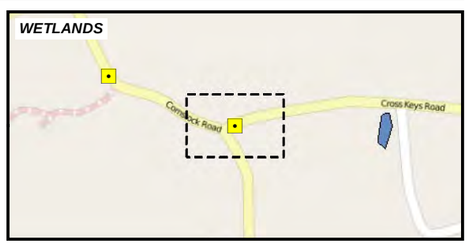
Map Sources:
ESRI Aerial Imagery 2010-2012, USGS Topographic 7.5 min Quadrangles, National Hydrology Dataset (NHD) 2015, National Wetlands Inventory, 2015.

LEGEND

- Visual Inspection Point
- 50-feet From Inspection Point



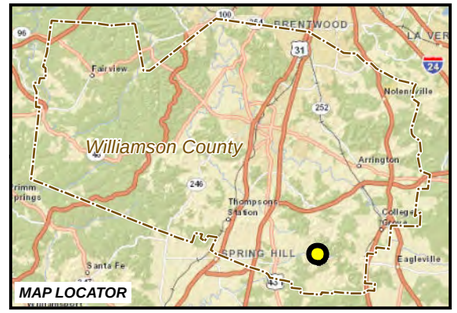


2014/2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 38
VSA SITE 13, RUTHERFORD CREEK AT CROSS KEYS ROAD AND COMSTOCK ROAD

TETRA TECH

Date: 3/17/2015 User: dale.vonbusch Path: L:\CADD\S\3287\01\002\mxd\Stream_visual_surveys_map_book.mxd



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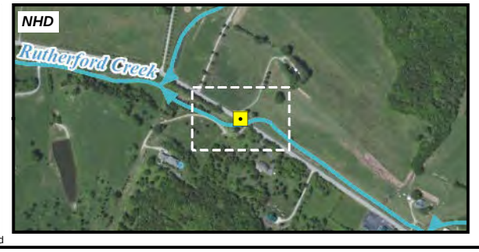
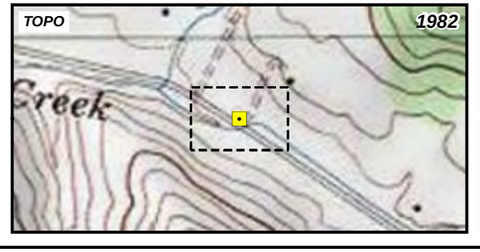
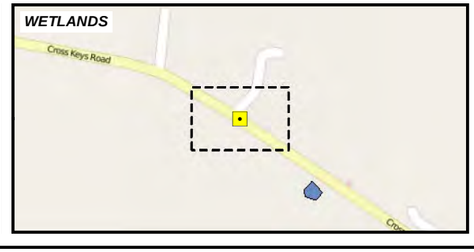
Map Sources:
ESRI Aerial Imagery 2010-2012, USGS Topographic 7.5 min Quadrangles, National Hydrology Dataset (NHD) 2015, National Wetlands Inventory, 2015.

LEGEND

- Visual Inspection Point
- 50-feet From Inspection Point







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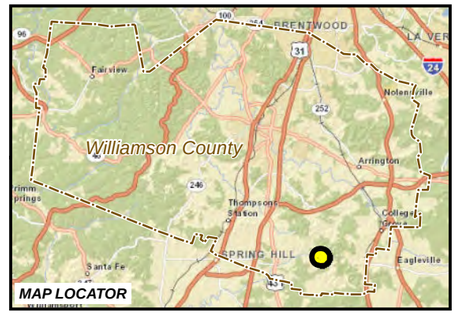
WILLIAMSON COUNTY, TENNESSEE

FIGURE 39
VSA SITE 14, RUTHERFORD CREEK AT CROSS KEYS ROAD

TETRA TECH

Date: 3/17/2015 User: dale.vonbusch Path: L:\CADD\S\3287\01\002\mxd\Stream_visual_surveys_map_book.mxd



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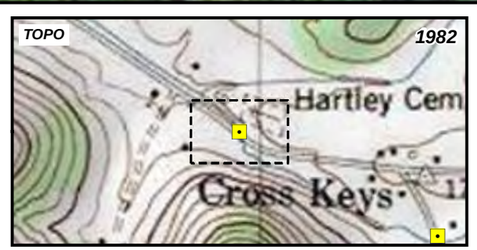
Map Sources:
ESRI Aerial Imagery 2010-2012, USGS Topographic 7.5 min Quadrangles, National Hydrology Dataset (NHD) 2015, National Wetlands Inventory, 2015.

LEGEND

- Visual Inspection Point
- 50-feet From Inspection Point



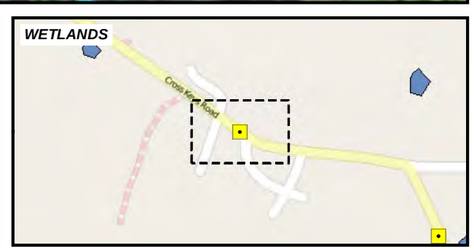


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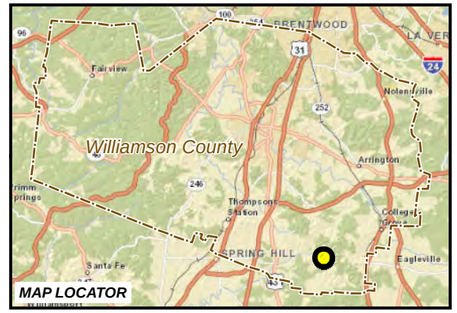
FIGURE 40
VSA SITE 15, RUTHERFORD CREEK AT CROSS KEYS ROAD

TETRA TECH

Date: 3/17/2015 User: dale.vonbusch Path: L:\CADD\S\3287\01\002\mxd\Stream_visual_surveys_map_book.mxd



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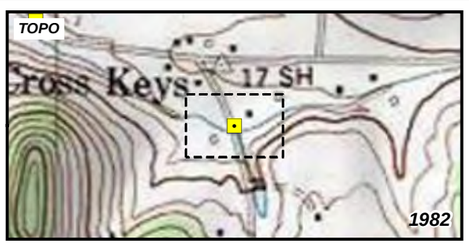
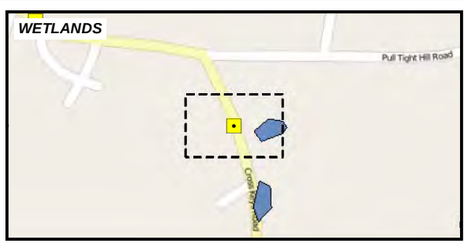
Map Sources:
ESRI Aerial Imagery 2010-2012, USGS Topographic 7.5 min Quadrangles, National Hydrology Dataset (NHD) 2015, National Wetlands Inventory, 2015.

LEGEND

- Visual Inspection Point
- 50-feet From Inspection Point



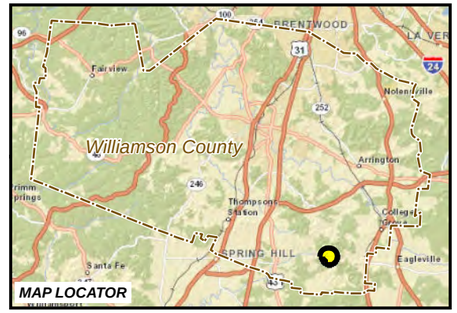


2014/2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 41
VSA SITE 16, RUTHERFORD CREEK AT CROSS KEYS ROAD

TETRA TECH

Date: 3/17/2015 User: dale.vonbusch Path: L:\CADD\S\3287\01\002\mxd\Stream_visual_surveys_map_book.mxd



NOTES:

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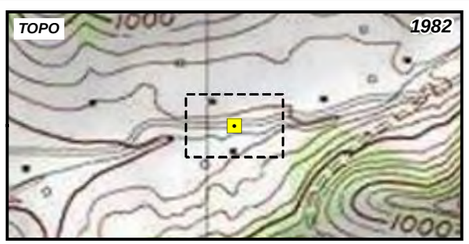
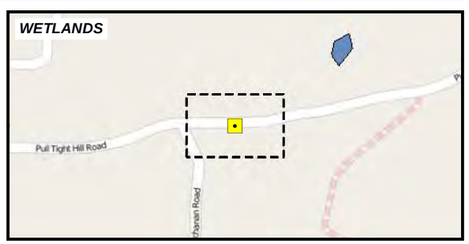
Map Sources:
ESRI Aerial Imagery 2010-2012, USGS Topographic 7.5 min Quadrangles, National Hydrology Dataset (NHD) 2015, National Wetlands Inventory, 2015.

LEGEND

- Visual Inspection Point
- 50-feet From Inspection Point



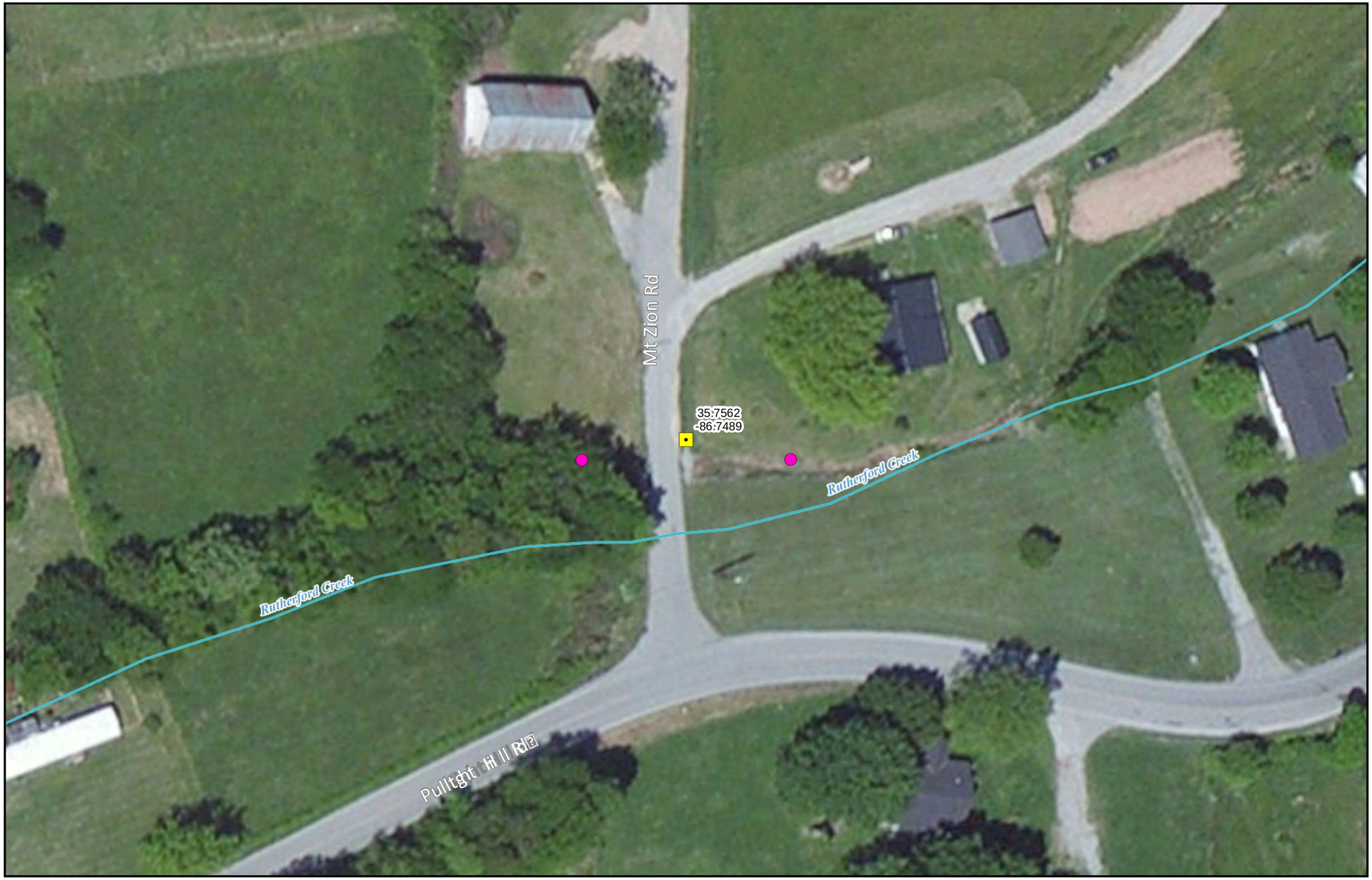


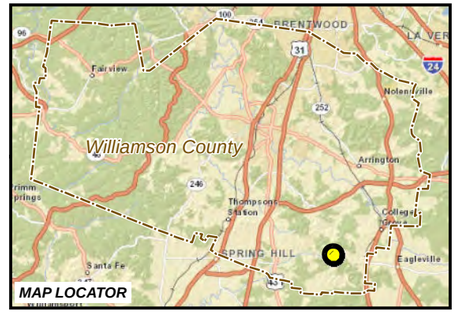
2014/2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 42
VSA SITE 17, RUTHERFORD CREEK AT PULLTIGHT HILL ROAD

TETRA TECH

Date: 3/17/2015 User: dale.vonbusch Path: L:\CADD\S\3287\01\002\mxd\Stream_visual_surveys_map_book.mxd





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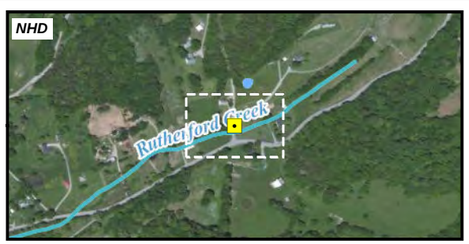
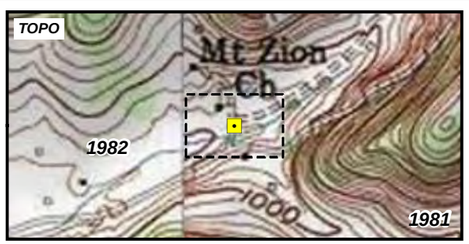
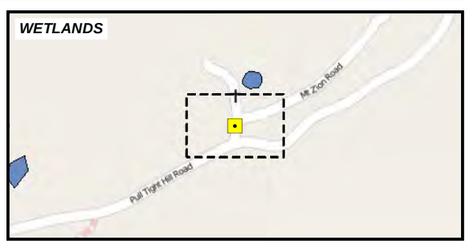
Map Sources:
ESRI Aerial Imagery 2010-2012, USGS Topographic 7.5 min Quadrangles, National Hydrology Dataset (NHD) 2015, National Wetlands Inventory, 2015.

LEGEND

- Visual Inspection Point
- 50-feet From Inspection Point





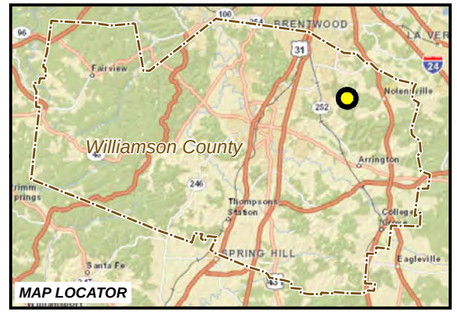


2014/2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 43
VSA SITE 18, RUTHERFORD CREEK AT MT ZION ROAD

TETRA TECH

Date: 3/17/2015 User: dale.vonbusch Path: L:\CADD\S\3287\01\002\mxd\Stream_visual_surveys_map_book.mxd



NOTES:

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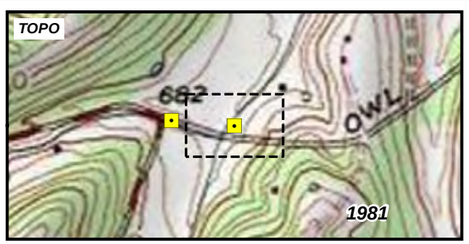
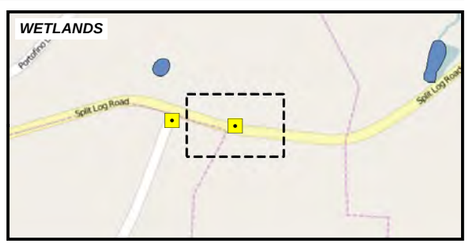
Map Sources:
ESRI Aerial Imagery 2010-2012, USGS Topographic 7.5 min Quadrangles, National Hydrology Dataset (NHD) 2015, National Wetlands Inventory, 2015.

LEGEND

- Visual Inspection Point
- 50-feet From Inspection Point



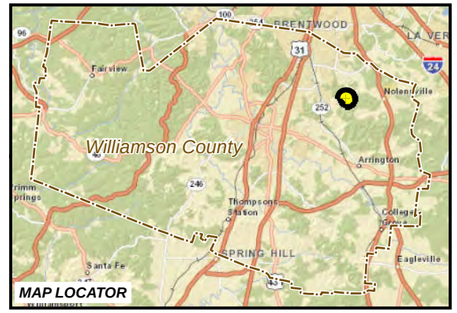


2014/2015 STREAM MONITORING REPORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 44
VSA SITE 19, OWL CREEK AT SPLIT LOG ROAD

TETRA TECH

Date: 9/14/2015 User: dale.vonbusch Path: L:\CADD\S\3287\01\002\mxd\Stream_visual_surveys_map_book_ONE_PAGE_FIX.mxd



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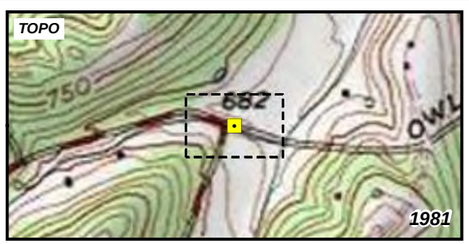
Map Sources:
ESRI Aerial Imagery 2010-2012, USGS Topographic 7.5 min Quadrangles, National Hydrology Dataset (NHD) 2015, National Wetlands Inventory, 2015.

LEGEND

- Visual Inspection Point
- 50-feet From Inspection Point



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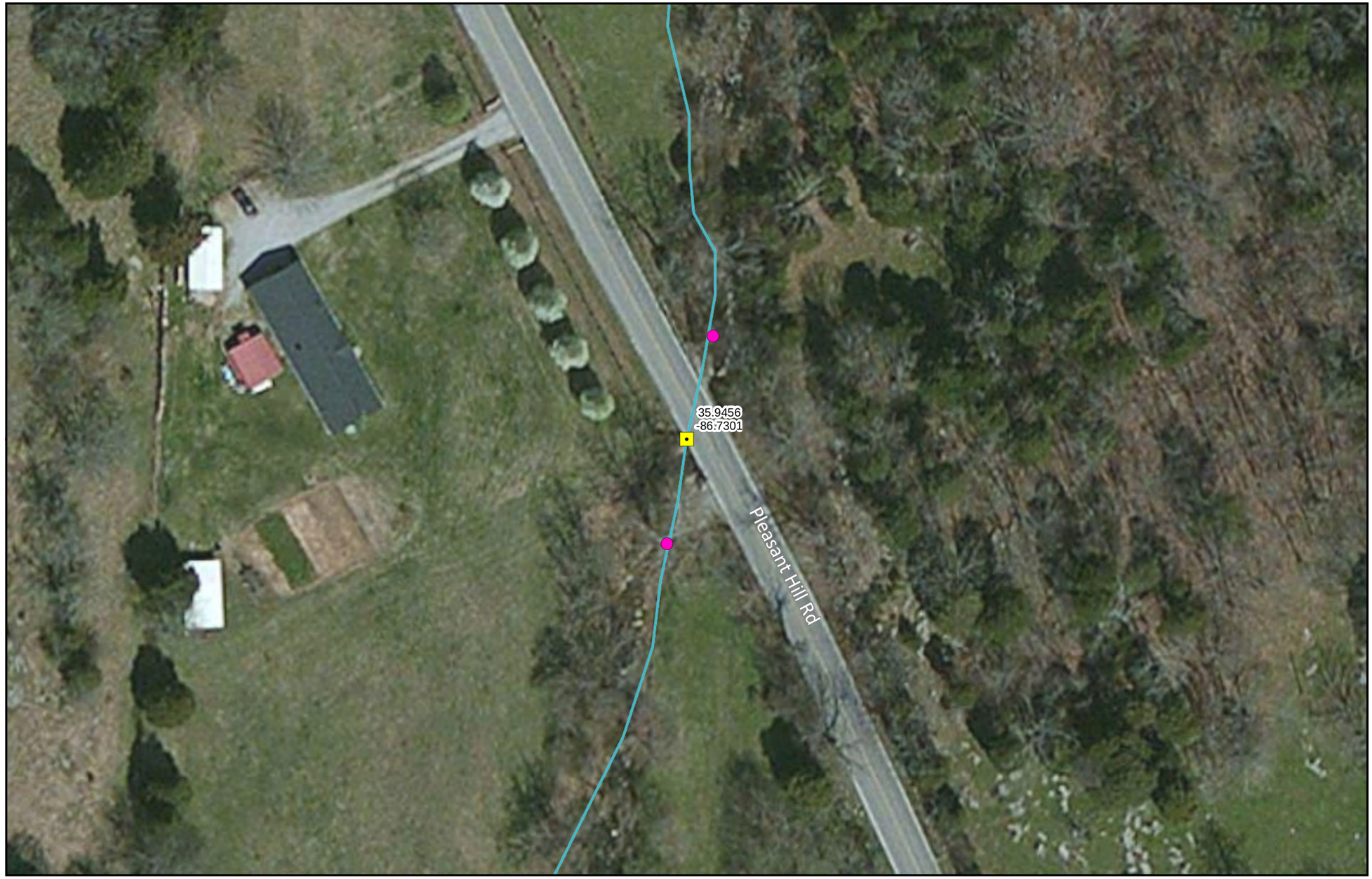
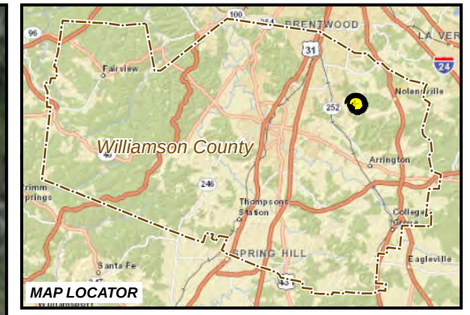
WILLIAMSON COUNTY, TENNESSEE

FIGURE 45
VSA SITE 20, OWL CREEK AT PLEASANT HILL ROAD AND SPLIT LOG ROAD

TETRA TECH

Date: 3/17/2015 User: dale.vonbusch Path: L:\CADD\S\3287\01\002\mxd\Stream_visual_surveys_map_book.mxd





NOTES:

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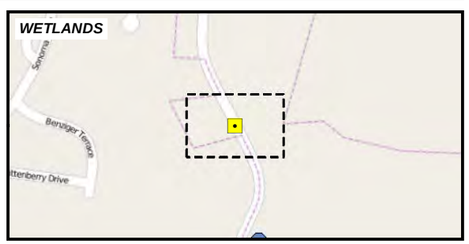
Feet

Map Sources:
ESRI Aerial Imagery 2010-2012, USGS Topographic 7.5 min Quadrangles, National Hydrology Dataset (NHD) 2015, National Wetlands Inventory, 2015.

LEGEND

- Visual Inspection Point
- 50-feet From Inspection Point

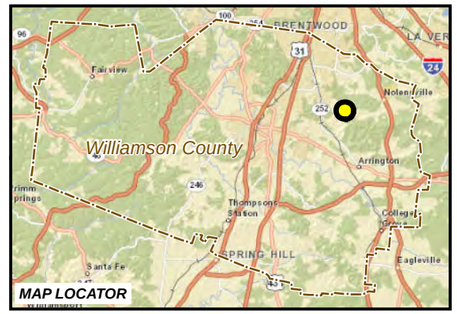


2014/2015 STREAM MONITORING RPEORT
WILLIAMSON COUNTY, TENNESSEE

FIGURE 46
VSA SITE 21, OWL CREEK AT
PLEASANT HILL ROAD

TETRA TECH

Date: 3/17/2015 User: dale.vonbusch Path: L:\CADD\S\3287\01\002\mxd\Stream_visual_surveys_map_book.mxd



NOTES:

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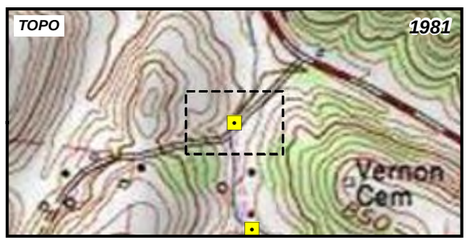
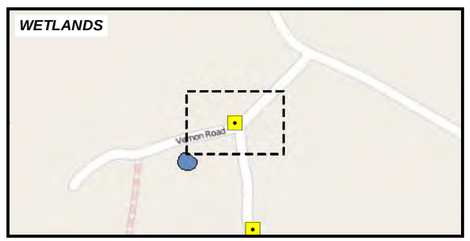
Map Sources:
ESRI Aerial Imagery 2010-2012, USGS Topographic 7.5 min Quadrangles, National Hydrology Dataset (NHD) 2015, National Wetlands Inventory, 2015.

LEGEND

- Visual Inspection Point
- 50-feet From Inspection Point





2014/2015 STREAM MONITORING REPORT
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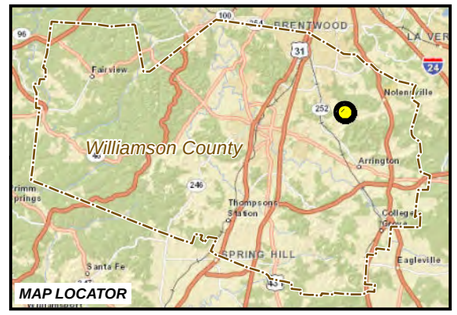
FIGURE 47
VSA SITE 22, OWL CREEK AT VERNON ROAD

TETRA TECH

Date: 3/17/2015 User: dale.vonbusch Path: L:\CADD\S\3287\01\002\mxd\Stream_visual_surveys_map_book.mxd



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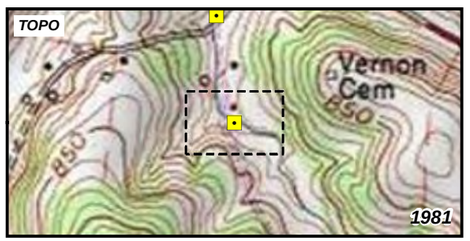
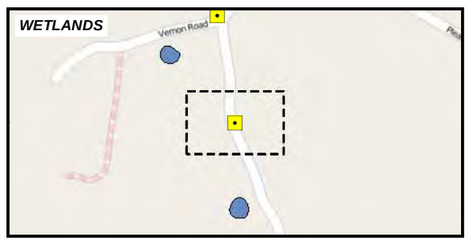
Map Sources:
ESRI Aerial Imagery 2010-2012, USGS Topographic 7.5 min Quadrangles, National Hydrology Dataset (NHD) 2015, National Wetlands Inventory, 2015.

LEGEND

- Visual Inspection Point
- 50-feet From Inspection Point





2014/2015 STREAM MONITORING REPORT
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FIGURE 48
VSA SITE 23, OWL CREEK AT WHISTLER COVE

TETRA TECH

Date: 3/17/2015 User: dale.vonbusch Path: L:\CADD\S\3287\01\002\mxd\Stream_visual_surveys_map_book.mxd

APPENDIX B – TABLES

TABLE 4: WATER QUALITY AND CHEMICAL SAMPLING RESULTS

Sample Reach Location		Harpeth at Sneed Road	Harpeth at Moran Road	Harpeth at Old Natchez Trace Road	Harpeth at Old Natchez Trace Road (Duplicate)	Harpeth at Old Hillsboro Road	Harpeth at Cotton Road	Harpeth at Arno Road	Little Harpeth at Vaughn Road	Little Harpeth at Hillsboro Road	Owl at Split Log Road	Rutherford at Old Bethesda Road	Rutherford at Cross Keys Road
Sampling Date		**6/18/2014**	**7/17/2014**	**7/17/2014**	**7/17/2014**	**7/17/2014**	**9/10/2014**	**9/10/2014**	**6/18/2014**	**7/11/2014**	**10/28/2014**	**10/27/2014**	**10/27/2014**
Analytical Paramater													
Laboratory Analysis (mg/L)	Ammonia Nitrogen as N	BDL	BDL	BDL	BDL	BDL	BDL	BDL	NS	NS	BDL	BDL	BDL
	Nitrate+Nitrite	1.2	0.45	0.54	0.55	0.68	0.81	0.42 (J+)	NS	NS	0.30	1.2	0.38
	Total Kjeldahl Nitrogen	BDL	BDL	0.30	0.26	0.33	0.45	0.48	NS	NS	BDL	BDL	BDL
	Total Phosphorus	0.41	0.37	0.38	0.38	0.42	0.65	0.43	NS	NS	0.47	0.30	0.29
	Suspended Residue	14.0	13.0	9.9	11.0	14.0	14.0	9.1	NS	NS	3.5	BDL	3.7
	Total Organic Carbon	1.8	2.9	2.8	2.8	2.6	2.7	2.5	NS	NS	2.3	1.5	2.1
	Dissolved Organic Carbon	1.8	2.2	2.3	2.2	2.2	2.4	2.4	NS	NS	NS	NS	NS
	$CBOD_5$	16.0 (J+)	BDL (J+)	BDL (J+)	BDL (J+)	BDL (J+)	BDL	BDL	NS	NS	NS	NS	NS
In-Situ/Field Meter	pH	8.01	7.82	7.85	NS	7.87	7.77	7.84	8.16	8.18	7.5	7.29	7.9
	Conductivity (mS/cm)	0.456	0.367	0.401	NS	0.434	0.515	0.430	0.552	0.562	0.427	0.297	0.28
	Temperature (Celcius)	24.24	23.15	23.2	NS	24.8	23.3	24.5	24.84	25.5	17.1	15.3	17.6
	Dissolved Oxygen (mg/L)	7.39	6.65	6.94	NS	8.47	6.11	7.48	9.66	10.09	8.2	9.15	10
	Turbidity (NTU)	14	9	10	NS	10.4	14	7.5	4	2.6	4.45	2.5	3.3

Notes:

Shaded results indicate a detection above the laboratory detection limit.

BDL = Below the laboratory detection limit

$CBOD_5$ = Carbonaceous Biochemical Oxygen Demand

J+ = A qualifier associated with the laboratory data that indicates a batch Quality Control was outside the upper control limits; associated data has a potential positive bias.

mg/L = Milligrams per liter

mS/cm = milliSiemens per cubic meter

NS = Not sampled

NTU = Nephelometric unit

TABLE 5A: BIOLGOICAL SAMPLING RESULTS - LITTLE HARPETH AT VAUGHN ROAD		
STATION NO: LHARP001.9WI	**STREAM:** Little Harpeth	**DRAINAGE AREA[1]:** 43
LOCATION: Vaughn Road	**ECOREGION:** 71h	**HUC NO:** TN05130204021 2000
WATERSHED GROUP: Harpeth River	**DATE SAMPLED:** 6.18.2014	**SAMPLE TYPE:** SQKICK
Total Number of Individuals in Sample = 225		
BIOMETRIC	**VALUE**	**CALIBRATED SCORE[2]**
Taxa Richness	26	4
EPT Richness	8	4
% OC	13.3	6
% EPT - Cheum	30.2	2
NCBI	5.28	4
% TNUTOL	56.4	2
% CLINGERS	60.9	6
	Total	**28**
TENNESSEE MACROINVERTEBRATE INDEX SCORE = 28/Fail[3]		

Notes:

1 Drainage Area of the sampling reach in square miles

2 Calculated using the scoring calibration values for Bioregions 71h, Drainage >2 square miles or≤2 square miles, 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, 2001 (Macroinvertebrate QSSOP), Appendix A.

3 A score of 32 or higher is considered to pass biocriteria guidelines in Ecorgeion 71h.

NO - Number

HUC - Hydrologic unit code

SQKICK - Semi-quantitative kick sample

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 - Cheum - EPT abundance excluding *Cheumatopsyche* spp.

NCBI - North Carolina Biotic Index

% TNUTOL - Percent Tennessee nutrient tolerant organisms

% CLINGERS - Percent clingers

TABLE 5B: BIOLOGICAL SAMPLING RESULTS - LITTLE HARPETH AT HILLSBORO ROAD		
STATION NUMBER: LHARP004.6WI	**STREAM:** Little Harpeth	**DRAINAGE AREA[1]:** 26
LOCATION: Hillsboro Road	**ECOREGION:** 71h	**HUC NO:** TN05130204021-2000
WATERSHED GROUP: Harpeth River	**DATE SAMPLED:** 7.11.2014	**SAMPLE TYPE:** SQKICK
Total Number of Individuals in Sample = 213		
METRIC	**VALUE**	**CALIBRATED SCORE[2]**
Taxa Richness	24	4
EPT Richness	9	4
% OC	22.1	6
% EPT - Cheum	20.7	2
NCBI	5.23	4
% TNUTOL	62.9	2
% CLINGERS	63.4	6
	Total	**28**
TENNESSEE MACROINVERTEBRATE INDEX SCORE = 28/Fail[3]		

Notes:

1 Drainage Area of the sampling reach in square miles

2 Calculated using the scoring calibration values for Bioregions 71h, Drainage >2 square miles or≤2 square miles, 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, 2001 (Macroinvertebrate QSSOP), Appendix A.

3 A score of 32 or higher is considered to pass biocriteria guidelines in Ecorgeion 71h.

NO - Number

HUC - Hydrologic unit code

SQKICK - Semi-quantitative kick sample

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 - Cheum - EPT abundance excluding *Cheumatopsyche* spp.

NCBI - North Carolina Biotic Index

% TNUTOL - Percent Tennessee nutrient tolerant organisms

% CLINGERS - Percent clingers

TABLE 5C: BIOLOGICAL SAMPLING RESULTS - OWL CREEK AT SPLIT LOG ROAD		
STATION NO: OWL004.78	**STREAM:** Owl Creek	**DRAINAGE AREA[1]:** 1.22
LOCATION: Split Log Road	**ECOREGION:** 71h	**HUC NO:** TN05130202007-0900
WATERSHED GROUP: Cheatam Reservoir	**DATE SAMPLED:** 10.28.2014	**SAMPLE TYPE:** SQKICK
Total Number of Individuals in Sample = 183		
METRIC	**VALUE**	**CALIBRATED SCORE[2]**
Taxa Richness	14	2
EPT Richness	6	2
% OC	2.2	6
% EPT - Cheum	8.2	0
NCBI	7.31	2
% TNUTOL	79.8	2
% CLINGERS	8.7	0
	Total	**14**
TENNESSEE MACROINVERTEBRATE INDEX SCORE = 14/Fail[3]		

Notes:

1 Drainage Area of the sampling reach in square miles

2 Calculated using the scoring calibration values for Bioregions 71h, Drainage >2 square miles or≤2 square miles, 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, 2001 (Macroinvertebrate QSSOP), Appendix A.

3 A score of 32 or higher is considered to pass biocriteria guidelines in Ecorgeion 71h.

NO - Number

HUC - Hydrologic unit code

SQKICK - Semi-quantitative kick sample

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 - Cheum - EPT abundance excluding *Cheumatopsyche* spp.

NCBI - North Carolina Biotic Index

% TNUTOL - Percent Tennessee nutrient tolerant organisms

% CLINGERS - Percent clingers

TABLE 5D: BIOLOGICAL SAMPLING RESULTS - RUTHERFORD CREEK AT BETHESDA ROAD		
STATION NUMBER: RUTHE026.7WI	**STREAM:** Rutherford Creek	**DRAINAGE AREA[1]:** 8.6
LOCATION: Old Bethesda Road	**ECOREGION:** 71h	**HUC NO:** TN06040003034-3000
WATERSHED GROUP: Duck River	**DATE SAMPLED:** 10.27.2014	**SAMPLE TYPE:** SQKICK
Total Number of Individuals in Sample = 243		
METRIC	**VALUE**	**CALIBRATED SCORE[2]**
Taxa Richness	26	4
EPT Richness	11	6
% OC	36.2	4
% EPT - Cheum	47.3	4
NCBI	4.02	6
% TNUTOL	18.1	6
% CLINGERS	20.6	2
	Total	32
TENNESSEE MACROINVERTEBRATE INDEX SCORE = 32/Pass[3]		

Notes:

1 Drainage Area of the sampling reach in square miles

2 Calculated using the scoring calibration values for Bioregions 71h, Drainage >2 square miles or≤2 square miles, 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, 2001 (Macroinvertebrate QSSOP), Appendix A.

