

NPDES Phase II Permit Monitoring Report Biological and Bacteriological Sampling

Montgomery County Jurisdiction Assessment
Montgomery County, Tennessee

PREPARED FOR:



PREPARED BY:



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Biological Monitoring Report

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EXECUTIVE SUMMARY

Barge Design Solutions, Inc. (BARGE) was retained by Montgomery County Buildings and Codes Department to perform biological monitoring in Montgomery County's jurisdiction area. Under the National Pollutant Discharge Elimination System (NPDES) permit requirements of the Tennessee Department of Environment and Conservation (TDEC), biological assessments to determine the current condition of the streams located within the jurisdictional boundaries of the county in which the permitted facility serves must be performed. Biological monitoring is required at selected monitoring sites currently listed as impaired.

Methodologies were followed according to the TDEC Division of Water Resources Standard Operating Procedures - *Quality System Standard Operation Procedure for Macroinvertebrate Stream Surveys* (TDEC, 2017) and *Quality System Standard Operating Procedure for Chemical and Bacteriological Sampling of Surface Water* (August 2018).

Nine monitoring stations were surveyed to determine biological integrity. Prior to surveying, a representative stream reach was identified at each location based on the available primary physical habitat characteristics. In situ water quality measurements, as well as physical characterizations were conducted at each monitoring site. In addition, a subset of three sites were selected to collect water samples to be analyzed for *E. coli*. Macroinvertebrates were collected from downstream to upstream locations using a multi-habitat approach. Sampling occurred during September and October of 2018.

An analysis of habitat, macroinvertebrate communities, and *E. coli* were conducted to determine current conditions of biotic integrity within each of the streams sampled. Comparisons were made with reference data acquired from TDEC for the Western Pennyroyal Karst (71e) and Western Highland Rim (71f), where applicable, for Tennessee Macroinvertebrate Index (TMI) (TDEC, 2017.)

A total of 85 macroinvertebrate taxa were collected. Species that were encountered during this survey were common representatives of those inhabiting the region. Sensitive/intolerant macroinvertebrate species were encountered at all sites. TMI scores ranged from 18-40, with five sites obtaining the required reference score for their given ecoregions.

Habitat was assessed at each site that a macroinvertebrate sample was taken from. Ecoregion 71e requires a score of greater than or equal to 114 to be considered to meet regional guidelines and Ecoregion 71f requires a score of greater than or equal to 123. Three of five sites in Ecoregion 71f did not meet regional guidelines and all of the sites in Ecoregion 71e met regional guidelines.

In addition, five *E. coli* samples were collected within a 30-day period at each of the sampling sites to determine the average most probable number (MPN)/100 mL of river water. These data were skewed by the above average amount of precipitation during September and October. The first three samples collected are ultimately the expected level of *E. coli* as the last two samples were influenced by rain events. Given the first three samples, two of the three sample locations are above the 132 MPN/100 mL threshold for an impaired stream.

1.0 INTRODUCTION

On behalf of Montgomery County Buildings and Codes Department, Barge Design Solutions, Inc. (BARGE) conducted a bioassessment in accordance with the Montgomery County NPDES permit issued by the Tennessee Department of Environment and Conservation (TDEC) following protocol set forth in the *Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys* (TDEC, 2017).

1.1 Study Area Location

The project is located in the Highland Rim geographic region in Montgomery County, Tennessee. The survey area is situated within the Guthrie KY, Sango TN, Clarksville TN, Excell TN, and Henrietta TN 7.5-minute United States Geological Survey (USGS) Topographic Quadrangles, and the Red River Watershed (05130206) and Lower Cumberland River Watershed (05130205) 8-digit Hydrologic Unit Codes (HUC). Locations are further categorized into five different 10 digit HUCs.

In total, ten sites were sampled during this study. Nine TDEC long-term monitoring locations were selected to evaluate biological integrity and three sites were selected to evaluate the concentration of *E.coli* (Figure 1). Site locations and designations are as follows:

Station ID	Waterbody Name	Latitude/Longitude	Ecoregion	Site Assessment Type
SPRIN009.8MT	Spring Creek at Jim Johnson Road	36.6170, -87.2535	71e	Macroinvertebrate
SPRIN006.9MT	Spring Creek at Oakland Road	36.6154, -87.2876	71e	Macroinvertebrate
WALL000.6MT	Wall Branch off Hwy 12	36.4964, -87.2994	71f	Macroinvertebrate
LOUIS001.8	Louise Creek at Watkins Ford Road	36.3592, -87.3061	71f	Macroinvertebrate
EFORK003.9MT	East Fork Creek off Benton Ridge Road	36.3981, -87.5272	71f	Macroinvertebrate and <i>E.coli</i>
BMCAD004.9MT	Big McAdoo Creek near Gholson Road	36.4617, -87.2744	71f	Macroinvertebrate and <i>E.coli</i>
SPRIN13.7T0.4MT	UNT to Spring Creek at Hwy 79	36.6361, -87.2113	71e	Macroinvertebrate
BARTE001.4	Bartee Branch at Lake Road	36.502, -87.5177	71f	Macroinvertebrate
RED024.7MT	Red River DS Sulphur Fork	36.5562, -87.1473	71e	Macroinvertebrate
RED000.4MT	Red River at Highway 741A	36.542, -87.368	71f	<i>E.coli</i>

2.0 METHODS

Biological and bacteriological monitoring were performed according to the methods outlined in the TDEC *Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys* (2017) and *Quality System Standard Operating Procedure for Chemical and Bacteriological Sampling of Surface Water* (TDEC, 2018). The primary components of the biomonitoring included physical stream characterization, macroinvertebrate sampling, and *E. coli*

sampling. Physical habitat assessments and in-situ water quality measurements were also performed at all sample locations.

2.1 Physical Characterization

2.1.1 Physical Habitat Assessment

Habitat quality was assessed by acquiring a consensus between field team members in each sampling reach using standard visual-based methods (Barbour et al. 1999). These methods address habitat quality based on the ten habitat-quality parameters as described in the standard operating procedures (TDEC, 2017). For this study habitat quality was assessed concurrently with water quality and macroinvertebrate sample collection in all reaches.

Total scores for each sampling reach were derived from the sum of all of the parameter scores. All streams were assessed as a high-gradient stream status. Photographs were taken at the upstream and downstream ends of each sampling reach (Appendix 2). Field data sheets summarizing physical characterizations are provided in Appendix 1.

2.2 Water Chemistry

Prior to biological surveys, water quality was assessed via in situ measurements using a YSI Pro DSS Multi-parameter meter to obtain the following parameters: temperature, pH, specific conductivity, and dissolved oxygen. In addition, at three locations, *E. coli* was collected following the TDEC SOP for surface water sampling (2018)

2.3 Macroinvertebrate Assessment

Macroinvertebrates were collected using semi-quantitative sampling methods. Single habitat sampling was conducted using the kick sampling technique in accordance with TDEC's 2017 SOP for macroinvertebrate collection (TDEC, 2017). To maintain consistency with TDEC sampling protocols, two 1-m² kick net samples were obtained from specified sampling reaches, if habitat allowed. Care was taken to avoid disruption of substrate from which a subsequent sub-sample was planned.

Enumeration and identification of macroinvertebrate samples were conducted in accordance with TDEC 2017 Standard Operating Procedures, except that macroinvertebrates were identified to the lowest possible taxonomic unit (i.e. species if available). However, even though the macroinvertebrates were identified to the lowest possible taxonomic unit, the data analysis provided in this report is based on genus-level data in accordance with the 2017 protocols. The raw data generated from laboratory identification are included in Appendix 1.

3.0 RESULTS AND DISCUSSION

3.1 Physical Characterization

3.1.1 Habitat Assessment

Results of the visual habitat assessments all of the streams are presented in Table 1, in Appendix 1. Field data sheets are provided in Appendix 1. Erosion within noted in all of the sampling reaches, which can be attributed to surrounding land use and soil composition in the area. Six sample reaches scored out to have a assessment rating within the "optimal" range and three reaches scored within the "suboptimal" range. As evaluated by the habitat parameters, site

RED024.7MT had the highest habitat assessment score (163) while BMCAD004.9MT and LOUIS001.8MT had the lowest habitat assessment scores (116).

SPRIN009.8MT – Spring Creek at Jim Johnson Road

This stream segment was limited by the riparian zone and bank stability. The surrounding land use is primarily agriculture, with no buffer on the left bank. Erosion was evident throughout the reach and beyond as there was little vegetation to support the stability. There was, however, very little evidence of sediment deposition, especially in the riffle areas. Overall, the reach received a score of 126, which is above the ecoregion reference score.

SPRIN006.9MT – Spring Creek at Oakland Road

This stream segment was limited by the riparian width and sediment deposition in the low flow areas. Like the previous Spring Creek site, and all of the remaining sites, agriculture is a detriment to the quality of the stream. However, there has been very little channel alteration and the velocity/depth regime spectrum is intact at this site. Overall, the reach received a score of 142, which is well above the ecoregion reference score.

WALL000.6MT – Wall Branch off Highway 12

Bank stability and sediment deposition are the two limiting factors in this reach. Heavy erosion was noted on each bank throughout the reach, and because of that, there is sediment deposition along the margins and in pool areas. The riparian vegetation is well preserved at this site, the left bank has dense old growth forest that extends beyond 18 meters, and the right bank has been cleared along the outer edges near the water treatment facility. Overall, this reach scored a 140, which is well above the ecoregion reference score.

LOUIS001.8MT – Louise Creek at Watkins Ford Road

Little epifaunal cover was observed at this stream segment and was primarily cobble and leaf pack. In addition, there was no slow-moving deep water, and very little fast-moving deep water. Another limiting factor at this reach was the riparian zone, which primarily consisted of a fence row and then cultivated land, giving a large source of sediment deposition. This segment scored a 116, which is below the ecoregion reference score of 123.

EFORK003.9MT – East Fork Creek off Benton Ridge Road

Sediment and embeddedness of riffles were limiting factors at this site. However, the most glaring limiting factor is the riparian zone, which is used heavily by cattle. Additionally, there were very few riffles and bends within the reach which has led to heavy erosion on each bank. The available instream epifaunal substrate and available cover is sufficient for macroinvertebrates and fish, which is reflected in the TMI score. Overall, this reach scored a 121, which is below the ecoregion reference score of 123.

BMCAD004.9 – Big McAdoo Creek near Gholson Road

This stream segment was observed to have little riffle area and those present were small. Additionally, the riparian zone was non-existent on the right bank, as the land was cleared up to the channel. This was an obvious source of erosion in the stream, which yielded a low parameter score on each bank. The bank vegetation did little to curb the erosion, and most were grasses, or saplings that were nearly eroded underneath. This reach scored a 116, which is below the ecoregion reference score of 123.

SPRING13.7T0.4MT – Unnamed Tributary to Spring Creek at Highway 79

This site was observed twice during the course of this study. The stream during the first visit in September only contained a minor amount of flow. Therefore, no macroinvertebrate sample was taken. Upon the second visit, there was significant flow. Within the reach only cobble and large woody debris provided instream cover for aquatic fauna and there was very little vegetation on the bank for stability. These two characteristics were the limiting factors at the site. There was a significant riparian buffer on each bank and there was little channel alteration observed. Overall, this reach scored a 144, well above the ecoregion reference score.

BARTE001.4MT – Bartee Branch at Lake Road

Bartee Branch had a noticeably higher amount of sediment deposition and riffle embeddedness than the other reaches sampled during this study. In addition, the right bank was highly impacted by the land owner, as it was cleared to the edge with little old growth vegetation left standing. There was little channel alteration in the reach and there was an abundance of re-oxygenation zones. Overall, this reach scored a 145, which is above the ecoregion reference score of 123.

RED024.7 – Red River Downstream Sulfur Fork

This reach of the Red River contained very little riffle habitat and what was present was embedded by soft sediment. While there is little channel alteration in the reach, and upstream bridge appears to be changing the flow dynamics and is causing a greater percentage of run compared to riffle in the area. The riparian buffer on both banks remains largely in tact and provides good stability and protection from the surrounding land use. Overall, this reach scored a 163, which is an indication of the quality of protection for the river in the area.

3.1.2 Stream Assessment

Cross section and velocity measurements are displayed in Table 2. The sites where discharge was calculated are related to the sites in which *E. coli* samples were collected. The first three collection dates for bacteria, were similar in discharge, below is the measurements from October 10, 2018. Additionally, the fourth sample occurred shortly after a large rain event and flow was not attainable due to unsafe wading conditions. The final event allowed for flow measurement. During this event, flow was still elevated due to the recent rains and is reflected in the *E.coli* results.

Table 2. *E. coli* Monitoring Sample Location Stream Measurements

Sample Location	Date	Stream Width (ft)	Average Depth (ft)	Cross Sectional Area (ft ²)	Average Velocity (ft/sec)	Discharge (cfs)
EFORK003.9MT	10/10/2018	27.0	0.6125	16.54	1.90	26.7
BMCAD004.9MT	10/10/2018	18.0	0.379	6.825	0.76	4.41
EFORK003.9MT	10/18/2018	28.0	1.28	35.75	1.58	47.77
BMCAD004.9MT	10/18/2018	36.0	1.34	48.38	1.20	45.44

3.2 In Situ Stream Measurements

The *in situ* water quality parameters measured at all locations appear to be within state water quality standards and are generally within acceptable levels for biological integrity (Table 4). Temperature, pH, and dissolved oxygen did not deviate much between sites. The only exception to this was during the October 25 macroinvertebrate sample at RED024.7MT, which occurred after a rain event and during colder water temperatures. These factors lead to a higher dissolved oxygen during this event.

In addition, *E. coli* was collected at three locations on five separate occasions. Rain events appear to have impacted the level of *E. coli* found in the final two sample events. Given the first three samples, it appears that BMCAD004.9Mt and EFORK003.9MT are over the 132 MPN/100 mL threshold for impaired waters (Table 3). RED000.4MT is well below the threshold and does not appear to be a concern regarding *E. coli*.

Sample Location	9/20/2018	10/10/2018	10/11/2018	10/16/2018	10/18/2018
EFORK003.9MT	130	150	160	1,200	310
BMCAD004.9MT	25	34	37	>2,400	7,800
RED000.4MT	1,700	1,700	650	29,000	9,800

3.3 Macroinvertebrate Assessment

3.3.1 Tennessee Macroinvertebrate Index

Tennessee Macroinvertebrate Index (TMI) excel spread sheets are presented in Appendix 1 for all sample locations. In general, site index scores for each location increase with distance downstream. BARTE001.4MT had the lowest TMI score (18). SPRIN009.8MT and RED024.7MT both had the highest TMI scores (40). These scores seemed to be directly related to the presence and abundance of riffles in the reach. Below is a summary of each individual and key characteristics that represent the community composition.

SPRIN009.8MT – Spring Creek at Jim Johnson Road

The macroinvertebrate sample at this location yielded 25 distinct taxa and 8 distinct Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa. A significant number of the specimen at this location were from the Order Trichoptera and the family Hydropsychidae, which are all clinger species. Clinger species are an indication of high-quality habitat availability. The TMI at this location was 40, which is above the ecoregion reference score of 32.

SPRIN006.9MT – Spring Creek at Oakland Road

Unlike the upstream Spring Creek location, the number of distinct taxa at this sample location was 13. The EPT species were more similar, with 6 distinct species identified. The percentage of EPT in this community was dominant and a low percentage of nutrient tolerant species. Like the upstream Spring Creek site, this community

was dominated by the family Hydropsychidae. The TMI at this location was 34, which is above the ecoregion reference score of 32.

WALL000.6MT – Wall Branch off Highway 12

The community at this sample location was comprised of 20 distinct taxa and 7 distinct EPT taxa. The assemblage of EPT, excluding *Cheumatopsyche*, which are generally considered a more tolerant EPT species, was approximately 58 percent. The dominant species in this community was again from the Trichoptera Order, but the Philopotamidae family. Overall, this site scored below the ecoregion reference of 32 with a 30.

LOUIS001.8MT – Louise Creek at Watkins Ford Road

The Louise Creek macroinvertebrate community included 27 distinct taxa and 9 distinct EPT taxa. The percentage of EPT, excluding *Cheumatopsyche*, was approximately 32 percent. The percentage of nutrient tolerant species was 52 percent. The percentage of clingers in the community was nearly 60 percent. Overall, this site scored a 32, which is equal to the required ecoregion reference score.

EFORK003.9MT – East Fork Creek off Benton Ridge Road

East Fork Creek contained the greatest number of distinct taxa, 38, and also the greatest number of EPT taxa, 11. The Order Ephemeroptera was the dominant group within the community assemblage. Within the Order, the taxa were distributed evenly among three different Families. The nutrient tolerant species in the community comprised nearly 30 percent of the community. Overall, this site received a TMI score of 36, which is above the ecoregion reference score.

BMCAD004.9MT – Big McAdoo Creek near Gholson Road

The community in Big McAdoo Creek was comprised of 21 distinct taxa and 9 distinct EPT taxa. Nutrient tolerant species comprised nearly 53 percent of the community, and the EPT, excluding *Cheumatopsyche*, represented nearly 37 percent of the community. *Cheumatopsyche* was the dominant taxa in the Big McAdoo Creek community assemblage. This site scored a TMI of 28, which is below the ecoregion reference score of 32.

SPRING13.7T0.4MT – Unnamed Tributary to Spring Creek at Highway 79

30 distinct taxa were identified in the macroinvertebrate community collected in the Unnamed Tributary to Spring Creek. In addition, 6 distinct EPT taxa were also identified. The percentage of EPT, excluding *Cheumatopsyche*, was approximately 12 percent. This community was dominated by a specimen in the Order Coleoptera, which contributed to the high percentage of nutrient tolerant species, approximately 66 percent. This site scored a TMI of 28, which is below the ecoregion reference score of 32.

BARTE001.4MT – Bartee Branch at Lake Road

The Bartee Branch macroinvertebrate community was comprised of 26 distinct taxa and only 3 distinct EPT taxa. The EPT, excluding *Cheumatopsyche*, comprised only 17 percent. With nearly 25 percent of the community being represented by *Cheumatopsyche*. Secondly, the Family Chironomidae was the most dominant grouping of species within the community. This site scored a TMI of 18, which is the lowest score of any site sampled during this investigation. This TMI is well below the ecoregion reference score of 32.

RED024.7MT – Red River Downstream Sulfur Fork

The Red River macroinvertebrate community contained 23 distinct taxa and 11 distinct EPT taxa. Nearly 75 percent of the community was represented by EPT taxa, excluding *Cheumatopsyche*. Only 22 percent of the community can be described as a nutrient tolerant species. The Order Ephemeroptera and Family Heptageniidae was the dominant grouping of specimen within this community. This site scored a TMI of 40, which was the highest score of all samples collected during this investigation. This TMI is above the ecoregion reference score of 32.

4.0 SUMMARY

Barge performed biological monitoring for Montgomery County Buildings and Codes Department as part of the biological monitoring in the Montgomery County jurisdiction area, under the National Pollutant Discharge Elimination System (NPDES) permit requirements. An analysis of habitat, macroinvertebrate communities, and bacteriological contamination were conducted to determine current conditions of streams within Montgomery County. Comparisons were made with reference data acquired from TDEC for the Western Pennyroyal Karst (71e) and Western Highland Rim (71f) ecoregions, where applicable, for macroinvertebrate TMI (TDEC, 2017) and habitat assessment (TDEC, 2017).

A total of 85 macroinvertebrate taxa were collected. Species that were encountered during this survey were common representatives of those inhabiting the Montgomery County jurisdiction tributaries to the Cumberland River. TMI scores ranged from 18-40, and four of the nine streams did not score above the ecoregion reference number of 32. Sensitive/intolerant macroinvertebrate species were encountered at all sites, which were reflected by the higher TMI scores where they were more abundant.

Overall, habitat at each of the sample locations was either above, or just below the ecoregion threshold for impairment. Those that were below were located within pastures and had been impacted severely by the surrounding land use. The lower habitat scores coincide with higher *E. coli* levels that were documented. EFORK003.9 MT and BMCAD004.9MT were both above the *E. coli* threshold for impairment and below the ecoregion reference score for habitat.