3 A score of 32 or higher is considered to pass biocriteria guidelines in Ecorgeion 71h.

NO - Number

SQKICK - Semi-quantitative kick sample

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 - Cheum - EPT abundance excluding *Cheumatopsyche* spp.

NCBI - North Carolina Biotic Index

% TNUTOL - Percent Tennessee nutrient tolerant organisms

% CLINGERS - Percent clingers

TABLE 5E: BIOLOGICAL SAMPLING RESULTS - RUTHERFORD CREEK AT CROSS KEYS ROAD		
STATION NUMBER: RUTHE028.6WI	**STREAM:** Rutherford Creek	**DRAINAGE AREA[1]:** 28.6
LOCATION: Cross Keys Road	**ECOREGION:** 71h	**HUC NO:** TN06040003034-3000
WATERSHED GROUP: Duck River	**DATE SAMPLED:** 10.27.2014	**SAMPLE TYPE:** SQKICK
Total Number of Individuals in Sample = 213		
METRIC	**VALUE**	**CALIBRATED SCORE[2]**
Taxa Richness	23	4
EPT Richness	12	6
% OC	4.7	6
% EPT - Cheum	30	2
NCBI	5.86	4
% TNUTOL	50.2	4
% CLINGERS	23.0	2
	Total	28
TENNESSEE MACROINVERTEBRATE INDEX SCORE = 28/Fail[3]		

Notes:

1 Drainage Area of the sampling reach in square miles

2 Calculated using the scoring calibration values for Bioregions 71h, Drainage >2 square miles or≤2 square miles, 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, 2001 (Macroinvertebrate QSSOP), Appendix A.

3 A score of 32 or higher is considered to pass biocriteria guidelines in Ecorgeion 71h.

4 Habitat Assessment Categories for Bioregion 71h, High Gradient Form, January through December, as found in the Macroinvertebrate QSSOP, Table 2. For Ecoregion 71h, a habitat assessment score of ≥127 for streams with a >2 square mile drainage area, and a habitat assessment score of ≥132 for a headwater stream with a ≤2 square mile drainage area are considered capable of supporting a healthy benthic community (not impaired).

NO - Number

SQKICK - Semi-quantitative kick sample

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 - Cheum - EPT abundance excluding *Cheumatopsyche* spp.

NCBI - North Carolina Biotic Index

% TNUTOL - Percent Tennessee nutrient tolerant organisms

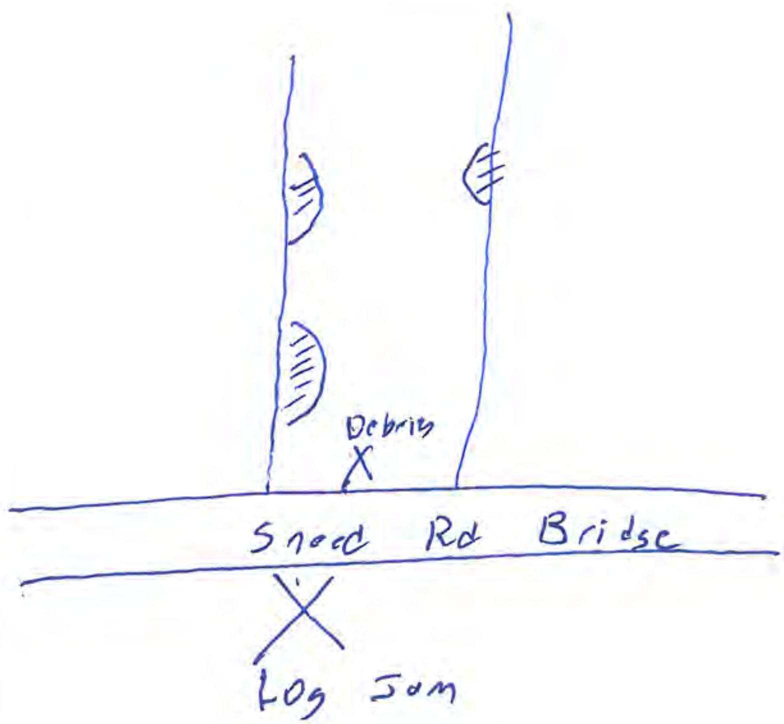
% CLINGERS - Percent clingers

APPENDIX C – FIELD DATA SHEETS

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Harpeth	LOCATION Sneed Rd
STATION # 1 ~~065.6~~ RIVERMILE 65.6	STREAM CLASS 71h
LAT 36.0241 LONG -86.9238	RIVER BASIN Harpeth
STORET # HARPE065.6WI	AGENCY Williamson County
INVESTIGATORS Amy Tolley, Michael Scott, Rich Hanson	
FORM COMPLETED BY MS/AT	DATE 6/18/14 TIME 11:00 AM ☒ PM — REASON FOR SURVEY Sampling

WEATHER CONDITIONS	**Now** / **Past 24 hours** ☐ / ☐ storm (heavy rain) ☐ / ☐ rain (steady rain) ☐ / ☐ showers (intermittent) 50 %☐ / ☐ 50% %cloud cover ☒ / ☒ clear/sunny **Has there been a heavy rain in the last 7 days?** ☒ Yes ☐ No **Air Temperature** 87 °F **Other** ______
SITE LOCATION/MAP	**Draw a map of the site and indicate the areas sampled (or attach a photograph)**



STREAM CHARACTERIZATION	**Stream Subsystem** ☒ Perennial ☐ Intermittent ☐ Tidal **Stream Type** ☐ Coldwater ☒ Warmwater **Stream Origin** ☐ Glacial ☐ Non-glacial montane ☐ Swamp and bog ☐ Spring-fed ☒ Mixture of origins ☐ Other ______ **Catchment Area** 932 km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

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

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

Local Watershed Erosion
☐ None ☒ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☒ Trees ☒ Shrubs ☐ Grasses ☐ Herbaceous
dominant species present mixture of hardwood & Shrubs

INSTREAM FEATURES

Estimated Reach Length 90 m ft.
Estimated Stream Width 115 m ft.
Sampling Reach Area 952 m² 10,350 ft²
Area in km² (m²x1000) 0.962 km²
Estimated Stream Depth 3.6 m ft.
Surface Velocity (at thalweg) 2.5 ~~m/sec~~ ft/sec

Canopy Cover
☒ Partly open ☐ Partly shaded ☐ Shaded

High Water Mark 1.6 m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle ___ % ☒ Run 25 %
☒ Pool 75 %

Channelized ☒ Yes ☐ No
Dam Present ☐ Yes ☒ No

LARGE WOODY DEBRIS

LWD n/a m²
Density of LWD n/a m²/km² (LWD/ reach area)

→ large log jam above bridge

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☒ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☒ Attached Algae
dominant species present Water willow
Portion of the reach with aquatic vegetation 5 %

WATER QUALITY

Site #1

Temperature 24.24° C
Specific Conductance 0.456 MS/CM
Dissolved Oxygen 88.5% 7.39 mg/L
pH 8.01
Turbidity 14 ntu
WQ Instrument Used YSI 556

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

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

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

SEDIMENT/ SUBSTRATE

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

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits None
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other _____

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

Cannot see stream bottom

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock		5	Detritus	sticks, wood, coarse plant materials (CPOM)	10
Boulder	> 256 mm (10")	30			
Cobble	64-256 mm (2.5"-10")	30	Muck-Mud	black, very fine organic (FPOM)	5
Gravel	2-64 mm (0.1"-2.5")	10			
Sand	0.06-2mm (gritty)	10	Marl	grey, shell fragments	0
Silt	0.004-0.06 mm	10			
Clay	< 0.004 mm (slick)	5			

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

STREAM NAME	Harpeth River	LOCATION	Sneed Rd.
STATION #	CRS 6W	RIVERMILE	65.6
LAT	36.0291	LONG	-86.9238
STORET #	HARPE065.6W1	AGENCY	Williamson County
INVESTIGATORS	Amy Talley, Michael Scott, Rich Hanson		
FORM COMPLETED BY	MS	DATE / TIME	6/18/14 11:00 AM (PM)
REASON FOR SURVEY	Sampling		

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 15	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 15	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 8	20 19 18 17 16	15 14 13 12 11	10 9 (8) 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 13	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 18	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

High water conditions

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

Parameters to be evaluated broader than sampling reach

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

Total Score 115

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME LHARP001.4WI	LOCATION Little Harpeth @ Vaughn Rd
STATION # 1 RIVERMILE 1.9	STREAM CLASS 7/h
LAT 35.0485 LONG -86.9034	RIVER BASIN Harpeth
~~STORET#~~ LHARP001.4W1	AGENCY Williamson Co.
INVESTIGATORS Amy Talley, Michael Scott, Rich Hanson	
FORM COMPLETED BY AFT / MS	DATE 6-18-14 TIME 1:00 AM (PM)
REASON FOR SURVEY Sampling	

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
60 % ☐	%cloud cover	☐ 50 %
☒	clear/sunny	☒

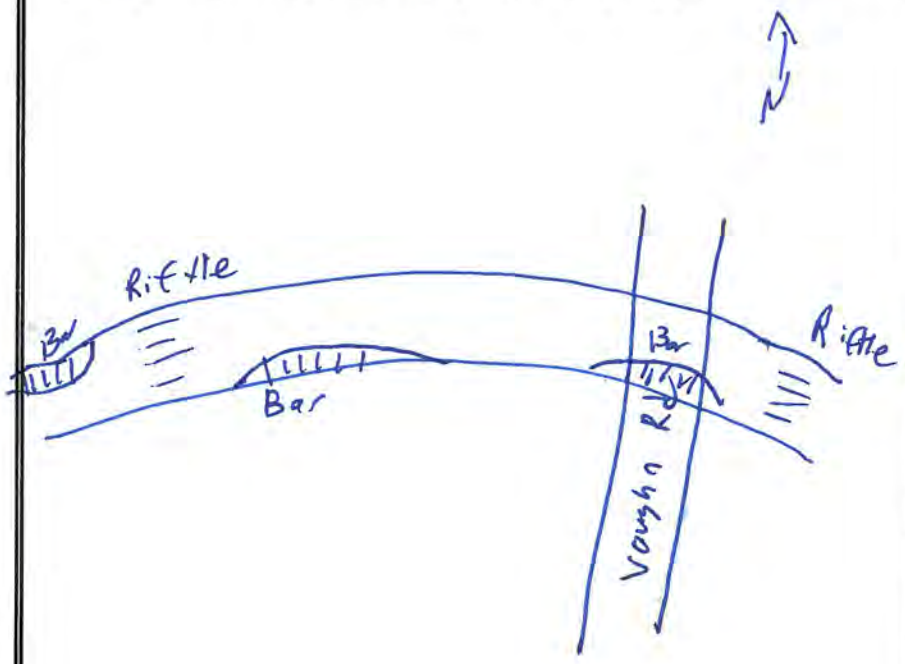
Has there been a heavy rain in the last 7 days? ☒ Yes ☐ No

Air Temperature 91 °C

Other _____

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☒ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☒ Mixture of origins
☐ Other _____

Catchment Area 12.9 km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☐ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☒ Other Warner Park
☐ Residential

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

Local Watershed Erosion
☒ None ☐ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

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

dominant species present Variety

INSTREAM FEATURES

Estimated Reach Length 133 m
Estimated Stream Width 12 m
Sampling Reach Area 1596 m²
Area in km² (m²x1000) 1.6 km²
Estimated Stream Depth 0.5 m
Surface Velocity (at thalweg) ~~m/sec~~ 0.3 ft/sec

Canopy Cover
☐ Partly open ☐ Partly shaded ☒ Shaded

High Water Mark 0.8 m

Proportion of Reach Represented by Stream Morphology Types
☒ Riffle 15 % ☒ Run 10 %
☒ Pool 80 %

Channelized ☐ Yes ☒ No

Dam Present ☐ Yes ☒ No

LARGE WOODY DEBRIS

LWD 84 m²
Density of LWD 2.5 m²/km² (LWD/ reach area)

AQUATIC VEGETATION

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

dominant species present N/A

Portion of the reach with aquatic vegetation N/A %

WATER QUALITY

Temperature 24.84 ° C
Specific Conductance 0.552 MS/CM
Dissolved Oxygen 116% 9.66 mg/L
pH 8.16
Turbidity 4 ntu
WQ Instrument Used YSI 556

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

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

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

SEDIMENT/ SUBSTRATE

Odors 1.
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits None
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other

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

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	10 %
Boulder	> 256 mm (10")	10			
Cobble	64-256 mm (2.5"-10")	20	Muck-Mud	black, very fine organic (FPOM)	0
Gravel	2-64 mm (0.1"-2.5")	30			
Sand	0.06-2mm (gritty)	10	Marl	grey, shell fragments	0
Silt	0.004-0.06 mm	30			
Clay	< 0.004 mm (slick)				

STREAM SURVEY FORM

STREAM SURVEY INFORMATION

STATION NUMBER:	11412p0001.9 WI	ASSESSORS:	MS/AT/RM
STREAM NAME:	Little Harpeth	DATE:	6/18/14
STATION LOCATION:	Vaughn Rd	TIME:	1:35
COUNTY:	Williamson	STREAM MILE:	1.9
WBID#/HUC:	TN 05130204 0501	STREAM ORDER:	4
WATERSHED GROUP #	Harpeth	DRAINAGE AREA	~ 43 mi2
LATITUDE DEC/DEG	36.0486 / 36.0495	ELEVATION (ft):	581
LONGITUDE DEC/DEG	-86.9034 -86.9049	GAZETTEER PAGE	53
ECOLOGICAL SUBREGION:	71h	USGS QUAD	Bethesda TN
PROJECT/PURPOSE:	Samples		

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 556

pH	8.16 SU	DISSOLVED OXYGEN	9.66 PPM
CONDUCTIVITY	See other Sheet UMHOS	TIME	1:00 Dm
TEMPERATURE	24.84 °C	OTHERS	

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

Ambient Weather: (SUNNY) CLOUDY BREEZY RAIN SNOW AIR TEMP 93°

WATERSHED CHARACTERISTICS

App. % of watershed observed: 90

UPSTREAM SURROUNDING LAND USE: (estimated %)

PASTURE	25%	URBAN	—	RESID	25%	50%
CROPS	—	INDUSTRY	—	OTHER	Park	
FOREST	—	MINING	—			

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

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

PHYSICAL STREAM CHARACTERISTICS

LENGTH OF STREAM AREA ASSESSED (m): 133

SURROUNDING LAND USE:

ESTIMATE %	RDB	LDB		RDB	LDB		RDB	LDB
PASTURE	50	50	URBAN	—	—	RESID	25	25
CROPS	—	—	INDUSTRY	—	—	OTHER	—	—
FOREST	25	25	MINING	—	—			

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

Measured: _____ U/S_____ D/S_____ LB_____ RB_____

BANK HEIGHT (m): 2 HIGH WATER MARK (m): 0.8

SEDIMENT DEPOSITS: NONE SLIGHT MODERATE (EXCESSIVE) BLANKET

TYPE: SLUDGE MUD SAND (SILT) NONE OTHER_____ Contaminated Y or (N) E-coli

TURBIDITY CLEAR SLIGHT (MODERATE) HIGH OPAQUE

ALGAE PRESENT? NONE (SLIGHT) MODERATE CHOKING TYPE _____

AQUATIC VEGET. (ROOTED) FLOATING TYPE _____

ADDITIONAL COMMENTS: (oil sheen, odor, colors) Very silty

STREAM SURVEY FORM

PHYSICAL STREAM CHARACTERISTICS (cont.)

	RIFFLE	RUN	POOL
DEPTH (m)	0.2	0.5	0.7
WIDTH (m)	25	15	10
REACH LENGTH (m)	15	50	20

Staff Gauge/Bench Ht: 0.8
VELOCITY (FS): 0.3
FLOW (CFS): 2.3
HABITAT ASSESSMENT SCORE #:
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 substate (%)

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	[illegible]	51-60
2.0-64.0	gravel	[illegible]	61-70
64-256	cobble	[illegible]	71-80
256-4096	boulder	[illegible]	81-90
---	bedrock	bdrx	91-100
---	woody debris	wood	

SUBSTRATE (%) (Visual estimates)

	RIFFLE	RUN	POOL		RIFFLE	RUN	POOL
BOULDER (> 10")	65 %	70 %	%	CLAY (slick)	%	%	80 %
COBBLE (2.5-10")	30 %	10 %	%	SILT	* %	10 %	50 %
GRAVEL (0.1-2.5")	10 %	10 %	5 %	DETRITUS (CPOM)	%	%	%
BEDROCK	%	%	35 %	MUCK-MUD (FPOM)	%	%	%
SAND (gritty)	5 %	%	%	MARL (shell frags.)	%	%	%

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?	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.) See Physical Characteristics Sheet

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

STREAM NAME	Little Harpeth	LOCATION	Williamson County
STATION #	001.9WI	RIVERMILE	1.9
STREAM CLASS	71 h		
LAT	36.0485	LONG	-86.9034
RIVER BASIN	Harpeth		
~~STORET~~ #	LHARP01.9WI	AGENCY	Williamson County
INVESTIGATORS	Michael Scott, Amy Talley, Rich Mason		
FORM COMPLETED BY	MS	DATE / TIME	6/16/14 1:00 AM (PM)
REASON FOR SURVEY	Sampling		

	Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
Parameters to be evaluated in sampling reach	1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	SCORE 10	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
	2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
	SCORE 13	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0
	3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
	SCORE 14	20 19 18 17 16	15 (14) 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	SCORE 10	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
	5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	SCORE 15	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

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

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 18	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 11	20 19 18 17 16	15 14 13 12 (11)	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 9 (LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 (9)	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 10 (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 8 (LB)	Left Bank 10 9	(8) 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	(8) 7 6	5 4 3	2 1 0

Total Score 145

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

LHARP004.6W1

STREAM NAME Little Harpeth	LOCATION Williamson @ Hillsboro Rd		
STATION # LHARP RIVERMILE 4.6	STREAM CLASS 7/4		
LAT 36.0432 LONG -86.8658	RIVER BASIN Harpeth		
~~STORET #~~ LHARP004.6W1	AGENCY Williamson County		
INVESTIGATORS Michael Scott, Nich Manson			
FORM COMPLETED BY Michael Scott	DATE 7/11/14 TIME 11:00 AM PM	REASON FOR SURVEY Sampling	

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
10 %	%cloud cover	☑ 10 %
☐	clear/sunny	☐

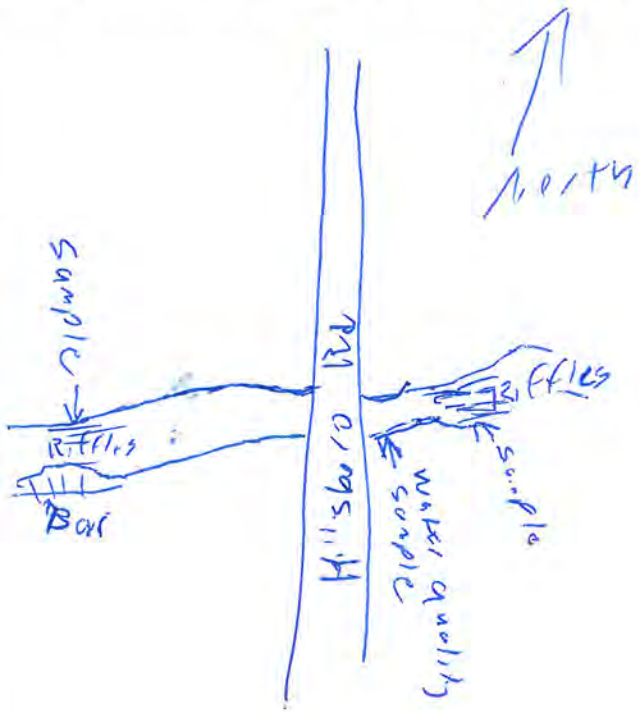
Has there been a heavy rain in the last 7 days? ☐ Yes ☒ No

Air Temperature 89 °F

Other _____

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☒ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☒ Mixture of origins
☐ Other _____

Catchment Area 70.4 km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

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

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

Local Watershed Erosion
☒ None ☐ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

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

dominant species present Invasives

INSTREAM FEATURES

Estimated Reach Length 141 m
Estimated Stream Width 10.4 m
Sampling Reach Area 1400 m²
Area in km² (m²x1000) 1.4 km²
Estimated Stream Depth 0.42 m
Surface Velocity (at thalweg) 0.3 m/sec

Canopy Cover
☒ Partly open ☐ Partly shaded ☐ Shaded

High Water Mark 0.60 m

Proportion of Reach Represented by Stream Morphology Types
☒ Riffle 25 % ☒ Run 25 %
☐ Pool 50 %

Channelized ☒ Yes ☐ No

Dam Present ☐ Yes ☒ No

LARGE WOODY DEBRIS

LWD 0 m²
Density of LWD N/A m²/km² **(LWD/ reach area)**

AQUATIC VEGETATION

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

dominant species present waterweed

Portion of the reach with aquatic vegetation 10 %

WATER QUALITY

Temperature 25.5 °C
Specific Conductance 0.562 mS/cm
Dissolved Oxygen 123% / 10.09 mg/L
pH 8.18
Turbidity 2.6 NTU
WQ Instrument Used YSI 556

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

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

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

SEDIMENT/ SUBSTRATE

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

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

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

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

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock		25	Detritus	sticks, wood, coarse plant materials (CPOM)	0
Boulder	> 256 mm (10")	50			
Cobble	64-256 mm (2.5"-10")		Muck-Mud	black, very fine organic (FPOM)	0
Gravel	2-64 mm (0.1"-2.5")	15			
Sand	0.06-2mm (gritty)		Marl	grey, shell fragments	0
Silt	0.004-0.06 mm	10			
Clay	< 0.004 mm (slick)				

STREAM SURVEY FORM

STREAM SURVEY INFORMATION

STATION NUMBER:	LMARP004.6W1	ASSESSORS:	MS/MH
STREAM NAME:	Little Harpeth	DATE:	7/11/14
STATION LOCATION:	Hillsboro Rd	TIME:	11:30
COUNTY:	Williamson	STREAM MILE:	4.6
WBID#/HUC:	05130204060 01	STREAM ORDER:	4
WATERSHED GROUP #	Harpeth	DRAINAGE AREA	26 mi2
LATITUDE DEC/DEG	36.0432 / 36.0478	ELEVATION (ft):	592 ft
LONGITUDE DEC/DEG	-86.8658 / -86.8677	GAZETTEER PAGE	53
ECOLOGICAL SUBREGION:	71h	USGS QUAD	Oak Hill
PROJECT/PURPOSE:	Sampling		

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 556

pH	8.18 SU	DISSOLVED OXYGEN	10.09 PPM
CONDUCTIVITY	0.552 mS/cm UMHOS	TIME	11:00 AM
TEMPERATURE	25.5 °C	OTHERS	

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

Ambient Weather: (SUNNY) CLOUDY BREEZY RAIN SNOW AIR TEMP 89° F

WATERSHED CHARACTERISTICS

App. % of watershed observed: 1%

UPSTREAM SURROUNDING LAND USE: (estimated %)

PASTURE		URBAN		RESID	75%
CROPS		INDUSTRY		OTHER	
FOREST	25%	MINING			

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

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

PHYSICAL STREAM CHARACTERISTICS

LENGTH OF STREAM AREA ASSESSED (m): 141 M

SURROUNDING LAND USE:

ESTIMATE %	RDB	LDB		RDB	LDB		RDB	LDB
PASTURE			URBAN			RESID	75%	75%
CROPS			INDUSTRY			OTHER		
FOREST	25%	25%	MINING					

% CANOPY COVER: Estimated: 5% (Open(0-10)) Partly Shaded(11-45) Mostly Shaded(46-80) Shaded(>80)

Measured: _____ U/S_____ D/S_____ LB_____ RB_____

BANK HEIGHT (m) HIGH WATER MARK (m)

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)	0.12	.15	0.33
WIDTH (m)	7.3	10.7	10.05
REACH LENGTH (m)	18-24	9.14	6.4

Staff Gauge/Bench Ht: 2 ft
VELOCITY (FS)
FLOW (CFS) 17[illegible]5
HABITAT ASSESSMENT SCORE #
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 substate (%)

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		RIFFLE	RUN	POOL
BOULDER (> 10")	%	50 %	35 %	CLAY (slick)	%	%	%
COBBLE (2.5-10")	10 %	50 %	35 %	SILT	%	%	10 %
GRAVEL (0.1-2.5")	%	%	20 %	DETRITUS (CPOM)	%	%	%
BEDROCK	90 %	%	10 %	MUCK-MUD (FPOM)	%	%	%
SAND (gritty)	%	%	%	MARL (shell frags.)	%	%	%

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?	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.)

See Physical Characteristics Sheet

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

STREAM NAME Little Harpeth	LOCATION Williamson County / Millsboro Rd.
STATION #004.6W1 RIVERMILE 4.6	STREAM CLASS 7/h
LAT 36.0432 LONG -86.9658	RIVER BASIN Harpeth
~~STORET#~~ HARP004.6W1	AGENCY Williamson County
INVESTIGATORS Michael Scott / Rich Hanson	
FORM COMPLETED BY MS	DATE 7/11/14 TIME 12:00 AM (PM) / REASON FOR SURVEY Sampling

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 13	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 13	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 13	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 17	20 19 18 (17) 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 15	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

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

Parameters to be evaluated broader than sampling reach

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

Total Score 124

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Harpeth	LOCATION off Natchez Trace Rd
STATION # 3 RIVERMILE 72.4	STREAM CLASS 71h
LAT 36.0084 LONG -86.9303	RIVER BASIN Harpeth
STORET # HARPE072.4WI	AGENCY Williamson County
INVESTIGATORS Michael Smith / Rich Hanson	
FORM COMPLETED BY	DATE 7/17/12 TIME 12:00 AM (PM)
	REASON FOR SURVEY Sampling

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
☐ %	%cloud cover	☐ %
☒	clear/sunny	☒

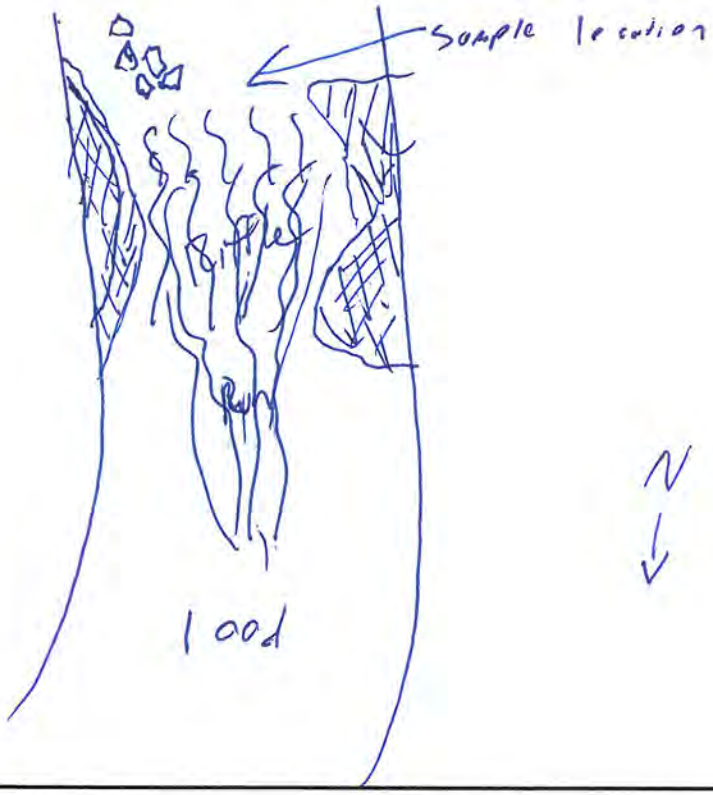
Has there been a heavy rain in the last 7 days? ☑ Yes ☐ No

Air Temperature 81 °F

Other 0.9" 3 days prior

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☒ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☒ Mixture of origins
☐ Other_____

Catchment Area 901 km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

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

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

Local Watershed Erosion
☐ None ☒ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

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

dominant species present Oak / Hickory / Maple

INSTREAM FEATURES

Estimated Reach Length 61 m 200'
Estimated Stream Width 27 m 87'
Sampling Reach Area 1,647 m²
Area in km² (m²x1000) 1.647 km²
Estimated Stream Depth 0.3 m 1'
Surface Velocity (at thalweg) 0.61 m/sec 1 AVG 2 Thalweg

Canopy Cover
☐ Partly open ☒ Partly shaded ☐ Shaded

High Water Mark 0.61 m 2'

Proportion of Reach Represented by Stream Morphology Types
☒ Riffle 15 % ☒ Run 40 %
☐ Pool 50 %

Channelized ☐ Yes ☒ No

Dam Present ☐ Yes ☒ No

LARGE WOODY DEBRIS

LWD 1 m²
Density of LWD 0.61 m²/km² (LWD/ reach area)

AQUATIC VEGETATION

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

dominant species present Water willow

Portion of the reach with aquatic vegetation 25%

WATER QUALITY

Temperature 23.2° C
Specific Conductance 0.401 mS/cm
Dissolved Oxygen 81.3% 6.94 mg/L
pH 7.85
Turbidity 10 NTU
WQ Instrument Used YSI 556

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

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

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

SEDIMENT/ SUBSTRATE

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

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits none
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other _____

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

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	
Boulder	> 256 mm (10")				
Cobble	64-256 mm (2.5"-10")	50%	Muck-Mud	black, very fine organic (FPOM)	
Gravel	2-64 mm (0.1"-2.5")	40%			
Sand	0.06-2mm (gritty)		Marl	grey, shell fragments	
Silt	0.004-0.06 mm	10%			
Clay	< 0.004 mm (slick)				

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

STREAM NAME	Harpeth	LOCATION	Off Old Natchez Trace Rd
STATION #	3	RIVERMILE	72.4
STREAM CLASS			TL
LAT	36.0084	LONG	-86.9303
RIVER BASIN			Harpeth
STORET #	HARPE072.4W1	AGENCY	Williamson County
INVESTIGATORS	Michael Scott / Rich Mansen		
FORM COMPLETED BY	Rich Mansen	DATE / TIME	7/17/14 1238 AM PM
REASON FOR SURVEY			Sampling

Parameters to be evaluated in sampling reach	Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
	1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	SCORE 15	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
	SCORE 17	20 19 18 (17) 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
	SCORE 16	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	SCORE 14	20 19 18 17 16	15 (14) 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	SCORE 13	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0

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

Parameters to be evaluated broader than sampling reach

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

Total Score 151

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Harpeth River	LOCATION @ Moran Rd.
STATION # 2 RIVERMILE 68.3	STREAM CLASS 71h
LAT 36.0173 LONG -86.9001	RIVER BASIN Harpeth
~~STORET#~~ HARPE068.3W1	AGENCY Williamson County
INVESTIGATORS Michael Scott / Rich Monson	
FORM COMPLETED BY [signature]	DATE 7/17/14 TIME 9:30 (AM) PM / REASON FOR SURVEY Sampling

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
___% ☐	%cloud cover	☐ ___%
☒	clear/sunny	☒

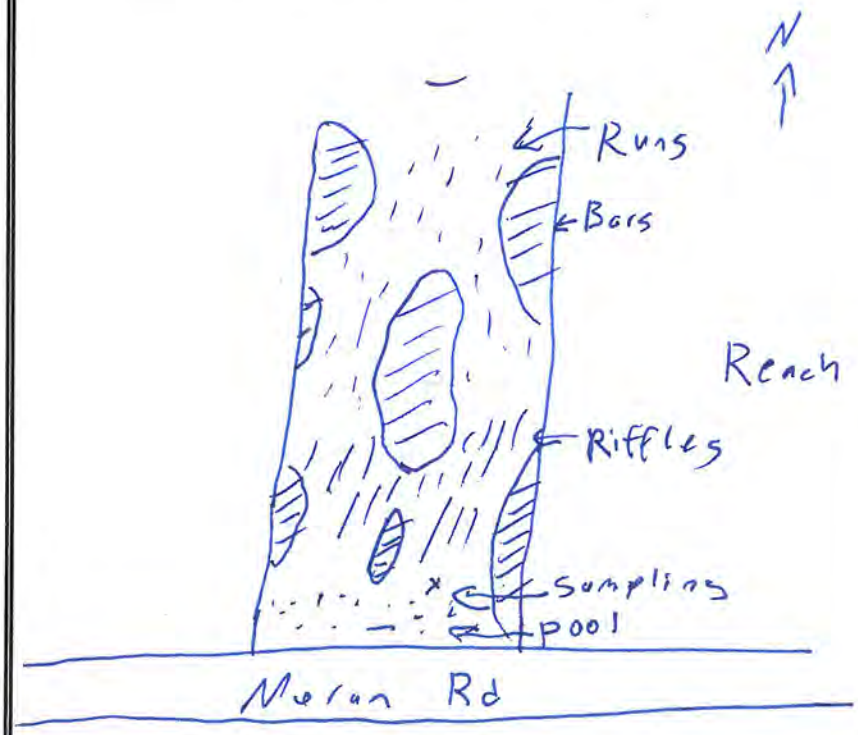
Has there been a heavy rain in the last 7 days? ☒ Yes ☐ No

Air Temperature 80 °F

Other 0.9" 3 days prior

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☒ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☒ Mixture of origins
☐ Other_____

Catchment Area 924 km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

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

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

Local Watershed Erosion
☐ None ☒ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

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

dominant species present Grass / Corn

INSTREAM FEATURES

Estimated Reach Length 110 m 362 ft
Estimated Stream Width 26 m 84 ft
Sampling Reach Area 2,860 m²
Area in km² (m²x1000) 2.860 km²
Estimated Stream Depth 1 m 2'-4'
Surface Velocity (at thalweg) 1.1 m/sec 3.7 ft/s 1.3 ft/s average

Canopy Cover
☐ Partly open ☒ Partly shaded ☐ Shaded

High Water Mark 1.8 m 6'

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle 25 % ☒ Run 50 %
☐ Pool 25 %

Channelized ☐ Yes ☒ No
Dam Present ☐ Yes ☒ No

LARGE WOODY DEBRIS

LWD 3 m²
Density of LWD 1 m²/km² (LWD/ reach area)

AQUATIC VEGETATION

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

dominant species present Water willow

Portion of the reach with aquatic vegetation 40 %

WATER QUALITY

Temperature 23.1 °C
Specific Conductance 0.367 mS/cm
Dissolved Oxygen 77.8% 6.65 mg/L
pH 7.82
Turbidity 9 NTU
WQ Instrument Used YSI 556

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

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

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

SEDIMENT/ SUBSTRATE

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

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits None
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other _____

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

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock		15	Detritus	sticks, wood, coarse plant materials (CPOM)	5
Boulder	> 256 mm (10")	25			
Cobble	64-256 mm (2.5"-10")	25	Muck-Mud	black, very fine organic (FPOM)	5
Gravel	2-64 mm (0.1"-2.5")	20			
Sand	0.06-2mm (gritty)		Marl	grey, shell fragments	
Silt	0.004-0.06 mm	5			
Clay	< 0.004 mm (slick)				

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

STREAM NAME Harpeth		LOCATION @ Moran Rd.	
STATION # 2	RIVERMILE 68.3	STREAM CLASS TL	
LAT 36.0173	LONG -86.9001	RIVER BASIN Harpeth	
STORET # HARPE068.3 WI		AGENCY Williamson County	
INVESTIGATORS Michael Scott / Rich Hanson			
FORM COMPLETED BY MMS	DATE 7/17/14 TIME 11:00 AM (PM)	REASON FOR SURVEY Sampling	