5.0 QUALIFICATIONS STATEMENT

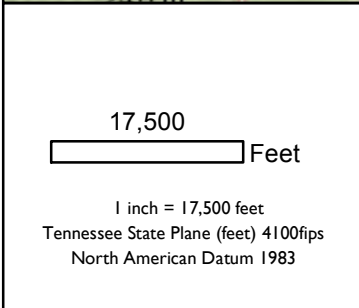
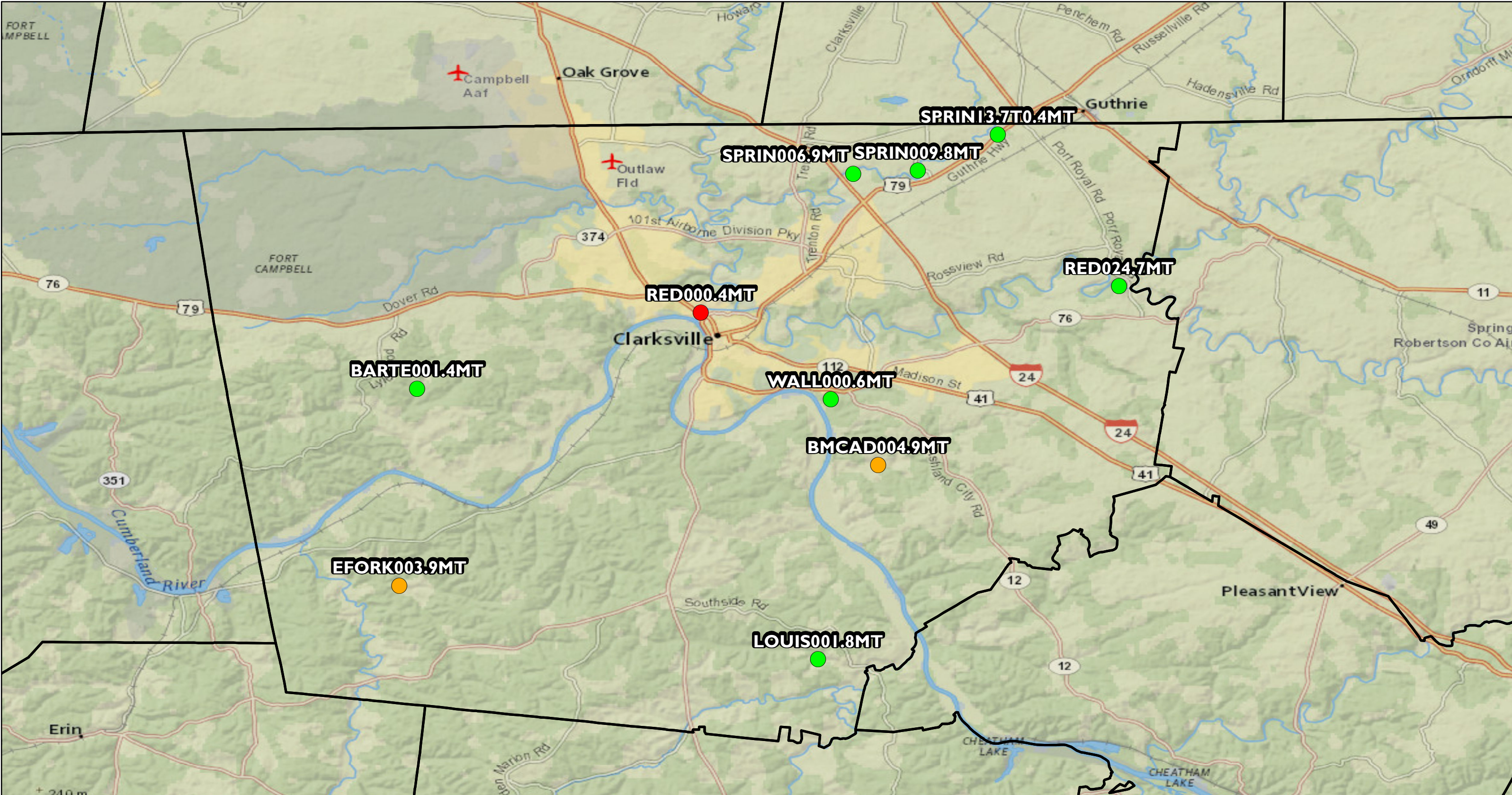
Surveys were led by Barge representative Mr. Nick Carmean. Mr. Carmean holds a M.S. in Fisheries Biology with over 9 years of experience in freshwater ecology. He holds a TDEC Scientific Collection Permit (29-WJH-16-237) and has over 8 years of experience conducting biological surveys throughout the south. Field work support during the bioassessment was provided by Barge representatives Grant Lynch, Kayla Hillis, and Brandon Page.

6.0 REFERENCES

- Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition*. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.
- TDEC (Tennessee Department of Environment and Conservation), 2017. *Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys*. Division of Water Resources. Nashville, TN. August 2017.
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Appendix 1

Supporting Information



Sample Locations Map

Montgomery County Water Quality Assessment

Sample Locations

- E. Coli Only
- Macroinvertebrates Only
- Macroinvertebrates and E. Coli

Figure 1

TABLE 1
Habitat Assessment Scores - Montgomery County 2018 Biological Monitoring

	REDO24.7	WALL000.6	SPRIN009.8	BARTE001.4	SPRIN13.7T0.4	EFORK0003.9	BMCAD004.9	SPRIN006.9	LOUIS001.8
Habitat_Parameter									
Epifaunal Substrate/Available Cover	18	14	15	15	10	16	12	15	10
Embeddedness	11	17	17	14	15	14	16	17	16
Velocity/Depth Regime	18	15	15	16	15	15	14	17	13
Sediment Deposition	16	12	18	12	16	12	16	14	17
Channel Flow Status	19	17	14	15	16	13	15	15	17
Channel Alteration	18	15	15	16	18	13	15	15	15
Frequency of Riffles (or bends)	15	16	12	18	15	8	10	15	15
Bank Stability (left bank)	9	3	4	9	4	4	3	5	6
Bank Stability (right bank)	9	3	4	6	4	4	3	7	3
Vegetative Protection (left bank)	8	7	5	9	7	6	5	6	2
Vegetative Protection (right bank)	8	6	5	5	7	6	5	6	2
Riparian Vegetative Zone Width (left bank)	7	9	0	9	10	6	2	2	0
Riparian Vegetative Zone Width (right bank)	7	6	2	1	7	4	0	8	0
Total Score	163	140	126	145	144	121	116	142	116

Notes:

Left and right bank designations are based on downstream orientation.

(a) Values indicate consensus scores from field team with condition category listed for each score. Reaches were at Green = above ecoregion reference, Yellow = below ecoregion reference.

TABLE 4
Summary of Field Water Quality Results
Montgomery County 2018 Biological Monitoring

Activity	Date	pH SU	Specific Conductivity uS/cm	Dissolved Oxygen mg/L	Temperature °C
Macroinvertebrate					
SPRIN009.8MT	9/19/2018	8.58	449.6	8.55	21.6
SPRIN006.9MT	9/19/2018	8.17	462.6	8.89	22.6
WALL000.6MT	9/19/2018	8.04	552.0	7.45	22.3
LOUIS001.8MT	9/19/2018	8.63	320.2	8.93	26.8
EFORK003.9MT*	9/20/2018	7.42	339.7	7.09	23.3
BMCAD004.9MT*	9/20/2018	8.13	426.8	7.51	22.9
SPRIN13.7T0.4MT	10/3/2018	7.60	349.3	7.10	21.8
BARTE001.4MT	10/10/2018	7.32	442.5	7.05	23.4
RED024.7MT	10/25/2018	7.96	424.3	14.00	12.1
<i>E.coli</i>					
EFORK003.9MT	10/10/2018	7.67	354.2	8.97	22.2
EFORK003.9MT	10/11/2018	7.5	331.4	9.35	19.9
EFORK003.9MT	10/16/2018	6.98	319.5	9.6	15.4
EFORK003.9MT	10/18/2018	7.57	347.6	12.41	15.1
RED000.4MT	9/20/20108	7.51	225.4	7.48	27.0
RED000.4MT	10/10/2018	7.32	442.5	7.05	23.4
RED000.4MT	10/11/2018	7.61	445.1	5.79	21.8
RED000.4MT	10/16/2018	5.91	256	7.94	16.4
RED000.4MT	10/18/2018	7.23	327.5	11.43	14.6
BMCAD004.9MT	10/10/2018	7.81	441.4	9.35	21.7
BMCAD004.9MT	10/11/2018	7.41	442.2	9	19.3
BMCAD004.9MT	10/16/2018	7.34	376.5	9.46	15.0
BMCAD004.9MT	10/18/2018	7.57	421.2	12.72	14.8

* *E.coli* sample taken concurrently

					RED024.7MT	WALL000.6MT	SPRIN009.8MT	BARTE001.4MT	SPRIN13.7T0.4MT	EFORK003.9MT	BMACAD004.9MT	SPRIN006.9MT	LOUIS001.8MT
Phylum	Class	Order	Family	Genus/Final Identificati	10/25/18	09/09/18	09/19/18	10/10/18	10/03/18	09/20/18	09/20/18	09/19/18	09/19/18
Annelida	Clitellata	Enchytraeida	Enchytraeidae	Enchytraeidae					1				
Annelida	Clitellata	Lumbriculida	Lumbriculidae	Lumbriculidae						3			3
Annelida	Clitellata	Tubificida	Naididae	<i>Branchiura</i>									1
Annelida	Clitellata	Tubificida	Naididae	<i>Bratislavia</i>				1					
Annelida	Clitellata	Tubificida	Naididae	<i>Nais</i>	1	1	1	1					1
Annelida	Clitellata	Tubificida	Naididae	<i>Slavina</i>		1				10			
Annelida	Clitellata	Tubificida	Naididae	Tubificinae: bifid chaeta	1			3					
Annelida	Clitellata	Tubificida	Naididae	Tubificinae: hair+pectinate chaetae					1				
Annelida	Clitellata	Tubificida	Naididae	<i>Varichaetadrilus</i>				1					
Annelida	Clitellata			Opisthopora							2		
Arthropoda	Arachnida	Trombidiformes	Hygrobatidae	<i>Atractides</i>							3		
Arthropoda	Arachnida	Trombidiformes	Hygrobatidae	<i>Hygrobates</i>					1				
Arthropoda	Arachnida	Trombidiformes	Lebertiidae	<i>Lebertia</i>						3	1		
Arthropoda	Arachnida	Trombidiformes	Sperchontidae	<i>Sperchon</i>			1		2	1			
Arthropoda	Arachnida	Trombidiformes	Sperchontidae	<i>Sperchonopsis</i>				1					
Arthropoda	Crustacea	Amphpoda	Crangonyctidae	<i>Crangonyx</i>			2			8			1
Arthropoda	Crustacea	Decapoda	Cambaridae	Cambaridae			2						
Arthropoda	Crustacea	Decapoda	Cambaridae	<i>Faxonius</i>			1						
Arthropoda	Crustacea	Isopoda	Asellidae	<i>Lirceus</i>				8	1	8			
Arthropoda	Insecta	Coleoptera	Elmidae	Elmidae									4
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Macronychus</i>									1
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Optioservus</i>						24			7
Arthropoda	Insecta	Coleoptera	Elmidae	<i>Stenelmis</i>	8	3	7	23	90	8	10	2	85
Arthropoda	Insecta	Coleoptera	Psephenidae	<i>Psephenus</i>			7		6	3	4	1	2
Arthropoda	Insecta	Diptera	Ceratopogonidae	<i>Atrichopogon</i>		1			1				
Arthropoda	Insecta	Diptera	Chironomidae	<i>Chironomus</i>				1					
Arthropoda	Insecta	Diptera	Chironomidae	<i>Cladotanytarsus</i>	1	1							
Arthropoda	Insecta	Diptera	Chironomidae	<i>Conchapelopia</i>		3	4	8	2	2	3		1
Arthropoda	Insecta	Diptera	Chironomidae	<i>Corynoneura</i>	1		1	2					2
Arthropoda	Insecta	Diptera	Chironomidae	<i>Cricotopus</i>	4			2	1		1		
Arthropoda	Insecta	Diptera	Chironomidae	<i>Cryptochironomus</i>	1			4					
Arthropoda	Insecta	Diptera	Chironomidae	<i>Dicrotendipes</i>		1							
Arthropoda	Insecta	Diptera	Chironomidae	<i>Eukiefferiella</i>			1						
Arthropoda	Insecta	Diptera	Chironomidae	<i>Lopescladius</i>	1								
Arthropoda	Insecta	Diptera	Chironomidae	<i>Nanocladius</i>				2					
Arthropoda	Insecta	Diptera	Chironomidae	<i>Nilotanypus</i>		1		1		1	3		1
Arthropoda	Insecta	Diptera	Chironomidae	<i>Orthocladius</i>						2			

					RED024.7MT	WALL000.6MT	SPRIN009.8MT	BARTE001.4MT	SPRIN13.7T0.4MT	EFORK003.9MT	BMACAD004.9MT	SPRIN006.9MT	LOUIS001.8MT
Phylum	Class	Order	Family	Genus/Final Identificati	10/25/18	09/09/18	09/19/18	10/10/18	10/03/18	09/20/18	09/20/18	09/19/18	09/19/18
Arthropoda	Insecta	Diptera	Chironomidae	<i>Phaenopsectra</i>							1		
Arthropoda	Insecta	Diptera	Chironomidae	<i>Polypedilum</i>	3	12	3	21	13	3	8	3	21
Arthropoda	Insecta	Diptera	Chironomidae	<i>Rheocricotpus</i>				2	1				
Arthropoda	Insecta	Diptera	Chironomidae	<i>Rheotanytarus</i>		5		43		11	8		10
Arthropoda	Insecta	Diptera	Chironomidae	<i>Stempellinella</i>					1	1			
Arthropoda	Insecta	Diptera	Chironomidae	<i>Sublettea</i>						1			
Arthropoda	Insecta	Diptera	Chironomidae	Tanypodinae				1					1
Arthropoda	Insecta	Diptera	Chironomidae	<i>Tanytarsus</i>	1			2	2	2			2
Arthropoda	Insecta	Diptera	Chironomidae	<i>Thienemanniella</i>		1		1	3				2
Arthropoda	Insecta	Diptera	Chironomidae	<i>Thienemannimyia</i>				3					
Arthropoda	Insecta	Diptera	Chironomidae	<i>Thienemannimyia</i> grp.	1			2					
Arthropoda	Insecta	Diptera	Chironomidae	<i>Tvetenia</i>			2						
Arthropoda	Insecta	Diptera	Empididae	Empididae		1							
Arthropoda	Insecta	Diptera	Empididae	<i>Hemerodromia</i>		1	2				3		
Arthropoda	Insecta	Diptera	Simuliidae	<i>Simulium</i>		4	2	2	1	2			
Arthropoda	Insecta	Diptera	Tabanidae	<i>Tabanus</i>						1			
Arthropoda	Insecta	Diptera	Tipulidae	<i>Tipula</i>					1				
Arthropoda	Insecta	Ephemeroptera	Baetidae	<i>Acentrella</i>	1								
Arthropoda	Insecta	Ephemeroptera	Baetidae	<i>Acerpenna</i>							1		
Arthropoda	Insecta	Ephemeroptera	Baetidae	<i>Baetis</i>	6	40	26	3	4	16	7	26	14
Arthropoda	Insecta	Ephemeroptera	Baetiscidae	<i>Baetisca</i>						1			
Arthropoda	Insecta	Ephemeroptera	Caenidae	<i>Caenis</i>	2			2			10	2	4
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Heptageniidae	7						7	20	9
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	<i>Leucrocuta</i>									1
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	96	2	34		14	24	4	31	8
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	<i>Stenacron</i>	4		1						
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	<i>Stenonema</i>		4			1				
Arthropoda	Insecta	Ephemeroptera	Isonychiidae	<i>Isonychia</i>	9		7			2	9	21	20
Arthropoda	Insecta	Ephemeroptera	Leptohyphidae	<i>Tricorythodes</i>	2					8	4		
Arthropoda	Insecta	Lepidoptera	Crambidae	<i>Petrophila</i>						1			
Arthropoda	Insecta	Megaloptera	Corydalidae	<i>Corydalus</i>	1		1	2		4		2	2
Arthropoda	Insecta	Odonata	Calopterygidae	<i>Calopteryx</i>			1						
Arthropoda	Insecta	Odonata	Coenagrionidae	<i>Argia</i>					4	6		1	
Arthropoda	Insecta	Odonata	Gomphidae	Gomphidae						1	1		1
Arthropoda	Insecta	Plecoptera	Leuctridae	<i>Leuctra</i>						3			
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Acroneuria</i>						1			
Arthropoda	Insecta	Plecoptera	Perlidae	<i>Agnetina</i>						1			

					RED024.7MT	WALL000.6MT	SPRIN009.8MT	BARTE001.4MT	SPRIN13.7T0.4MT	EFORK003.9MT	BMACAD004.9MT	SPRIN006.9MT	LOUIS001.8MT
Phylum	Class	Order	Family	Genus/Final Identificati	10/25/18	09/09/18	09/19/18	10/10/18	10/03/18	09/20/18	09/20/18	09/19/18	09/19/18
Arthropoda	Insecta	Plecoptera	Taeniopterygidae	<i>Taeniopteryx</i>	14								
Arthropoda	Insecta	Trichoptera	Glossosomatidae	<i>Agapetus</i>	4								
Arthropoda	Insecta	Trichoptera	Glossosomatidae	Glossosomatidae		1							
Arthropoda	Insecta	Trichoptera	Helicopsychidae	<i>Helicopsyche</i>									1
Arthropoda	Insecta	Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	24	47	47	51	5	21	65	45	6
Arthropoda	Insecta	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>		1	5		1	1		5	5
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsychidae		4	12	33			23	14	
Arthropoda	Insecta	Trichoptera	Leptoceridae	Leptoceridae	1								
Arthropoda	Insecta	Trichoptera	Leptoceridae	<i>Oecetis</i>			1						
Arthropoda	Insecta	Trichoptera	Philopotamidae	<i>Chimarra</i>		64	9		3	1	2		12
Mollusca	Bivalvia	Veneroida	Corbiculidae	<i>Corbicula</i>	3			1	6	2			
Mollusca	Bivalvia	Veneroida	Sphaeriidae	<i>Pisidium</i>					6				
Mollusca	Gastropoda	Basommatophora	Ancylidae	<i>Ferrissia</i>						1			
Mollusca	Gastropoda	Basommatophora	Physidae	Physidae					1				
Mollusca	Gastropoda	Basommatophora	Planorbidae	<i>Menetus</i>					1				
Mollusca	Gastropoda	Neotaenioglossa	Pleuroceridae	<i>Pleurocera (Elimia)</i>			4		17	1			
Nematoda				Nematoda								1	
Nemertea	Enopla	Hoplonemertea	Tertastemmatidae	<i>Prostoma</i>			1		1	14			
Platyhelminthes	Turbellaria	Tricladida	DugesIIDae	DugesIIDae					6	1			
Platyhelminthes	Turbellaria	Tricladida	Planariidae	Planariidae							2		
Platyhelminthes	Turbellaria	Tricladida		Tricladida								1	3
				Total number of individ	197	199	185	227	198	204	182	175	231
				Number of taxa per sar	23	20	25	26	30	38	21	13	27
				Total number of taxa	85								
				Number of EPT per sar	11	7	8	3	6	11	9	6	9
				%EPT-Cheum	74.11%	58.29%	51.35%	16.74%	11.62%	28.43%	36.81%	68.00%	32.03%
				%OC	7.61%	13.07%	6.49%	44.49%	12.63%	17.65%	14.29%	1.71%	19.48%
				NCBI	4.27162	5.2407	5.05649	6.16811	5.613939	5.19593	5.3944505	4.80069	5.0974
				%Clingers-CHEUM	62.94%	41.71%	42.70%	27.31%	59.09%	35.78%	28.02%	42.86%	59.31%
				%TNUTOL	21.83%	32.16%	33.51%	49.78%	66.16%	26.96%	52.75%	29.71%	52.38%
					71e	71f	71e	71f	71e	71f	71f	71e	71f
				Number of taxa per sar	4	4	6	4	6	6	4	2	4
				Number of EPT per sar	6	2	6	0	4	6	4	4	4
				%EPT-Cheum	6	6	6	0	0	2	4	6	2
				%OC	6	6	6	4	6	6	6	6	6

					RED024.7MT	WALL000.6MT	SPRIN009.8MT	BARTE001.4MT	SPRIN13.7T0.4MT	EFORK003.9MT	BMACAD004.9MT	SPRIN006.9MT	LOUIS001.8MT
Phylum	Class	Order	Family	Genus/Final Identificati	10/25/18	09/09/18	09/19/18	10/10/18	10/03/18	09/20/18	09/20/18	09/19/18	09/19/18
				NCBI	6	4	6	4	4	6	4	6	6
				%Clingers-CHEUM	6	4	4	2	6	4	2	4	6
				%TNUTOL	6	4	6	4	2	6	4	6	4
				Sum	40	30	40	18	28	36	28	34	32

HABITAT ASSESSMENT FIELD SHEET- MODERATE TO HIGH GRADIENT STREAMS (FRONT)
 (See Protocol E for detailed descriptions and rank information)

DWR Station ID: Spring 009.8 MT		Habitat Assessment By: NC + GL		
Monitoring Location Name: Spring Creek		Date: 9-19-18		Time: 0920
Monitoring Location: Tim Johnson Rd		Field Log Number:		
HUC:	WS Group:	Ecoregion:	QC: <input type="checkbox"/> Duplicate <input checked="" type="checkbox"/> Consensus	
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Over 70% of stream reach has natural stable habitat suitable for colonization by fish and/or macroinvertebrates. Four or more productive habitats are present.	Natural stable habitat covers 40-70% of stream reach. Three or more productive habitats present. (If near 70% and more than 3 go to optimal.)	Natural stable habitat covers 20 -40% of stream reach or only 1-2 productive habitats present. (If near 40% and more than 2 go to suboptimal.)	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
Comments	Cobble/Gravel, Alligator weed, LWD			
2. Embeddedness of Riffles	Gravel, cobble, and boulders 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. If near 25% drop to suboptimal if riffle not layered cobble.	Gravel, cobble and boulders 25-50% surrounded by fine sediment. Niches in bottom layers of cobble compromised. If near 50% & riffles not layered cobble drop to marginal.	Gravel, cobble, and boulders are 50-75% surrounded by fine sediment. Niche space in middle layers of cobble is starting to fill with fine sediment.	Gravel, cobble, and boulders are more than 75% surrounded by fine sediment. Niche space is reduced to a single layer or is absent.
SCORE 17	20 19 18 (17) 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	Sandy substrate little fine sed.			
3. Velocity/ Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow).	Only 3 of the 4 regimes present (if fast-shallow is missing score lower). If slow-deep missing score 15.	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime. Others regimes too small or infrequent to support aquatic populations.
SCORE 15	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	None little slow-deep, but all others present			
4. Sediment Deposition	Sediment deposition affects less than 5% of stream bottom in quiet areas. New deposition on islands and point bars is absent or minimal.	Sediment deposition affects 5-30% of stream bottom. Slight deposition in pool or slow areas. Some new deposition on islands and point bars. Move to marginal if build-up approaches 30%.	Sediment deposition affects 30-50% of stream bottom. Sediment deposits at obstruction, constrictions and bends. Moderate pool deposition.	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 18	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	Very minimal bedrock free of sed, stable gravel bars			
5. Channel Flow Status.	Water reaches base of both lower banks and streambed is covered by water throughout reach. Minimal productive habitat is exposed.	Water covers > 75% of streambed or 25% of productive habitat is exposed.	Water covers 25-75% of streambed and/or productive habitat is mostly exposed.	Very little water in channel and mostly present as standing pools. Little or no productive habitat due to lack of water.
SCORE 14	20 19 18 17 16	15 (14) 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	Island in middle of riffle, gravel bars along sides			