Parameters to be evaluated in sampling reach	Habitat Parameter	Condition Category			
		Optimal	Suboptimal	Marginal	Poor
	1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	SCORE 14	20 19 18 17 16	15 (14) 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
	SCORE 18	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
	SCORE 18	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	SCORE 13	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0
	5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	SCORE 14	20 19 18 17 16	15 (14) 13 12 11	10 9 8 7 6	5 4 3 2 1 0

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

Parameters to be evaluated broader than sampling reach

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

Total Score 155

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Harpeth		LOCATION Harpeth @ Old Hillsboro Rd	
STATION # 4	RIVERMILE 75.8	STREAM CLASS 71 h	
LAT 35.9937	LONG -86.9029	RIVER BASIN Harpeth	
STORET # HARPE 075.8 W1		AGENCY W. Williamson County	
INVESTIGATORS Michael Scott / Rich Hanson			
FORM COMPLETED BY	DATE 7/17/14 TIME 2:00 AM (PM)	REASON FOR SURVEY Sample	

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
___% ☐	%cloud cover	☐ ___%
☒	clear/sunny	☒

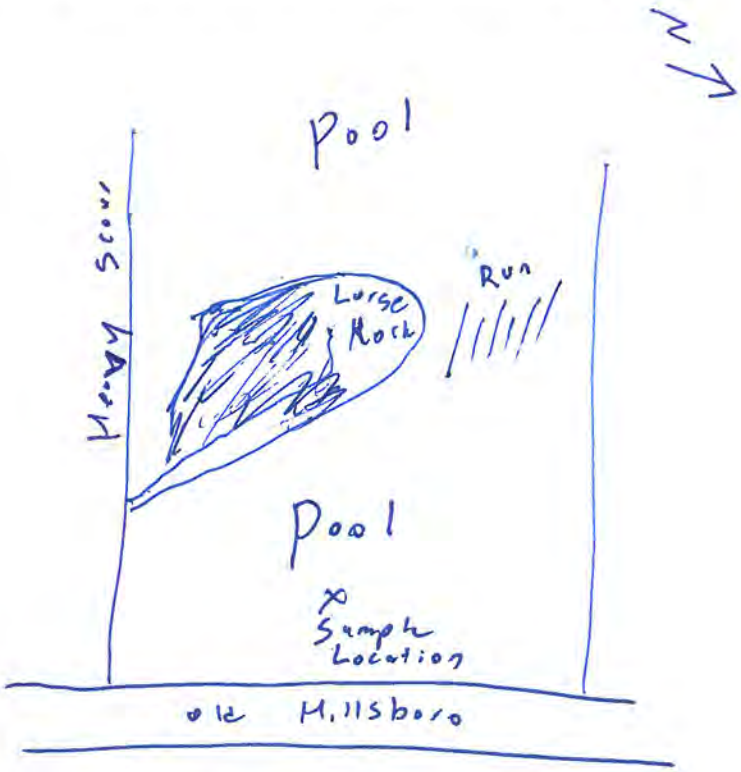
Has there been a heavy rain in the last 7 days? ☒ Yes ☐ No

Air Temperature 80 °F

Other 0.4" 3 days prior

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☒ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☒ Mixture of origins
☐ Other_____

Catchment Area 883 km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

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

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

Local Watershed Erosion
☐ None ☒ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

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

dominant species present Hickory, Oak

INSTREAM FEATURES

Estimated Reach Length 69 m 225'
Estimated Stream Width 47 m 153'
Sampling Reach Area 3243 m²
Area in km² (m²x1000) 3.243 km²
Estimated Stream Depth 0.9 m 3'
Surface Velocity (at thalweg) .21 m/sec 0.7 ft/s

Canopy Cover
☒ Partly open ☐ Partly shaded ☐ Shaded

High Water Mark 2 m 6'

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle ____ % ☒ Run 5 %
☒ Pool 95 %

Channelized ☒ Yes ☐ No

Dam Present ☐ Yes ☒ No

LARGE WOODY DEBRIS

LWD 7 m²
Density of LWD 2.2 m²/km² (LWD/ reach area)

AQUATIC VEGETATION

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

dominant species present Water willow

Portion of the reach with aquatic vegetation 5 %

WATER QUALITY

Temperature 24.8 C
Specific Conductance 0.434 mS/cm
Dissolved Oxygen 100.5% 8.47 mg/L
pH 7.87
Turbidity 10.4
WQ Instrument Used YSI 556

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

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

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

SEDIMENT/ SUBSTRATE

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

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits None
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other _____

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

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock		25	Detritus	sticks, wood, coarse plant materials (CPOM)	5
Boulder	> 256 mm (10")	25			
Cobble	64-256 mm (2.5"-10")	25	Muck-Mud	black, very fine organic (FPOM)	
Gravel	2-64 mm (0.1"-2.5")	10			
Sand	0.06-2mm (gritty)	5	Marl	grey, shell fragments	
Silt	0.004-0.06 mm	5			
Clay	< 0.004 mm (slick)				

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

STREAM NAME Morgan	LOCATION Old Hillsboro Rd
STATION # 4 RIVERMILE 73.8	STREAM CLASS 71 h
LAT 35.9952 LONG -85.9024	RIVER BASIN Harpeth
STORET # HARPE073.8	AGENCY Williamson County
INVESTIGATORS Michael Smith / Rich Mason	
FORM COMPLETED BY Rich Mason	DATE 7/17/14 TIME 200 AM (PM)
REASON FOR SURVEY Sampling	

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 10	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 13	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 9	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 14	20 19 18 17 16	15 (14) 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 19	20 (19) 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

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

Parameters to be evaluated broader than sampling reach

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

Total Score 111

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Harpeth	LOCATION Harpeth @ Cotton Rd		
STATION # 5 RIVERMILE 79.8	STREAM CLASS 7 4		
LAT 35.9681 LONG -86.9008	RIVER BASIN Harpeth		
STORET # HARPE 079.8WI	AGENCY Williamson County		
INVESTIGATORS Michael Scott / Rich Hanson			
FORM COMPLETED BY Michael Scott	DATE 9/10/14 TIME 9:30 AM PM	REASON FOR SURVEY Sampling	

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
35 % ☑	%cloud cover	☐ ___ %
☐	clear/sunny	☑

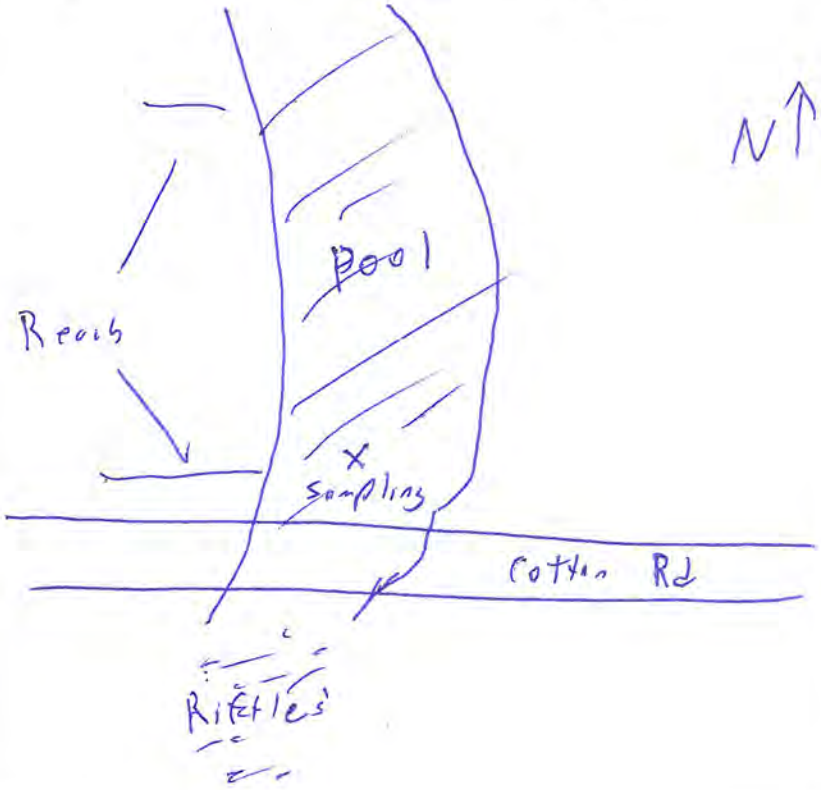
Has there been a heavy rain in the last 7 days? ☑ Yes ☐ No

Air Temperature ___ °C 80°F

Other 0.5" 4 days prior

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☒ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☒ Mixture of origins
☐ Other ___

Catchment Area 571 km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

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

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

Local Watershed Erosion
☐ None ☒ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

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

dominant species present Hickory

INSTREAM FEATURES

Estimated Reach Length 76 m 250 ft
Estimated Stream Width 22 m 73 ft
Sampling Reach Area 1672 m²
Area in km² (m²x1000) .1672 km²
Estimated Stream Depth 1 m
Surface Velocity (at thalweg) 0.2 m/sec

Canopy Cover
☐ Partly open ☒ Partly shaded ☐ Shaded

High Water Mark 0.8 m 2.5 ft

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle ____ % ☒ Run 5 %
☒ Pool 95 %

Channelized ☐ Yes ☒ No

Dam Present ☐ Yes ☒ No

LARGE WOODY DEBRIS

LWD 6 m²
Density of LWD 3.6 m²/km² (LWD/ reach area)

AQUATIC VEGETATION

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

dominant species present Algae

Portion of the reach with aquatic vegetation 2 %

WATER QUALITY

Temperature 23.3 ° C
Specific Conductance 0.515 mS/cm
Dissolved Oxygen 71.7 % 6.11 mg/l
pH 7.77
Turbidity 14 NTU
WQ Instrument Used YSI 556

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

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

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

SEDIMENT/ SUBSTRATE

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

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits None
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other _____

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

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock		2 %	Detritus	sticks, wood, coarse plant materials (CPOM)	
Boulder	> 256 mm (10")	20 %			
Cobble	64-256 mm (2.5"-10")	25 %	Muck-Mud	black, very fine organic (FPOM)	5 %
Gravel	2-64 mm (0.1"-2.5")	30 %			
Sand	0.06-2mm (gritty)		Marl	grey, shell fragments	
Silt	0.004-0.06 mm	15 %			
Clay	< 0.004 mm (slick)				

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

STREAM NAME Horsepath		LOCATION ~~SEE~~ Horsepath @ Cotton Rd	
STATION # 5	RIVERMILE	STREAM CLASS 71h	
LAT 35.9681	LONG -86.9008	RIVER BASIN Harpeth	
STORET # HARPE079.2W1		AGENCY Williamson County	
INVESTIGATORS Michael Scott / Rich Manson			
FORM COMPLETED BY Rich Manson		DATE 9/10/14 TIME 9:30 (AM) PM	REASON FOR SURVEY Sampling

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 10	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 15	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 5	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	(5) 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 15	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 15	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

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

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 10	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 5	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	(5) 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 10 (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 10 (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 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

Total Score 127

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Harpeth	LOCATION Harpeth @ Arno Rd		
STATION # 6 RIVERMILE 97.6	STREAM CLASS Tli		
LAT 35.8782 LONG -86.7910	RIVER BASIN Harpeth		
STORET # HARPE097.6WM 16	AGENCY Williamson County		
INVESTIGATORS Michael Scott / Rich Mangum			
FORM COMPLETED BY Michael Scott	DATE 9/10/14 TIME ~~2:00~~ AM (PM)	REASON FOR SURVEY Sampling	

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
85 %☒	%cloud cover	☐ ___%
☐	clear/sunny	☒

Has there been a heavy rain in the last 7 days? ☒ Yes ☐ No

Air Temperature ___ °C 80°F

Other 0.5" 4 days prior

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)

STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☒ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☒ Mixture of origins
☐ Other_____

Catchment Area 417 km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

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

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

Local Watershed Erosion
☐ None ☒ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

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

dominant species present Maple

INSTREAM FEATURES

Estimated Reach Length 46 m 150 Ft
Estimated Stream Width 17 m 55 Ft
Sampling Reach Area 782 m²
Area in km² (m²x1000) 0.782 km²
Estimated Stream Depth 0.55 m 1.8 Ft
Surface Velocity (at thalweg) 0.1 m/sec

Canopy Cover
☐ Partly open ☒ Partly shaded ☐ Shaded

High Water Mark 0.95 m 3.1 Ft

Proportion of Reach Represented by Stream Morphology Types
☒ Riffle 25 % ☒ Run 25 %
☒ Pool 50 %

Channelized ☐ Yes ☒ No

Dam Present ☐ Yes ☒ No

LARGE WOODY DEBRIS

LWD 0 m²
Density of LWD 0 m²/km² (LWD/ reach area)

AQUATIC VEGETATION

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

dominant species present Water willow

Portion of the reach with aquatic vegetation 25 %

WATER QUALITY

Temperature 24.5 ° C
Specific Conductance 0.43 mS/cm
Dissolved Oxygen 90% 7.48 mg/L
pH 7.84
Turbidity 7.5 NTU
WQ Instrument Used YSI 55

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

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

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

SEDIMENT/ SUBSTRATE

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

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits None
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other _____

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

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	
Boulder	> 256 mm (10")	5 %			
Cobble	64-256 mm (2.5"-10")	25%	Muck-Mud	black, very fine organic (FPOM)	
Gravel	2-64 mm (0.1"-2.5")	50 %			
Sand	0.06-2mm (gritty)		Marl	grey, shell fragments	
Silt	0.004-0.06 mm	20 %			
Clay	< 0.004 mm (slick)				

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

STREAM NAME	Murpeth	LOCATION	Murpeth @ Arno Rd
STATION # 6	RIVERMILE 97.6	STREAM CLASS	71i
LAT 35.8787	LONG -86.7910	RIVER BASIN	Murpeth
STORET #	MARPE097.6WI	AGENCY	Williamson County
INVESTIGATORS	Michael / Scott / Rich Masson		
FORM COMPLETED BY	Rich Masson	DATE 9/10/14 TIME 2:00 AM (PM)	REASON FOR SURVEY Sampling

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 15	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 17	20 19 18 (17) 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 16	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 13	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 15	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

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

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 13	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 18	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 8 (LB)	Left Bank 10 9	(8) 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	(8) 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 9 (LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 6 (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 155

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Owl Creek	LOCATION Owl @ Split Log Rd.		
STATION # 1 RIVERMILE 4.78	STREAM CLASS TLH		
LAT 35.9510 LONG -85.7277	RIVER BASIN Cheatam Reservoir		
STORET # Owl 004.78 WI	AGENCY WI Hansen County		
INVESTIGATORS Michael Scott, Rich Hanson, Amy Tolley			
FORM COMPLETED BY Michael Scott	DATE 10/21/14 TIME 10:00 (AM) PM	REASON FOR SURVEY Sampling	

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
100 % ☒	%cloud cover	☒ 70 %
☐	clear/sunny	☐

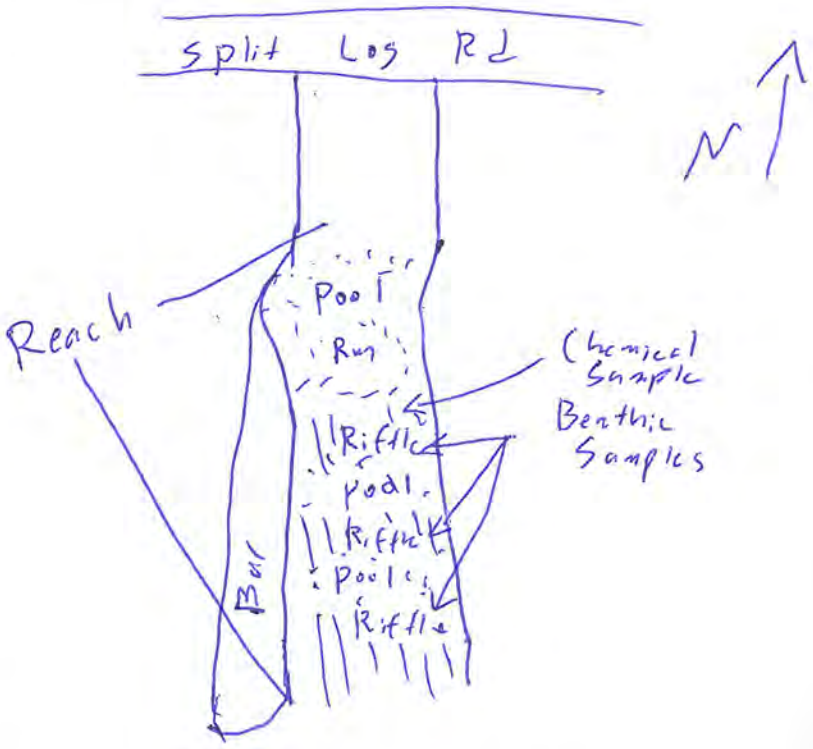
Has there been a heavy rain in the last 7 days? ☐ Yes ☒ No

Air Temperature 73 °F

Other _____

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☒ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☒ Mixture of origins
☐ Other _____

Catchment Area 3.16 km² 1.22 mi²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

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

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

Local Watershed Erosion
☐ None ☒ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☒ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous
dominant species present Oak / Sycamore / evergreens

INSTREAM FEATURES

Estimated Reach Length 53 m 175 ft
Estimated Stream Width 2.7 m 9 ft
Sampling Reach Area 143 m²
Area in km² (m²x1000) 0.14 km²
Estimated Stream Depth 0.1 m 4 in
Surface Velocity (at thalweg) 0.1 m/sec

Canopy Cover
☐ Partly open ☐ Partly shaded ☒ Shaded
High Water Mark 0.3 m 1 ft
Proportion of Reach Represented by Stream Morphology Types
☒ Riffle 50 % ☒ Run 40 %
☒ Pool 10 %
Channelized ☐ Yes ☒ No
Dam Present ☐ Yes ☒ No

LARGE WOODY DEBRIS

LWD 0 m²
Density of LWD 0 m²/km² **(LWD/ reach area)**

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☒ Attached Algae
dominant species present Algae
Portion of the reach with aquatic vegetation 10 %

WATER QUALITY

Temperature 17.1 °C
Specific Conductance 0.427
Dissolved Oxygen 85.4% 8.2 mg/L
pH 7.5
Turbidity 4.45
WQ Instrument Used YSI 556

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

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

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

SEDIMENT/ SUBSTRATE

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

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits None
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other _____

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

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock		50%	Detritus	sticks, wood, coarse plant materials (CPOM)	10%
Boulder	> 256 mm (10")	10%			
Cobble	64-256 mm (2.5"-10")	10%	Muck-Mud	black, very fine organic (FPOM)	
Gravel	2-64 mm (0.1"-2.5")	10			
Sand	0.06-2mm (gritty)	10	Marl	grey, shell fragments	
Silt	0.004-0.06 mm	10			
Clay	< 0.004 mm (slick)				

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

STREAM NAME Owl Creek		LOCATION At	
STATION # 1	RIVERMILE 4.8	STREAM CLASS 71 h	
LAT 35.9510	LONG 86.7777	RIVER BASIN Cheatom Reservoir	
STORET # OWL004.8WI		AGENCY Williamson Co.	
INVESTIGATORS A. Tolley M. Smith R. Munsey			
FORM COMPLETED BY A. Tolley	DATE 10-28-14 TIME 09:45 (AM) PM	REASON FOR SURVEY Macro + Chem Survey	

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 17	20 19 18 (17) 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 16	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 14	20 19 18 17 16	15 (14) 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 7	20 19 18 17 16	15 14 13 12 11	10 9 8 (7) 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 18	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

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

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 11	20 19 18 17 16	15 14 13 12 (11)	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 15	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 2 (LB)	Left Bank 10 9	8 7 6	5 4 3	(2) 1 0
SCORE 9 (RB)	Right Bank 10 (9)	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 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
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 10 (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE 3 (RB)	Right Bank 10 9	8 7 6	5 4 (3)	2 1 0

Total Score 133

STREAM SURVEY FORM

STREAM SURVEY INFORMATION

STATION NUMBER:	OWL004.8W1	ASSESSORS:	MS / JT / RM
STREAM NAME:	Owl Creek	DATE:	10/28/14
STATION LOCATION:	@ Split Log Rd	TIME:	9:45 A.M.
COUNTY:	Williamson	STREAM MILE:	4.8
WBID#/HUC:	05130202-0101	STREAM ORDER:	1st
WATERSHED GROUP #	Cheatham Reservoir	DRAINAGE AREA	1.22 mi²
LATITUDE DEC/DEG	35.9510	ELEVATION (ft):	680
LONGITUDE DEC/DEG	-86.7277	GAZETTEER PAGE	37
ECOLOGICAL SUBREGION:	71h	USGS QUAD	Nolensville
PROJECT/PURPOSE:	Sampling		

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 556

pH	7.5	SU	DISSOLVED OXYGEN	85.4%	PPM 8.2 mg/L
CONDUCTIVITY	0.477	UMHOS	TIME	10:00 AM	
TEMPERATURE	17.1	°C	OTHERS		

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

Ambient Weather: SUNNY (CLOUDY) BREEZY RAIN SNOW AIR TEMP: 72°

WATERSHED CHARACTERISTICS

App. % of watershed observed: 1%

UPSTREAM SURROUNDING LAND USE: (estimated %)

PASTURE	40%	URBAN		RESID	30%
CROPS	10%	INDUSTRY		OTHER	
FOREST	20%	MINING			

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

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

PHYSICAL STREAM CHARACTERISTICS

LENGTH OF STREAM AREA ASSESSED (m): 53 m / 143 m²

SURROUNDING LAND USE:

ESTIMATE %	RDB	LDB		RDB	LDB		RDB	LDB
PASTURE	25	50	URBAN			RESID.	25	25
CROPS			INDUSTRY			OTHER		
FOREST	50	25	MINING					

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

Measured: N/A U/S_____ D/S_____ LB_____ RB_____

BANK HEIGHT (m): 2 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. ROOTED FLOATING TYPE N/A

ADDITIONAL COMMENTS: (oil sheen, odor, colors)

STREAM SURVEY FORM

PHYSICAL STREAM CHARACTERISTICS (cont.)

	RIFFLE	RUN	POOL
DEPTH (m)	6 cm	12 cm	14 cm
WIDTH (m)	10 Ft	9 Ft	11 Ft
REACH LENGTH (m)	22 Ft	30 Ft	40 Ft

Staff Gauge/Bench Ht: 1 Ft
VELOCITY (FS) 0.3 Ft/s
FLOW (CFS) 0.12 cfs based on Riffle measurements
HABITAT ASSESSMENT SCORE #:
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 substate (%)

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		RIFFLE	RUN	POOL
BOULDER (> 10")	20 %	10 %	10 %	CLAY (slick)	0 %	0 %	0 %
COBBLE (2.5-10")	20 %	10 %	10 %	SILT	10 %	10 %	20 %
GRAVEL (0.1-2.5")	10 %	10 %	10 %	DETRITUS (CPOM)	50 %	60 %	60 %
BEDROCK	50 %	70 %	70 %	MUCK-MUD (FPOM)	0 %	10 %	10 %
SAND (gritty)	0 %	0 %	0 %	MARL (shell frags.)	40 %	10 %	10 %

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?	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.)

See physical characterizations field sheet

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Rutherford	LOCATION Rutherford @ old Bethesda		
STATION # 1 RIVERMILE 26.7	STREAM CLASS 7 1 h		
LAT 35.9509 LONG -86.8775	RIVER BASIN Duck		
STORET # Ruthe 026.7 W1	AGENCY Williamson		
INVESTIGATORS Michael Scott, Rich Manson, Amy Jolley			
FORM COMPLETED BY Michael Scott	DATE 10/27/14 TIME 9:30 AM (PM)	REASON FOR SURVEY Sampling	

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
10 % ☑	%cloud cover	☑ 10 %
☐	clear/sunny	☐

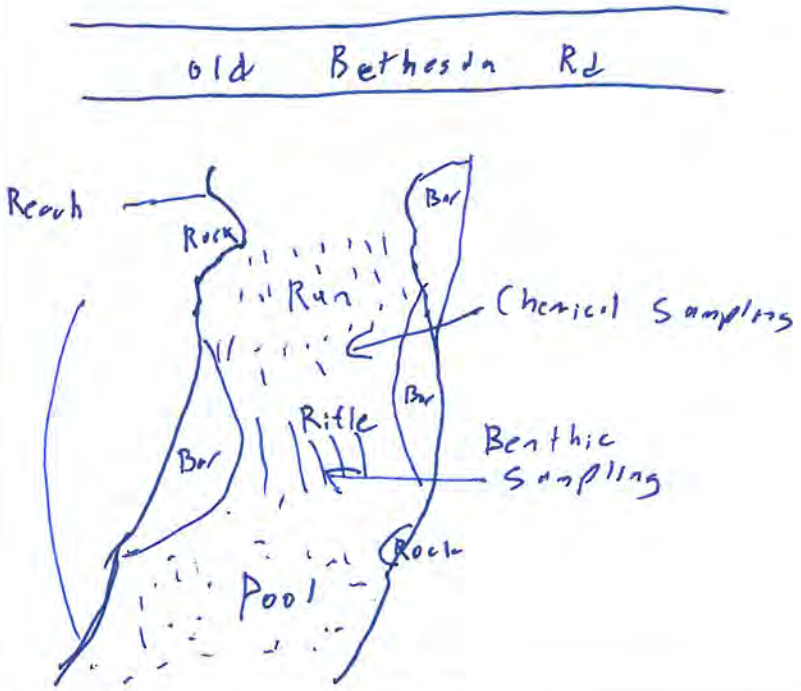
Has there been a heavy rain in the last 7 days? ☐ Yes ☒ No

Air Temperature 66 °F

Other _____

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☒ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Non-glacial montane ☒ Mixture of origins
☐ Swamp and bog ☐ Other _____

Catchment Area 32.3 km² 8.6 m²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

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

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

Local Watershed Erosion
☐ None ☒ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☒ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous
dominant species present Sycamore / Privit

INSTREAM FEATURES

Estimated Reach Length 56 m 185 ft
Estimated Stream Width 8.5 m 28 ft
Sampling Reach Area 476 m²
Area in km² (m²x1000) 0.476 km²
Estimated Stream Depth 0.2 m
Surface Velocity (at thalweg) 0.2 m/sec

Canopy Cover
☐ Partly open ☒ Partly shaded ☐ Shaded
High Water Mark 2 m
Proportion of Reach Represented by Stream Morphology Types
☒ Riffle 20 % ☒ Run 35 %
☐ Pool 45 %
Channelized ☐ Yes ☒ No
Dam Present ☐ Yes ☒ No

LARGE WOODY DEBRIS

LWD 1 m²
Density of LWD 0.476 m²/km² **(LWD/ reach area)**

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☒ Attached Algae
dominant species present Algae
Portion of the reach with aquatic vegetation 5 %

WATER QUALITY

Temperature 15.3 °C
Specific Conductance 0.297
Dissolved Oxygen 92.0% 9.15 mg/L
pH 7.29
Turbidity 2.5
WQ Instrument Used YSI

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

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

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

SEDIMENT/ SUBSTRATE

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

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits none
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other _____

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

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock		30%	Detritus	sticks, wood, coarse plant materials (CPOM)	
Boulder	> 256 mm (10")	2%			
Cobble	64-256 mm (2.5"-10")	8%	Muck-Mud	black, very fine organic (FPOM)	
Gravel	2-64 mm (0.1"-2.5")	40%			
Sand	0.06-2mm (gritty)	10%	Marl	grey, shell fragments	
Silt	0.004-0.06 mm	10%			
Clay	< 0.004 mm (slick)				

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

STREAM NAME Rutherford		LOCATION Rutherford @ old Bethesda	
STATION # 1	RIVERMILE 26.7	STREAM CLASS 71 h	
LAT 35.7509	LONG -86.8175	RIVER BASIN Duck	
STORET # Ruthe 026.7 W1		AGENCY Williamson County	
INVESTIGATORS Rich Mason / M. Scott / A. Tolley			
FORM COMPLETED BY Rich Mason	DATE 10/27/14 TIME 9:30 (AM) PM	REASON FOR SURVEY Sampling	

Parameters to be evaluated in sampling reach	Habitat Parameter	Condition Category			
		Optimal	Suboptimal	Marginal	Poor
	1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	SCORE 14	20 19 18 17 16	15 (14) 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
	SCORE 12	20 19 18 17 16	15 14 13 (12) 11	10 9 8 7 6	5 4 3 2 1 0
	3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
	SCORE 14	20 19 18 17 16	15 (14) 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	SCORE 10	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
	5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	SCORE 10	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0

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

Parameters to be evaluated broader than sampling reach

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

Total Score 133

STREAM SURVEY FORM

STREAM SURVEY INFORMATION

STATION NUMBER:	Duthe 026.7WI	ASSESSORS:	M.S./A.T./
STREAM NAME:	Rutherford	DATE:	10-27-14
STATION LOCATION:	@ Old Bethesda Rd.	TIME:	09:30
COUNTY:	Williamson	STREAM MILE:	26.7
WBID#/HUC:	06040003020 01	STREAM ORDER:	3
WATERSHED GROUP #	Duck	DRAINAGE AREA	8.6 mi²
LATITUDE DEC/DEG	35.7509	ELEVATION (ft):	742.5
LONGITUDE DEC/DEG	-86.8175	GAZETTEER PAGE	37
ECOLOGICAL SUBREGION:	71h	USGS QUAD	Bethesda

PROJECT/PURPOSE: Chem & Macro Sampling

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 556

pH	7.29	SU	DISSOLVED OXYGEN	92% 9.15	mg/L
CONDUCTIVITY	0.297	UMHOS	TIME	9:30 AM	
TEMPERATURE	15.3	°C	OTHERS		

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

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

WATERSHED CHARACTERISTICS

App. % of watershed observed: 1%

UPSTREAM SURROUNDING LAND USE: (estimated %)

PASTURE	50	URBAN		RESID	20
CROPS	30	INDUSTRY		OTHER	
FOREST	10	MINING			

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

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

PHYSICAL STREAM CHARACTERISTICS

LENGTH OF STREAM AREA ASSESSED (m): 50m / 478 m²

SURROUNDING LAND USE :

ESTIMATE %	RDB	LDB		RDB	LDB		RDB	LDB
PASTURE	50	50	URBAN			RESID.	20	20
CROPS	30	20	INDUSTRY			OTHER		
FOREST	10	10	MINING					

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

Measured: n/a U/S_____ D/S_____ LB_____ RB_____

BANK HEIGHT (m): 4m 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 ND

ADDITIONAL COMMENTS:(oil sheen, odor, colors) Orange flocculent

STREAM SURVEY FORM

PHYSICAL STREAM CHARACTERISTICS (cont.)

	RIFFLE	RUN	POOL
DEPTH (m)	0.1	0.2m	0.2
WIDTH (m)	[illegible] 3	[illegible] 8	2
REACH LENGTH (m)	~4m	80%	16%

Staff Gauge/Bench Ht: 0.6 ft / 5.6 ft
VELOCITY (FS): 0.2 m/s .66 ft/s
FLOW (CFS): 2.1 - Based on riffle measurements
HABITAT ASSESSMENT SCORE #:
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 substate (%)

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		RIFFLE	RUN	POOL
BOULDER (> 10")	— %	— %	— %	CLAY (slick)	10 %	20 %	10 %
COBBLE (2.5-10")	5 %	— %	25 %	SILT	10 %	20 %	10 %
GRAVEL (0.1-2.5")	35 %	10 %	5 %	DETRITUS (CPOM)	10 %	10 %	15 %
BEDROCK	— %	20 %	— %	MUCK-MUD (FPOM)	5 %	10 %	15 %
SAND (gritty)	20 %	10 %	20 %	MARL (shell frags.)	— %	— %	— %

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?	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.)

See Physical Characteristics form.

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Rutherford	LOCATION Rutherford @ Cross Keys Rd		
STATION # 2	RIVERMILE 28.6	STREAM CLASS 71h	
LAT 35.7584	LONG -86.7893	RIVER BASIN Duck	
STORET # RUTHE 028.6 WI	AGENCY Williamson County		
INVESTIGATORS Michael Scott, Rich Yonsen, Amy Tolley			
FORM COMPLETED BY Michael Scott	DATE 10/27/14 TIME 1:00 AM (PM)	REASON FOR SURVEY Sampling	

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐ None
☐	showers (intermittent)	☐
30 % ☐	%cloud cover	☒ 10 %
☒	clear/sunny	☐

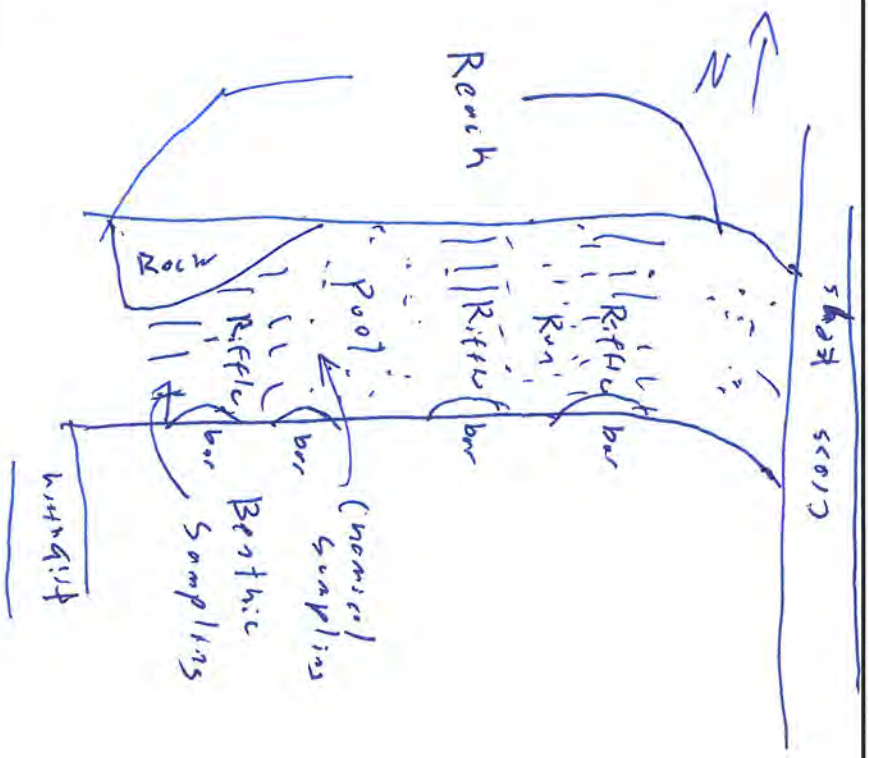
Has there been a heavy rain in the last 7 days? ☐ Yes ☒ No

Air Temperature ~84° F

Other _____

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☒ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☒ Mixture of origins
☐ Other _____

Catchment Area 7.5 km² 2.9 mi²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

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

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

Local Watershed Erosion
☐ None ☒ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

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

INSTREAM FEATURES

Estimated Reach Length 41 [redacted] m 135 ft
Estimated Stream Width 7.3 m 24 ft
Sampling Reach Area 300 [redacted] m² 3229 ft²
Area in km² (m²x1000) 03 [redacted] km²
Estimated Stream Depth 0.16 m 0.16
Surface Velocity (at thalweg) 0.4 m/sec

Canopy Cover
☐ Partly open ☐ Partly shaded ☒ Shaded
High Water Mark 0.5 m
Proportion of Reach Represented by Stream Morphology Types
☒ Riffle 15 % ☒ Run 5 %
☒ Pool 80 %
Channelized ☐ Yes ☒ No
Dam Present ☐ Yes ☒ No

LARGE WOODY DEBRIS

LWD 0 m²
Density of LWD 0 m²/km² **(LWD/ reach area)**

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☒ Attached Algae
dominant species present Algae
Portion of the reach with aquatic vegetation 10 %

WATER QUALITY

Temperature 17.6 °C
Specific Conductance 0.28
Dissolved Oxygen 105% / 10 mg/L
pH 7.9
Turbidity 3.3
WQ Instrument Used YSI 556

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

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

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

SEDIMENT/ SUBSTRATE

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

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

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

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

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock		60 %	Detritus	sticks, wood, coarse plant materials (CPOM)	10 %
Boulder	> 256 mm (10")	5 %			
Cobble	64-256 mm (2.5"-10")	10 %	Muck-Mud	black, very fine organic (FPOM)	
Gravel	2-64 mm (0.1"-2.5")	15 %			
Sand	0.06-2mm (gritty)	5 %	Marl	grey, shell fragments	
Silt	0.004-0.06 mm	5 %			
Clay	< 0.004 mm (slick)				

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

STREAM NAME	Rutherford Creek	LOCATION	Rutherford @ Cross Keys Rd
STATION #	2	RIVERMILE	28.6
STREAM CLASS			71h
LAT	35.7589	LONG	-86.7893
RIVER BASIN			Duck
STORET #	RUTHE028.6W1	AGENCY	Williamson County
INVESTIGATORS	R. Hanson / M. Smith / A. Talley		
FORM COMPLETED BY	R. Hanson	DATE / TIME	10-27-14 / 14:00 AM (PM)
REASON FOR SURVEY			Sampling

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 13	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 17	20 19 18 (17) 16	15 14 13 (12) 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 15	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 13	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 14	20 19 18 17 16	15 (14) 13 12 11	10 9 8 7 6	5 4 3 2 1 0

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

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 16	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 20	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 10 (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 9 (LB)	Left Bank 10 (9)	8 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	(8) 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 6 (LB)	Left Bank 10 9	8 7 (6)	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	(8) 7 6	5 4 3	2 1 0

Total Score 159

STREAM SURVEY FORM

STREAM SURVEY INFORMATION

STATION NUMBER:	Ruth e 028.6 W I	ASSESSORS:	AT / MS / RM
STREAM NAME:	Rutherford	DATE:	10-27-14
STATION LOCATION:	@	TIME:	13:00
COUNTY:	Williamson	STREAM MILE:	28.6
WBID#/HUC:	06040003030 01	STREAM ORDER:	2
WATERSHED GROUP #	Duck	DRAINAGE AREA	2.4 mi²
LATITUDE DEC/DEG	35.7584	ELEVATION (ft):	782.5
LONGITUDE DEC/DEG	-86.7893	GAZETTEER PAGE	37
ECOLOGICAL SUBREGION:	71 m	USGS QUAD	Bethesda

PROJECT/PURPOSE: Macro & Chem Sampling

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 556

pH	7.9 SU	DISSOLVED OXYGEN	105% / 10 ~~ppm~~
CONDUCTIVITY	0.29 UMHOS	TIME	1:00 PM
TEMPERATURE	17.5 °C	OTHERS	

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

Ambient Weather: (SUNNY) CLOUDY (BREEZY) RAIN SNOW AIR TEMP: 72°F

WATERSHED CHARACTERISTICS

App. % of watershed observed: 1%

UPSTREAM SURROUNDING LAND USE: (estimated %)

PASTURE	50	URBAN		RESID	20
CROPS	20	INDUSTRY		OTHER	
FOREST	10	MINING			

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

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

PHYSICAL STREAM CHARACTERISTICS

LENGTH OF STREAM AREA ASSESSED (m): 300 m² / 41 m

SURROUNDING LAND USE :

ESTIMATE %	RDB	LDB		RDB	LDB		RDB	LDB
PASTURE	50	30	URBAN			RESID.	20	20
CROPS	20	20	INDUSTRY			OTHER		
FOREST	10	10	MINING					

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

Measured: 100% U/S 100 D/S 100 LB 100 RB 100

BANK HEIGHT (m): 1 HIGH WATER MARK (m): 0.5

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			

ADDITIONAL COMMENTS: (oil sheen, odor, colors) 2 damselflies; 1 dragon fly

STREAM SURVEY FORM

PHYSICAL STREAM CHARACTERISTICS (cont.)

	RIFFLE	RUN	POOL
DEPTH (m)	0.2	0.6	0.7
WIDTH (m)	1	20	1
REACH LENGTH (m)	25%	60%	15%

Staff Gauge/Bench Ht: 0.5m
VELOCITY (FS) 0.4
FLOW (CFS) — based on riffle 0.87 cfs measurements
HABITAT ASSESSMENT SCORE #:
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 substate (%)

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")	5 %	0 %	5 %
COBBLE (2.5-10")	15 %	10 %	15 %
GRAVEL (0.1-2.5")	25 %	10 %	10 %
BEDROCK	20 %	50 %	20 %
SAND (gritty)	10 %	10 %	10 %

	RIFFLE	RUN	POOL
CLAY (slick)	10 %	10 %	5 %
SILT	10 %	5 %	5 %
DETRITUS (CPOM)	15 %	5 %	15 %
MUCK-MUD (FPOM)	5 %	— %	15 %
MARL (shell frags.)	— %	— %	— %

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?	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.)

See Physical Characteristics Sheet

UNUSUAL CONDITION OR COMMENT — UC

Map: Fig 1 Team: A Site: 1101-02

Date: 5 / 15 / 15 (MM DD YY) Photo: 150-352 Survey: _____

Type: (circle one) **Unusual Condition** Comment

Describe: Odor, Scum, Excessive Algae, Water Color/Clarity, Red Flock, Sewage Discharge, Oil

Large Log jam at bridge

Potential Cause: Log Jam

Severity	Severe	1	(2)	3	4	5	Minor	Unknown (-1)
Correctability	Best	1	(2)	3	4	5	Worst	Unknown (-1)
Access	Best	1	(2)	3	4	5	Worst	Unknown (-1)

UNUSUAL CONDITION OR COMMENT — UC

Map: _____ Team: _____ Site: _____

Date: ___ / ___ / ___ (MM DD YY) Photo: _____ Survey: _____

Type: (circle one) **Unusual Condition** Comment

Describe: Odor, Scum, Excessive Algae, Water Color/Clarity, Red Flock, Sewage Discharge, Oil

Potential Cause: _____

Severity	Severe	1	2	3	4	5	Minor	Unknown (-1)
Correctability	Best	1	2	3	4	5	Worst	Unknown (-1)
Access	Best	1	2	3	4	5	Worst	Unknown (-1)

EROSION SITE

ES

Map: Fig 1 Team: A Site: H01-01

Date: 5/15/15 (MM DD YY) Photo: 150-352 Survey: H01-01

Type: (Downcutting) Widening Headcutting Unknown

Cause: Bend at steep slope, Pipe Outfall, Below Channelization, (Below Road Crossing,) Livestock, Land Use Change Upstream, Other: _____

Length: 100 + ft. **Average exposed bank height:** 6 ft.

Present Land Use Left Side (looking downstream): Crop field, Pasture, Lawn, Paved, Shrubs & Small Trees, (Forest,) Multiflora Rose, Other _____

Present Land Use Right Side (looking downstream): Crop field, (Pasture,) Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Threat to Infrastructure?: Yes (No) **Describe:** _____

Severity	Severe	1	2	3	(4)	5	Minor	Unknown (-1)
Correctability	Best	1	2	3	(4)	5	Worst	Unknown (-1)
Access	Best	1	2	3	(4)	5	Worst	Unknown (-1)

EROSION SITE

ES

Map: Fig 5 Team: A Site: H05-01

Date: 5/15/15 (MM DD YY) Photo: 805/816 Survey: _____

Type: (Downcutting) Widening Headcutting Unknown

Cause: Bend at steep slope, Pipe Outfall, Below Channelization, (Below Road Crossing,) Livestock, Land Use Change Upstream, Other: _____

Length: 100 + ft. **Average exposed bank height:** 6 ft.

Present Land Use Left Side (looking downstream): Crop field, (Pasture,) Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Present Land Use Right Side (looking downstream): Crop field, Pasture, (Lawn,) Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Threat to Infrastructure?: Yes (No) **Describe:** _____

Severity	Severe	1	2	3	(4)	5	Minor	Unknown (-1)
Correctability	Best	1	2	3	(4)	5	Worst	Unknown (-1)
Access	Best	1	(2)	3	4	5	Worst	Unknown (-1)

ATE BUFFER

IB

Map: Fig 2 Team: A Site: M07-01

Date: 5/15/15 (MM DD YY) Photo: 346-355 Survey: _____

Buffer inadequate on: Left Right Both (looking downstream)

Is stream unshaded? Left Right Both (looking downstream) Neither

Buffer width left: 725 ft. Buffer width right: 210 ft.

Length left: 7100 ft. Length right: 7100 ft.

Present land use left side: Crop field, Pasture, Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Present land use right side: Crop field, Pasture, Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other Golf Course

Has a buffer recently been established: Yes No

Are Livestock present: Yes No Type: Cattle, Horses, Pigs, Other: _____

Severity	Severe	1	2	~~3~~	4	5	Minor	Unknown (-1)
Correctability	Best	1	2	3	4	5	Worst	Unknown (-1)
Access	Best	1	2	3	4	5	Worst	Unknown (-1)
Wetland Potential	Best	1	2	3	4	5	Worst	Unknown (-1)

(Good wetland potential = low slope, low bank height)

INADEQUATE BUFFER

IB

Map: Fig 4 Team: A Site: M04-01

Date: 5/15/15 (MM DD YY) Photo: 718-752 Survey: _____

Buffer inadequate on: Left Right Both (looking downstream)

Is stream unshaded? Left Right Both (looking downstream) Neither

Buffer width left: 225 ft. Buffer width right: 725 ft.

Length left: 7100 ft. Length right: 7100 ft.

Present land use left side: Crop field, Pasture, Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Present land use right side: Crop field, Pasture, Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Has a buffer recently been established: Yes No

Are Livestock present: Yes No Type: Cattle, Horses, Pigs, Other: _____

Severity	Severe	1	2	3	4	5	Minor	Unknown (-1)
Correctability	Best	1	2	3	4	5	Worst	Unknown (-1)
Access	Best	1	2	3	4	5	Worst	Unknown (-1)
Wetland Potential	Best	1	2	3	4	5	Worst	Unknown (-1)

(Good wetland potential = low slope, low bank height)

REPRESENTATIVE SITE

RE

Map: Fig 6 **Team:** A **Site:** L06-1
Date: 5/15/15 (MM DD YY) **Photo:** 528/533 **Survey:** _____

	Optimal	Suboptimal	Marginal	Poor
Macroinvertebrate Substrata	X			
Embeddedness		X		
Shelter for fish	X			
Channel Alteration		X		
Sediment Deposition			X	
Velocity and Depth		X		
Channel Flow	X			
Bank Vegetation		X		
Bank Condition		X		
Riparian Vegetation		X		

Wetted width: Riffles: 300 in. **Runs:** 360 in. **Pools:** 400 in.
Thalweg depth: Riffles: 6 in. **Runs:** 12 in. **Pools:** 18 in.
Bottom type: Silts, Sands, Gravel, Cobble, Boulder, Bedrock

REPRESENTATIVE SITE

RE

Map: Fig 3 **Team:** A **Site:** M03-1
Date: 5/15/15 (MM DD YY) **Photo:** 934-953 **Survey:** _____

	Optimal	Suboptimal	Marginal	Poor
Macroinvertebrate Substrata	X			
Embeddedness		X		
Shelter for fish	X			
Channel Alteration			X	
Sediment Deposition			X	
Velocity and Depth	X			
Channel Flow	X			
Bank Vegetation		X		
Bank Condition		X		
Riparian Vegetation			X	

Wetted width: Riffles: 600 in. **Runs:** 900 in. **Pools:** 1200 in.
Thalweg depth: Riffles: 12 in. **Runs:** 18 in. **Pools:** 24 in.
Bottom type: Silts, Sands, Gravel, Cobble, Boulder, Bedrock

INADEQUATE BUFFER

IB

Map: Figure 7 **Team:** A **Site:** R7-01
Date: 03/18/15 (MM DD YY) **Photo:** 372-480 **Survey:** _____

Buffer inadequate on: (Left) Right Both (looking downstream)
Is stream unshaded? Left Right Both (looking downstream) (Neither)
Buffer width left: 25 ft. **Buffer width right:** 50 ft.
Length left: 100 ft. **Length right:** 0 ft.
Present land use left side: Crop field, Pasture, Lawn, (Paved), Shrubs & Small Trees, Forest, Multiflora Rose, Other _____
Present land use right side: Crop field, (Pasture), Lawn, Paved, Shrubs & Small Trees, (Forest), Multiflora Rose, Other _____
Has a buffer recently been established: Yes (No)
Are Livestock present: Yes (No) **Type:** Cattle, Horses, Pigs, Other: _____

Severity	Severe	1	2	(3)	4	~~5~~	Minor	Unknown (-1)
Correctability	Best	1	2	3	(4)	~~5~~	Worst	Unknown (-1)
Access	Best	(1)	2	3	4	5	Worst	Unknown (-1)
Wetland Potential	Best	1	2	(3)	4	5	Worst	Unknown (-1)

(Good wetland potential = low slope, low bank height)

INADEQUATE BUFFER

IB

Map: Figure 8 **Team:** A **Site:** R8-01
Date: 3/18/15 (MM DD YY) **Photo:** 831-609 **Survey:** _____

Buffer inadequate on: (Left) (Right) Both (looking downstream)
Is stream unshaded? Left Right Both (looking downstream) (Neither)
Buffer width left: 5 ft. **Buffer width right:** 15 ft.
Length left: 100 ft. **Length right:** 103 ft.
Present land use left side: Crop field, Pasture, Lawn, (Paved), Shrubs & Small Trees, Forest, Multiflora Rose, Other _____
Present land use right side: Crop field, Pasture, (Lawn), Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____
Has a buffer recently been established: Yes (No)
Are Livestock present: Yes (No) **Type:** Cattle, Horses, Pigs, Other: _____

Severity	Severe	1	(2)	3	~~4~~	5	Minor	Unknown (-1)
Correctability	Best	1	2	3	4	(5)	Worst	Unknown (-1)
Access	Best	(1)	2	3	4	5	Worst	Unknown (-1)
Wetland Potential	Best	1	(2)	3	4	5	Worst	Unknown (-1)

(Good wetland potential = low slope, low bank height)

EROSION SITE

ES

Map: Figure 7 Team: A Site: R7-01

Date: 03/18/15 (MM DD YY) Photo: 772 Survey: _____

Type: Downcutting (Widening) Headcutting Unknown

Cause: (Bend at steep slope), Pipe Outfall, Below Channelization, Below Road Crossing, Livestock, Land Use Change Upstream, Other: _____

Length: 100 + ft. **Average exposed bank height:** 4 ft.

Present Land Use Left Side (looking downstream): Crop field, Pasture, Lawn, (Paved), Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Present Land Use Right Side (looking downstream): Crop field, (Pasture), Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Threat to Infrastructure?: Yes (No) **Describe:** _____

Severity	Severe	1	(2)	3	4	~~(5)~~	Minor	Unknown (-1)
Correctability	Best	1	2	3	(4)	~~5~~	Worst	Unknown (-1)
Access	Best	1	(2)	3	4	5	Worst	Unknown (-1)

EROSION SITE

ES

Map: Figure 17 Team: A Site: R17-02

Date: 03/18/15 (MM DD YY) Photo: 540-761 Survey: _____

Type: (Downcutting) Widening Headcutting Unknown

Cause: Bend at steep slope, (Pipe Outfall), Below Channelization, Below Road Crossing, Livestock, Land Use Change Upstream, Other: _____

Length: 20 ft. **Average exposed bank height:** 4 ft

Present Land Use Left Side (looking downstream): Crop field, (Pasture), Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Present Land Use Right Side (looking downstream): Crop field, (Pasture), Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Threat to Infrastructure?: Yes (No) **Describe:** _____

Severity	Severe	1	2	(3)	4	5	Minor	Unknown (-1)
Correctability	Best	1	(2)	3	4	5	Worst	Unknown (-1)
Access	Best	1	(2)	3	4	5	Worst	Unknown (-1)

PIPE OUTFALL

PO

Map: Figure 8 **Team:** A **Site:** R08-02

Date: 03/18/15 (MM DD YY) **Photo:** 831-869 **Survey:** _____

Type of Outfall: (Stormwater), Sewage Overflow, Industrial, Pumping Station, Agricultural, Other: _____

Type of Pipe: Earth Channel, Concrete Channel, Concrete Pipe, Smooth Metal Pipe, (Corrugated Metal), Plastic, Other: _____

Location (facing downstream): (left bank), right bank, head of stream, Other _____

Pipe Diameter: 16 crushed in. **Channel width:** N/A ft.

Evidence of Discharge?: Yes No Not an issue

Color: Clear, medium brown, dark brown, green brown, yellow brown, green, other: Dry

Odor: Sewage, oily, musky, fishy, rotten eggs, chlorine, none, other: Dry

Severity	Severe	1	2	3	4	(5)	Minor	Unknown (-1)
Correctability	Best	(1)	2	3	4	5	Worst	Unknown (-1)
Access	Best	(1)	2	3	4	5	Worst	Unknown (-1)

PIPE OUTFALL

PO

Map: Fig 16 **Team:** A **Site:** R16-02

Date: 3/24/12 (MM DD YY) **Photo:** 967-990 **Survey:** _____

Type of Outfall: (Stormwater), Sewage Overflow, Industrial, Pumping Station, Agricultural, Other: _____

Type of Pipe: Earth Channel, Concrete Channel, (Concrete Pipe), Smooth Metal Pipe, Corrugated Metal, Plastic, Other: _____

Location (facing downstream): (left bank), right bank, head of stream, Other _____

Pipe Diameter: 20 in. **Channel width:** 10 ft.

Evidence of Discharge?: (Yes) No

Color: (Clear), medium brown, dark brown, green brown, yellow brown, green, other: _____

Odor: Sewage, oily, musky, fishy, rotten eggs, chlorine, (none), other: _____

Severity	Severe	1	2	3	4	(5)	Minor	Unknown (-1)
Correctability	Best	1	2	(3)	4	5	Worst	Unknown (-1)
Access	Best	(1)	2	3	4	5	Worst	Unknown (-1)

CHANNEL ALTERATION

CA

Map: Figure 8 Team: A Site: P-29-03

Date: 03/19/15 (MM DD YY) Photo: 831-609 Survey: _____

Type: Concrete, Gabion, Rip-rap, (Earth Channel), Other: _____

Bottom Width: 240 in **Length:** 100 + ft.

Does channel have perennial flow? (Yes) No

Is sediment deposition occurring in the channel? Yes (No)

Is vegetation growing in the channel? Yes (No)

Is it part of a road crossing? (No) Above Below Both

Channelized length above road crossing _____ ft.

Channelized length below road crossing _____ ft.

Severity	Severe	1	2	3	(4)	5	Minor	Unknown (-1)
Correctability	Best	1	2	3	4	(5)	Worst	Unknown (-1)
Access	Best	(1)	2	3	4	5	Worst	Unknown (-1)

CHANNEL ALTERATION

CA

Map: Figure 9 Team: A Site: P-29-02

Date: 03/18/15 (MM DD YY) Photo: 433-146 Survey: _____

Type: Concrete, Gabion, Rip-rap, (Earth Channel) Other: _____

Bottom Width: 240 in **Length:** 100 + ft.

Does channel have perennial flow? (Yes) No

Is sediment deposition occurring in the channel? Yes (No)

Is vegetation growing in the channel? Yes (No)

Is it part of a road crossing? (No) Above Below Both

Channelized length above road crossing _____ ft.

Channelized length below road crossing _____ ft.

Severity	Severe	1	2	3	(4)	5	Minor	Unknown (-1)
Correctability	Best	1	2	3	4	(5)	Worst	Unknown (-1)
Access	Best	(1)	2	3	4	5	Worst	Unknown (-1)

INADEQUATE BUFFER

IB

Map: Figure 9 **Team:** 4 **Site:** R04-01

Date: 3 / 18 / 15 (MM DD YY) **Photo:** 433-446 **Survey:** _____

Buffer inadequate on: (Left) (Right) Both (looking downstream)

Is stream unshaded? Left Right Both (looking downstream) (Neither)

Buffer width left: 5 ft. **Buffer width right:** 10 ft.

Length left: 100 ft. **Length right:** 0 ft.

Present land use left side: Crop field, Pasture, Lawn, (Paved), Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Present land use right side: Crop field, (Pasture), Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Has a buffer recently been established: Yes (No)

Are Livestock present: Yes (No) **Type:** Cattle, Horses, Pigs, Other: _____

Severity	Severe	1	(2)	3	~~4~~	5	Minor	Unknown (-1)
Correctability	Best	1	2	3	4	(5)	Worst	Unknown (-1)
Access	Best	(1)	2	3	4	5	Worst	Unknown (-1)
Wetland Potential	Best	1	2	3	(4)	5	Worst	Unknown (-1)

(Good wetland potential = low slope, low bank height)

INADEQUATE BUFFER

IB

Map: Fig 10 **Team:** A **Site:** R10-01

Date: 3 / 18 / 15 (MM DD YY) **Photo:** 287-296 **Survey:** _____

Buffer inadequate on: Left Right (Both) (looking downstream)

Is stream unshaded? Left Right Both (looking downstream) (Neither)

Buffer width left: 5 ft. **Buffer width right:** 20 ft.

Length left: 100+ ft. **Length right:** 170+ ft.

Present land use left side: Crop field, Pasture, (Lawn), Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Present land use right side: Crop field, (Pasture), Lawn, (Paved), Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Has a buffer recently been established: Yes (No)

Are Livestock present: Yes (No) **Type:** Cattle, Horses, Pigs, Other: _____

Severity	Severe	1	2	3	(4)	5	Minor	Unknown (-1)
Correctability	Best	1	2	3	4	(5)	Worst	Unknown (-1)
Access	Best	1	(2)	3	4	5	Worst	Unknown (-1)
Wetland Potential	Best	1	(2)	3	4	5	Worst	Unknown (-1)

(Good wetland potential = low slope, low bank height)

INADEQUATE BUFFER

IB

Map: Fig 11 **Team:** A **Site:** R11-01

Date: 3 / 18 / 15 (MM DD YY) **Photo:** 791-912 **Survey:** _____

Buffer inadequate on: Left Right (Both) (looking downstream)

Is stream unshaded? Left Right (Both) (looking downstream) Neither

Buffer width left: 0 ft. **Buffer width right:** 0 ft.

Length left: 50+ ft. **Length right:** 50 ft. downstream

Present land use left side: Crop field, (Pasture,) Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Present land use right side: Crop field, (Pasture,) Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Has a buffer recently been established: Yes (No)

Are Livestock present: (Yes) No **Type:** Cattle, Horses, Pigs, Other: _____

Severity	Severe	1	2	(3)	4	5	Minor	Unknown (-1)
Correctability	Best	(1)	2	3	4	5	Worst	Unknown (-1)
Access	Best	(1)	2	3	4	5	Worst	Unknown (-1)
Wetland Potential	Best	1	(2)	3	4	5	Worst	Unknown (-1)

(Good wetland potential = low slope, low bank height)

INADEQUATE BUFFER

IB

Map: Fig 17 **Team:** A **Site:** R12-01

Date: 3 / 18 / 15 (MM DD YY) **Photo:** 540-781 **Survey:** _____

Buffer inadequate on: Left Right (Both) (looking downstream)

Is stream unshaded? Left Right (Both) (looking downstream) Neither

Buffer width left: 0 ft. **Buffer width right:** 25 ft.

Length left: 100+ ft. **Length right:** 50 ft.

Present land use left side: Crop field, Pasture, (Lawn,) (Paved,) Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Present land use right side: Crop field, (Pasture,) Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Has a buffer recently been established: Yes (No)

Are Livestock present: Yes (No) **Type:** Cattle, Horses, Pigs, Other: _____

Severity	Severe	1	2	(3)	4	5	Minor	Unknown (-1)
Correctability	Best	1	(2)	3	4	5	Worst	Unknown (-1)
Access	Best	(1)	2	3	4	5	Worst	Unknown (-1)
Wetland Potential	Best	(1)	2	3	4	5	Worst	Unknown (-1)

(Good wetland potential = low slope, low bank height)

REPRESENTATIVE SITE

RE

Map: Eo 13 **Team:** A **Site:** R13-04

Date: 3 / 18 / 15 (MM DD YY) **Photo:** 393-394 **Survey:** _____

	Optimal	Suboptimal	Marginal	Poor
Macroinvertebrate Substrata			X	
Embeddedness		X		
Shelter for fish			X	
Channel Alteration		X		
Sediment Deposition		X		
Velocity and Depth	X			
Channel Flow		X		
Bank Vegetation		X		
Bank Condition		X		
Riparian Vegetation				X

Wetted width: Riffles: 288 in. **Runs:** 250 in. **Pools:** 60 in.

Thalweg depth: Riffles: 4 in. **Runs:** 18 in. **Pools:** 24 in.

Bottom type: (Silts), Sands, (Gravel), (Cobble), Boulder, (Bedrock)

REPRESENTATIVE SITE

RE

Map: _____ **Team:** _____ **Site:** _____

Date: ___ / ___ / ___ (MM DD YY) **Photo:** _____ **Survey:** _____

	Optimal	Suboptimal	Marginal	Poor
Macroinvertebrate Substrata				
Embeddedness				
Shelter for fish				
Channel Alteration				
Sediment Deposition				
Velocity and Depth				
Channel Flow				
Bank Vegetation				
Bank Condition				
Riparian Vegetation				

Wetted width: Riffles: _____ in. **Runs:** _____ in. **Pools:** _____ in.

Thalweg depth: Riffles: _____ in. **Runs:** _____ in. **Pools:** _____ in.

Bottom type: Silts, Sands, Gravel, Cobble, Boulder, Bedrock

FISH BARRIER

FB

Map: Eg 13 Team: A Site: R13-03

Date: 7 / 18 / 15 (MM DD YY) Photo: 393-394 Survey: _____

Fish Blockage: (Total), Partial, Temporary, Unknown

Type of Barrier: Dam, Road Crossing, Pipe Crossing, Natural Falls, Beaver Dam, Channelized, Instream Pond, Debris Dam, (Other:) Concrete Sluice Pipe

Blockage because: (Too high) (Too shallow) Too fast

Water drop: 6 inches (if too high)

Water depth: 1 inches (if too shallow)

Severity	Severe	~~1~~	(2)	3	4	5	Minor	Unknown (-1)
Correctability	Best	(1)	2	3	4	5	Worst	Unknown (-1)
Access	Best	(1)	2	3	4	5	Worst	Unknown (-1)

FISH BARRIER

FB

Map: _____ Team: A Site: R15-01

Date: 7 / 18 / 15 (MM DD YY) Photo: 042-143 Survey: _____

Fish Blockage: Total, (Partial,) Temporary, Unknown

Type of Barrier: Dam, Road Crossing, Pipe Crossing, Natural Falls, Beaver Dam, Channelized, Instream Pond, Debris Dam, Other: Road Fill

Blockage because: (Too high) Too shallow Too fast

Water drop: 24 inches (if too high)

Water depth: 4 inches (if too shallow)

Severity	Severe	1	2	(3)	4	5	Minor	Unknown (-1)
Correctability	Best	1	(2)	3	4	5	Worst	Unknown (-1)
Access	Best	1	(2)	3	4	5	Worst	Unknown (-1)

INADEQUATE BUFFER

IB

Map: Fig 13 Team: A Site: R13-01

Date: 2 / 18 / 15 (MM DD YY) Photo: 393-394 Survey: _____

Buffer inadequate on: Left Right (Both) (looking downstream)

Is stream unshaded? Left Right (Both) (looking downstream) Neither

Buffer width left: 10 ft. **Buffer width right:** 15 ft.

Length left: 100 ft. **Length right:** 100 ft.

Present land use left side: Crop field, Pasture, Lawn, (Paved), Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Present land use right side: Crop field, (Pasture), Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Has a buffer recently been established: Yes (No)

Are Livestock present: Yes (No) **Type:** Cattle, Horses, Pigs, Other: _____

Severity	Severe	1	2	(3)	4	5	Minor	Unknown (-1)
Correctability	Best	(1)	2	3	4	5	Worst	Unknown (-1)
Access	Best	(1)	2	3	4	5	Worst	Unknown (-1)
Wetland Potential	Best	1	(2)	3	4	5	Worst	Unknown (-1)

(Good wetland potential = low slope, low bank height)

INADEQUATE BUFFER

IB

Map: Fig 14 Team: A Site: R-14-01

Date: 3 / 18 / 15 (MM DD YY) Photo: 037-038 Survey: _____

Buffer inadequate on: Left Right (Both) (looking downstream)

Is stream unshaded? Left Right (Both) (looking downstream) Neither

Buffer width left: 5 ft. **Buffer width right:** 5 ft.

Length left: 100 ft. **Length right:** 100 ft.

Present land use left side: Crop field, (Pasture), Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Present land use right side: Crop field, (Pasture), Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Has a buffer recently been established: Yes (No)

Are Livestock present: Yes (No) **Type:** Cattle, Horses, Pigs, Other: _____

Severity	Severe	~~1~~	2	(3)	4	5	Minor	Unknown (-1)
Correctability	Best	1	(2)	3	4	5	Worst	Unknown (-1)
Access	Best	1	(2)	3	4	5	Worst	Unknown (-1)
Wetland Potential	Best	(1)	2	3	4	5	Worst	Unknown (-1)

(Good wetland potential = low slope, low bank height)

CHANNEL ALTERATION

CA

Map: Fig 13 Team: A Site: R13-02

Date: 3/18/15 (MM DD YY) Photo: 343-324 Survey: _____

Type: Concrete, Gabion, Rip-rap, (Earth Channel), Other: _____

Bottom Width: 25 in Length: 100' ft.

Does channel have perennial flow? (Yes) No

Is sediment deposition occurring in the channel? Yes (No)

Is vegetation growing in the channel? Yes (No)

Is it part of a road crossing? No Above Below (Both)

Channelized length above road crossing 50+ ft.

Channelized length below road crossing 50+ ft.

Severity	Severe	1	2	3	(4)	5	Minor	Unknown (-1)
Correctability	Best	1	2	3	4	(5)	Worst	Unknown (-1)
Access	Best	(1)	2	3	4	5	Worst	Unknown (-1)

CHANNEL ALTERATION

CA

Map: Fig 4 Team: A Site: R11-03

Date: 3/18/15 (MM DD YY) Photo: 037-128 Survey: _____

Type: Concrete, Gabion, Rip-rap, (Earth Channel), Other: _____

Bottom Width: 10 in Length: 100' ft.

Does channel have perennial flow? (Yes) No

Is sediment deposition occurring in the channel? Yes (No)

Is vegetation growing in the channel? Yes (No)

Is it part of a road crossing? No Above Below Both

Channelized length above road crossing 50+ ft.

Channelized length below road crossing 50+ ft.

Severity	Severe	1	2	(3)	4	5	Minor	Unknown (-1)
Correctability	Best	1	2	3	(4)	5	Worst	Unknown (-1)
Access	Best	(1)	2	3	4	5	Worst	Unknown (-1)

EXPOSED PIPE

EP

Map: Fig 14 **Team:** A **Site:** RH-02

Date: 11 / 18 / 15 (MM DD YY) **Photo:** 037-128 **Survey:** _____

Pipe is: Exposed across bottom of stream, Exposed along stream bank, Exposed manhole, (Above stream,) Other: 1 D [illegible] stream

Type of Pipe: Concrete, (Smooth Metal,) Corrugated Metal, Plastic, Terra Cotta, Other: _____

Pipe Diameter: 8 in. **Length exposed:** 8 ft.

Purpose of Pipe: Sewage, Water Supply, Stormwater, (Unknown,) Other: pond, water ?

Evidence of Discharge?: Yes (No)

Color: Clear, medium brown, dark brown, green brown, yellow brown, green, other: _____

Odor: Sewage, oily, musky, fishy, rotten eggs, chlorine, none, other: _____

Severity	Severe	1	2	3	(4)	5	Minor	Unknown (-1)
Correctability	Best	1	2	3	(4)	5	Worst	Unknown (-1)
Access	Best	(1)	2	3	4	5	Worst	Unknown (-1)

EXPOSED PIPE

EP

Map: _____ **Team:** _____ **Site:** _____

Date: ___ / ___ / ___ (MM DD YY) **Photo:** _____ **Survey:** _____

Pipe is: Exposed across bottom of stream, Exposed along stream bank, Exposed manhole, Above stream, Other: _____

Type of Pipe: Concrete, Smooth Metal, Corrugated Metal, Plastic, Terra Cotta, Other: _____

Pipe Diameter: _____ in. **Length exposed:** _____ ft.

Purpose of Pipe: Sewage, Water Supply, Stormwater, Unknown, Other: _____

Evidence of Discharge?: Yes No

Color: Clear, medium brown, dark brown, green brown, yellow brown, green, other: _____

Odor: Sewage, oily, musky, fishy, rotten eggs, chlorine, none, other: _____

Severity	Severe	1	2	3	4	5	Minor	Unknown (-1)
Correctability	Best	1	2	3	4	5	Worst	Unknown (-1)
Access	Best	1	2	3	4	5	Worst	Unknown (-1)

EROSION SITE

ES

Map: Figure 15 Team: A Site: R15-02

Date: 03/18/15 (MM DD YY) Photo: 042-143 Survey: _____

Type: (Downcutting) Widening Headcutting Unknown

Cause: Bend at steep slope, Pipe Outfall, Below Channelization, Below Road Crossing, (Livestock), Land Use Change Upstream, Other: _____

Length: 100 ft. Average exposed bank height: 1 ft.

Present Land Use Left Side (looking downstream): Crop field, (Pasture), Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Present Land Use Right Side (looking downstream): Crop field, (Pasture), Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Threat to Infrastructure?: Yes (No) Describe: _____

Severity	Severe	1	2	(3)	~~4~~	5	Minor	Unknown (-1)
Correctability	Best	1	(2)	3	4	5	Worst	Unknown (-1)
Access	Best	1	2	(3)	4	5	Worst	Unknown (-1)

EROSION SITE

ES

Map: _____ Team: _____ Site: _____

Date: ___/___/___ (MM DD YY) Photo: _____ Survey: _____

Type: Downcutting Widening Headcutting Unknown

Cause: Bend at steep slope, Pipe Outfall, Below Channelization, Below Road Crossing, Livestock, Land Use Change Upstream, Other: _____

Length: _____ ft. Average exposed bank height: _____ ft.

Present Land Use Left Side (looking downstream): Crop field, Pasture, Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Present Land Use Right Side (looking downstream): Crop field, Pasture, Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Threat to Infrastructure?: Yes No Describe: _____

Severity	Severe	1	2	3	4	5	Minor	Unknown (-1)
Correctability	Best	1	2	3	4	5	Worst	Unknown (-1)
Access	Best	1	2	3	4	5	Worst	Unknown (-1)

INADEQUATE BUFFER

IB

Map: Fig 15 Team: A Site: R15-03

Date: 3/18/15 (MM DD YY) Photo: 042-143 Survey: _____

Buffer inadequate on: Left Right **Both** (looking downstream)

Is stream unshaded? Left Right **Both** (looking downstream) Neither

Buffer width left: 2 ft. **Buffer width right:** 0 ft.

Length left: 50+ ft. **Length right:** 50+ ft.

Present land use left side: Crop field, **Pasture**, Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Present land use right side: Crop field, **Pasture**, Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Has a buffer recently been established: Yes **No**

Are Livestock present: **Yes** No **Type:** Cattle, Horses, Pigs, Other: _____

Severity	Severe	**1**	2	3	4	5	Minor	Unknown (-1)
Correctability	Best	1	2	3	**4**	5	Worst	Unknown (-1)
Access	Best	1	**2**	3	4	5	Worst	Unknown (-1)
Wetland Potential	Best	**1**	2	3	4	5	Worst	Unknown (-1)

(Good wetland potential = low slope, low bank height)

INADEQUATE BUFFER

IB

Map: Fig 16 Team: A Site: R16-01

Date: 03/24/15 (MM DD YY) Photo: 167-490 Survey: _____

Buffer inadequate on: **Left** **Right** **Both** (looking downstream)

Is stream unshaded? **Left** **Right** **Both** (looking downstream) Neither

Buffer width left: 20 ft. **Buffer width right:** 10 ft.

Length left: 100+ ft. **Length right:** 100+ ft.