HABITAT ASSESSMENT FIELD SHEET- MODERATE TO HIGH GRADIENT STREAMS (BACK)

DWR Station ID	Date										Assessors										
6. Channel Alteration	Optimal					Suboptimal					Marginal					Poor					
	Channelization, dredging rock removal or 4-wheel activity (past or present) absent or minimal; natural meander pattern. NO artificial structures in reach. Upstream or downstream structures do not affect reach.					Channelization, dredging or 4-wheel activity up to 40%. Channel has stabilized. If larger reach, channelization is historic and stable. Artificial structures in or out of reach do not affect natural flow patterns.					Channelization, dredging or 4-wheel activity 40-80% (or less that has not stabilized.) Artificial structures in or out of reach may have slight affect.					Over 80% of reach channelized, dredged or affected by 4-wheelers. Instream habitat greatly altered or removed. Artificial structures have greatly affected flow pattern.					
	SCORE 15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments Historic channelization. Stabilized, bridge US does not impact																					
7. Frequency of re-oxygenation zones. Use frequency of riffle or bends for category. Rank by quality.	Occurrence of re-oxygenation zones relatively frequent; ratio of distance between areas divided by average stream width <7:1.					Occurrence of re-oxygenation zones infrequent; distance between areas divided by average stream width is 7 - 15.					Occasional re-oxygenation area. The distance between areas divided by average stream width is over 15 and up to 25.					Generally all flat water or flat bedrock; little opportunity for re-oxygenation. Distance between areas divided by average stream width >25.					
	SCORE 12	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
	Comments Two riffles located @ bridge + DS @ sample location																				
8. Bank Stability (score each bank) 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. If approaching 30% score marginal if banks steep.					Moderately unstable; 30-60 % of bank in reach has areas of erosion; high erosion potential during floods, If approaching 60% score poor if banks steep.					Unstable; many eroded area; raw areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.					
	SCORE 4 (LB)	Left Bank	10	9			8	7	6			5	4	3			2	1	0		
	SCORE 4 (RB)	Right Bank	10	9			8	7	6			5	4	3			2	1	0		
Comments																					
9. Vegetative Protective (score each bank) includes vegetation from top of bank to base of bank. Determine left or right side by facing downstream	More than 90% of the bank covered by undisturbed vegetation. All 4 classes (mature trees, understory trees, shrubs, groundcover) are represented and allowed to grow naturally. All plants are native.					70-90% of the bank covered by undisturbed vegetation. One class may not be well represented. Disruption evident but not effecting full plant growth. Non-natives are rare (< 30%)					50-70% of the bank covered by undisturbed vegetation. Two classes of vegetation may not be well represented. Non-native vegetation may be common (30-50%).					Less than 50% of the bank covered by undisturbed vegetation or more than 2 classes are not well represented or most vegetation has been cropped. Non-native vegetation may dominate (> 50%)					
	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		
Comments No shrub, little understory																					
10. Riparian Vegetative Zone Width (score each bank.) Zone begins at top of bank.	Average width of riparian zone > 18 meters. Unpaved footpaths may score 9 if run-off potential is negligible.					Average width of riparian zone 12-18 meters. Score high if areas < 18 meters are small or are minimally disturbed.					Average width of riparian zone 6-11 meters. Score high if areas less than 12 meters are small or are minimally disturbed.					Average width of riparian zone <6 meters. Score high if areas less than 6 meters are small or are minimally disturbed.					
	SCORE 9 (LB)	Left Bank	10	9			8	7	6			5	4	3			2	1	0		
	SCORE 2 (RB)	Right Bank	10	9			8	7	6			5	4	3			2	1	0		
Comments LB small immediate Ag. RB - com w/ ag following																					

Total Score 1260 Comparison to Ecoregion Guidelines (circle): ABOVE or BELOW
 If score is below guidelines, result of (circle): Natural Conditions or Human Disturbance
 Describe:

HABITAT ASSESSMENT FIELD SHEET- MODERATE TO HIGH GRADIENT STREAMS (FRONT)
 (See Protocol E for detailed descriptions and rank information)

DWR Station ID: <i>SRKIN006-9MT</i>		Habitat Assessment By: <i>NC GL</i>		
Monitoring Location Name: <i>TNWOOD5933</i>		Date: <i>9-19-18</i>	Time: <i>1115</i>	
Monitoring Location: <i>Oakland Road (DS)</i>		Field Log Number:		
HUC:	WS Group:	Ecoregion:	QC: <input type="checkbox"/> Duplicate <input checked="" type="checkbox"/> Consensus	
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Over 70% of stream reach has natural stable habitat suitable for colonization by fish and/or macroinvertebrates. Four or more productive habitats are present.	Natural stable habitat covers 40-70% of stream reach. Three or more productive habitats present. (If near 70% and more than 3 go to optimal.)	Natural stable habitat covers 20 -40% of stream reach or only 1-2 productive habitats present. (If near 40% and more than 2 go to suboptimal.)	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE <i>15</i>	20 19 18 17 16	<i>(15)</i> 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	<i>Cobble / veg / LW (minimal) / root dead (minimal)</i>			
2. Embeddedness of Riffles	Gravel, cobble, and boulders 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. If near 25% drop to suboptimal if riffle not layered cobble.	Gravel, cobble and boulders 25-50% surrounded by fine sediment. Niches in bottom layers of cobble compromised. If near 50% & riffles not layered cobble drop to marginal.	Gravel, cobble, and boulders are 50-75% surrounded by fine sediment. Niche space in middle layers of cobble is starting to fill with fine sediment.	Gravel, cobble, and boulders are more than 75% surrounded by fine sediment. Niche space is reduced to a single layer or is absent.
SCORE <i>17</i>	20 19 18 <i>(17)</i> 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	<i>Fine sediment minimal in riffle areas (~10%)</i>			
3. Velocity/ Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow).	Only 3 of the 4 regimes present (if fast-shallow is missing score lower). If slow-deep missing score 15.	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime. Others regimes too small or infrequent to support aquatic populations.
SCORE <i>17</i>	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	<i>All 4 present. Large pool above, slight run, riffle + riffle/run</i>			
4. Sediment Deposition	Sediment deposition affects less than 5% of stream bottom in quiet areas. New deposition on islands and point bars is absent or minimal.	Sediment deposition affects 5-30% of stream bottom. Slight deposition in pool or slow areas. Some new deposition on islands and point bars. Move to marginal if build-up approaches 30%.	Sediment deposition affects 30-50% of stream bottom. Sediment deposits at obstruction, constrictions and bends. Moderate pool deposition.	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 <i>14</i>	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	<i>Noticable in pool/slow areas. Little noted on bars</i>			
5. Channel Flow Status.	Water reaches base of both lower banks and streambed is covered by water throughout reach. Minimal productive habitat is exposed.	Water covers > 75% of streambed or 25% of productive habitat is exposed.	Water covers 25-75% of streambed and/or productive habitat is mostly exposed.	Very little water in channel and mostly present as standing pools. Little or no productive habitat due to lack of water.
SCORE <i>15</i>	20 19 18 17 16	<i>(15)</i> 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	<i>Island + gravel point bars ~70</i>			

HABITAT ASSESSMENT FIELD SHEET- MODERATE TO HIGH GRADIENT STREAMS (BACK)

DWR Station ID	Date		Assessors	
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization, dredging rock removal or 4-wheel activity (past or present) absent or minimal; natural meander pattern. NO artificial structures in reach. Upstream or downstream structures do not affect reach.	Channelization, dredging or 4-wheel activity up to 40%. Channel has stabilized. If larger reach, channelization is historic and stable. Artificial structures in or out of reach do not affect natural flow patterns.	Channelization, dredging or 4-wheel activity 40-80% (or less that has not stabilized.) Artificial structures in or out of reach may have slight affect.	Over 80% of reach channelized, dredged or affected by 4-wheelers. Instream habitat greatly altered or removed. Artificial structures have greatly affected flow pattern.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	Historical for dig + bridge			
7. Frequency of re-oxygenation zones. Use frequency of riffle or bends for category. Rank by quality.	Occurrence of re-oxygenation zones relatively frequent; ratio of distance between areas divided by average stream width <7:1.	Occurrence of re-oxygenation zones infrequent; distance between areas divided by average stream width is 7 - 15.	Occasional re-oxygenation area. The distance between areas divided by average stream width is over 15 and up to 25.	Generally all flat water or flat bedrock; little opportunity for re-oxygenation. Distance between areas divided by average stream width >25.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	IS of pool large riffle			
8. Bank Stability (score each bank) 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. If approaching 30% score marginal if banks steep.	Moderately unstable; 30-60 % of bank in reach has areas of erosion; high erosion potential during floods, If approaching 60% score poor if banks steep.	Unstable; many eroded area; raw areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 5 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Comments				
9. Vegetative Protective (score each bank) includes vegetation from top of bank to base of bank. Determine left or right side by facing downstream	More than 90% of the bank covered by undisturbed vegetation. All 4 classes (mature trees, understory trees, shrubs, groundcover) are represented and allowed to grow naturally. All plants are native.	70-90% of the bank covered by undisturbed vegetation. One class may not be well represented. Disruption evident but not effecting full plant growth. Non-natives are rare (< 30%)	50-70% of the bank covered by undisturbed vegetation. Two classes of vegetation may not be well represented. Non-native vegetation may be common (30-50%).	Less than 50% of the bank covered by undisturbed vegetation or more than 2 classes are not well represented or most vegetation has been cropped. Non-native vegetation may dominate (> 50%)
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
Comments				
10. Riparian Vegetative Zone Width (score each bank.) Zone begins at top of bank.	Average width of riparian zone > 18 meters. Unpaved footpaths may score 9 if run-off potential is negligible.	Average width of riparian zone 12-18 meters. Score high if areas < 18 meters are small or are minimally disturbed.	Average width of riparian zone 6-11 meters. Score high if areas less than 12 meters are small or are minimally disturbed.	Average width of riparian zone <6 meters. Score high if areas less than 6 meters are small or are minimally disturbed.
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
Comments				

Total Score 148 Comparison to Ecoregion Guidelines (circle): ABOVE or BELOW
 If score is below guidelines, result of (circle): Natural Conditions or Human Disturbance
 Describe:

HABITAT ASSESSMENT FIELD SHEET- MODERATE TO HIGH GRADIENT STREAMS (FRONT)
 (See Protocol E for detailed descriptions and rank information)

DWR Station ID: <i>Wall 000.6 MT</i>		Habitat Assessment By: <i>NC GL</i>		
Monitoring Location Name: <i>TNW000006580</i>		Date: <i>9/19/18</i>	Time: <i>1410</i>	
Monitoring Location: <i>off Hwy 12</i>		Field Log Number:		
HUC:	WS Group:	Ecoregion:	QC: <input type="checkbox"/> Duplicate <input checked="" type="checkbox"/> Consensus	
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Over 70% of stream reach has natural stable habitat suitable for colonization by fish and/or macroinvertebrates. Four or more productive habitats are present.	Natural stable habitat covers 40-70% of stream reach. Three or more productive habitats present. (If near 70% and more than 3 go to optimal.)	Natural stable habitat covers 20-40% of stream reach or only 1-2 productive habitats present. (If near 40% and more than 2 go to suboptimal.)	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE <i>14</i>	20 19 18 17 16	15 <i>(14)</i> 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	<i>Cobble + gravel / rootward / LWD</i>			
2. Embeddedness of Riffles	Gravel, cobble, and boulders 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. If near 25% drop to suboptimal if riffle not layered cobble.	Gravel, cobble and boulders 25-50% surrounded by fine sediment. Niches in bottom layers of cobble compromised. If near 50% & riffles not layered cobble drop to marginal.	Gravel, cobble, and boulders are 50-75% surrounded by fine sediment. Niche space in middle layers of cobble is starting to fill with fine sediment.	Gravel, cobble, and boulders are more than 75% surrounded by fine sediment. Niche space is reduced to a single layer or is absent.
SCORE <i>17</i>	20 19 18 <i>(17)</i> 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	<i>~10 embedded → cobble armored</i>			
3. Velocity/ Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow).	Only 3 of the 4 regimes present (if fast-shallow is missing score lower). If slow-deep missing score 15.	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime. Others regimes too small or infrequent to support aquatic populations.
SCORE <i>15</i>	20 19 18 17 16	<i>(15)</i> 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	<i>No slow-deep, riffle run complex primarily</i>			
4. Sediment Deposition	Sediment deposition affects less than 5% of stream bottom in quiet areas. New deposition on islands and point bars is absent or minimal.	Sediment deposition affects 5-30% of stream bottom. Slight deposition in pool or slow areas. Some new deposition on islands and point bars. Move to marginal if build-up approaches 30%.	Sediment deposition affects 30-50% of stream bottom. Sediment deposits at obstruction, constrictions and bends. Moderate pool deposition.	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 <i>12</i>	20 19 18 17 16	15 14 13 <i>(12)</i> 11	10 9 8 7 6	5 4 3 2 1
Comments	<i>Pools have obvious sediment + present on exposed cobble</i>			
5. Channel Flow Status.	Water reaches base of both lower banks and streambed is covered by water throughout reach. Minimal productive habitat is exposed.	Water covers > 75% of streambed or 25% of productive habitat is exposed.	Water covers 25-75% of streambed and/or productive habitat is mostly exposed.	Very little water in channel and mostly present as standing pools. Little or no productive habitat due to lack of water.
SCORE <i>17</i>	20 19 18 <i>(17)</i> 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	<i>Meandering narrow stream water in 90%</i>			

HABITAT ASSESSMENT FIELD SHEET- MODERATE TO HIGH GRADIENT STREAMS (BACK)

DWR Station ID	Date		Assessors	
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization, dredging rock removal or 4-wheel activity (past or present) absent or minimal; natural meander pattern. NO artificial structures in reach. Upstream or downstream structures do not affect reach.	Channelization, dredging or 4-wheel activity up to 40%. Channel has stabilized. If larger reach, channelization is historic and stable. Artificial structures in or out of reach do not affect natural flow patterns.	Channelization, dredging or 4-wheel activity 40-80% (or less that has not stabilized.) Artificial structures in or out of reach may have slight affect.	Over 80% of reach channelized, dredged or affected by 4-wheelers. Instream habitat greatly altered or removed. Artificial structures have greatly affected flow pattern.
SCORE 15	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	Old bridge remains vs. pilings erecting issue w/ debris collection			
7. Frequency of re-oxygenation zones. Use frequency of riffle or bends for category. Rank by quality.	Occurrence of re-oxygenation zones relatively frequent; ratio of distance between areas divided by average stream width <7:1.	Occurrence of re-oxygenation zones infrequent; distance between areas divided by average stream width is 7 - 15.	Occasional re-oxygenation area. The distance between areas divided by average stream width is over 15 and up to 25.	Generally all flat water or flat bedrock; little opportunity for re-oxygenation. Distance between areas divided by average stream width >25.
SCORE 10	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	Primarily riffle/run w/in reach			
8. Bank Stability (score each bank) 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. If approaching 30% score marginal if banks steep.	Moderately unstable; 30-60 % of bank in reach has areas of erosion; high erosion potential during floods, If approaching 60% score poor if banks steep.	Unstable; many eroded area; raw areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 3 (LB)	Left Bank 10 9	8 7 6	5 4 (3)	2 1 0
SCORE 3 (RB)	Right Bank 10 9	8 7 6	5 4 (3)	2 1 0
Comments	Heavy erosion on both banks			
9. Vegetative Protective (score each bank) includes vegetation from top of bank to base of bank. Determine left or right side by facing downstream	More than 90% of the bank covered by undisturbed vegetation. All 4 classes (mature trees, understory trees, shrubs, groundcover) are represented and allowed to grow naturally. All plants are native.	70-90% of the bank covered by undisturbed vegetation. One class may not be well represented. Disruption evident but not effecting full plant growth. Non-natives are rare (< 30%)	50-70% of the bank covered by undisturbed vegetation. Two classes of vegetation may not be well represented. Non-native vegetation may be common (30-50%).	Less than 50% of the bank covered by undisturbed vegetation or more than 2 classes are not well represented or most vegetation has been cropped. Non-native vegetation may dominate (> 50%)
SCORE (LB) 7	Left Bank 10 9	8 (7) (6)	5 4 3	2 1 0
SCORE (RB) 6	Right Bank 10 9	8 7 (6)	5 4 3	2 1 0
Comments	6L, Mature + understory + present Natives primarily			
10. Riparian Vegetative Zone Width (score each bank.) Zone begins at top of bank.	Average width of riparian zone > 18 meters. Unpaved footpaths may score 9 if run-off potential is negligible.	Average width of riparian zone 12-18 meters. Score high if areas < 18 meters are small or are minimally disturbed.	Average width of riparian zone 6-11 meters. Score high if areas less than 12 meters are small or are minimally disturbed.	Average width of riparian zone <6 meters. Score high if areas less than 6 meters are small or are minimally disturbed.
SCORE (LB) 9	Left Bank 10 (9)	8 7 (6)	5 4 3	2 1 0
SCORE (RB) 6	Right Bank 10 9	8 7 (6)	5 4 3	2 1 0
Comments	Clearing + WWTP beyond riparian - RB. LB dense riparian			

Total Score 140 Comparison to Ecoregion Guidelines (circle): ABOVE or BELOW
 If score is below guidelines, result of (circle): Natural Conditions or Human Disturbance
 Describe:

HABITAT ASSESSMENT FIELD SHEET- MODERATE TO HIGH GRADIENT STREAMS (FRONT)

(See Protocol E for detailed descriptions and rank information)

DWR Station ID: LOUIS 001-8MT		Habitat Assessment By: NTZ GTL		
Monitoring Location Name: Louise Creek		Date: 9-19-18		Time: 1645
Monitoring Location: Watkins Ford Rd		Field Log Number:		
HUC:	WS Group:	Ecoregion:	QC: <input type="checkbox"/> Duplicate <input checked="" type="checkbox"/> Consensus	
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Over 70% of stream reach has natural stable habitat suitable for colonization by fish and/or macroinvertebrates. Four or more productive habitats are present.	Natural stable habitat covers 40-70% of stream reach. Three or more productive habitats present. (If near 70% and more than 3 go to optimal.)	Natural stable habitat covers 20 -40% of stream reach or only 1-2 productive habitats present. (If near 40% and more than 2 go to suboptimal.)	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
Comments	Cobbles gravel / leafpack			
2. Embeddedness of Riffles	Gravel, cobble, and boulders 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. If near 25% drop to suboptimal if riffle not layered cobble.	Gravel, cobble and boulders 25-50% surrounded by fine sediment. Niches in bottom layers of cobble compromised. If near 50% & riffles not layered cobble drop to marginal.	Gravel, cobble, and boulders are 50-75% surrounded by fine sediment. Niche space in middle layers of cobble is starting to fill with fine sediment.	Gravel, cobble, and boulders are more than 75% surrounded by fine sediment. Niche space is reduced to a single layer or is absent.
SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	~20% embedded by silt/sand mixture			
3. Velocity/ Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow).	Only 3 of the 4 regimes present (if fast-shallow is missing score lower). If slow-deep missing score 15.	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime. Others regimes too small or infrequent to support aquatic populations.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	No slow-deeps + very little fast deep			
4. Sediment Deposition	Sediment deposition affects less than 5% of stream bottom in quiet areas. New deposition on islands and point bars is absent or minimal.	Sediment deposition affects 5-30% of stream bottom. Slight deposition in pool or slow areas. Some new deposition on islands and point bars. Move to marginal if build-up approaches 30%.	Sediment deposition affects 30-50% of stream bottom. Sediment deposits at obstruction, constrictions and bends. Moderate pool deposition.	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
Comments	deposition less than 5% but still present			
5. Channel Flow Status.	Water reaches base of both lower banks and streambed is covered by water throughout reach. Minimal productive habitat is exposed.	Water covers > 75% of streambed or 25% of productive habitat is exposed.	Water covers 25-75% of streambed and/or productive habitat is mostly exposed.	Very little water in channel and mostly present as standing pools. Little or no productive habitat due to lack of water.
SCORE 17	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	H2O covers majority of streambed.			