Present land use left side: Crop field, **Pasture**, Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Present land use right side: Crop field, **Pasture**, Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Has a buffer recently been established: Yes **No**

Are Livestock present: **Yes** No **Type:** **Cattle**, Horses, Pigs, Other: _____

Severity	Severe	1	2	**3**	4	5	Minor	Unknown (-1)
Correctability	Best	1	**2**	3	4	5	Worst	Unknown (-1)
Access	Best	**1**	2	3	4	5	Worst	Unknown (-1)
Wetland Potential	Best	1	2	**3**	4	5	Worst	Unknown (-1)

(Good wetland potential = low slope, low bank height)

UNUSUAL CONDITION OR COMMENT

UC

Map: Fig 5 Team: A Site: R15-04

Date: 3 / 12 / 15 (MM DD YY) Photo: 042-143 Survey: _____

Type: (circle one) (Unusual Condition) Comment

Describe: Odor, Scum, Excessive Algae, Water Color/Clarity, Red Flock, Sewage Discharge, Oil

Cattle - fencing at both ends of bridge crossing
& upstream cattle in stream

Potential Cause: _____

Severity	Severe	1	(2)	~~3~~	4	5	Minor	Unknown (-1)
Correctability	Best	1	2	3	4	5	Worst	Unknown (-1)
Access	Best	1	2	3	4	5	Worst	Unknown (-1)

UNUSUAL CONDITION OR COMMENT

UC

Map: Fig 17 Team: A Site: R17-05

Date: 3 / 24 / 15 (MM DD YY) Photo: 520-781 Survey: _____

Type: (circle one) Unusual Condition (Comment)

Describe: Odor, Scum, Excessive Algae, Water Color/Clarity, Red Flock, Sewage Discharge, Oil

Creek has been piped for about 200 ft on private property. Pipe is failing in areas and causing potential fish barriers

Potential Cause: Piped creek

Severity	Severe	1	(2)	3	4	5	Minor	Unknown (-1)
Correctability	Best	1	2	3	4	(5)	Worst	Unknown (-1)
Access	Best	1	(2)	3	4	5	Worst	Unknown (-1)

INADEQUATE BUFFER

IB

Map: Figure 17 **Team:** A **Site:** R17-01

Date: 3/24/15 (MM DD YY) **Photo:** 581-074 **Survey:** _____

Buffer inadequate on: (Left) (Right) (Both) (looking downstream)

Is stream unshaded? (Left) (Right) (Both) (looking downstream) Neither

Buffer width left: 0 ft. **Buffer width right:** 0 ft.

Length left: 100+ ft. **Length right:** 100+ ft.

Present land use left side: Crop field, (Pasture), Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Present land use right side: Crop field, (Pasture), Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Has a buffer recently been established: Yes (No)

Are Livestock present: (Yes) No **Type:** Cattle, (Horses), Pigs, Other: _____

Severity	Severe	1	(2)	3	~~4~~	5	Minor	Unknown (-1)
Correctability	Best	1	2	(3)	4	5	Worst	Unknown (-1)
Access	Best	1	(2)	3	4	5	Worst	Unknown (-1)
Wetland Potential	Best	1	2	(3)	4	5	Worst	Unknown (-1)

(Good wetland potential = low slope, low bank height)

INADEQUATE BUFFER

IB

Map: Figure 18 **Team:** A **Site:** R18-01

Date: 03/24/15 (MM DD YY) **Photo:** 582-078 **Survey:** _____

Buffer inadequate on: (Left) Right Both (looking downstream)

Is stream unshaded? Left (Right) Both (looking downstream) Neither

Buffer width left: 25 ft. **Buffer width right:** 10 ft.

Length left: 50 ft. **Length right:** 100+ ft.

Present land use left side: Crop field, Pasture, (Lawn), Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Present land use right side: Crop field, Pasture, (Lawn), Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Has a buffer recently been established: Yes (No)

Are Livestock present: Yes (No) **Type:** Cattle, Horses, Pigs, Other: _____

Severity	Severe	1	2	(3)	4	5	Minor	Unknown (-1)
Correctability	Best	1	(2)	3	4	5	Worst	Unknown (-1)
Access	Best	(1)	2	3	4	5	Worst	Unknown (-1)
Wetland Potential	Best	1	(2)	3	4	5	Worst	Unknown (-1)

(Good wetland potential = low slope, low bank height)

FISH BARRIER FB

Map: Fig 17 Team: A Site: R17-03

Date: 3/24/15 (MM DD YY) Photo: 551-574 Survey: _____

Fish Blockage: (Total), Partial, Temporary, Unknown

Type of Barrier: Dam, Road Crossing, (Pipe Crossing), Natural Falls, Beaver Dam, Channelized, Instream Pond, Debris Dam, Other: _____

Blockage because: (Too high) Too shallow Too fast

Water drop: 36" (in pipe) inches (if too high)

Water depth: _____ inches (if too shallow)

Severity	Severe	(1)	2	3	4	5	Minor	Unknown (-1)
Correctability	Best	1	2	3	4	(5)	Worst	Unknown (-1)
Access	Best	1	2	3	(4)	5	Worst	Unknown (-1)

FISH BARRIER /Channel Alteration FB

Map: Fig 18 Team: A Site: R18-02

Date: 3/24/15 (MM DD YY) Photo: 882-078 Survey: _____

Fish Blockage: (Total), Partial, Temporary, Unknown

Type of Barrier: Dam, Road Crossing, (Pipe Crossing), Natural Falls, Beaver Dam, Channelized, Instream Pond, Debris Dam, Other: _____

Blockage because: (Too high) Too shallow Too fast

Water drop: 24" inches (if too high)

Water depth: 3 inches (if too shallow)

Severity	Severe	(1)	2	3	4	5	Minor	Unknown (-1)
Correctability	Best	1	2	3	(4)	5	Worst	Unknown (-1)
Access	Best	(1)	2	3	4	5	Worst	Unknown (-1)

CHANNEL ALTERATION

CA

Map: Fig. 17 Team: A Site: R17-04

Date: 03/24/15 (MM DD YY) Photo: 540-781 Survey: _____

Type: Concrete, Gabion, Rip-rap, Earth Channel, Other: Metal Pipe

Bottom Width: 24 in Length: 200 ft.

Does channel have perennial flow? (Yes) No

Is sediment deposition occurring in the channel? Yes (No)

Is vegetation growing in the channel? Yes (No)

Is it part of a road crossing? No Above Below (Both)

Channelized length above road crossing 10 ft.

Channelized length below road crossing 10 ft.

Severity	Severe	1	2	(3)	4	5	Minor	Unknown (-1)
Correctability	Best	1	2	3	(4)	5	Worst	Unknown (-1)
Access	Best	1	(2)	3	4	5	Worst	Unknown (-1)

CHANNEL ALTERATION

CA

Map: _____ Team: _____ Site: _____

Date: ___/___/___ (MM DD YY) Photo: _____ Survey: _____

Type: Concrete, Gabion, Rip-rap, Earth Channel, Other: _____

Bottom Width: _____ in Length: _____ ft.

Does channel have perennial flow? Yes No

Is sediment deposition occurring in the channel? Yes No

Is vegetation growing in the channel? Yes No

Is it part of a road crossing? No Above Below Both

Channelized length above road crossing _____ ft.

Channelized length below road crossing _____ ft.

Severity	Severe	1	2	3	4	5	Minor	Unknown (-1)
Correctability	Best	1	2	3	4	5	Worst	Unknown (-1)
Access	Best	1	2	3	4	5	Worst	Unknown (-1)

INADEQUATE BUFFER

IB

Map: Fig 19 **Team:** A **Site:** 019-01
Date: 05/01/15 (MM DD YY) **Photo:** 059-066 **Survey:** _____

Buffer inadequate on: Left Right (Both) (looking downstream)
Is stream unshaded? Left Right (Both) (looking downstream) Neither
* **Buffer width left:** 5- ft. * **Buffer width right:** 5- ft.
Length left: 25 + ft. **Length right:** 25 + ft.
Present land use left side: Crop field, (Pasture), Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____
Present land use right side: Crop field, (Pasture), Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____
Has a buffer recently been established: Yes (No)
Are Livestock present: Yes (No) **Type:** Cattle, Horses, Pigs, Other: _____

Severity	Severe	1	2	(3)	4	5	Minor	Unknown (-1)
Correctability	Best	1	(2)	3	4	5	Worst	Unknown (-1)
Access	Best	(1)	2	3	4	5	Worst	Unknown (-1)
Wetland Potential	Best	1	2	3	(4)	5	Worst	Unknown (-1)

(Good wetland potential = low slope, low bank height) * Brentwood City side

INADEQUATE BUFFER

IB

Map: Fig 20 **Team:** A **Site:** 020-01
Date: 05/01/15 (MM DD YY) **Photo:** 067-069 **Survey:** _____

* **Buffer inadequate on:** Left Right (Both) (looking downstream)
Is stream unshaded? Left Right (Both) (looking downstream) Neither
Buffer width left: 0 ft. **Buffer width right:** 0 ft.
Length left: 25+ ft. **Length right:** 25+ ft.
Present land use left side: Crop field, Pasture, Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____
Present land use right side: Crop field, (Pasture), Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____
Has a buffer recently been established: Yes (No)
Are Livestock present: Yes (No) **Type:** Cattle, Horses, Pigs, Other: _____

Severity	Severe	~~1~~	2	(3)	4	5	Minor	Unknown (-1)
Correctability	Best	1	(2)	3	4	5	Worst	Unknown (-1)
Access	Best	(1)	2	3	4	5	Worst	Unknown (-1)
Wetland Potential	Best	1	2	(3)	4	5	Worst	Unknown (-1)

(Good wetland potential = low slope, low bank height)

* Downstream of crossing

REPRESENTATIVE SITE

RE

Map: Fig 21 **Team:** A **Site:** 021-1

Date: 05 / 21 / 15 (MM DD YY) **Photo:** 071-074 **Survey:** _____

	Optimal	Suboptimal	Marginal	Poor
Macroinvertebrate Substrata		X		
Embeddedness	X			
Shelter for fish		X		
Channel Alteration		X		
Sediment Deposition		X		
Velocity and Depth	X			
Channel Flow	X			
Bank Vegetation		X		
Bank Condition		X		
Riparian Vegetation		X		

Wetted width: Riffles: 24 in. **Runs:** 144 in. **Pools:** 240 in.

Thalweg depth: Riffles: 10 in. **Runs:** 5 in. **Pools:** 4 in.

Bottom type: Silts, Sands, Gravel, Cobble, Boulder, (Bedrock)

REPRESENTATIVE SITE

RE

Map: _____ **Team:** _____ **Site:** _____

Date: ___ / ___ / ___ (MM DD YY) **Photo:** _____ **Survey:** _____

	Optimal	Suboptimal	Marginal	Poor
Macroinvertebrate Substrata				
Embeddedness				
Shelter for fish				
Channel Alteration				
Sediment Deposition				
Velocity and Depth				
Channel Flow				
Bank Vegetation				
Bank Condition				
Riparian Vegetation				

Wetted width: Riffles: _____ in. **Runs:** _____ in. **Pools:** _____ in.

Thalweg depth: Riffles: _____ in. **Runs:** _____ in. **Pools:** _____ in.

Bottom type: Silts, Sands, Gravel, Cobble, Boulder, Bedrock

FISH BARRIER FB

Map: F-22 Team: A Site: O-22-1

Date: 05/01/15 (MM DD YY) Photo: 075-079 Survey: _____

Fish Blockage: **T**otal, **P**artial, **T**emporary, **U**nknown

Type of Barrier: **D**am, **R**oad Crossing, **P**ipe Crossing, **N**atural **F**alls, **B**eaver **D**am, **C**hannelized, Instream **P**ond, **D**ebris **D**am, **O**ther: _____

Blockage because: Too **h**igh Too **s**hallow Too **f**ast

Water drop: _____ inches (if too high)

Water depth: 2-3 inches (if too shallow)

Severity	Severe	1	2	3	4	5	Minor	Unknown (-1)
Correctability	Best	1	2	3	4	5	Worst	Unknown (-1)
Access	Best	1	2	3	4	5	Worst	Unknown (-1)

FISH BARRIER FB

Map: _____ Team: _____ Site: _____

Date: ___/___/___ (MM DD YY) Photo: _____ Survey: _____

Fish Blockage: **T**otal, **P**artial, **T**emporary, **U**nknown

Type of Barrier: **D**am, **R**oad Crossing, **P**ipe Crossing, **N**atural **F**alls, **B**eaver **D**am, **C**hannelized, Instream **P**ond, **D**ebris **D**am, **O**ther: _____

Blockage because: Too **h**igh Too **s**hallow Too **f**ast

Water drop: _____ inches (if too high)

Water depth: _____ inches (if too shallow)

Severity	Severe	1	2	3	4	5	Minor	Unknown (-1)
Correctability	Best	1	2	3	4	5	Worst	Unknown (-1)
Access	Best	1	2	3	4	5	Worst	Unknown (-1)

UNUSUAL CONDITION OR COMMENT

UC

Map: Fig 22 Team: A Site: 022-S

Date: 05/01/15 (MM DD YY) Photo: 075-079 Survey: _____

Type: (circle one) **Unusual Condition** Comment

Describe: Odor, Scum, Excessive Algae, Water Color/Clarity, Red Flock, Sewage Discharge, Oil

Excessive Algae in Stream

Potential Cause: Application of fertilizer

No buffer

Severity	Severe	1	2	(3)	4	5	Minor	Unknown (-1)
Correctability	Best	(1)	2	3	4	5	Worst	Unknown (-1)
Access	Best	(1)	2	3	4	5	Worst	Unknown (-1)

UNUSUAL CONDITION OR COMMENT

UC

Map: _____ Team: _____ Site: _____

Date: ___/___/___ (MM DD YY) Photo: _____ Survey: _____

Type: (circle one) **Unusual Condition** **Comment**

Describe: Odor, Scum, Excessive Algae, Water Color/Clarity, Red Flock, Sewage Discharge, Oil

Potential Cause: _____

Severity	Severe	1	2	3	4	5	Minor	Unknown (-1)
Correctability	Best	1	2	3	4	5	Worst	Unknown (-1)
Access	Best	1	2	3	4	5	Worst	Unknown (-1)

EROSION SITE

ES

Map: F-22 Team: A Site: 0-22-2

Date: 05/01/15 (MM DD YY) Photo: 075-079 Survey: _____

Type: (Downcutting) Widening Headcutting Unknown

Cause: Bend at steep slope, Pipe Outfall, Below Channelization, Below Road Crossing, Livestock, Land Use Change Upstream, (Other): No Buffer

Length: 50 + ft. Average exposed bank height: 20" ft.

Present Land Use Left Side (looking downstream): Crop field, Pasture, (Lawn), Paved, (Shrubs & Small Trees), Forest, Multiflora Rose, Other _____

Present Land Use Right Side (looking downstream): Crop field, Pasture, (Lawn), (Paved), (Shrubs & Small Trees), Forest, Multiflora Rose, Other _____

Threat to Infrastructure?: Yes (No) Describe: _____

Severity	Severe	1	(2)	3	~~4~~	5	Minor	Unknown (-1)
Correctability	Best	(1)	2	3	4	5	Worst	Unknown (-1)
Access	Best	(1)	2	3	4	5	Worst	Unknown (-1)

EROSION SITE

ES

Map: _____ Team: _____ Site: _____

Date: ___/___/___ (MM DD YY) Photo: _____ Survey: _____

Type: Downcutting Widening Headcutting Unknown

Cause: Bend at steep slope, Pipe Outfall, Below Channelization, Below Road Crossing, Livestock, Land Use Change Upstream, Other: _____

Length: _____ ft. Average exposed bank height: _____ ft.

Present Land Use Left Side (looking downstream): Crop field, Pasture, Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Present Land Use Right Side (looking downstream): Crop field, Pasture, Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____

Threat to Infrastructure?: Yes No Describe: _____

Severity	Severe	1	2	3	4	5	Minor	Unknown (-1)
Correctability	Best	1	2	3	4	5	Worst	Unknown (-1)
Access	Best	1	2	3	4	5	Worst	Unknown (-1)

PIPE OUTFALL

PO

Map: F-3 22 **Team:** A **Site:** 022-3

Date: 05/01/15 (MM DD YY) **Photo:** 075-079 **Survey:** _____

Type of Outfall: (Stormwater), Sewage Overflow, Industrial, Pumping Station, Agricultural, Other: _____

Type of Pipe: Earth Channel, Concrete Channel, (Concrete Pipe), Smooth Metal Pipe, Corrugated Metal, Plastic, Other: _____

Location (facing downstream): left bank, (right bank), head of stream, Other _____

Pipe Diameter: 2-15 in. **Channel width:** 4 ft.

Evidence of Discharge?: Yes (No)

Color: Clear, medium brown, dark brown, green brown, yellow brown, green, other: N/A

Odor: Sewage, oily, musky, fishy, rotten eggs, chlorine, (none), other: _____

Severity	Severe	**1**	**2**	**3**	**4**	(**5**)	Minor	Unknown (**-1**)
Correctability	Best	(**1**)	**2**	**3**	**4**	**5**	Worst	Unknown (**-1**)
Access	Best	(**1**)	**2**	**3**	**4**	**5**	Worst	Unknown (**-1**)

PIPE OUTFALL

PO

Map: _____ **Team:** _____ **Site:** _____

Date: ___/___/___ (MM DD YY) **Photo:** _____ **Survey:** _____

Type of Outfall: Stormwater, Sewage Overflow, Industrial, Pumping Station, Agricultural, Other: _____

Type of Pipe: Earth Channel, Concrete Channel, Concrete Pipe, Smooth Metal Pipe, Corrugated Metal, Plastic, Other: _____

Location (facing downstream): left bank, right bank, head of stream, Other _____

Pipe Diameter: _____ in. **Channel width:** _____ ft.

Evidence of Discharge?: Yes No

Color: Clear, medium brown, dark brown, green brown, yellow brown, green, other: _____

Odor: Sewage, oily, musky, fishy, rotten eggs, chlorine, none, other: _____

Severity	Severe	**1**	**2**	**3**	**4**	**5**	Minor	Unknown (**-1**)
Correctability	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**-1**)
Access	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**-1**)

INADEQUATE BUFFER

IB

Map: Fig 22 **Team:** A **Site:** 0 22-4
Date: 05/01/15 (MM DD YY) **Photo:** 075-077 **Survey:** _____

Buffer inadequate on: Left Right **Both** (looking downstream)
Is stream unshaded? Left Right **Both** (looking downstream) Neither
Buffer width left: 0 ft. **Buffer width right:** 0 ft.
Length left: 100± ft. **Length right:** 100± ft.
Present land use left side: Crop field, Pasture, **Lawn**, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____
Present land use right side: Crop field, Pasture, **Lawn**, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____
Has a buffer recently been established: Yes **No**
Are Livestock present: Yes **No** **Type:** Cattle, Horses, Pigs, Other: _____

Severity	Severe	**1**	2	3	~~4~~	5	Minor	Unknown (-1)
Correctability	Best	1	2	**3**	4	5	Worst	Unknown (-1)
Access	Best	**1**	2	3	4	5	Worst	Unknown (-1)
Wetland Potential	Best	1	**2**	3	4	5	Worst	Unknown (-1)

(Good wetland potential = low slope, low bank height)

INADEQUATE BUFFER

IB

Map: Fig 22 **Team:** A **Site:** 022-1
Date: 05/01/15 (MM DD YY) **Photo:** 080-081 **Survey:** _____

Buffer inadequate on: Left Right **Both** (looking downstream)
Is stream unshaded? Left Right **Both** (looking downstream) Neither
* **Buffer width left:** 0 ft. **Buffer width right:** 0 ft.
Length left: 50± ft. **Length right:** 50± ft.
Present land use left side: Crop field, Pasture, **Lawn**, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____
Present land use right side: Crop field, Pasture, **Lawn**, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _____
Has a buffer recently been established: Yes **No**
Are Livestock present: Yes **No** **Type:** Cattle, Horses, Pigs, Other: _____

Severity	Severe	1	2	3	4	**5**	Minor	Unknown (-1)
Correctability	Best	**1**	2	3	4	5	Worst	Unknown (-1)
Access	Best	1	**2**	3	4	5	Worst	Unknown (-1)
Wetland Potential	Best	1	2	**3**	4	5	Worst	Unknown (-1)

(Good wetland potential = low slope, low bank height)

* Above Crossing

APPENDIX D – PHOTOGRAPHIC DOCUMENTATION

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of the Harpeth River at Sneed Road chemical sampling site facing upstream.

TETRA TECH, INC.

Photograph Number 1

Photograph taken by Williamson County between June 18, 2014 and October 28, 2014.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of the Harpeth River at Sneed Road chemical sampling site facing downstream.

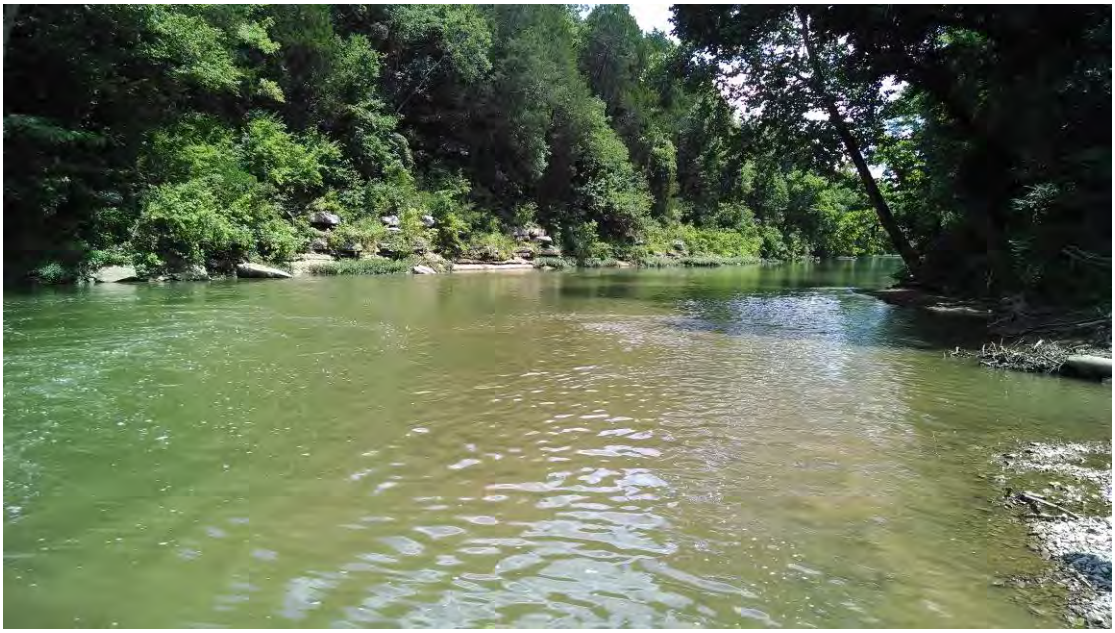
Photograph taken by Williamson County between June 18, 2014 and October 28, 2014.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of the Harpeth River at Old Natchez Trace Road chemical sampling site facing upstream.

Photograph taken by Williamson County between June 18, 2014 and October 28, 2014.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee



Description:	View of the Harpeth River at Old Natchez Trace Road chemical sampling site facing downstream.

TETRA TECH, INC.

Photograph Number 4

Photograph taken by Williamson County between June 18, 2014 and October 28, 2014.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of the Harpeth River at Moran Road chemical sampling site facing upstream.

Photograph taken by Williamson County between June 18, 2014 and October 28, 2014.

Description:	View of the Harpeth River at Moran Road chemical sampling site facing downstream.

Photograph taken by Williamson County between June 18, 2014 and October 28, 2014.

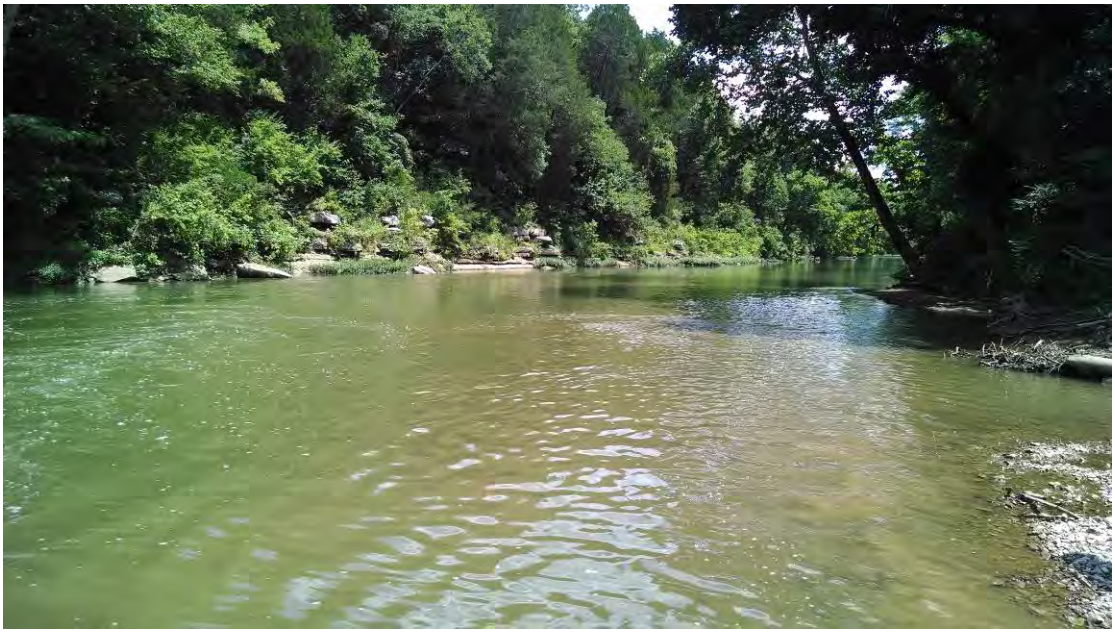
Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of the Harpeth River at Old Hillsboro Road chemical sampling site facing upstream.

Photograph taken by Williamson County between June 18, 2014 and October 28, 2014.

Description:	View of the Harpeth River at Old Hillsboro Road chemical sampling site mid-reach showing the rocks in the stream.

Photograph taken by Williamson County between June 18, 2014 and October 28, 2014.

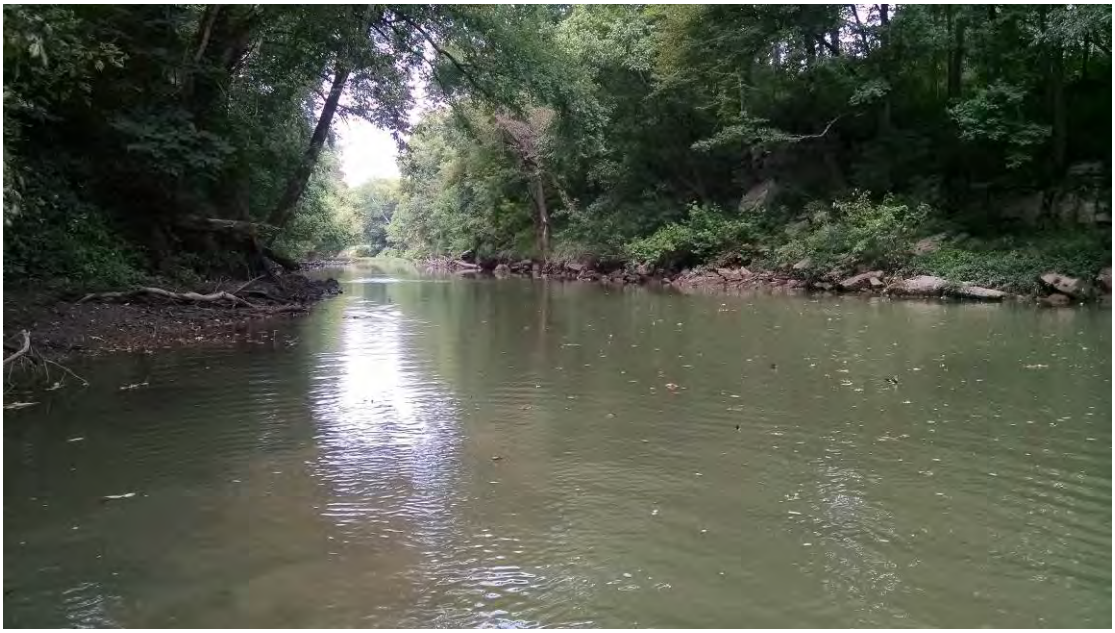


Description:	View of the Harpeth River at Old Hillsboro Road chemical sampling site facing downstream.

Photograph taken by Williamson County between June 18, 2014 and October 28, 2014.

Description:	View of the Harpeth River at Cotton Road chemical sampling site facing upstream.

Photograph taken by Williamson County between June 18, 2014 and October 28, 2014.



Description:	View of the Harpeth River at Cotton Road chemical sampling site facing downstream.

Photograph taken by Williamson County between June 18, 2014 and October 28, 2014.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of the Harpeth River at Arno Road facing upstream.

TETRA TECH, INC.

Photograph Number 12

Photograph taken by Williamson County between June 18, 2014 and October 28, 2014.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of the Harpeth River at Arno Road chemical sampling site facing downstream.

TETRA TECH, INC.

Photograph Number 13

Photograph taken by Williamson County between June 18, 2014 and October 28, 2014.

Description:	View of the Little Harpeth River at Vaughn Road biological sampling site facing upstream.

Photograph taken by Williamson County between June 18, 2014 and October 28, 2014.

Description:	View of the Little Harpeth River at Vaughn Road biological sampling site at mid-reach.

Photograph taken by Williamson County between June 18, 2014 and October 28, 2014.

Description:	View of the Little Harpeth River at Vaugh Road biological sampling site facing downstream and showing one of the riffles sampled.

Photograph taken by Williamson County between June 18, 2014 and October 28, 2014.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of the Little Harpeth River at Hillsboro Road biological sampling site facing upstream.

TETRA TECH, INC.

Photograph Number 17

Photograph taken by Williamson County between June 18, 2014 and October 28, 2014.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of the Little Harpeth River at Hillsboro Road biological sampling site at mid-reach.

TETRA TECH, INC.

Photograph Number 18

Photograph taken by Williamson County between June 18, 2014 and October 28, 2014.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of the Little Harpeth River at Hillsboro Road biological sampling site facing downstream.

TETRA TECH, INC.

Photograph Number 19

Photograph taken by Williamson County between June 18, 2014 and October 28, 2014.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of the Owl Creek at Split Log Road biological sampling site facing upstream.

Photograph taken by Williamson County between June 18, 2014 and October 28, 2014.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of the Owl Creek at Split Log Road biological sampling site facing downstream.

Photograph taken by Williamson County between June 18, 2014 and October 28, 2014.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of the Rutherford Creek at Old Bethesda Road biological sampling site facing upstream.

Photograph taken by Williamson County between June 18, 2014 and October 28, 2014.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of the Rutherford Creek at Old Bethesda Road biological sampling site facing downstream.

Photograph taken by Williamson County between June 18, 2014 and October 28, 2014.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of the Rutherford Creek at Cross Keys Road biological sampling site facing upstream.

Photograph taken by Williamson County between June 18, 2014 and October 28, 2014.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of the Rutherford Creek at Cross Keys Road biological sampling site facing downstream.

Photograph taken by Williamson County between June 18, 2014 and October 28, 2014.

Description:	View of VSA Site 1, Harpeth River at Sneed Road, facing south, showing torrent flow debris build up on bridge pilings, facing northeast (upstream). The debris pile is visible on aerial imagery, Figure 26.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Description:	Additional view of VSA Site 1 showing the torrent flow debris across bridge pilings and across the stream, facing east.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 1 showing the torrent flow debris below the bridge, facing east.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Description:	View of VSA Site 1 showing erosion on the river bank below the bridge. Photograph taken facing north, downstream.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 2, Harpeth River at Moran Road, showing minor floodplain erosion and sediment bars in the stream reach. The residential lawn is visible in the left background of the photograph.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 2, Harpeth River at Moran Road, showing erosion, and collapsing river banks.

TETRA TECH, INC.

Photograph Number 31

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 3, Harpeth River at Old Natchez Trace Road, a representative site.

TETRA TECH, INC.

Photograph Number 32

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 3, Harpeth River at Old Natchez Trace Road showing riffle pools and some torrent debris.

TETRA TECH, INC.

Photograph Number 33

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA 4 Site, Harpeth River at Old Natchez Trace and Lawrence Road showing torrent debris.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of the bank of VSA Site 4, Harpeth River at Old Natchez Trace and Lawrence Roads. Note sheet flow runoff adjacent properties and proximity of the edge of pavement to bank edge. It appears as if some vegetation was planted here recently.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Description:	View of VSA Site 5, Harpeth River at Cotton Lane with steep banks and inadequate buffer. Note a recently cleared area that has been covered with hay.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Description:	Additional view of VSA Site 5, Harpeth River at Cotton Lane with steep banks and inadequate buffer.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Description:	View of VSA Site 6, Little Harpeth River at Vaughn Road, a representative site. Note the sediment deposition on the creek bed.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Description:	View of VSA Site 6, Little Harpeth River at Vaughn Road.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 7, Rutherford Creek at Smithson Road showing high flow bank erosion and sediment bars, facing southwest.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 7, Rutherford Creek at Smithson Road showing bank under cutting and gravel bars, facing northeast.

TETRA TECH, INC.

Photograph Number 41

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 7, Rutherford Creek at Smithson Road showing the proximity of the edge of pavement and edge of creek bank. Photograph taken facing south.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 8, Rutherford Creek at Old Bethesda-Duplex Road indicating proximity of road surface and edge of creek bank. Photograph taken facing northeast.

TETRA TECH, INC.

Photograph Number 43

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 8, Rutherford Creek at Old Bethesda-Duplex Road illustrating corrugated metal stormwater pipe eroding steep creek bank.

TETRA TECH, INC.

Photograph Number 44

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Description:	Additional view of the stormwater pipe at VSA Site 8, Rutherford Creek at Old Bethesda-Duplex Road.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 8, Rutherford Creek at Old Bethesda-Duplex Road.

TETRA TECH, INC.

Photograph Number 46

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 9, Rutherford Creek at Old Bethesda-Duplex Road documenting the edge of road surface to creek bed. Photograph taken facing southwest.

TETRA TECH, INC.

Photograph Number 47

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Description:	View of VSA Site 9, Rutherford Creek and proximity of road surface to creek bank, facing north.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 10, Rutherford Creek at Bethesda-Duplex Road, facing northeast. Note the proximity of the road surface to the creek bank.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Description:	View of VSA Site 10, Rutherford Creek at Bethesda-Duplex Road, facing south.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 11, Rutherford Creek at Mosley Road, facing west and showing steep vegetated creek banks and bridge abutment erosion.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Description:	View of VSA Site 11, Rutherford Creek at Mosley Road and surrounding agricultural operation facing east.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 12, Rutherford Creek at Cross Keys Road with steep creek banks and bridge erosion and sediment deposition. The photograph was taken facing east.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	Additional view of VSA Site 12, Rutherford Creek at Cross Keys Road showing debris washed up on the bank. Photograph taken facing northwest.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 13, Rutherford Creek at Cross Keys/ Comstock Road documenting natural or manmade fish barrier. Photograph taken facing east.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 13, Rutherford Creek at Cross Keys/ Comstock Road documenting bank erosion.

TETRA TECH, INC.

Photograph Number 56

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Description:	View of VSA Site 14, Rutherford Creek at Cross Keys Road documenting blockage with a cattle gate.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 14, showing an iron pipe crossing the stream corridor.

TETRA TECH, INC.

Photograph Number 58

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of Rutherford Creek at VSA Site 14 south of Cross Keys Road, facing southwest.

TETRA TECH, INC.