HABITAT ASSESSMENT FIELD SHEET- MODERATE TO HIGH GRADIENT STREAMS (BACK)

DWR Station ID	Date				Assessors			
	Optimal	Suboptimal	Marginal	Poor				
6. Channel Alteration	Channelization, dredging rock removal or 4-wheel activity (past or present) absent or minimal; natural meander pattern. NO artificial structures in reach. Upstream or downstream structures do not affect reach.	Channelization, dredging or 4-wheel activity up to 40%. Channel has stabilized. If larger reach, channelization is historic and stable. Artificial structures in or out of reach do not affect natural flow patterns.	Channelization, dredging or 4-wheel activity 40-80% (or less that has not stabilized.) Artificial structures in or out of reach may have slight affect.	Over 80% of reach channelized, dredged or affected by 4-wheelers. Instream habitat greatly altered or removed. Artificial structures have greatly affected flow pattern.				
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1				
Comments	Historically moved for ag							
7. Frequency of re-oxygenation zones. Use frequency of riffle or bends for category. Rank by quality.	Occurrence of re-oxygenation zones relatively frequent; ratio of distance between areas divided by average stream width <7:1.	Occurrence of re-oxygenation zones infrequent; distance between areas divided by average stream width is 7 - 15.	Occasional re-oxygenation area. The distance between areas divided by average stream width is over 15 and up to 25.	Generally all flat water or flat bedrock; little opportunity for re-oxygenation. Distance between areas divided by average stream width >25.				
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1				
Comments	longer riffle @ collection site, one upstream near bridge							
8. Bank Stability (score each bank) 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. If approaching 30% score marginal if banks steep.	Moderately unstable; 30-60 % of bank in reach has areas of erosion; high erosion potential during floods, If approaching 60% score poor if banks steep.	Unstable; many eroded area; raw areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0				
SCORE 3 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0				
Comments								
9. Vegetative Protective (score each bank) includes vegetation from top of bank to base of bank. Determine left or right side by facing downstream	More than 90% of the bank covered by undisturbed vegetation. All 4 classes (mature trees, understory trees, shrubs, groundcover) are represented and allowed to grow naturally. All plants are native.	70-90% of the bank covered by undisturbed vegetation. One class may not be well represented. Disruption evident but not effecting full plant growth. Non-natives are rare (< 30%)	50-70% of the bank covered by undisturbed vegetation. Two classes of vegetation may not be well represented. Non-native vegetation may be common (30-50%).	Less than 50% of the bank covered by undisturbed vegetation or more than 2 classes are not well represented or most vegetation has been cropped. Non-native vegetation may dominate (>50%)				
SCORE 2 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0				
SCORE 2 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0				
Comments	No real veg on bank, small amount of ground cover							
10. Riparian Vegetative Zone Width (score each bank.) Zone begins at top of bank.	Average width of riparian zone > 18 meters. Unpaved footpaths may score 9 if run-off potential is negligible.	Average width of riparian zone 12-18 meters. Score high if areas < 18 meters are small or are minimally disturbed.	Average width of riparian zone 6-11 meters. Score high if areas less than 12 meters are small or are minimally disturbed.	Average width of riparian zone <6 meters. Score high if areas less than 6 meters are small or are minimally disturbed.				
SCORE 2 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0				
SCORE 0 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0				
Comments								

Total Score 116 Comparison to Ecoregion Guidelines (circle): ABOVE or BELOW
 If score is below guidelines, result of (circle): Natural Conditions or Human Disturbance
 Describe:

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS

STREAM NAME _____		LOCATION _____	
SITE ID # _____ REACH ID _____		STREAM CLASS _____	
UTM N _____ UTM E _____		RIVER BASIN _____	
STORET # _____		AGENCY _____	
INVESTIGATORS _____			
FORM COMPLETED BY _____		DATE _____ TIME _____	REASON FOR SURVEY _____

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 <u>not</u> 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	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	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	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	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	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Parameters to be evaluated in sampling reach

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS

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

Parameters to be evaluated broader than sampling reach

Total Score _____

HABITAT ASSESSMENT FIELD SHEET- MODERATE TO HIGH GRADIENT STREAMS (FRONT)
 (See Protocol E for detailed descriptions and rank information)

DWR Station ID: <i>BMCA0049 MT</i>		Habitat Assessment By: <i>UJC GTL</i>		
Monitoring Location Name: <i>Big McAdoe Creek</i>		Date: <i>9/20/18</i>	Time: <i>1225</i>	
Monitoring Location: <i>US Gholson Rd Bridge</i>		Field Log Number:		
HUC:	WS Group:	Ecoregion:	QC: <input type="checkbox"/> Duplicate <input type="checkbox"/> Consensus	
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Over 70% of stream reach has natural stable habitat suitable for colonization by fish and/or macroinvertebrates. Four or more productive habitats are present.	Natural stable habitat covers 40-70% of stream reach. Three or more productive habitats present. (If near 70% and more than 3 go to optimal.)	Natural stable habitat covers 20 -40% of stream reach or only 1-2 productive habitats present. (If near 40% and more than 2 go to suboptimal.)	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE <i>12</i>	20 19 18 17 16	15 14 13 <i>(12)</i> 11	10 9 8 7 6	5 4 3 2 1
Comments	<i>Gravel + cobble / large woody debris / minimal RW</i>			
2. Embeddedness of Riffles	Gravel, cobble, and boulders 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. If near 25% drop to suboptimal if riffle not layered cobble.	Gravel, cobble and boulders 25-50% surrounded by fine sediment. Niches in bottom layers of cobble compromised. If near 50% & riffles not layered cobble drop to marginal.	Gravel, cobble, and boulders are 50-75% surrounded by fine sediment. Niche space in middle layers of cobble is starting to fill with fine sediment.	Gravel, cobble, and boulders are more than 75% surrounded by fine sediment. Niche space is reduced to a single layer or is absent.
SCORE <i>16</i>	20 19 18 17 <i>(16)</i>	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	<i>~ 20% embedded</i>			
3. Velocity/ Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow).	Only 3 of the 4 regimes present (if fast-shallow is missing score lower). If slow-deep missing score 15.	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime. Others regimes too small or infrequent to support aquatic populations.
SCORE <i>14</i>	20 19 18 17 16	15 <i>(14)</i> 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	<i>No deep fast.</i>			
4. Sediment Deposition	Sediment deposition affects less than 5% of stream bottom in quiet areas. New deposition on islands and point bars is absent or minimal.	Sediment deposition affects 5-30% of stream bottom. Slight deposition in pool or slow areas. Some new deposition on islands and point bars. Move to marginal if build-up approaches 30%.	Sediment deposition affects 30-50% of stream bottom. Sediment deposits at obstruction, constrictions and bends. Moderate pool deposition.	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 <i>16</i>	20 19 18 17 <i>(16)</i>	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	<i>Deposition in pools, minimal</i>			
5. Channel Flow Status.	Water reaches base of both lower banks and streambed is covered by water throughout reach. Minimal productive habitat is exposed.	Water covers > 75% of streambed or 25% of productive habitat is exposed.	Water covers 25-75% of streambed and/or productive habitat is mostly exposed.	Very little water in channel and mostly present as standing pools. Little or no productive habitat due to lack of water.
SCORE <i>15</i>	20 19 18 17 16	<i>(15)</i> 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	<i>Gravel bars + Islands throughout ~ small in size</i>			

HABITAT ASSESSMENT FIELD SHEET- MODERATE TO HIGH GRADIENT STREAMS (BACK)

DWR Station ID	Date				Assessors			
	Optimal	Suboptimal	Marginal	Poor				
6. Channel Alteration	Channelization, dredging rock removal or 4-wheel activity (past or present) absent or minimal; natural meander pattern. NO artificial structures in reach. Upstream or downstream structures do not affect reach.	Channelization, dredging or 4-wheel activity up to 40%. Channel has stabilized. If larger reach, channelization is historic and stable. Artificial structures in or out of reach do not affect natural flow patterns.	Channelization, dredging or 4-wheel activity 40-80% (or less that has not stabilized.) Artificial structures in or out of reach may have slight affect.	Over 80% of reach channelized, dredged or affected by 4-wheelers. Instream habitat greatly altered or removed. Artificial structures have greatly affected flow pattern.				
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1				
Comments	Historically bc ag field							
7. Frequency of re-oxygenation zones. Use frequency of riffle or bends for category. Rank by quality.	Occurrence of re-oxygenation zones relatively frequent; ratio of distance between areas divided by average stream width <7:1.	Occurrence of re-oxygenation zones infrequent; distance between areas divided by average stream width is 7 - 15.	Occasional re-oxygenation area. The distance between areas divided by average stream width is over 15 and up to 25.	Generally all flat water or flat bedrock; little opportunity for re-oxygenation. Distance between areas divided by average stream width >25.				
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1				
Comments	Few + small riffles							
8. Bank Stability (score each bank) 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. If approaching 30% score marginal if banks steep.	Moderately unstable; 30-60 % of bank in reach has areas of erosion; high erosion potential during floods, If approaching 60% score poor if banks steep.	Unstable; many eroded area; raw areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
SCORE 3 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0				
SCORE 3 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0				
Comments	Heavy erosion on each bank. Nearly vertical bank							
9. Vegetative Protective (score each bank) includes vegetation from top of bank to base of bank. Determine left or right side by facing downstream	More than 90% of the bank covered by undisturbed vegetation. All 4 classes (mature trees, understory trees, shrubs, groundcover) are represented and allowed to grow naturally. All plants are native.	70-90% of the bank covered by undisturbed vegetation. One class may not be well represented. Disruption evident but not effecting full plant growth. Non-natives are rare (< 30%)	50-70% of the bank covered by undisturbed vegetation. Two classes of vegetation may not be well represented. Non-native vegetation may be common (30-50%).	Less than 50% of the bank covered by undisturbed vegetation or more than 2 classes are not well represented or most vegetation has been cropped. Non-native vegetation may dominate (> 50%)				
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				
Comments	No shrubs. Minimal mature. Primarily GC + US							
10. Riparian Vegetative Zone Width (score each bank.) Zone begins at top of bank.	Average width of riparian zone > 18 meters. Unpaved footpaths may score 9 if run-off potential is negligible.	Average width of riparian zone 12-18 meters. Score high if areas < 18 meters are small or are minimally disturbed.	Average width of riparian zone 6-11 meters. Score high if areas less than 12 meters are small or are minimally disturbed.	Average width of riparian zone <6 meters. Score high if areas less than 6 meters are small or are minimally disturbed.				
SCORE 2 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0				
SCORE 0 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0				
Comments	LB small rip + then road + Ag. RB -> Cleared pasture							

Total Score 116 Comparison to Ecoregion Guidelines (circle): ABOVE or BELOW
 If score is below guidelines, result of (circle): Natural Conditions or Human Disturbance
 Describe:

HABITAT ASSESSMENT FIELD SHEET- MODERATE TO HIGH GRADIENT STREAMS (FRONT)

(See Protocol E for detailed descriptions and rank information)

DWR Station ID: Spring 3.7 TO 4 MT		Habitat Assessment By: JRL, KRH		
Monitoring Location Name: Spring Creek UNT		Date: 10/31/18		Time: 0940
Monitoring Location: US Hwy 79		Field Log Number:		
HUC:	WS Group:	Ecoregion:	QC: <input type="checkbox"/> Duplicate <input checked="" type="checkbox"/> Consensus	
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Over 70% of stream reach has natural stable habitat suitable for colonization by fish and/or macroinvertebrates. Four or more productive habitats are present.	Natural stable habitat covers 40-70% of stream reach. Three or more productive habitats present. (If near 70% and more than 3 go to optimal.)	Natural stable habitat covers 20 -40% of stream reach or only 1-2 productive habitats present. (If near 40% and more than 2 go to suboptimal.)	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	D Cobble/Gravel + LWD			
2. Embeddedness of Riffles	Gravel, cobble, and boulders 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. If near 25% drop to suboptimal if riffle not layered cobble.	Gravel, cobble and boulders 25-50% surrounded by fine sediment. Niches in bottom layers of cobble compromised. If near 50% & riffles not layered cobble drop to marginal.	Gravel, cobble, and boulders are 50-75% surrounded by fine sediment. Niche space in middle layers of cobble is starting to fill with fine sediment.	Gravel, cobble, and boulders are more than 75% surrounded by fine sediment. Niche space is reduced to a single layer or is absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	IS ~30%			
3. Velocity/ Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow).	Only 3 of the 4 regimes present (if fast-shallow is missing score lower). If slow-deep missing score 15.	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime. Others regimes too small or infrequent to support aquatic populations.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	IS No slow deep			
4. Sediment Deposition	Sediment deposition affects less than 5% of stream bottom in quiet areas. New deposition on islands and point bars is absent or minimal.	Sediment deposition affects 5-30% of stream bottom. Slight deposition in pool or slow areas. Some new deposition on islands and point bars. Move to marginal if build-up approaches 30%.	Sediment deposition affects 30-50% of stream bottom. Sediment deposits at obstruction, constrictions and bends. Moderate pool deposition.	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	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	C 5% deposition			
5. Channel Flow Status.	Water reaches base of both lower banks and streambed is covered by water throughout reach. Minimal productive habitat is exposed.	Water covers > 75% of streambed or 25% of productive habitat is exposed.	Water covers 25-75% of streambed and/or productive habitat is mostly exposed.	Very little water in channel and mostly present as standing pools. Little or no productive habitat due to lack of water.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	Narrows significantly @ riffle			