Photograph Number 59

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 14, showing Rutherford Creek north of Cross Keys Road, facing northeast.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 15, Rutherford Creek at Cross Keys Road showing blockage with a cattle gate. Note the bank failure in the background of the photo. Photograph taken on the northern side of the road facing northwest.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 15 showing a cattle gate on the southern side of the bridge and evidence of cattle presence in the creek. Photograph taken facing northwest along Cross Keys Road.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Description:	Additional view of the cattle gate at VSA Site 15, facing northwest.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Description:	View of VSA Site 15, to the south showing another cattle gate across the creek and evidence of cattle in the creek.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 16, Rutherford Creek at Cross Keys Road showing the recessed stormwater outfall pipe. Photograph taken facing east.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Description:	View of VSA Site 16, Rutherford Creek at Cross Keys Road facing west.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 16, Rutherford Creek at Cross Keys Road showing the cattle gate beneath the road bridge.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Description:	View of VSA Site 17, Rutherford Creek at Pulltight Hill Road, documenting channel alteration through a corrugated metal pipe, pipe damage, and debris blockage which is a fish barrier.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 17, facing west, showing agricultural use.

TETRA TECH, INC.

Photograph Number 69

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 17 facing east.

TETRA TECH, INC.

Photograph Number 70

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Description:	View of VSA Site 18, east of Mt. Zion Road showing the creek banks that appear to be mowed as a residential lawn. Note the corrugated metal pipe that acts as a road culvert.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Description:	View of the corrugated metal pipe that acts a road culvert at VSA Site 18 on the west side of Mt. Zion Road. The creek bed has been blocked by rip rap below the pipe.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Description:	View of the creek channel to the west of Mt. Zion Road at VSA Site 18.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 19, Owl Creek at Split Log Road. Excessive algae was observed in the stream reach.

TETRA TECH, INC.

Photograph Number 74

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 19, Owl Creek at Split Log Road showing inadequate riparian buffer and excessive vegetation in the creek.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Description:	View of VSA Site 20, Owl Creek at Pleasant Hill Road and Split log Road, facing south.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 20 facing east.

TETRA TECH, INC.

Photograph Number 77

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 21, Owl Creek at Pleasant Hill Road which is a representative site. Photograph taken facing south along Pleasant Hill Road.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 21, Owl Creek at Pleasant Hill Road. This is a representative site.

TETRA TECH, INC.

Photograph Number 79

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 22, Owl Creek at Vernon Road with excessive algae in creek bed and downcutting of creek banks.

TETRA TECH, INC.

Photograph Number 80

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	View of VSA Site 22 with showing creek channel blockage and slight headwall erosion.

TETRA TECH, INC.

Photograph Number 81

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Photographic Documentation
2014 / 2015 Stream Monitoring Report
Williamson County, Tennessee

Description:	Close-up view of creek blockage at VSA Site 22.

TETRA TECH, INC.

Photograph Number 82

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Description:	View of VSA Site 22, Owl Creek at Vernon Road, showing algae in the stream and build up around the road.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Description:	View of VSA Site 22 showing sedimentation at the culverts that is blocking stream flow.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Description:	View of VSA Site 23, west of Whistler Cove. The creek banks appear to be mowed as a residential lawn.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

Description:	View of VSA Site 23, to the east of Whistler Cove that has a wider riparian buffer beyond the residential fence.

Photograph taken by Williamson County between March 18, 2015 to May 15, 2015.

APPENDIX E – LABORATORY REPORTS

12065 Lebanon Rd.
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Tax I.D. 62-0814289

Est. 1970

Amy Tolley
Tetra Tech EMI
712 Melrose Ave.
Nashville, TN 37211

Report Summary

Friday June 27, 2014

Report Number: L705597
Samples Received: 06/19/14
Client Project:

Description: Harpeth River at Sneed Road

The analytical results in this report are based upon information supplied by you, the client, and are for your exclusive use. If you have any questions regarding this data package, please do not hesitate to call.

Entire Report Reviewed By: Darren O. Reeder

Darren Reeder , ESC Representative

Laboratory Certification Numbers

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - 01157CA, CT - PH-0197, FL - E87487, GA - 923, IN - C-TN-01, KY - 90010, KYUST - 0016, NC - ENV375/DW21704/BIO041, ND - R-140. NJ - TN002, NJ NELAP - TN002, SC - 84004, TN - 2006, VA - 460132, WV - 233, AZ - 0612, MN - 047-999-395, NY - 11742, WI - 998093910, NV - TN000032011-1, TX - T104704245-11-3, OK - 9915, PA - 68-02979, IA Lab #364, EPA - TN002

Accreditation is only applicable to the test methods specified on each scope of accreditation held by ESC Lab Sciences.

Where applicable, sampling conducted by ESC is performed per guidance provided in laboratory standard operating procedures: 060302, 060303, and 060304.

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REPORT OF ANALYSIS

Amy Tolley
Tetra Tech EMI
712 Melrose Ave.
Nashville, TN 37211

June 27, 2014

ESC Sample # : L705597-01

Date Received : June 19, 2014
Description : Harpeth River at Sneed Road

Site ID :

Sample ID : SNEED ROAD

Project # :

Collected By : Michael Scott
Collection Date : 06/18/14 09:30

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
CBOD	16.0	2.00	mg/l	5210 B-2011	06/24/14	1
DOC	1.8	1.0	mg/l	5310 B-2011	06/26/14	1
Ammonia Nitrogen	BDL	0.25	mg/l	350.1	06/27/14	1
Nitrate-Nitrite	1.2	0.10	mg/l	353.2	06/25/14	1
Phosphorus,Total	0.41	0.10	mg/l	365.4	06/26/14	1
Kjeldahl Nitrogen, TKN	BDL	0.25	mg/l	351.2	06/25/14	1
TOC (Total Organic Carbon)	1.8	1.0	mg/l	9060A	06/20/14	1
Suspended Solids	14.	2.5	mg/l	2540 D-2011	06/24/14	1

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
The reported analytical results relate only to the sample submitted.

.
Reported: 06/27/14 17:10 Printed: 06/27/14 17:10

Attachment A
List of Analytes with QC Qualifiers

Sample Number	Work Group	Sample Type	Analyte	Run ID	Qualifier
L705597-01	WG727470	SAMP	CBOD	R2948525	J+

Attachment B
Explanation of QC Qualifier Codes

Qualifier	Meaning
J+	The associated batch QC was outside the upper control limits; associated data has a potential positive bias

Qualifier Report Information

ESC utilizes sample and result qualifiers as set forth by the EPA Contract Laboratory Program and as required by most certifying bodies including NELAC. In addition to the EPA qualifiers adopted by ESC, we have implemented ESC qualifiers to provide more information pertaining to our analytical results. Each qualifier is designated in the qualifier explanation as either EPA or ESC. Data qualifiers are intended to provide the ESC client with more detailed information concerning the potential bias of reported data. Because of the wide range of constituents and variety of matrices incorporated by most EPA methods,it is common for some compounds to fall outside of established ranges. These exceptions are evaluated and all reported data is valid and useable "unless qualified as 'R' (Rejected)."

Definitions

Accuracy - The relationship of the observed value of a known sample to the true value of a known sample. Represented by percent recovery and relevant to samples such as: control samples, matrix spike recoveries, surrogate recoveries, etc.

Precision - The agreement between a set of samples or between duplicate samples. Relates to how close together the results are and is represented by Relative Percent Differrence.

Surrogate - Organic compounds that are similar in chemical composition, extraction, and chromotography to analytes of interest. The surrogates are used to determine the probable response of the group of analytes that are chemically related to the surrogate compound. Surrogates are added to the sample and carried through all stages of preparation and analyses.

TIC - Tentatively Identified Compound: Compounds detected in samples that are not target compounds, internal standards, system monitoring compounds, or surrogates.

Summary of Remarks For Samples Printed
06/27/14 at 17:10:55

TSR Signing Reports: 296
R5 - Desired TAT

Sample: L705597-01 Account: TETRA Received: 06/19/14 10:50 Due Date: 06/26/14 00:00 RPT Date: 06/27/14 17:10

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Nashville, TN 37211

Quality Assurance Report
Level II

L705597

June 27, 2014

Laboratory Blank

Analyte	Result	Units	% Rec	Limit	Batch	Date Analyzed
TOC (Total Organic Carbon)	< 1	mg/l			WG727485	06/20/14 06:56
Suspended Solids	< 2.5	mg/l			WG728048	06/24/14 09:46
CBOD	-0.100	mg/l			WG727470	06/24/14 09:31
CBOD	-0.0400	mg/l			WG727470	06/24/14 09:31
CBOD	-0.0500	mg/l			WG727470	06/24/14 11:26
CBOD	-0.0800	mg/l			WG727470	06/24/14 11:27
Nitrate-Nitrite	< .1	mg/l			WG728138	06/25/14 10:37
Kjeldahl Nitrogen, TKN	< .25	mg/l			WG728300	06/25/14 19:50
Phosphorus,Total	< .1	mg/l			WG728579	06/26/14 01:44
DOC	< 1	mg/l			WG728202	06/26/14 10:50
Ammonia Nitrogen	< .25	mg/l			WG728550	06/27/14 13:22

Duplicate

Analyte	Units	Result	Duplicate	RPD	Limit	Ref Samp	Batch
TOC (Total Organic Carbon)	mg/l	34.8	35.0	0.573	20	L704816-02	WG727485
TOC (Total Organic Carbon)	mg/l	1.65	1.80	8.70	20	L705597-01	WG727485
Suspended Solids	mg/l	248.	258.	3.95	5	L705516-01	WG728048
Suspended Solids	mg/l	173.	174.	0.576	5	L705727-01	WG728048
CBOD	mg/l	5.60	0.00	NA	30	L705516-02	WG727470
Nitrate-Nitrite	mg/l	0.0	0.0	0.0	20	L705700-02	WG728138
Nitrate-Nitrite	mg/l	1.10	1.10	0.0	20	L705700-05	WG728138
Kjeldahl Nitrogen, TKN	mg/l	1.26	1.40	10.5	20	L701773-06	WG728300
Phosphorus,Total	mg/l	0.0	0.0	0.0	20	L705586-01	WG728579
Phosphorus,Total	mg/l	0.940	0.880	6.59	20	L705897-01	WG728579
DOC	mg/l	1.80	1.80	0.0	20	L705597-01	WG728202
Ammonia Nitrogen	mg/l	0.0	0.0	0.0	20	L705505-07	WG728550
Ammonia Nitrogen	mg/l	0.0	0.0	0.0	20	L705499-02	WG728550

* Performance of this Analyte is outside of established criteria.
For additional information, please see Attachment A 'List of Analytes with QC Qualifiers.'

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Nashville, TN 37211

Quality Assurance Report
Level II

L705597

June 27, 2014

Laboratory Control Sample

Analyte	Units	Known Val	Result	% Rec	Limit	Batch
TOC (Total Organic Carbon)	mg/l	75	75.0	99.9	85-115	WG727485
Suspended Solids	mg/l	773	856.	111.	85-115	WG728048
CBOD	mg/l	198	199.	101.	85-115	WG727470
CBOD	mg/l	198	231.	117.*	85-115	WG727470
Nitrate-Nitrite	mg/l	5	4.78	95.6	90-110	WG728138
Kjeldahl Nitrogen, TKN	mg/l	16.7	17.0	102.	90-110	WG728300
Phosphorus,Total	mg/l	1	0.994	99.4	90-110	WG728579
DOC	mg/l	75	78.5	105.	85-115	WG728202
Ammonia Nitrogen	mg/l	7.5	7.05	94.0	90-110	WG728550

Laboratory Control Sample Duplicate

Analyte	Units	Result	Ref	%Rec	Limit	RPD	Limit	Batch
TOC (Total Organic Carbon)	mg/l	74.9	75.0	100.	85-115	0.0267	20	WG727485
Suspended Solids	mg/l	840.	856.	109.	85-115	1.89	5	WG728048
Nitrate-Nitrite	mg/l	4.78	4.78	96.0	90-110	0.0	20	WG728138
Kjeldahl Nitrogen, TKN	mg/l	17.1	17.0	102.	90-110	0.587	20	WG728300
Phosphorus,Total	mg/l	0.987	0.994	99.0	90-110	0.707	20	WG728579
DOC	mg/l	78.4	78.5	104.	85-115	0.0382	20	WG728202

Matrix Spike

Analyte	Units	MS Res	Ref Res	TV	% Rec	Limit	Ref Samp	Batch
TOC (Total Organic Carbon)	mg/l	52.0	2.70	50	98.6	80-120	L705442-01	WG727485
Nitrate-Nitrite	mg/l	4.06	0.100	5	79.0*	90-110	L705724-03	WG728138
Kjeldahl Nitrogen, TKN	mg/l	4.94	0.00	5	98.8	90-110	L705508-01	WG728300
Phosphorus,Total	mg/l	2.74	0.260	2.5	99.0	90-110	L705678-02	WG728579
DOC	mg/l	53.2	1.80	50	100.	80-120	L705597-01	WG728202

* Performance of this Analyte is outside of established criteria.
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Quality Assurance Report
Level II

L705597

June 27, 2014

Analyte	Units	Matrix Spike MS Res	Ref Res	TV	% Rec	Limit	Ref Samp	Batch
Ammonia Nitrogen	mg/l	10.0	0.0	10	100.	90-110	L705499-01	WG728550

Analyte	Units	Matrix Spike Duplicate MSD	Ref	%Rec	Limit	RPD	Limit	Ref Samp	Batch
TOC (Total Organic Carbon)	mg/l	51.6	52.0	97.7	80-120	0.869	20	L705442-01	WG727485
Nitrate-Nitrite	mg/l	4.18	4.06	81.6*	90-110	2.91	20	L705724-03	WG728138
Kjeldahl Nitrogen, TKN	mg/l	5.00	4.94	100.	90-110	1.21	20	L705508-01	WG728300
Phosphorus,Total	mg/l	2.78	2.74	101.	90-110	1.45	20	L705678-02	WG728579
DOC	mg/l	53.4	53.2	103.	80-120	0.300	20	L705597-01	WG728202
Ammonia Nitrogen	mg/l	9.99	10.0	99.9	90-110	0.100	20	L705499-01	WG728550

Batch number /Run number / Sample number cross reference

WG727485: R2945705: L705597-01
WG728048: R2947541: L705597-01
WG727470: R2948525: L705597-01
WG728138: R2948669: L705597-01
WG728300: R2949474: L705597-01
WG728579: R2950214: L705597-01
WG728202: R2950345: L705597-01
WG728550: R2951150: L705597-01

* * Calculations are performed prior to rounding of reported values.
* Performance of this Analyte is outside of established criteria.
For additional information, please see Attachment A 'List of Analytes with QC Qualifiers.'

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Amy Tolley
712 Melrose Ave.
Nashville, TN 37211

Quality Assurance Report
Level II

L705597

June 27, 2014

The data package includes a summary of the analytic results of the quality control samples required by the SW-846 or CWA methods. The quality control samples include a method blank, a laboratory control sample, and the matrix spike/matrix spike duplicate analysis. If a target parameter is outside the method limits, every sample that is effected is flagged with the appropriate qualifier in Appendix B of the analytic report.

Method Blank - an aliquot of reagent water carried through the entire analytic process. The method blank results indicate if any possible contamination exposure during the sample handling, digestion or extraction process, and analysis. Concentrations of target analytes above the reporting limit in the method blank are qualified with the "B" qualifier.

Laboratory Control Sample - is a sample of known concentration that is carried through the digestion/extraction and analysis process. The percent recovery, expressed as a percentage of the theoretical concentration, has statistical control limits indicating that the analytic process is "in control". If a target analyte is outside the control limits for the laboratory control sample or any other control sample, the parameter is flagged with a "J4" qualifier for all effected samples.

Matrix Spike and Matrix Spike Duplicate - is two aliquots of an environmental sample that is spiked with known concentrations of target analytes. The percent recovery of the target analytes also has statistical control limits. If any recoveries that are outside the method control limits, the sample that was selected for matrix spike/matrix spike duplicate analysis is flagged with either a "J5" or a "J6". The relative percent difference (%RPD) between the matrix spike and the matrix spike duplicate recoveries is all calculated. If the RPD is above the method limit, the effected samples are flagged with a "J3" qualifier.

Tetra Tech EMI - Nash/Knox

712 Melrose Ave.
Nashville, TN 37211

Billing Information:
Amy Tolley
712 Melrose Ave.
Nashville, TN 37211

Report to: **Amy Tolley**

Email To: **amy.tolley@tetratech.com; dana.lingle@tetratech.com**

Project Description: Harpeth River at SNEED RD

City/State Collected: Franklin, TN

Phone: **615-254-4559**
Fax: **615-254-4507**

Client Project #

Lab Project # **TETRA-SURFACE**

Collected by (print): Michael Scott

Site/Facility ID #

P.O. #

Collected by (signature):

Immediately Packed on Ice N ___ (Y) MS

Rush? (Lab MUST Be Notified)
___ Same Day 200%
___ Next Day 100%
___ Two Day 50%
___ Three Day 25%

Date Results Needed

Email? ___No X__Yes
FAX? ___No ___Yes

Analysis / Container / Preservative

Sample ID	Comp/Grab	Matrix *	Depth	Date MT	Time MT	No. of Cntrs	CBODLL 1L-HDPE-NoPres	DOC 250mlAmb-SeptaNoPres	NH3,NO2NO3 250mlHDPE-H2SO4 <2	PT,TKN 250mlHDPE-H2SO4 <2	TOC 250mlAmb-Septa-HCl <2	TSS 1L-HDPE NoPres					Rem./Contaminant	Sample # (lab only)
SNEED ROAD		GW		6-18-14	0930	6	X	X	X	X	X	X						-01
		GW				6	X	X	X	X	X	X						
		GW				6	X	X	X	X	X	X						
		GW				6	X	X	X	X	X	X						
		GW				6	X	X	X	X	X	X						
		GW				6	X	X	X	X	X	X						
		GW				6	X	X	X	X	X	X						
		GW				6	X	X	X	X	X	X						

* Matrix: **SS** - Soil **GW** - Groundwater **WW** - WasteWater **DW** - Drinking Water **OT** - Other_____

Remarks: 6/19/14 9:30 upper containers

pH _____ Temp _____
Flow _____ Other _____

Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)
			Wayne Shull
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature)
Wayne Shull	6/19/14	1050	[illegible]

Samples returned via: ☐ UPS ☐ FedEx ☐ Courier ☐ _____

Temp: 3.0 °C Bottles Received: 6

Date: 6-19-14 Time: 1050

Hold #

Condition: (lab use only)

COC Seal Intact: ___Y ___N ___NA

pH Checked: <2 NCF:

Chain of Custody Page ___ of ___

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Mount Juliet, TN 37122
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Phone: 800-767-5859
Fax: 615-758-5859

L# L705597

E156

Acctnum: **TETRA**
Template: **T94409**
Prelogin: **P469573**
TSR: **296 - Darren Reeder**
PB: CG 5/23
Shipped Via: **FedEX Ground**

L 705597

Chain of Custody

PROJECT/SITE NO. Harpeth / Snord Rd	PROJECT NAME Williamson Co Sampling
STATION NUMBER 065.6W	COUNTY Williamson
DESCRIPTION North of Bridge	
STREAM MILE 65.6	MATRIX
COLLECTED: DATE 6/18/14	TIME 11:00
SAMPLER'S NAME (printed) Michael Scott	
SAMPLING AGENCY Williamson County	
Laboratory Number	Branch Lab Number

CHAIN OF CUSTODY

Only one chain of custody form is required per sample set or point (if all collected at the same time)

1. Collected by Michael Scott	
Date 6/18/14	Time 11:00 A.M.
Delivered to County Administrative Complex	
Date 6/18/14	Time 4:00 P.M.
2. Received by	
Date	Time
Delivered to	
Date	Time
3. Received by	
Date	Time
Delivered to	
Date	Time
4. Received in Lab by	
Date	Time
Logged in by	
Date	Time

ADDITIONAL INFORMATION

1. Approximate volume of sample	6 containers
2. Nearest town or city	Franklin TN
3. Others present at collection	AMY TOLLEY, RICH HANSIN
4. Number of other samples collected at same time at this point.	N/A
5. Field collection procedure, handling and/or preservation of this sample	per instructions
6. Mode of transportation to lab	Pick up
7. Sample sealed by	Michael Scott
8. Date sample sealed	6/18/14
9. Remarks	

From PH-3011 (rev 10/98), PH-3013 (rev 11/97), and PH-3014 (rev 1/96)

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Est. 1970

Amy Tolley
Tetra Tech EMI
712 Melrose Ave.
Nashville, TN 37211

Report Summary

Monday July 28, 2014

Report Number: L710856
Samples Received: 07/18/14
Client Project:

Description: Williamson County Sampling

The analytical results in this report are based upon information supplied by you, the client, and are for your exclusive use. If you have any questions regarding this data package, please do not hesitate to call.

Entire Report Reviewed By: Darren O. Reeder

Darren Reeder , ESC Representative

Laboratory Certification Numbers

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - 01157CA, CT - PH-0197, FL - E87487, GA - 923, IN - C-TN-01, KY - 90010, KYUST - 0016, NC - ENV375/DW21704/BIO041, ND - R-140. NJ - TN002, NJ NELAP - TN002, SC - 84004, TN - 2006, VA - 460132, WV - 233, AZ - 0612, MN - 047-999-395, NY - 11742, WI - 998093910, NV - TN000032011-1, TX - T104704245-11-3, OK - 9915, PA - 68-02979, IA Lab #364, EPA - TN002

Accreditation is only applicable to the test methods specified on each scope of accreditation held by ESC Lab Sciences.

Where applicable, sampling conducted by ESC is performed per guidance provided in laboratory standard operating procedures: 060302, 060303, and 060304.

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Case Narrative

Monday July 28, 2014

Report Number: L710856
Samples Received: 07/18/14
Client Project:

Description: Williamson County Sampling

Other Comments

All Laboratory Control Samples for BOD and CBOD failed high, owing to over depletion.

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REPORT OF ANALYSIS

Amy Tolley
Tetra Tech EMI
712 Melrose Ave.
Nashville, TN 37211

July 28, 2014

ESC Sample # : L710856-01

Date Received : July 18, 2014
Description : Williamson County Sampling

Site ID :

Sample ID : HARPE068.3W1/2

Project # :

Collected By : Michael Scott
Collection Date : 07/17/14 09:30

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
DOC	2.2	1.0	mg/l	5310 B-2011	07/22/14	1
Ammonia Nitrogen	BDL	0.25	mg/l	350.1	07/22/14	1
Nitrate-Nitrite	0.45	0.10	mg/l	353.2	07/23/14	1
Phosphorus,Total	0.37	0.10	mg/l	365.4	07/19/14	1
Kjeldahl Nitrogen, TKN	BDL	0.25	mg/l	351.2	07/19/14	1
TOC (Total Organic Carbon)	2.9	1.0	mg/l	9060A	07/22/14	1
Suspended Solids	13.	2.5	mg/l	2540 D-2011	07/21/14	1

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
The reported analytical results relate only to the sample submitted.

.
Reported: 07/25/14 07:50 Revised: 07/28/14 11:33

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REPORT OF ANALYSIS

Amy Tolley
Tetra Tech EMI
712 Melrose Ave.
Nashville, TN 37211

July 28, 2014

ESC Sample # : L710856-02

Date Received : July 18, 2014
Description : Williamson County Sampling

Site ID :

Sample ID : HARPE068.3W1/2

Project # :

Collected By : Michael Scott
Collection Date : 07/17/14 09:30

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
CBOD	BDL	2.00	mg/l	5210 B-2011	07/24/14	1

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
The reported analytical results relate only to the sample submitted.

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Reported: 07/25/14 07:50 Revised: 07/28/14 11:33

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REPORT OF ANALYSIS

Amy Tolley
Tetra Tech EMI
712 Melrose Ave.
Nashville, TN 37211

July 28, 2014

ESC Sample # : L710856-03

Date Received : July 18, 2014
Description : Williamson County Sampling

Site ID :

Sample ID : HARPE072.4W1/3

Project # :

Collected By : Michael Scott
Collection Date : 07/17/14 12:00

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
DOC	2.3	1.0	mg/l	5310 B-2011	07/22/14	1
Ammonia Nitrogen	BDL	0.25	mg/l	350.1	07/26/14	1
Nitrate-Nitrite	0.54	0.10	mg/l	353.2	07/23/14	1
Phosphorus,Total	0.38	0.10	mg/l	365.4	07/19/14	1
Kjeldahl Nitrogen, TKN	0.30	0.25	mg/l	351.2	07/19/14	1
TOC (Total Organic Carbon)	2.8	1.0	mg/l	9060A	07/22/14	1
Suspended Solids	9.9	2.5	mg/l	2540 D-2011	07/21/14	1

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
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Reported: 07/25/14 07:50 Revised: 07/28/14 11:33

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REPORT OF ANALYSIS

Amy Tolley
Tetra Tech EMI
712 Melrose Ave.
Nashville, TN 37211

July 28, 2014

ESC Sample # : L710856-04

Date Received : July 18, 2014
Description : Williamson County Sampling

Site ID :

Sample ID : HARPE072.4W1/3

Project # :

Collected By : Michael Scott
Collection Date : 07/17/14 12:00

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
CBOD	BDL	2.00	mg/l	5210 B-2011	07/24/14	1

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
The reported analytical results relate only to the sample submitted.

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Reported: 07/25/14 07:50 Revised: 07/28/14 11:33

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REPORT OF ANALYSIS

Amy Tolley
Tetra Tech EMI
712 Melrose Ave.
Nashville, TN 37211

July 28, 2014

ESC Sample # : L710856-05

Date Received : July 18, 2014
Description : Williamson County Sampling

Site ID :

Sample ID : HARPE072.4W1/3 DUP

Project # :

Collected By : Michael Scott
Collection Date : 07/17/14 12:00

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
DOC	2.2	1.0	mg/l	5310 B-2011	07/22/14	1
Ammonia Nitrogen	BDL	0.25	mg/l	350.1	07/26/14	1
Nitrate-Nitrite	0.55	0.10	mg/l	353.2	07/23/14	1
Phosphorus,Total	0.38	0.10	mg/l	365.4	07/19/14	1
Kjeldahl Nitrogen, TKN	0.26	0.25	mg/l	351.2	07/19/14	1
TOC (Total Organic Carbon)	2.8	1.0	mg/l	9060A	07/22/14	1
Suspended Solids	11.	2.5	mg/l	2540 D-2011	07/21/14	1

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
The reported analytical results relate only to the sample submitted.

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Reported: 07/25/14 07:50 Revised: 07/28/14 11:33

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REPORT OF ANALYSIS

Amy Tolley
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712 Melrose Ave.
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July 28, 2014

ESC Sample # : L710856-06

Site ID :

Project # :

Date Received : July 18, 2014
Description : Williamson County Sampling

Sample ID : HARPE072.4W1/3 DUP

Collected By : Michael Scott
Collection Date : 07/17/14 12:00

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
CBOD	BDL	2.00	mg/l	5210 B-2011	07/24/14	1

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
The reported analytical results relate only to the sample submitted.

.
Reported: 07/25/14 07:50 Revised: 07/28/14 11:33

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REPORT OF ANALYSIS

Amy Tolley
Tetra Tech EMI
712 Melrose Ave.
Nashville, TN 37211

July 28, 2014

ESC Sample # : L710856-07

Date Received : July 18, 2014
Description : Williamson County Sampling

Site ID :

Sample ID : HARPE075.8W1/4

Project # :

Collected By : Michael Scott
Collection Date : 07/17/14 14:00

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
DOC	2.2	1.0	mg/l	5310 B-2011	07/22/14	1
Ammonia Nitrogen	BDL	0.25	mg/l	350.1	07/22/14	1
Nitrate-Nitrite	0.68	0.10	mg/l	353.2	07/23/14	1
Phosphorus,Total	0.42	0.10	mg/l	365.4	07/19/14	1
Kjeldahl Nitrogen, TKN	0.33	0.25	mg/l	351.2	07/19/14	1
TOC (Total Organic Carbon)	2.6	1.0	mg/l	9060A	07/22/14	1
Suspended Solids	14.	2.5	mg/l	2540 D-2011	07/21/14	1

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
The reported analytical results relate only to the sample submitted.

.
Reported: 07/25/14 07:50 Revised: 07/28/14 11:33

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REPORT OF ANALYSIS

Amy Tolley
Tetra Tech EMI
712 Melrose Ave.
Nashville, TN 37211

July 28, 2014

ESC Sample # : L710856-08

Site ID :

Project # :

Date Received : July 18, 2014
Description : Williamson County Sampling

Sample ID : HARPE075.8W1/4

Collected By : Michael Scott
Collection Date : 07/17/14 14:00

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
CBOD	BDL	2.00	mg/l	5210 B-2011	07/24/14	1

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
The reported analytical results relate only to the sample submitted.

.
Reported: 07/25/14 07:50 Revised: 07/28/14 11:33

Attachment A
List of Analytes with QC Qualifiers

Sample Number	Work Group	Sample Type	Analyte	Run ID	Qualifier
L710856-02	WG732644	SAMP	CBOD	R2967834	J+
L710856-04	WG732644	SAMP	CBOD	R2967834	J+
L710856-06	WG732644	SAMP	CBOD	R2967834	J+
L710856-08	WG732644	SAMP	CBOD	R2967834	J+

Attachment B
Explanation of QC Qualifier Codes

Qualifier	Meaning
J+	The associated batch QC was outside the upper control limits; associated data has a potential positive bias

Qualifier Report Information

ESC utilizes sample and result qualifiers as set forth by the EPA Contract Laboratory Program and as required by most certifying bodies including NELAC. In addition to the EPA qualifiers adopted by ESC, we have implemented ESC qualifiers to provide more information pertaining to our analytical results. Each qualifier is designated in the qualifier explanation as either EPA or ESC. Data qualifiers are intended to provide the ESC client with more detailed information concerning the potential bias of reported data. Because of the wide range of constituents and variety of matrices incorporated by most EPA methods,it is common for some compounds to fall outside of established ranges. These exceptions are evaluated and all reported data is valid and useable "unless qualified as 'R' (Rejected)."

Definitions

Accuracy - The relationship of the observed value of a known sample to the true value of a known sample. Represented by percent recovery and relevant to samples such as: control samples, matrix spike recoveries, surrogate recoveries, etc.

Precision - The agreement between a set of samples or between duplicate samples. Relates to how close together the results are and is represented by Relative Percent Differrence.

Surrogate - Organic compounds that are similar in chemical composition, extraction, and chromotography to analytes of interest. The surrogates are used to determine the probable response of the group of analytes that are chemically related to the surrogate compound. Surrogates are added to the sample and carried through all stages of preparation and analyses.

TIC - Tentatively Identified Compound: Compounds detected in samples that are not target compounds, internal standards, system monitoring compounds, or surrogates.

Summary of Remarks For Samples Printed
07/28/14 at 11:33:24

TSR Signing Reports: 296
R5 - Desired TAT

Sample: L710856-01 Account: TETRA Received: 07/18/14 10:35 Due Date: 07/28/14 00:00 RPT Date: 07/25/14 07:50
Changed to std per AH. AV 7/18
Sample: L710856-02 Account: TETRA Received: 07/18/14 10:35 Due Date: 07/28/14 00:00 RPT Date: 07/25/14 07:50
Changed to std per AH. AV 7/18
Sample: L710856-03 Account: TETRA Received: 07/18/14 10:35 Due Date: 07/28/14 00:00 RPT Date: 07/25/14 07:50
Changed to std per AH. AV 7/18
Sample: L710856-04 Account: TETRA Received: 07/18/14 10:35 Due Date: 07/28/14 00:00 RPT Date: 07/25/14 07:50
Changed to std per AH. AV 7/18
Sample: L710856-05 Account: TETRA Received: 07/18/14 10:35 Due Date: 07/28/14 00:00 RPT Date: 07/25/14 07:50
Changed to std per AH. AV 7/18
Sample: L710856-06 Account: TETRA Received: 07/18/14 10:35 Due Date: 07/28/14 00:00 RPT Date: 07/25/14 07:50
Changed to std per AH. AV 7/18
Sample: L710856-07 Account: TETRA Received: 07/18/14 10:35 Due Date: 07/28/14 00:00 RPT Date: 07/25/14 07:50
Changed to std per AH. AV 7/18
Sample: L710856-08 Account: TETRA Received: 07/18/14 10:35 Due Date: 07/28/14 00:00 RPT Date: 07/25/14 07:50
Changed to std per AH. AV 7/18

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Tetra Tech EMI
Amy Tolley
712 Melrose Ave.
Nashville, TN 37211

Quality Assurance Report
Level II

L710856

July 28, 2014

Laboratory Blank

Analyte	Result	Units	% Rec	Limit	Batch	Date Analyzed
Kjeldahl Nitrogen, TKN	< .25	mg/l			WG732506	07/19/14 15:17
Phosphorus,Total	< .1	mg/l			WG732504	07/19/14 02:37
Suspended Solids	< 2.5	mg/l			WG732518	07/21/14 10:07
DOC	< 1	mg/l			WG732633	07/22/14 06:30
Ammonia Nitrogen	< .25	mg/l			WG732756	07/22/14 17:26
Ammonia Nitrogen	< .25	mg/l			WG732757	07/22/14 19:09
Nitrate-Nitrite	< .1	mg/l			WG732848	07/23/14 03:22
TOC (Total Organic Carbon)	< 1	mg/l			WG732664	07/22/14 15:06
CBOD		mg/l			WG732644	07/24/14 09:04
CBOD		mg/l			WG732644	07/24/14 09:04
CBOD		mg/l			WG732644	07/24/14 10:01
CBOD		mg/l			WG732644	07/24/14 10:01
Ammonia Nitrogen	< .25	mg/l			WG733835	07/26/14 12:11

Duplicate

Analyte	Units	Result	Duplicate	RPD	Limit	Ref Samp	Batch
Kjeldahl Nitrogen, TKN	mg/l	0.766	0.720	6.19	20	L710024-02	WG732506
Kjeldahl Nitrogen, TKN	mg/l	0.00	0.00	0.00	20	L710145-03	WG732506
Phosphorus,Total	mg/l	0.330	0.320	3.08	20	L710145-01	WG732504
Phosphorus,Total	mg/l	2.10	2.00	4.88	20	L708711-01	WG732504
Suspended Solids	mg/l	97.0	95.0	2.08	5	L710571-01	WG732518
Suspended Solids	mg/l	126.	122.	3.23	5	L710770-01	WG732518
DOC	mg/l	2.40	2.30	4.26	20	L710856-03	WG732633
Ammonia Nitrogen	mg/l	0.0	0.0	0.0	20	L709137-01	WG732756
Ammonia Nitrogen	mg/l	0.0	0.0	0.0	20	L708576-05	WG732756
Nitrate-Nitrite	mg/l	0.140	0.140	0.0	20	L710687-03	WG732848
Nitrate-Nitrite	mg/l	0.0	0.0	0.0	20	L710791-01	WG732848
TOC (Total Organic Carbon)	mg/l	66.3	67.0	1.05	20	L709478-16	WG732664

* Performance of this Analyte is outside of established criteria.
For additional information, please see Attachment A 'List of Analytes with QC Qualifiers.'

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Tetra Tech EMI
Amy Tolley
712 Melrose Ave.
Nashville, TN 37211

Quality Assurance Report
Level II

L710856

July 28, 2014

Analyte	Units	Result	Duplicate	RPD	Limit	Ref Samp	Batch
			Duplicate				
TOC (Total Organic Carbon)	mg/l	2.41	2.50	3.67	20	L710885-01	WG732664
CBOD	mg/l	0.00	0.770	0.00	30	L710856-08	WG732644
Ammonia Nitrogen	mg/l	0.0	0.0	0.0	20	L710856-03	WG733835
Ammonia Nitrogen	mg/l	0.0	0.0	0.0	20	L710856-05	WG733835

Analyte	Units	Known Val	Result	% Rec	Limit	Batch
		Laboratory Control Sample				
Kjeldahl Nitrogen, TKN	mg/l	16.7	17.1	102.	90-110	WG732506
Phosphorus,Total	mg/l	1	0.944	94.4	90-110	WG732504
Suspended Solids	mg/l	773	844.	109.	85-115	WG732518
DOC	mg/l	75	76.5	102.	85-115	WG732633
Ammonia Nitrogen	mg/l	7.5	7.51	100.	90-110	WG732756
Ammonia Nitrogen	mg/l	7.5	7.24	96.5	90-110	WG732757
Nitrate-Nitrite	mg/l	5	4.80	96.0	90-110	WG732848
TOC (Total Organic Carbon)	mg/l	75	76.1	102.	85-115	WG732664
CBOD	mg/l	198	347.	175.*	84.6-115.4	WG732644
CBOD	mg/l	198	338.	171.*	84.6-115.4	WG732644
Ammonia Nitrogen	mg/l	7.5	7.17	95.6	90-110	WG733835

Analyte	Units	Result	Ref	%Rec	Limit	RPD	Limit	Batch
		Laboratory Control Sample Duplicate						
Kjeldahl Nitrogen, TKN	mg/l	17.1	17.1	102.	90-110	0.00	20	WG732506
Phosphorus,Total	mg/l	0.926	0.944	93.0	90-110	1.93	20	WG732504
Suspended Solids	mg/l	848.	844.	110.	85-115	0.473	5	WG732518
DOC	mg/l	76.7	76.5	102.	85-115	0.196	20	WG732633
Ammonia Nitrogen	mg/l	7.37	7.51	98.0	90-110	1.88	20	WG732756

* Performance of this Analyte is outside of established criteria.
For additional information, please see Attachment A 'List of Analytes with QC Qualifiers.'

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Tetra Tech EMI
Amy Tolley
712 Melrose Ave.
Nashville, TN 37211

Quality Assurance Report
Level II

L710856

July 28, 2014

Laboratory Control Sample Duplicate

Analyte	Units	Result	Ref	%Rec	Limit	RPD	Limit	Batch
Ammonia Nitrogen	mg/l	7.17	7.24	96.0	90-110	0.972	20	WG732757
Nitrate-Nitrite	mg/l	4.85	4.80	97.0	90-110	1.04	20	WG732848
TOC (Total Organic Carbon)	mg/l	75.8	76.1	101.	85-115	0.434	20	WG732664
Ammonia Nitrogen	mg/l	7.06	7.17	94.0	90-110	1.55	20	WG733835

Matrix Spike

Analyte	Units	MS Res	Ref Res	TV	% Rec	Limit	Ref Samp	Batch
Kjeldahl Nitrogen, TKN	mg/l	5.58	0.370	5	104.	90-110	L710032-02	WG732506
Phosphorus,Total	mg/l	2.46	0.0	2.5	98.0	90-110	L710110-04	WG732504
DOC	mg/l	52.6	2.20	50	100.	80-120	L710856-05	WG732633
Ammonia Nitrogen	mg/l	10.3	0.0	10	100.	90-110	L710856-05	WG732756
Ammonia Nitrogen	mg/l	11.6	1.50	10	100.	90-110	L710559-01	WG732757
Nitrate-Nitrite	mg/l	5.73	0.680	5	100.	90-110	L710856-07	WG732848
TOC (Total Organic Carbon)	mg/l	57.7	8.40	50	98.6	80-120	L710697-02	WG732664
Ammonia Nitrogen	mg/l	10.1	0.270	10	98.0	90-110	L712021-01	WG733835

Matrix Spike Duplicate

Analyte	Units	MSD	Ref	%Rec	Limit	RPD	Limit	Ref Samp	Batch
Kjeldahl Nitrogen, TKN	mg/l	5.46	5.58	102.	90-110	2.17	20	L710032-02	WG732506
Phosphorus,Total	mg/l	2.47	2.46	98.8	90-110	0.406	20	L710110-04	WG732504
DOC	mg/l	52.5	52.6	101.	80-120	0.0381	20	L710856-05	WG732633
Ammonia Nitrogen	mg/l	10.2	10.3	102.	90-110	0.976	20	L710856-05	WG732756
Ammonia Nitrogen	mg/l	11.8	11.6	103.	90-110	1.71	20	L710559-01	WG732757
Nitrate-Nitrite	mg/l	5.71	5.73	101.	90-110	0.350	20	L710856-07	WG732848

* Performance of this Analyte is outside of established criteria.
For additional information, please see Attachment A 'List of Analytes with QC Qualifiers.'

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Quality Assurance Report
Level II

L710856

July 28, 2014

Analyte	Units	Matrix Spike Duplicate MSD	Ref	%Rec	Limit	RPD	Limit	Ref Samp	Batch
TOC (Total Organic Carbon)	mg/l	58.6	57.7	100.	80-120	1.57	20	L710697-02	WG732664
Ammonia Nitrogen	mg/l	10.1	10.1	98.3	90-110	0.0	20	L712021-01	WG733835

Batch number /Run number / Sample number cross reference

WG732506: R2965365: L710856-01 03 05 07
WG732504: R2965366: L710856-01 03 05 07
WG732518: R2965987: L710856-01 03 05 07
WG732633: R2966990: L710856-01 03 05 07
WG732756: R2967171: L710856-07
WG732757: R2967172: L710856-01
WG732848: R2967587: L710856-01 03 05 07
WG732664: R2967595: L710856-01 03 05 07
WG732644: R2967834: L710856-02 04 06
WG733835: R2968648: L710856-03 05

* * Calculations are performed prior to rounding of reported values.
* Performance of this Analyte is outside of established criteria.
For additional information, please see Attachment A 'List of Analytes with QC Qualifiers.'

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Quality Assurance Report
Level II

L710856

July 28, 2014

The data package includes a summary of the analytic results of the quality control samples required by the SW-846 or CWA methods. The quality control samples include a method blank, a laboratory control sample, and the matrix spike/matrix spike duplicate analysis. If a target parameter is outside the method limits, every sample that is effected is flagged with the appropriate qualifier in Appendix B of the analytic report.

Method Blank - an aliquot of reagent water carried through the entire analytic process. The method blank results indicate if any possible contamination exposure during the sample handling, digestion or extraction process, and analysis. Concentrations of target analytes above the reporting limit in the method blank are qualified with the "B" qualifier.

Laboratory Control Sample - is a sample of known concentration that is carried through the digestion/extraction and analysis process. The percent recovery, expressed as a percentage of the theoretical concentration, has statistical control limits indicating that the analytic process is "in control". If a target analyte is outside the control limits for the laboratory control sample or any other control sample, the parameter is flagged with a "J4" qualifier for all effected samples.

Matrix Spike and Matrix Spike Duplicate - is two aliquots of an environmental sample that is spiked with known concentrations of target analytes. The percent recovery of the target analytes also has statistical control limits. If any recoveries that are outside the method control limits, the sample that was selected for matrix spike/matrix spike duplicate analysis is flagged with either a "J5" or a "J6". The relative percent difference (%RPD) between the matrix spike and the matrix spike duplicate recoveries is all calculated. If the RPD is above the method limit, the effected samples are flagged with a "J3" qualifier.

Chain of Custody Page ___ of ___

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L# L710856

H038

Acctnum:
Template:
Prelogin:
TSR:
PB:
Shipped Via:

Company Name/Address: Tetra Tech EMI-Nash/[illegible] 712 Melrose Ave. Nashville, TN 37211

Billing Information: Amy Tolley 712 Melrose Ave. Nashville, TN 37211

Report to: Amy Tolley

Email To: amy.tolley@tetratech.com dana.lingle@tetratech.com

Project Description: Williamson County Sampling

City/State Collected: Franklin, TN

Phone: 615-254-4559
Fax: 615-254-4507

Client Project # —

Lab Project # Tetra-Surface

Collected by (print): Michael Scott

Site/Facility ID # —

P.O. # —

Collected by (signature): [signature]

Immediately Packed on Ice N ___ Y ✓ ms

Rush? (Lab MUST Be Notified)
✓ Same Day 200%
___ Next Day 100%
___ Two Day 50%
___ Three Day 25%

Date Results Needed —

Email? ___ No X Yes
FAX? ___ No ___ Yes

Analysis / Container / Preservative

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	CBODLL 1L-HDPE-No Pres	DOC 250ml Amb-Septa No Pres	NH3, NO2NO3 250ml HDPE-H2SO4	TP, TKN 250ml HDPE-H2SO4	TOC 250ml Amb-Septa-HCl	TSS 1L-HDPE No Pres	Rem./Contaminant	Sample # (lab only)
HARPE068.3WI /2	Grab	GW/OT	1 ft.	7/17/14	9:30 AM	6	X	X	X	X	X	X		-01/-02
HARPE072.4WI /3	Grab	GW/OT	6 in.	7/17/14	12:00PM	6	X	X	X	X	X	X		-03/-04
Duplicate	Grab	GW/OT	6 in.	7/17/14	12:00PM	6	X	X	X	X	X	X		-05/-06
HARPE075.8WI /4	Grab	GW/OT	2 ft.	7/17/14	2:00PM	6	X	X	X	X	X	X		-07/-08

* Matrix: SS - Soil GW - Groundwater WW - WasteWater DW - Drinking Water OT - Other Surface Water

pH ✓ n/a Temp ✓ n/a
Flow ✓ n/a Other ✓ n/a

Remarks: Harpeth River Samples

Hold #

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)
[signature]	7/18/14	9:30 AM	Wayne Shull
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)
Relinquished by: (Signature) Wayne Shull	Date: 7/18/14	Time: 1035	Received for lab by: (Signature) Michael [illegible]

Samples returned via: ☐ UPS ☐ FedEx ☒ Courier ☐ ____

Temp: 3.2 °C Bottles Received: 24

Date: 7-18-14 Time: 1035

Condition: (lab use only) OK

COC Seal Intact: ___ Y ___ N ___ NA

pH Checked: <2

NCF:

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Amy Tolley
Tetra Tech EMI
712 Melrose Ave.
Nashville, TN 37211

Report Summary

Tuesday September 23, 2014

Report Number: L721025
Samples Received: 09/11/14
Client Project:

Description: Williamson County Samples

The analytical results in this report are based upon information supplied by you, the client, and are for your exclusive use. If you have any questions regarding this data package, please do not hesitate to call.

Entire Report Reviewed By: Darren O. Reeder

Darren Reeder , ESC Representative

Laboratory Certification Numbers

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - 01157CA, CT - PH-0197, FL - E87487, GA - 923, IN - C-TN-01, KY - 90010, KYUST - 0016, NC - ENV375/DW21704/BIO041, ND - R-140. NJ - TN002, NJ NELAP - TN002, SC - 84004, TN - 2006, VA - 460132, WV - 233, AZ - 0612, MN - 047-999-395, NY - 11742, WI - 998093910, NV - TN000032011-1, TX - T104704245-11-3, OK - 9915, PA - 68-02979, IA Lab #364, EPA - TN002

Accreditation is only applicable to the test methods specified on each scope of accreditation held by ESC Lab Sciences.

Where applicable, sampling conducted by ESC is performed per guidance provided in laboratory standard operating procedures: 060302, 060303, and 060304.

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REPORT OF ANALYSIS

Amy Tolley
Tetra Tech EMI
712 Melrose Ave.
Nashville, TN 37211

September 23, 2014

ESC Sample # : L721025-01

Site ID :

Project # :

Date Received : September 11, 2014
Description : Williamson County Samples

Sample ID : HARPE079.8W1/5

Collected By : Michael Scott
Collection Date : 09/10/14 09:30

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
CBOD	BDL	2.00	mg/l	5210 B-2011	09/16/14	1
DOC	2.4	1.0	mg/l	5310 B-2011	09/12/14	1
Ammonia Nitrogen	BDL	0.25	mg/l	350.1	09/17/14	1
Nitrate-Nitrite	0.81	0.10	mg/l	353.2	09/16/14	1
Phosphorus,Total	0.65	0.10	mg/l	365.4	09/17/14	1
Kjeldahl Nitrogen, TKN	0.45	0.25	mg/l	351.2	09/17/14	1
TOC (Total Organic Carbon)	2.7	1.0	mg/l	9060A	09/15/14	1
Suspended Solids	14.	2.5	mg/l	2540 D-2011	09/15/14	1

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
The reported analytical results relate only to the sample submitted.

.
Reported: 09/18/14 13:26 Revised: 09/23/14 08:07

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REPORT OF ANALYSIS

Amy Tolley
Tetra Tech EMI
712 Melrose Ave.
Nashville, TN 37211

September 23, 2014

ESC Sample # : L721025-02

Site ID :

Project # :

Date Received : September 11, 2014
Description : Williamson County Samples

Sample ID : HARPE097.6W1/6

Collected By : Michael Scott
Collection Date : 09/10/14 14:00

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
CBOD	BDL	2.00	mg/l	5210 B-2011	09/16/14	1
DOC	2.4	1.0	mg/l	5310 B-2011	09/20/14	1
Ammonia Nitrogen	BDL	0.25	mg/l	350.1	09/17/14	1
Nitrate-Nitrite	0.42	0.10	mg/l	353.2	09/16/14	1
Phosphorus,Total	0.43	0.10	mg/l	365.4	09/17/14	1
Kjeldahl Nitrogen, TKN	0.48	0.25	mg/l	351.2	09/17/14	1
TOC (Total Organic Carbon)	2.5	1.0	mg/l	9060A	09/15/14	1
Suspended Solids	9.1	2.5	mg/l	2540 D-2011	09/15/14	1

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
The reported analytical results relate only to the sample submitted.

.
Reported: 09/18/14 13:26 Revised: 09/23/14 08:07

Attachment A
List of Analytes with QC Qualifiers

Sample Number	Work Group	Sample Type	Analyte	Run ID	Qualifier
L721025-02	WG742736	SAMP	Nitrate-Nitrite	R2989934	J6

Attachment B
Explanation of QC Qualifier Codes

Qualifier	Meaning
J6	The sample matrix interfered with the ability to make any accurate determination; spike value is low

Qualifier Report Information

ESC utilizes sample and result qualifiers as set forth by the EPA Contract Laboratory Program and as required by most certifying bodies including NELAC. In addition to the EPA qualifiers adopted by ESC, we have implemented ESC qualifiers to provide more information pertaining to our analytical results. Each qualifier is designated in the qualifier explanation as either EPA or ESC. Data qualifiers are intended to provide the ESC client with more detailed information concerning the potential bias of reported data. Because of the wide range of constituents and variety of matrices incorporated by most EPA methods,it is common for some compounds to fall outside of established ranges. These exceptions are evaluated and all reported data is valid and useable "unless qualified as 'R' (Rejected)."

Definitions

Accuracy - The relationship of the observed value of a known sample to the true value of a known sample. Represented by percent recovery and relevant to samples such as: control samples, matrix spike recoveries, surrogate recoveries, etc.

Precision - The agreement between a set of samples or between duplicate samples. Relates to how close together the results are and is represented by Relative Percent Differrence.

Surrogate - Organic compounds that are similar in chemical composition, extraction, and chromotography to analytes of interest. The surrogates are used to determine the probable response of the group of analytes that are chemically related to the surrogate compound. Surrogates are added to the sample and carried through all stages of preparation and analyses.

TIC - Tentatively Identified Compound: Compounds detected in samples that are not target compounds, internal standards, system monitoring compounds, or surrogates.

Summary of Remarks For Samples Printed
09/23/14 at 08:07:07

TSR Signing Reports: 296
R5 - Desired TAT

Sample: L721025-01 Account: TETRA Received: 09/11/14 10:45 Due Date: 09/22/14 00:00 RPT Date: 09/18/14 13:26
dd changed 9/18/14 dor for lab inquiry
Sample: L721025-02 Account: TETRA Received: 09/11/14 10:45 Due Date: 09/22/14 00:00 RPT Date: 09/18/14 13:26

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Quality Assurance Report
Level II

L721025

September 23, 2014

Laboratory Blank

Analyte	Result	Units	% Rec	Limit	Batch	Date Analyzed
DOC	< 1	mg/l			WG742451	09/12/14 15:27
Suspended Solids	< 2.5	mg/l			WG742635	09/15/14 10:10
CBOD		mg/l			WG742272	09/16/14 11:39
Nitrate-Nitrite	< .1	mg/l			WG742736	09/16/14 01:46
TOC (Total Organic Carbon)	< 1	mg/l			WG742704	09/15/14 15:11
Phosphorus,Total	< .1	mg/l			WG743155	09/17/14 10:24
Kjeldahl Nitrogen, TKN	< .25	mg/l			WG743154	09/17/14 09:39
Ammonia Nitrogen	< .25	mg/l			WG742719	09/17/14 12:15
DOC	< 1	mg/l			WG744426	09/19/14 15:13

Duplicate

Analyte	Units	Result	Duplicate	RPD	Limit	Ref Samp	Batch
DOC	mg/l	0.0	0.0	0.0	20	L720774-01	WG742451
DOC	mg/l	2.20	2.20	0.0	20	L720779-11	WG742451
Suspended Solids	mg/l	668.	694.	3.82	5	L720986-01	WG742635
Suspended Solids	mg/l	184.	183.	0.727	5	L721037-01	WG742635
CBOD	mg/l	0.00	4.60	0.00	30	L720905-01	WG742272
Nitrate-Nitrite	mg/l	0.0	0.0	0.0	20	L720819-03	WG742736
Nitrate-Nitrite	mg/l	0.0	0.0	0.0	20	L720940-01	WG742736
TOC (Total Organic Carbon)	mg/l	2.51	2.70	7.29	20	L720717-02	WG742704
TOC (Total Organic Carbon)	mg/l	0.303	0.280	7.89	20	L720984-05	WG742704
Phosphorus,Total	mg/l	31.0	31.0	0.0	20	L719418-01	WG743155
Ammonia Nitrogen	mg/l	0.0	0.0	0.0	20	L721025-01	WG742719
Ammonia Nitrogen	mg/l	1.20	1.20	0.0	20	L720526-02	WG742719
DOC	mg/l	1.40	1.60	13.3	20	L723113-01	WG744426
DOC	mg/l	8.20	7.80	5.00	20	L723113-02	WG744426
DOC	mg/l	2.20	2.40	8.70	20	L721025-02	WG744426

* Performance of this Analyte is outside of established criteria.
For additional information, please see Attachment A 'List of Analytes with QC Qualifiers.'

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Nashville, TN 37211

Quality Assurance Report
Level II

L721025

September 23, 2014

Laboratory Control Sample

Analyte	Units	Known Val	Result	% Rec	Limit	Batch
DOC	mg/l	75	75.8	101.	85-115	WG742451
Suspended Solids	mg/l	773	776.	100.	85-115	WG742635
CBOD	mg/l	198	172.	86.7	84.6-115.4	WG742272
CBOD	mg/l	198	220.	111.	84.6-115.4	WG742272
Nitrate-Nitrite	mg/l	5	4.85	97.0	90-110	WG742736
TOC (Total Organic Carbon)	mg/l	75	78.5	105.	85-115	WG742704
Phosphorus,Total	mg/l	1	0.999	99.9	90-110	WG743155
Kjeldahl Nitrogen, TKN	mg/l	12.4	11.8	95.2	85-115	WG743154
Ammonia Nitrogen	mg/l	7.5	6.86	91.5	90-110	WG742719
DOC	mg/l	75	77.3	103.	85-115	WG744426

Laboratory Control Sample Duplicate

Analyte	Units	Result	Ref	%Rec	Limit	RPD	Limit	Batch
DOC	mg/l	77.8	75.8	104.	85-115	2.60	20	WG742451
Suspended Solids	mg/l	772.	776.	100.	85-115	0.517	5	WG742635
Nitrate-Nitrite	mg/l	5.08	4.85	102.	90-110	4.63	20	WG742736
TOC (Total Organic Carbon)	mg/l	77.8	78.5	104.	85-115	0.870	20	WG742704
Phosphorus,Total	mg/l	1.00	0.999	100.	90-110	0.100	20	WG743155
Kjeldahl Nitrogen, TKN	mg/l	11.6	11.8	94.0	85-115	1.71	20	WG743154
Ammonia Nitrogen	mg/l	6.80	6.86	91.0	90-110	0.878	20	WG742719
DOC	mg/l	75.7	77.3	101.	85-115	2.14	20	WG744426

Matrix Spike

Analyte	Units	MS Res	Ref Res	TV	% Rec	Limit	Ref Samp	Batch
DOC	mg/l	50.5	0.0	50	100.	80-120	L720774-03	WG742451
Nitrate-Nitrite	mg/l	4.29	0.420	5	77.0*	90-110	L721025-02	WG742736

* Performance of this Analyte is outside of established criteria.
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Nashville, TN 37211

Quality Assurance Report
Level II

L721025

September 23, 2014

Analyte	Units	Matrix Spike MS Res	Ref Res	TV	% Rec	Limit	Ref Samp	Batch
TOC (Total Organic Carbon)	mg/l	55.8	3.70	50	104.	80-120	L720717-03	WG742704
Phosphorus,Total	mg/l	5.28	0.0430	5	100.	90-110	L720984-06	WG743155
Kjeldahl Nitrogen, TKN	mg/l	10.1	0.330	10	97.7	90-110	L720975-01	WG743154
Ammonia Nitrogen	mg/l	8.27	0.0600	10	82.0*	90-110	L720984-01	WG742719
DOC	mg/l	51.6	2.40	50	98.0	80-120	L721025-02	WG744426

Analyte	Units	Matrix Spike Duplicate MSD	Ref	%Rec	Limit	RPD	Limit	Ref Samp	Batch
DOC	mg/l	52.0	50.5	104.	80-120	3.02	20	L720774-03	WG742451
Nitrate-Nitrite	mg/l	4.27	4.29	77.0*	90-110	0.467	20	L721025-02	WG742736
TOC (Total Organic Carbon)	mg/l	53.7	55.8	100.	80-120	3.74	20	L720717-03	WG742704
Phosphorus,Total	mg/l	5.29	5.28	105.	90-110	0.189	20	L720984-06	WG743155
Kjeldahl Nitrogen, TKN	mg/l	10.1	10.1	97.7	90-110	0.00	20	L720975-01	WG743154
Ammonia Nitrogen	mg/l	8.38	8.27	83.2*	90-110	1.32	20	L720984-01	WG742719
DOC	mg/l	51.7	51.6	98.7	80-120	0.290	20	L721025-02	WG744426

Batch number /Run number / Sample number cross reference

WG742451: R2988827: L721025-01
WG742635: R2989454: L721025-01
WG742272: R2989880: L721025-01
WG742736: R2989934: L721025-01
WG742704: R2989958: L721025-01
WG743155: R2990191: L721025-01
WG743154: R2990218: L721025-01
WG742719: R2990604: L721025-01
WG744426: R2991873: L721025-

* * Calculations are performed prior to rounding of reported values.
* Performance of this Analyte is outside of established criteria.
For additional information, please see Attachment A 'List of Analytes with QC Qualifiers.'

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Tax I.D. 62-0814289

Est. 1970

Tetra Tech EMI
Amy Tolley
712 Melrose Ave.
Nashville, TN 37211

Quality Assurance Report
Level II

L721025

September 23, 2014

The data package includes a summary of the analytic results of the quality control samples required by the SW-846 or CWA methods. The quality control samples include a method blank, a laboratory control sample, and the matrix spike/matrix spike duplicate analysis. If a target parameter is outside the method limits, every sample that is effected is flagged with the appropriate qualifier in Appendix B of the analytic report.

Method Blank - an aliquot of reagent water carried through the entire analytic process. The method blank results indicate if any possible contamination exposure during the sample handling, digestion or extraction process, and analysis. Concentrations of target analytes above the reporting limit in the method blank are qualified with the "B" qualifier.

Laboratory Control Sample - is a sample of known concentration that is carried through the digestion/extraction and analysis process. The percent recovery, expressed as a percentage of the theoretical concentration, has statistical control limits indicating that the analytic process is "in control". If a target analyte is outside the control limits for the laboratory control sample or any other control sample, the parameter is flagged with a "J4" qualifier for all effected samples.

Matrix Spike and Matrix Spike Duplicate - is two aliquots of an environmental sample that is spiked with known concentrations of target analytes. The percent recovery of the target analytes also has statistical control limits. If any recoveries that are outside the method control limits, the sample that was selected for matrix spike/matrix spike duplicate analysis is flagged with either a "J5" or a "J6". The relative percent difference (%RPD) between the matrix spike and the matrix spike duplicate recoveries is all calculated. If the RPD is above the method limit, the effected samples are flagged with a "J3" qualifier.

Company Name/Address:	Billing Information:
Tetra Tech EMI-Nash/Knox 712 Melrose Ave. Nashville, TN 37211	Amy Tolley 712 Melrose Ave. Nashville, TN 37211
Report to: Amy Tolley	Email To: amy.tolley@tetratech.com dana.lingle@tetratech.com
Project Description: Williamson County Sampling	City/State Collected: Franklin, TN

Phone: 615-254-4559 Fax: 615-254-4507	Client Project # —	Lab Project # Tetra-Surface
Collected by (print): Michael Scott	Site/Facility ID # —	P.O. # —
Collected by (signature): [signature] Immediately Packed on Ice N ___ Y ✓ MS	**Rush?** (Lab MUST Be Notified) ✓ Same Day ....200% ___ Next Day ....100% ___ Two Day ....50% ___ Three Day 25%	Date Results Needed — Email? ___No X Yes FAX? ___No ___Yes

Analysis / Container / Preservative

Chain of Custody Page ___ of ___

ESC L·A·B S·C·I·E·N·C·E·S
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Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

L# L721025
Table #
Acctnum:
Template:
Prelogin:
TSR:
PB:
Shipped Via:

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	CBOD 1L-HDPE-No Pres	DOC 250ml Amb-Septa No Pres	NH3, NO2NO3 250ml HDPE-H2SO4 <2	P, TKN 250ml HDPE-H2SO4 <2	TOC 250ml Amb-Septa-HCl	TSS 1L-HDPE No Pres					Rem./Contaminant	Sample # (lab only)
HARPE079.8W1/5	Grab	GW/OT	1 ft	9/10/14	9:30 AM	6	X	X	X	X	X	X						01
HARPE097.6W1/6	Grab	GW/OT	1 ft.	9/10/14	2:00 PM	6	X	X	X	X	X	X						02

* Matrix: **SS** - Soil **GW** - Groundwater **WW** - WasteWater **DW** - Drinking Water **OT** - Other Surface Water

pH n/a Temp n/a

Remarks: Harpeth River Samples

Flow n/a Other n/a

Hold #

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Samples returned via: ☐ UPS ☐ FedEx ☑ Courier ☐ ___	Condition: (lab use only)
[signature]	9/11/14	9:15	Bob [signature]		[mark]
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Temp: 2.9 °C Bottles Received: 12	COC Seal Intact: ___Y ___N ___NA
Relinquished by: (Signature)	Date:	Time:	Received for lab by: (Signature)	Date: Time:	pH Checked: NCF:
Bob [signature]	9/11/14	10:45	[signature]	9/11/14 1045	<2

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Est. 1970

Amy Tolley
Tetra Tech EMI
712 Melrose Ave.
Nashville, TN 37211

Report Summary

Saturday November 08, 2014

Report Number: L730286
Samples Received: 10/29/14
Client Project:

Description: Williams County Sampling Phase 2

The analytical results in this report are based upon information supplied by you, the client, and are for your exclusive use. If you have any questions regarding this data package, please do not hesitate to call.

Entire Report Reviewed By: Darren O. Reeder

Darren Reeder , ESC Representative

Laboratory Certification Numbers

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - 01157CA, CT - PH-0197, FL - E87487, GA - 923, IN - C-TN-01, KY - 90010, KYUST - 0016, NC - ENV375/DW21704/BIO041, ND - R-140. NJ - TN002, NJ NELAP - TN002, SC - 84004, TN - 2006, VA - 460132, WV - 233, AZ - 0612, MN - 047-999-395, NY - 11742, WI - 998093910, NV - TN000032011-1, TX - T104704245-11-3, OK - 9915, PA - 68-02979, IA Lab #364, EPA - TN002

Accreditation is only applicable to the test methods specified on each scope of accreditation held by ESC Lab Sciences.

Where applicable, sampling conducted by ESC is performed per guidance provided in laboratory standard operating procedures: 060302, 060303, and 060304.

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REPORT OF ANALYSIS

Amy Tolley
Tetra Tech EMI
712 Melrose Ave.
Nashville, TN 37211

November 08, 2014

ESC Sample # : L730286-01

Date Received : October 29, 2014
Description : Williams County Sampling Phase 2

Site ID :

Sample ID : RUTHE026.7 WI 6 IN

Project # :

Collected By : Michael Scott
Collection Date : 10/27/14 09:30

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Ammonia Nitrogen	BDL	0.25	mg/l	350.1	11/03/14	1
Nitrate-Nitrite	1.2	0.10	mg/l	353.2	11/06/14	1
Phosphorus,Total	0.30	0.10	mg/l	365.4	11/06/14	1
Kjeldahl Nitrogen, TKN	BDL	0.25	mg/l	351.2	11/05/14	1
TOC (Total Organic Carbon)	1.5	1.0	mg/l	9060A	11/08/14	1
Suspended Solids	BDL	2.5	mg/l	2540 D-2011	10/30/14	1

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
The reported analytical results relate only to the sample submitted.

.
Reported: 11/08/14 20:22 Printed: 11/08/14 20:24

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REPORT OF ANALYSIS

Amy Tolley
Tetra Tech EMI
712 Melrose Ave.
Nashville, TN 37211

November 08, 2014

ESC Sample # : L730286-02

Date Received : October 29, 2014
Description : Williams County Sampling Phase 2

Site ID :

Sample ID : RUTHE028.6 WI 6 IN

Project # :

Collected By : Michael Scott
Collection Date : 10/27/14 13:00

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Ammonia Nitrogen	BDL	0.25	mg/l	350.1	11/03/14	1
Nitrate-Nitrite	0.38	0.10	mg/l	353.2	11/06/14	1
Phosphorus,Total	0.29	0.10	mg/l	365.4	11/06/14	1
Kjeldahl Nitrogen, TKN	BDL	0.25	mg/l	351.2	11/05/14	1
TOC (Total Organic Carbon)	2.1	1.0	mg/l	9060A	11/08/14	1
Suspended Solids	3.7	2.5	mg/l	2540 D-2011	10/30/14	1

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
The reported analytical results relate only to the sample submitted.

.
Reported: 11/08/14 20:22 Printed: 11/08/14 20:24

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REPORT OF ANALYSIS

Amy Tolley
Tetra Tech EMI
712 Melrose Ave.
Nashville, TN 37211

November 08, 2014

ESC Sample # : L730286-03

Date Received : October 29, 2014
Description : Williams County Sampling Phase 2

Site ID :

Sample ID : OWL004.8 WI 6 IN

Project # :

Collected By : Michael Scott
Collection Date : 10/28/14 09:30

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Ammonia Nitrogen	BDL	0.25	mg/l	350.1	11/03/14	1
Nitrate-Nitrite	0.30	0.10	mg/l	353.2	11/06/14	1
Phosphorus,Total	0.47	0.10	mg/l	365.4	11/06/14	1
Kjeldahl Nitrogen, TKN	BDL	0.25	mg/l	351.2	11/05/14	1
TOC (Total Organic Carbon)	2.3	1.0	mg/l	9060A	11/08/14	1
Suspended Solids	3.5	2.5	mg/l	2540 D-2011	10/31/14	1

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
The reported analytical results relate only to the sample submitted.

.
Reported: 11/08/14 20:22 Printed: 11/08/14 20:24

Summary of Remarks For Samples Printed
11/08/14 at 20:24:18

TSR Signing Reports: 296
R5 - Desired TAT

Sample: L730286-01 Account: TETRA Received: 10/29/14 11:50 Due Date: 11/05/14 00:00 RPT Date: 11/08/14 20:22

Sample: L730286-02 Account: TETRA Received: 10/29/14 11:50 Due Date: 11/05/14 00:00 RPT Date: 11/08/14 20:22

Sample: L730286-03 Account: TETRA Received: 10/29/14 11:50 Due Date: 11/05/14 00:00 RPT Date: 11/08/14 20:22

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Tetra Tech EMI
Amy Tolley
712 Melrose Ave.
Nashville, TN 37211

Quality Assurance Report
Level II

L730286

November 08, 2014

Laboratory Blank

Analyte	Result	Units	% Rec	Limit	Batch	Date Analyzed
Suspended Solids	< 2.5	mg/l			WG751515	10/30/14 11:05
Suspended Solids	< 2.5	mg/l			WG751599	10/31/14 09:55
Ammonia Nitrogen	< .25	mg/l			WG752300	11/03/14 13:56
Kjeldahl Nitrogen, TKN	< .25	mg/l			WG752527	11/05/14 15:54
Nitrate-Nitrite	< .1	mg/l			WG752890	11/06/14 11:15
Phosphorus,Total	< .1	mg/l			WG752809	11/06/14 15:36
TOC (Total Organic Carbon)	< 1	mg/l			WG753134	11/08/14 03:32

Duplicate

Analyte	Units	Result	Duplicate	RPD	Limit	Ref Samp	Batch
Suspended Solids	mg/l	5.33	5.33	0.00	5	L730185-01	WG751515
Suspended Solids	mg/l	11.0	11.5	4.44	5	L730242-02	WG751599
Ammonia Nitrogen	mg/l	0.0	0.0	0.0	20	L730286-03	WG752300
Ammonia Nitrogen	mg/l	0.410	0.410	0.0	20	L730170-01	WG752300
Kjeldahl Nitrogen, TKN	mg/l	0.999	0.940	6.09	20	L730277-02	WG752527
Kjeldahl Nitrogen, TKN	mg/l	0.00	0.00	0.00	20	L730406-01	WG752527
Nitrate-Nitrite	mg/l	0.280	0.300	6.90	20	L730286-03	WG752890
Nitrate-Nitrite	mg/l	0.0	0.0	0.0	20	L730304-14	WG752890
Phosphorus,Total	mg/l	0.110	0.100	9.52	20	L730520-01	WG752809
Phosphorus,Total	mg/l	0.0	0.0	0.0	20	L730688-02	WG752809
TOC (Total Organic Carbon)	mg/l	3.59	3.60	0.278	20	L730048-02	WG753134
TOC (Total Organic Carbon)	mg/l	1.46	1.50	2.70	20	L730286-01	WG753134

Laboratory Control Sample

Analyte	Units	Known Val	Result	% Rec	Limit	Batch
Suspended Solids	mg/l	773	868.	112.	85-115	WG751515
Suspended Solids	mg/l	773	756.	97.8	85-115	WG751599
Ammonia Nitrogen	mg/l	7.5	7.39	98.5	90-110	WG752300

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Tetra Tech EMI
Amy Tolley
712 Melrose Ave.
Nashville, TN 37211

Quality Assurance Report
Level II

L730286

November 08, 2014

Laboratory Control Sample

Analyte	Units	Known Val	Result	% Rec	Limit	Batch
Kjeldahl Nitrogen, TKN	mg/l	12.4	12.3	99.2	85-115	WG752527
Nitrate-Nitrite	mg/l	5	5.08	102.	90-110	WG752890
Phosphorus,Total	mg/l	1	0.932	93.2	90-110	WG752809
TOC (Total Organic Carbon)	mg/l	75	75.0	100.	85-115	WG753134

Laboratory Control Sample Duplicate

Analyte	Units	Result	Ref	%Rec	Limit	RPD	Limit	Batch
Suspended Solids	mg/l	852.	868.	110.	85-115	1.86	5	WG751515
Suspended Solids	mg/l	776.	756.	100.	85-115	2.61	5	WG751599
Ammonia Nitrogen	mg/l	7.37	7.39	98.0	90-110	0.271	20	WG752300
Kjeldahl Nitrogen, TKN	mg/l	12.4	12.3	100.	85-115	0.810	20	WG752527
Nitrate-Nitrite	mg/l	4.72	5.08	94.0	90-110	7.35	20	WG752890
Phosphorus,Total	mg/l	0.932	0.932	93.0	90-110	0.0	20	WG752809
TOC (Total Organic Carbon)	mg/l	75.0	75.0	100.	85-115	0.107	20	WG753134

Matrix Spike

Analyte	Units	MS Res	Ref Res	TV	% Rec	Limit	Ref Samp	Batch
Ammonia Nitrogen	mg/l	9.36	0.0	10	94.0	90-110	L730171-01	WG752300
Kjeldahl Nitrogen, TKN	mg/l	5.13	0.00	5	103.	90-110	L730286-02	WG752527
Nitrate-Nitrite	mg/l	4.51	0.0	5	90.0	90-110	L730339-01	WG752890
Phosphorus,Total	mg/l	2.51	0.0	2.5	100.	90-110	L730688-01	WG752809
TOC (Total Organic Carbon)	mg/l	65.5	13.0	50	105.	80-120	L730026-01	WG753134

Matrix Spike Duplicate

Analyte	Units	MSD	Ref	%Rec	Limit	RPD	Limit	Ref Samp	Batch
Ammonia Nitrogen	mg/l	8.66	9.36	86.6*	90-110	7.77	20	L730171-01	WG752300
Kjeldahl Nitrogen, TKN	mg/l	5.19	5.13	104.	90-110	1.16	20	L730286-02	WG752527

* Performance of this Analyte is outside of established criteria.
For additional information, please see Attachment A 'List of Analytes with QC Qualifiers.'

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Tetra Tech EMI
Amy Tolley
712 Melrose Ave.
Nashville, TN 37211

Quality Assurance Report
Level II

L730286

November 08, 2014

Analyte	Units	Matrix Spike MSD	Duplicate Ref	%Rec	Limit	RPD	Limit	Ref Samp	Batch
Nitrate-Nitrite	mg/l	4.45	4.51	89.0*	90-110	1.34	20	L730339-01	WG752890
Phosphorus,Total	mg/l	2.50	2.51	100.	90-110	0.399	20	L730688-01	WG752809
TOC (Total Organic Carbon)	mg/l	65.6	65.5	105.	80-120	0.0305	20	L730026-01	WG753134

Batch number /Run number / Sample number cross reference

WG751515: R3001201: L730286-01
WG751599: R3001936: L730286-03
WG752300: R3002140: L730286-01 02 03
WG752527: R3002566: L730286-01 02 03
WG752890: R3002802: L730286-01 02 03
WG752809: R3002868: L730286-01 02 03
WG753134: R3003249: L730286-01 02 03

* * Calculations are performed prior to rounding of reported values.
* Performance of this Analyte is outside of established criteria.
For additional information, please see Attachment A 'List of Analytes with QC Qualifiers.'

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Tetra Tech EMI
Amy Tolley
712 Melrose Ave.
Nashville, TN 37211

Quality Assurance Report
Level II

L730286

November 08, 2014

The data package includes a summary of the analytic results of the quality control samples required by the SW-846 or CWA methods. The quality control samples include a method blank, a laboratory control sample, and the matrix spike/matrix spike duplicate analysis. If a target parameter is outside the method limits, every sample that is effected is flagged with the appropriate qualifier in Appendix B of the analytic report.

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Laboratory Control Sample - is a sample of known concentration that is carried through the digestion/extraction and analysis process. The percent recovery, expressed as a percentage of the theoretical concentration, has statistical control limits indicating that the analytic process is "in control". If a target analyte is outside the control limits for the laboratory control sample or any other control sample, the parameter is flagged with a "J4" qualifier for all effected samples.

Matrix Spike and Matrix Spike Duplicate - is two aliquots of an environmental sample that is spiked with known concentrations of target analytes. The percent recovery of the target analytes also has statistical control limits. If any recoveries that are outside the method control limits, the sample that was selected for matrix spike/matrix spike duplicate analysis is flagged with either a "J5" or a "J6". The relative percent difference (%RPD) between the matrix spike and the matrix spike duplicate recoveries is all calculated. If the RPD is above the method limit, the effected samples are flagged with a "J3" qualifier.

Tetra Tech EMI - Nash/Knox

712 Melrose Ave.
Nashville, TN 37211

Billing Information:
Amy Tolley
712 Melrose Ave.
Nashville, TN 37211

Report to: Amy Tolley

Email To: amy.tolley@tetratech.com; dana.lingle@tetratech.com

Project Description: Williamson County Sampling, Phase 2

City/State Collected: Franklin, TN

Phone: 615-254-4559
Fax: 615-254-4507

Client Project #

Lab Project # TETRA-SURFACE

Collected by (print): Michael Scott

Site/Facility ID #

P.O. #

Collected by (signature):

Immediately Packed on Ice N ___ Y X

Rush? (Lab MUST Be Notified)
___ Same Day 200%
___ Next Day 100%
___ Two Day 50%
___ Three Day 25%

Date Results Needed

Email? ___No X__Yes
FAX? ___No ___Yes

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	NH3,NO2NO3 250mlHDPE-H2SO4	PT,TKN 250mlHDPE-H2SO4	TOC 250mlAmb-Septa-HCl	TSS 1L-HDPE NoPres	Rem./Contaminant	Sample # (lab only)
RUTHE026.7W1	Grab	GW	6"	10/27/14	9:30 AM	4	X	X	X	X		01
RUTHE028.6W1	Grab	GW	6"	10/27/14	1:00 PM	4	X	X	X	X		02
OWL004.8W1	Grab	GW	6"	10/28/14	9:30 AM	4	X	X	X	X		03
—		GW				4	X	X	X	X		

Analysis / Container / Preservative

Chain of Custody Page ___ of ___

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Phone: 800-767-5859
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L# L730276
H049

Acctnum: TETRA
Template: T94409
Prelogin: P487237
TSR: 296 - Darren Reeder
PB: 10/23/14 MW6
Shipped Via: FedEX Ground

* Matrix: SS - Soil GW - Groundwater WW - WasteWater DW - Drinking Water OT - Other_____

Remarks: Stream samples

pH N/a Temp N/a
Flow N/a Other N/a

Hold #

Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)
Michael Scott	10/29/14	1045	Wayne Shull
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature)
Wayne Shull	10/29/14	1150	

Samples returned via: ☐ UPS ☐ FedEx ☒ Courier ☐ ____

Temp: 29°C Bottles Received: 12

Date: 10.29.14 Time: 1150

Condition: (lab use only) OK TDI

COC Seal Intact: ___Y ___N ✓NA

pH Checked: LR NCF:

AQUATIC RESOURCES CENTER, INC

545 Cathy Jo Circle
Nashville, TN 37211
aquatres@ix.netcom.com

Phone: 615-781-2901
Fax: 615-781-2254

18 September 2014

Ms. Amy Tolley
Tetra Tech
712 Melrose Avenue
Nashville, TN 37211

RE: Enumeration and identification of benthic invertebrate samples
Aquatic Resources Center Project No. 709

Dear Amy:

Attached please find the results from the work completed on the above referenced project. Enclosed is a brief summary of methods, data, copy of the bench sheets, and an invoice for the completed work. A total of 31 taxa was identified from the two samples with a range of 24 to 26 taxa per sample.

Please contact me with any questions you may have.

Sincerely yours,

Todd W. Askegaard
President

Two benthic invertebrate samples were received from Tetra Tech, Inc. for processing, identification, enumeration and biological measures calculation. The samples were collected from the Little Harpeth River in Williamson County (ecoregion 71fgh) at river mile 1.9 on 18 June 2014 by Tetra Tech and Williamson County personnel and at river mile 4.6 by Williamson County personnel on 11 July 2014. This stream has a drainage area greater than 2 square miles. Below is a brief description of the processing methods and results.

Samples were washed using a US Series No. 35 (500 µm mesh) sieve to remove ethanol and excess detritus. Because the samples contained a large amounts of material (detritus and organisms), they were subsampled using the Caton (1991) method, which is recommended by TDEC (2011). This procedure consists of dividing a given sample into 30 equal portions (termed grids) using a specified subsampling device, then sorting at least four of these grids (which have been randomly selected) to obtain 200±20 percent (160-240) organisms. If sorting a grid had been started, it was finished in its entirety. The benthic organisms removed from the sample were placed by major groupings (e.g., mayflies, worms, snails) into glass vials containing 70 percent EtOH (ethyl alcohol). Each vial was labeled with information such as date of collection, location, specific sample identification, name of taxonomic group and number of organisms. The residue from the sorted portion of a sample was preserved separately from the portion that was not sorted. Organisms were identified using either a dissecting or compound microscope. The latter microscope was used for identifying chironomids (midgefly larvae) and oligochaetes (aquatic segmented worms) after these organisms were mounted on microscope slides using CMCP mounting medium. Most organisms were identified to the generic level, unless the specimens were too small or damaged to allow identification to this level. Identifications were recorded on laboratory bench sheets (see attached copies). When identifications were complete, the data were entered onto an Excel spreadsheet and checked for accuracy.

The total number of individuals identified was 225 and 213 per sample (LHARP001.9WI and LHARP004.6WI, respectively). The total number of taxa per sample was 26 and 24 (LHARP001.9WI and LHARP004.6WI, respectively). Tolerance values ranged from 0.56 (*Micrasema*) to 9.84 (*Enchytraeus*). There were twelve (12) taxa classified as having "clinger" habit and nine (9) taxa classified as nutrient tolerant. These data were used in the calculations of the biological measures required by TDEC (2011) and the values for these measures are shown in the table below.

	LHARP001.9WI		LHARP004.6WI	
	Value	Score	Value	Score
Taxa Richness	26	4	24	4
EPT Index	8	4	9	4
%EPT-Cheumatopsyche	30.2	2	20.7	2
%Oligochaeta+Chironomidae	13.3	6	22.1	6
NCBI	5.28	4	5.23	4
Percent Clingers	60.9	6	63.4	6
Percent Nutrient Tolerant	56.4	2	62.9	2
TMI Score		28		28

Sample ID	Location	Date	Phylum	Class	Order	Family	Taxon	Number	Stage	Comments
LHARP001.9WI	Little Harpeth River	18-Jun-14	Annelida	Clitellata	Tubificida	Naididae	Tubificinae: bifid chaetae	3	I	
LHARP001.9WI	Little Harpeth River	18-Jun-14	Platyhelminthes	Turbellaria	Tricladida	Dugesiidae	*Cura*	11	A	
LHARP001.9WI	Little Harpeth River	18-Jun-14	Arthropoda	Insecta	Ephemeroptera	Baetidae	*Acerpenna*	2	N	
LHARP001.9WI	Little Harpeth River	18-Jun-14	Arthropoda	Insecta	Ephemeroptera	Baetidae	*Baetis*	14	N	
LHARP001.9WI	Little Harpeth River	18-Jun-14	Arthropoda	Insecta	Ephemeroptera	Baetidae	Baetidae	18	N	e.i./damaged, possibly Baetis
LHARP001.9WI	Little Harpeth River	18-Jun-14	Arthropoda	Insecta	Ephemeroptera	Caenidae	*Caenis*	8	N	
LHARP001.9WI	Little Harpeth River	18-Jun-14	Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Heptageniidae	9	N	e.i./damaged, possibly Maccaffertium
LHARP001.9WI	Little Harpeth River	18-Jun-14	Arthropoda	Insecta	Ephemeroptera	Heptageniidae	*Maccaffertium*	6	N	
LHARP001.9WI	Little Harpeth River	18-Jun-14	Arthropoda	Insecta	Ephemeroptera	Leptohyphidae	*Tricorythodes*	1	N	
LHARP001.9WI	Little Harpeth River	18-Jun-14	Arthropoda	Insecta	Trichoptera	Hydropsychidae	*Cheumatopsyche*	47	L	
LHARP001.9WI	Little Harpeth River	18-Jun-14	Arthropoda	Insecta	Trichoptera	Philopotamidae	*Chimarra*	9	L	
LHARP001.9WI	Little Harpeth River	18-Jun-14	Arthropoda	Insecta	Trichoptera	Hydropsychidae	*Hydropsyche*	1	L	
LHARP001.9WI	Little Harpeth River	18-Jun-14	Arthropoda	Insecta	Coleoptera	Psephenidae	*Psephenus*	4	L	
LHARP001.9WI	Little Harpeth River	18-Jun-14	Arthropoda	Insecta	Coleoptera	Elmidae	*Stenelmis*	52	L	
LHARP001.9WI	Little Harpeth River	18-Jun-14	Arthropoda	Insecta	Coleoptera	Elmidae	*Stenelmis*	4	A	
LHARP001.9WI	Little Harpeth River	18-Jun-14	Arthropoda	Insecta	Diptera	Empididae	*Hemerodromia*	2	L	
LHARP001.9WI	Little Harpeth River	18-Jun-14	Arthropoda	Insecta	Diptera	Simuliidae	*Simulium*	2	L	
LHARP001.9WI	Little Harpeth River	18-Jun-14	Arthropoda	Insecta	Diptera	Chironomidae	*Conchepelopia*	7	L	
LHARP001.9WI	Little Harpeth River	18-Jun-14	Arthropoda	Insecta	Diptera	Chironomidae	*Cricotopus*	1	L	C. bicinctus
LHARP001.9WI	Little Harpeth River	18-Jun-14	Arthropoda	Insecta	Diptera	Chironomidae	*Cricotopous/Orthocladius*	2	L	early instars
LHARP001.9WI	Little Harpeth River	18-Jun-14	Arthropoda	Insecta	Diptera	Chironomidae	*Nilothauma*	1	L	
LHARP001.9WI	Little Harpeth River	18-Jun-14	Arthropoda	Insecta	Diptera	Chironomidae	*Parametriocnemus*	1	L	
LHARP001.9WI	Little Harpeth River	18-Jun-14	Arthropoda	Insecta	Diptera	Chironomidae	*Paratanytarsus*	1	L	
LHARP001.9WI	Little Harpeth River	18-Jun-14	Arthropoda	Insecta	Diptera	Chironomidae	*Polypedilum*	8	L	
LHARP001.9WI	Little Harpeth River	18-Jun-14	Arthropoda	Insecta	Diptera	Chironomidae	*Stempellinella*	1	L	
LHARP001.9WI	Little Harpeth River	18-Jun-14	Arthropoda	Insecta	Diptera	Chironomidae	*Tanytarsus*	3	L	
LHARP001.9WI	Little Harpeth River	18-Jun-14	Arthropoda	Insecta	Diptera	Chironomidae	*Thienemanniella*	2	L	
LHARP001.9WI	Little Harpeth River	18-Jun-14	Arthropoda	Insecta	Diptera	Corbidulidae	*Corbicula*	1	A	
LHARP001.9WI	Little Harpeth River	18-Jun-14	Mollusca	Bivalvia	Veneroida	Sphaeriidae	*Pisidium*	1	A	
LHARP001.9WI	Little Harpeth River	18-Jun-14	Mollusca	Bivalvia	Veneroida	Sphaeriidae	Sphaeriidae	1	I	small/damaged
LHARP001.9WI	Little Harpeth River	18-Jun-14	Mollusca	Gastropoda	Neotaenioglossa	Pleuroceridae	*Pleurocera (Elimia)*	2	A	
							Total number of individuals	225		
							Total number of taxa	26		

Sample ID	Location	Date	Phylum	Class	Order	Family	Taxon	Number	Stage	Comments
LHARP004.6WI	Little Harpeth River	11-Jul-14	Annelida	Clitellata	Tubificida	Naididae	Tubificinae: bifid chaetae	3	I	
LHARP004.6WI	Little Harpeth River	11-Jul-14	Annelida	Clitellata		Enchytraeidae	*Enchytraeus*	1	A	
LHARP004.6WI	Little Harpeth River	11-Jul-14	Platyhelminthes	Turbellaria	Tricladida	Dugesiidae	*Cura*	1	A	
LHARP004.6WI	Little Harpeth River	11-Jul-14	Arthropoda	Insecta	Ephemeroptera	Baetidae	*Acerpenna*	5	N	
LHARP004.6WI	Little Harpeth River	11-Jul-14	Arthropoda	Insecta	Ephemeroptera	Baetidae	*Baetis*	2	N	
LHARP004.6WI	Little Harpeth River	11-Jul-14	Arthropoda	Insecta	Ephemeroptera	Baetidae	Baetidae	12	N	e.i./damaged, possibly Baetis
LHARP004.6WI	Little Harpeth River	11-Jul-14	Arthropoda	Insecta	Ephemeroptera	Caenidae	*Caenis*	1	N	
LHARP004.6WI	Little Harpeth River	11-Jul-14	Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Heptageniidae	7	N	e.i./damaged, possibly Maccaffertium
LHARP004.6WI	Little Harpeth River	11-Jul-14	Arthropoda	Insecta	Ephemeroptera	Isonychiidae	*Isonychia*	2	N	
LHARP004.6WI	Little Harpeth River	11-Jul-14	Arthropoda	Insecta	Ephemeroptera	Heptageniidae	*Maccaffertium*	3	N	
LHARP004.6WI	Little Harpeth River	11-Jul-14	Arthropoda	Insecta	Ephemeroptera	Leptohyphidae	*Tricorythodes*	6	N	
LHARP004.6WI	Little Harpeth River	11-Jul-14	Arthropoda	Insecta	Trichoptera	Hydropsychidae	*Cheumatopsyche*	44	L	
LHARP004.6WI	Little Harpeth River	11-Jul-14	Arthropoda	Insecta	Trichoptera	Hydropsychidae	*Hydropsyche*	1	L	
LHARP004.6WI	Little Harpeth River	11-Jul-14	Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsychidae	4	L	early instars
LHARP004.6WI	Little Harpeth River	11-Jul-14	Arthropoda	Insecta	Trichoptera	Brachycentridae	*Micrasema*	1	L	
LHARP004.6WI	Little Harpeth River	11-Jul-14	Arthropoda	Insecta	Coleoptera	Psephenidae	*Psephenus*	12	L	
LHARP004.6WI	Little Harpeth River	11-Jul-14	Arthropoda	Insecta	Coleoptera	Elmidae	*Stenelmis*	56	L	
LHARP004.6WI	Little Harpeth River	11-Jul-14	Arthropoda	Insecta	Coleoptera	Elmidae	*Stenelmis*	2	A	
LHARP004.6WI	Little Harpeth River	11-Jul-14	Arthropoda	Insecta	Diptera	Chironomidae	*Conchepelopia*	8	L	
LHARP004.6WI	Little Harpeth River	11-Jul-14	Arthropoda	Insecta	Diptera	Chironomidae	*Corynoneura*	2	L	
LHARP004.6WI	Little Harpeth River	11-Jul-14	Arthropoda	Insecta	Diptera	Chironomidae	*Cricotopus*	2	L	
LHARP004.6WI	Little Harpeth River	11-Jul-14	Arthropoda	Insecta	Diptera	Chironomidae	*Cricotopous/Orthocladius*	2	L	early instars
LHARP004.6WI	Little Harpeth River	11-Jul-14	Arthropoda	Insecta	Diptera	Chironomidae	*Cricotopous/Orthocladius*	1	P	
LHARP004.6WI	Little Harpeth River	11-Jul-14	Arthropoda	Insecta	Diptera	Chironomidae	*Polypedilum*	20	L	
LHARP004.6WI	Little Harpeth River	11-Jul-14	Arthropoda	Insecta	Diptera	Chironomidae	*Polypedilum*	1	P	
LHARP004.6WI	Little Harpeth River	11-Jul-14	Arthropoda	Insecta	Diptera	Chironomidae	*Stempellinella*	1	L	
LHARP004.6WI	Little Harpeth River	11-Jul-14	Arthropoda	Insecta	Diptera	Chironomidae	*Tanytarsus*	1	L	
LHARP004.6WI	Little Harpeth River	11-Jul-14	Arthropoda	Insecta	Diptera	Chironomidae	*Thienemanniella*	4	L	
LHARP004.6WI	Little Harpeth River	11-Jul-14	Arthropoda	Insecta	Diptera	Chironomidae	*Thienemannimyia* grp.	1	L	early instars
LHARP004.6WI	Little Harpeth River	11-Jul-14	Mollusca	Bivalvia	Veneroida	Sphaeriidae	*Pisidium*	1	A	
LHARP004.6WI	Little Harpeth River	11-Jul-14	Mollusca	Bivalvia	Veneroida	Sphaeriidae	Sphaeriidae	4	I	small
LHARP004.6WI	Little Harpeth River	11-Jul-14	Mollusca	Gastropoda	Neotaenioglossa	Pleuroceridae	Pleuroceridae	1	I	small
LHARP004.6WI	Little Harpeth River	11-Jul-14	Mollusca	Gastropoda	Neotaenioglossa	Pleuroceridae	*Pleurocera (Elimia)*	1	A	
							Total number of individuals	213		
							Total number of taxa	24		

Chain of Custody

PROJECT/SITE NO. Little Harpeth @ Vaughn	PROJECT NAME Williamson Co Sampling
STATION NUMBER LHARP001.9WI	COUNTY Williamson
DESCRIPTION At Vaughn Rd	
STREAM MILE 1.9	MATRIX Surface Water
COLLECTED DATE 6/18/14	TIME 1:00 PM
SAMPLER'S NAME (printed) Michael Scott	
SAMPLING AGENCY Williamson County	
Laboratory Number	Branch Lab Number

CHAIN OF CUSTODY

Only one chain of custody form is required per sample set or point (if all collected at the same time)

1. Collected by Michael Scott Amy Tolley Rich Manson	
Date 6/18/14	Time 1:00 PM
Delivered to Amy Tolley	
Date 8/8/14	Time 1:00 PM
2. Received by Amy Tolley	
Date 8-8-14	Time 1:00 pm
Delivered to Todd Askegaard	
Date 8-26-14	Time 11:30
3. Received by Todd Askegaard	
Date 26 Aug 14	Time 11:30 Am
Delivered to	
Date	Time
4. Received in Lab by	
Date	Time
Logged in by	
Date	Time

ADDITIONAL INFORMATION

1. Approximate volume of sample	1000 ml
2. Nearest town or city	Franklin TN
3. Others present at collection	Amy Tolley, Rich Manson
4. Number of other samples collected at same time at this point.	0
5. Field collection procedure, handling and/or preservation of this sample	See Field preserved in Ethyl Alcohol
6. Mode of transportation to lab	By car
7. Sample sealed by	Michael Scott
8. Date sample sealed	6/18/14
9. Remarks	

From PH-3011 (rev 10/98), PH-3013 (rev 11/97), and PH-3014 (rev 1/96)

Chain of Custody

PROJECT/SITE NO Little Harpeth @ Hillsb	PROJECT NAME Williamson County Sampling
STATION NUMBER LHARP0046WI	COUNTY Williamson
DESCRIPTION At Hillsboro Rd	
STREAM MILE 4.6	MATRIX Surface Water
COLLECTED DATE 7/11/14	TIME 11:00 AM
SAMPLER'S NAME (printed) Michael Scott	
SAMPLING AGENCY Williamson County	
Laboratory Number	Branch Lab Number

CHAIN OF CUSTODY

Only one chain of custody form is required per sample set or point (if all collected at the same time)

1. Collected by Michael Scott, Rich Hanson	
Date 7/11/14	Time 11:00 AM.
Delivered to Amy Tolley	
Date 8/8/14	Time 1:00 PM
2. Received by [signature]	
Date 8-8-14	Time 1:00 PM
Delivered to Todd Askegaard	
Date 8-26-14	Time 11:30 PM
3. Received by [signature]	
Date 26Aug14	Time 11:30 AM
Delivered to	
Date	Time
4. Received in Lab by	
Date	Time
Logged in by	
Date	Time

ADDITIONAL INFORMATION

1. Approximate volume of sample 1000 ml
2. Nearest town or city Franklin, TN
3. Others present at collection Rich Hanson
4. Number of other samples collected at same time at this point 0
5. Field collection procedure, handling and/or preservation of this sample SQ kick Preserved in Ethyl Alcohol
6. Mode of transportation to lab by Car
7. Sample sealed by Michael Scott
8. Date sample sealed 7/11/14
9. Remarks

From PH-3011 (rev 10/98), PH-3013 (rev 11/97), and PH-3014 (rev 1/96)

AQUATIC RESOURCES CENTER, INC

545 Cathy Jo Circle
Nashville, TN 37211
aquatres@ix.netcom.com

Phone: 615-781-2901
Fax: 615-781-2254

18 December 2014

Ms. Amy Tolley
Tetra Tech
712 Melrose Avenue
Nashville, TN 37211

RE: Enumeration and identification of benthic invertebrate samples
Aquatic Resources Center Project No. 709b

Dear Amy:

Attached please find the results from the work completed on the above referenced project. Enclosed is a brief summary of methods, data, copy of the bench sheets, and an invoice for the completed work. A total of 35 taxa was identified from the three samples with a range of 14 to 26 taxa per sample.

Please contact me with any questions you may have.

Sincerely yours,

Todd W. Askegaard
President

Three benthic invertebrate samples were received from Tetra Tech, Inc. for processing, identification, enumeration and biological measures calculation. The samples were collected from Rutherford Creek (river miles 26.7 and 28.6) and Owl Creek (river mile 4.78) in Williamson County (ecoregion 71fgh) on 27 and 28 October 2014. Rutherford Creek had a drainage area greater than 2 square miles upstream of the sampling sites. Owl Creek had a drainage area of 1.22 square miles upstream of the sampling area. Below is a brief description of the processing methods and results.

Samples were washed using a US Series No. 35 (500 µm mesh) sieve to remove ethanol and excess detritus. Because the samples contained a large amounts of material (detritus and organisms), they were subsampled using the Caton (1991) method, which is recommended by TDEC (2011). This procedure consists of dividing a given sample into 30 equal portions (termed grids) using a specified subsampling device, then sorting at least four of these grids (which have been randomly selected) to obtain 200±20 percent (160-240) organisms. If sorting a grid had been started, it was finished in its entirety. The benthic organisms removed from the sample were placed by major groupings (e.g., mayflies, worms, snails) into glass vials containing 70 percent EtOH (ethyl alcohol). Each vial was labeled with information such as date of collection, location, specific sample identification, name of taxonomic group and number of organisms. The residue from the sorted portion of a sample was preserved separately from the portion that was not sorted. Organisms were identified using either a dissecting or compound microscope. The latter microscope was used for identifying chironomids (midgefly larvae) and oligochaetes (aquatic segmented worms) after these organisms were mounted on microscope slides using CMCP mounting medium. Most organisms were identified to the generic level, unless the specimens were too small or damaged to allow identification to this level. Identifications were recorded on laboratory bench sheets (see attached copies). When identifications were complete, the data were entered onto an Excel spreadsheet and checked for accuracy.

The total number of individuals identified ranged from 183 and 243 per sample. The total number of taxa per sample was 26 and 23 (RUTHE26.7WI and RUTHE28.6WI, respectively) and 14 for Owl Creek. Tolerance values ranged from 0.20 (Leuctridae) to 9.50 (Tubificinae: bifid chaetae). There were ten (10) taxa classified as having “clinger” habit and six (6) taxa classified as nutrient tolerant. These data were used in the calculations of the biological measures required by TDEC (2011) and the values for these measures are shown in the table below.

	RUTHE26.7WI		RUTHE28.6WI		OWL004.78WI	
	Value	Score	Value	Value	Value	Value
Taxa Richness	26	4	23	4	14	2
EPT Index	11	6	12	6	6	2
%EPT-Cheumatopsyche	47.3	4	30.0	2	8.2	0
%Oligochaeta+Chironomidae	36.2	4	4.7	6	2.2	6
NCBI	4.02	6	5.86	4	7.31	2
Percent Clingers	20.6	2	23.0	2	8.7	0
Percent Nutrient Tolerant	18.1	6	50.2	4	79.8	2
TMI Score		32		28		14

SAMPLE ID RUTHE026.7W1 LOCATION Rutherford Crk PROJECT 709

Date Collected 27Oct14 Grids: sorted/total 4/30 x 8/16 Mult. Factor x15 Sorter RTH Date 9Dec14

QC? Y or N by ____ Total 243 Taxa 26 Other info drainage = 116 sqmi Log# 87090003

Chironomidae 88 Others 144 EPT= 11
Amp/Iso/Dec 11

Amphipoda	
Crangonyx	6
Isopoda	
Lirceus	5
Ephemeroptera	
Caenis	8
Heptageniidae (ei/damaged)	1
Isonychia	10
Diphetor	42
Acerpenna	6
Baetis	25
Acentrella	2
Plecoptera	
Perlodidae (e.instars)	3
Leuctridae (e.instar)	1
Trichoptera	
Cheumatopsyche	3
Chimarra	17
Coleoptera	
Psephenus (L)	8
Stenelmis (L)	2
Diptera	
Simulium	16
Chironomidae	
Cladotanytarsus (1pupa)	8
Corynoneura (1pupa)	5
Cryptochironomus	3
Eukiefferiella	18
Orthocladius	1
Parametriocnemus (1pupa)	8
Polypedilum	26
Stempellinella	2
Thienemanniella	13
Thienemannimyia grp	4

Comments: 3 adult mayflies discarded

x = not counted as a separate taxon

SAMPLE ID RUTHE028.6W1 LOCATION Rutherford Crk PROJECT 709

Date Collected 27Oct14 Grids: sorted/total 4/30 Mult. Factor x 7.5 Sorter RTH Date 9Dec14

QC? Y or N by ____ Total 213 Taxa 23 Other info drainage = 116 sqmi Log#B7090004

Oligochaeta	1	Bivalv/Gastro	97		EPT index = 12
Chironomidae	9	Others	106		

Amphipoda	
Crangonyx	24
Isopoda	
Lirceus	73
(4 parasitized w/Acanthocephala)	
Ephemeroptera	
Caenis	16
Stenacron	16
Isonychia	4
Leptophlebiidae (ei/damaged)	11
Baetis	8
Diphetor	3
Acerpenna	2
Odonata	
Calopteryx	1
Plecoptera	
Perlodidae (e.instar)	1
Leuctridae (e.instar)	1
Trichoptera	
Chimarra	1
Cheumatopsyche	6
Hydropsyche	1
Coleoptera	
Psephenus (L)	17
Stenelmis (5L, 2A)	7
Diptera	
Hexatoma	10
Myxosargus	1

Oligochaeta	
Tubificinae: bifid chaetae	1
Chironomidae	
Eukiefferiella	3
Polypedilum	4
Stempellinella	2

Comments: Acanthocephala -1 mounted w/ Oligo's

x = not counted as a separate taxon

SAMPLE ID OWL664.78 W1 LOCATION Owl Creek PROJECT 709

Date Collected 28Oct14 Grids: sorted/total 4/30 x 8/16 Mult. Factor x15 Sorter RTH Date 8Dec14

QC? Y or N by ____ Total 183 Taxa 14 Other info Owl Crk @ Split Log Rd Log# B7090005

Oligochaeta 02 Amp/Iso/Dec 160 EPT index = 6
Chironomidae 4 others 19

Amphipoda	
Crangonyx	16
Isopoda	
Lirceus	142
(6 parasitized w/ Acanthocephala)	
Decapoda	
Orconectes (male)	1
x Cambaridae (female)	1
Ephemeroptera	
Acentrella	1
Diphetor	1
Caenis	1
Stenacron	8
Trichoptera	
Chimarra	3
Hydropsyche	1
Coleoptera	
Ectopria (L)	1
Psephenus (L)	1
Stenelmis (L)	2
x Acanthocephala (omit)	3
Chironomidae	
Polypedilum	1
Eukiefferiella	3

Comments: drainage area = 13.2 sq mi

x = not counted as a separate taxon

Chain of Custody

PROJECT/SITE NO. Rutherford @ Cross Keys	PROJECT NAME Williamson County Sampling
STATION NUMBER RUTME 028.6 W1	COUNTY Williamson
DESCRIPTION @ Cross Keys RD	
STREAM MILE 28.6	MATRIX Surface Water
COLLECTED: DATE 10/27/14	TIME 100 PM
SAMPLER'S NAME (printed) Michael Scott	
SAMPLING AGENCY Williamson County	
Laboratory Number	Branch Lab Number

CHAIN OF CUSTODY

Only one chain of custody form is required per sample set or point (if all collected at the same time)

1. Collected by Michael Scott, Amy Tolley, Rich Manson	
Date 10/27/14	Time [redacted] 1:00 PM
Delivered to Amy Tolley	
Date 11/13/14	Time 12:00 PM
2. Received by Amy Tolley	
Date 11-13-14	Time 11:30
Delivered to Aquatic Resources	
Date 11-14-14	Time
3. Received by Aquat Res Reg Holder	
Date 11-14-14	Time 1600
Delivered to	
Date	Time
4. Received in Lab by	
Date	Time
Logged in by	
Date	Time

ADDITIONAL INFORMATION

1. Approximate volume of sample 1000 ML
2. Nearest town or city Franklin, TN
3. Others present at collection Amy Tolley, Rich Manson
4. Number of other samples collected at same time at this point. —
5. Field collection procedure, handling and/or preservation of this sample SQuick preserved in Ethyl Alcohol
6. Mode of transportation to lab Car
7. Sample sealed by Michael Scott
8. Date sample sealed 10/27/14
9. Remarks

From PH-3011 (rev 10/98), PH-3013 (rev 11/97), and PH-3014 (rev 1/96)

Chain of Custody

PROJECT/SITE NO. Rutherford @ Old Bethesda	PROJECT NAME Williamson County Sampling
STATION NUMBER RUTHE 026.7 W1	COUNTY Williamson
DESCRIPTION @ Old Bethesda Rd	
STREAM MILE 26.7	MATRIX Surface water
COLLECTED: DATE 10/27/14	TIME 9:30 A.M.
SAMPLER'S NAME (printed) Michael Scott	
SAMPLING AGENCY Williamson County	
Laboratory Number	Branch Lab Number

CHAIN OF CUSTODY

Only one chain of custody form is required per sample set or point (if all collected at the same time)

1. Collected by Michael Scott, Amy Tolley, Richard Manson	
Date 10/27/14	Time 9:30 AM
Delivered to Amy Tolley	
Date 11/13/14	Time 12:00 PM
2. Received by Amy Tolley	
Date 11-13-2014	Time 11:30
Delivered to Aquatic Resources	
Date 11-14-2014	Time
3. Received by Aquat Res Resth Lab	
Date 11-14-14	Time 16:00
Delivered to	
Date	Time
4. Received in Lab by	
Date	Time
Logged in by	
Date	Time

ADDITIONAL INFORMATION

1. Approximate volume of sample	1000 mL
2. Nearest town or city	Franklin
3. Others present at collection	Amy Tolley, Richard Manson
4. Number of other samples collected at same time at this point.	2 Part 10 Sample
5. Field collection procedure, handling and/or preservation of this sample	SQ Kick (Preserved in Ethyl Alcohol)
6. Mode of transportation to lab	Car
7. Sample sealed by	Michael Scott
8. Date sample sealed	10/27/14
9. Remarks	

From PH-3011 (rev 10/98), PH-3013 (rev 11/97), and PH-3014 (rev 1/96)

Chain of Custody

PROJECT/SITE NO. Owl Creek @ Split Log	PROJECT NAME Williamson County Surface
STATION NUMBER OWL 004.78 WI	COUNTY Williamson
DESCRIPTION @ Split Log Rd	
STREAM MILE 4.78	MATRIX surface water
COLLECTED: DATE 10/28/14	TIME 10:00 AM
SAMPLER'S NAME (printed) Michael Smith	
SAMPLING AGENCY Williamson County	
Laboratory Number	Branch Lab Number

CHAIN OF CUSTODY

Only one chain of custody form is required per sample set or point (if all collected at the same time)

1. Collected by Michael Smith, Amy Talley, Rich Mason	
Date 10/28/14	Time 10:00 AM
Delivered to Amy Talley	
Date 11/13/14	Time 17:00 pm
2. Received by Amy Talley	
Date 11-13-14	Time 11:30
Delivered to Aquatic Resources	
Date 11-14-14	Time
3. Received by Aquatic Res Rich Holt	
Date 11-14-14	Time 1600
Delivered to	
Date	Time
4. Received in Lab by	
Date	Time
Logged in by	
Date	Time

ADDITIONAL INFORMATION

1. Approximate volume of sample 1000 ml
2. Nearest town or city Franklin, TN
3. Others present at collection Amy Talley, Rich Mason
4. Number of other samples collected at same time at this point. —
5. Field collection procedure, handling and/or preservation of this sample Sq Kick Preserved in Ethyl Alcohol
6. Mode of transportation to lab Car
7. Sample sealed by Michael Smith
8. Date sample sealed 10/28/14
9. Remarks

From PH-3011 (rev 10/98), PH-3013 (rev 11/97), and PH-3014 (rev 1/96)