HABITAT ASSESSMENT FIELD SHEET- MODERATE TO HIGH GRADIENT STREAMS (BACK)

DWR Station ID	Date										Assessors									
	Optimal					Suboptimal					Marginal					Poor				
6. Channel Alteration	Channelization, dredging rock removal or 4-wheel activity (past or present) absent or minimal; natural meander pattern. NO artificial structures in reach. Upstream or downstream structures do not affect reach.					Channelization, dredging or 4-wheel activity up to 40%. Channel has stabilized. If larger reach, channelization is historic and stable. Artificial structures in or out of reach do not affect natural flow patterns.					Channelization, dredging or 4-wheel activity 40-80% (or less that has not stabilized.) Artificial structures in or out of reach may have slight affect.					Over 80% of reach channelized, dredged or affected by 4-wheelers. Instream habitat greatly altered or removed. Artificial structures have greatly affected flow pattern.				
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments	Very little road crossing																			
7. Frequency of re-oxygenation zones. Use frequency of riffle or bends for category. Rank by quality.	Occurrence of re-oxygenation zones relatively frequent; ratio of distance between areas divided by average stream width <7:1.					Occurrence of re-oxygenation zones infrequent; distance between areas divided by average stream width is 7 - 15.					Occasional re-oxygenation area. The distance between areas divided by average stream width is over 15 and up to 25.					Generally all flat water or flat bedrock; little opportunity for re-oxygenation. Distance between areas divided by average stream width >25.				
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments	1 riffle w/in reach, long																			
8. Bank Stability (score each bank) 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. If approaching 30% score marginal if banks steep.					Moderately unstable; 30-60 % of bank in reach has areas of erosion; high erosion potential during floods, If approaching 60% score poor if banks steep.					Unstable; many eroded area; raw areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
SCORE 4 (LB)	Left Bank	10	9			8	7	6			5	4	3			2	1	0		
SCORE 4 (RB)	Right Bank	10	9			8	7	6			5	4	3			2	1	0		
Comments																				
9. Vegetative Protective (score each bank) includes vegetation from top of bank to base of bank. Determine left or right side by facing downstream	More than 90% of the bank covered by undisturbed vegetation. All 4 classes (mature trees, understory trees, shrubs, groundcover) are represented and allowed to grow naturally. All plants are native.					70-90% of the bank covered by undisturbed vegetation. One class may not be well represented. Disruption evident but not effecting full plant growth. Non-natives are rare (< 30%)					50-70% of the bank covered by undisturbed vegetation. Two classes of vegetation may not be well represented. Non-native vegetation may be common (30-50%).					Less than 50% of the bank covered by undisturbed vegetation or more than 2 classes are not well represented or most vegetation has been cropped. Non-native vegetation may dominate (> 50%)				
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		
Comments																				
10. Riparian Vegetative Zone Width (score each bank.) Zone begins at top of bank.	Average width of riparian zone > 18 meters. Unpaved footpaths may score 9 if run-off potential is negligible.					Average width of riparian zone 12-18 meters. Score high if areas < 18 meters are small or are minimally disturbed.					Average width of riparian zone 6-11 meters. Score high if areas less than 12 meters are small or are minimally disturbed.					Average width of riparian zone <6 meters. Score high if areas less than 6 meters are small or are minimally disturbed.				
SCORE (LB)	Left Bank	10	9			8	7	6			5	4	3			2	1	0		
SCORE (RB)	Right Bank	10	9			8	7	6			5	4	3			2	1	0		
Comments	RB - road ~15m away.																			

Total Score 144 Comparison to Ecoregion Guidelines (circle): ABOVE or BELOW
 If score is below guidelines , result of (circle): Natural Conditions or Human Disturbance
 Describe:

HABITAT ASSESSMENT FIELD SHEET- MODERATE TO HIGH GRADIENT STREAMS (FRONT)
 (See Protocol E for detailed descriptions and rank information)

DWR Station ID: <i>Barte 001-4MT</i>		Habitat Assessment By: <i>NZ BTP</i>		
Monitoring Location Name: <i>Bartee Branch</i>		Date: <i>10-10-18</i>	Time: <i>1000</i>	
Monitoring Location: <i>25 Lake Road</i>		Field Log Number:		
HUC:	WS Group:	Ecoregion:	QC: <input type="checkbox"/> Duplicate <input checked="" type="checkbox"/> Consensus	
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Over 70% of stream reach has natural stable habitat suitable for colonization by fish and/or macroinvertebrates. Four or more productive habitats are present.	Natural stable habitat covers 40-70% of stream reach. Three or more productive habitats present. (If near 70% and more than 3 go to optimal.)	Natural stable habitat covers 20 -40% of stream reach or only 1-2 productive habitats present. (If near 40% and more than 2 go to suboptimal.)	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE <i>15</i>	20 19 18 17 16	<u>15</u> 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	<i>SWD, overhanging roots/res, cobble/gravel</i>			
2. Embeddedness of Riffles	Gravel, cobble, and boulders 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. If near 25% drop to suboptimal if riffle not layered cobble.	Gravel, cobble and boulders 25-50% surrounded by fine sediment. Niches in bottom layers of cobble compromised. If near 50% & riffles not layered cobble drop to marginal.	Gravel, cobble, and boulders are 50-75% surrounded by fine sediment. Niche space in middle layers of cobble is starting to fill with fine sediment.	Gravel, cobble, and boulders are more than 75% surrounded by fine sediment. Niche space is reduced to a single layer or is absent.
SCORE <i>14</i>	20 19 18 17 16	15 <u>14</u> 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	<i>Fine sediment around gravel w/in riffle</i>			
3. Velocity/ Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow).	Only 3 of the 4 regimes present (if fast-shallow is missing score lower). If slow-deep missing score 15.	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime. Others regimes too small or infrequent to support aquatic populations.
SCORE <i>10</i>	20 19 18 17 <u>16</u>	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	<i>Very little slow shallow. Riffle/run/pool</i>			
4. Sediment Deposition	Sediment deposition affects less than 5% of stream bottom in quiet areas. New deposition on islands and point bars is absent or minimal.	Sediment deposition affects 5-30% of stream bottom. Slight deposition in pool or slow areas. Some new deposition on islands and point bars. Move to marginal if build-up approaches 30%.	Sediment deposition affects 30-50% of stream bottom. Sediment deposits at obstruction, constrictions and bends. Moderate pool deposition.	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 <i>12</i>	20 19 18 17 16	15 14 13 <u>12</u> 11	10 9 8 7 6	5 4 3 2 1
Comments	<i>~25% in slow water areas</i>			
5. Channel Flow Status.	Water reaches base of both lower banks and streambed is covered by water throughout reach. Minimal productive habitat is exposed.	Water covers > 75% of streambed or 25% of productive habitat is exposed.	Water covers 25-75% of streambed and/or productive habitat is mostly exposed.	Very little water in channel and mostly present as standing pools. Little or no productive habitat due to lack of water.
SCORE <i>15</i>	20 19 18 17 16	<u>15</u> 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	<i>~20% exposed. Cobble exposed near riffle</i>			

HABITAT ASSESSMENT FIELD SHEET- MODERATE TO HIGH GRADIENT STREAMS (BACK)

DWR Station ID	Date		Assessors	
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization, dredging rock removal or 4-wheel activity (past or present) absent or minimal; natural meander pattern. NO artificial structures in reach. Upstream or downstream structures do not affect reach.	Channelization, dredging or 4-wheel activity up to 40%. Channel has stabilized. If larger reach, channelization is historic and stable. Artificial structures in or out of reach do not affect natural flow patterns.	Channelization, dredging or 4-wheel activity 40-80% (or less that has not stabilized.) Artificial structures in or out of reach may have slight affect.	Over 80% of reach channelized, dredged or affected by 4-wheelers. Instream habitat greatly altered or removed. Artificial structures have greatly affected flow pattern.
SCORE 10	20 19 18 17 16 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	4 wheel path present, riparian added to stream bank			
7. Frequency of re-oxygenation zones. Use frequency of riffle or bends for category. Rank by quality.	Occurrence of re-oxygenation zones relatively frequent; ratio of distance between areas divided by average stream width <7:1.	Occurrence of re-oxygenation zones infrequent; distance between areas divided by average stream width is 7 - 15.	Occasional re-oxygenation area. The distance between areas divided by average stream width is over 15 and up to 25.	Generally all flat water or flat bedrock; little opportunity for re-oxygenation. Distance between areas divided by average stream width >25.
SCORE 18	20 19 18 17 16 (18)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	Multiple riffles in reach			
8. Bank Stability (score each bank) 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. If approaching 30% score marginal if banks steep.	Moderately unstable; 30-60 % of bank in reach has areas of erosion; high erosion potential during floods, If approaching 60% score poor if banks steep.	Unstable; many eroded area; raw areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE (LB) 9	Left Bank 10 9 (9)	8 7 6	5 4 3	2 1 0
SCORE (RB) 6	Right Bank 10 9	8 7 6 (6)	5 4 3	2 1 0
Comments	~30% RB, LB pretty well protected			
9. Vegetative Protective (score each bank) includes vegetation from top of bank to base of bank. Determine left or right side by facing downstream	More than 90% of the bank covered by undisturbed vegetation. All 4 classes (mature trees, understory trees, shrubs, groundcover) are represented and allowed to grow naturally. All plants are native.	70-90% of the bank covered by undisturbed vegetation. One class may not be well represented. Disruption evident but not effecting full plant growth. Non-natives are rare (< 30%)	50-70% of the bank covered by undisturbed vegetation. Two classes of vegetation may not be well represented. Non-native vegetation may be common (30-50%).	Less than 50% of the bank covered by undisturbed vegetation or more than 2 classes are not well represented or most vegetation has been cropped. Non-native vegetation may dominate (> 50%)
SCORE (LB) 9	Left Bank 10 9 (9)	8 7 6	5 4 3	2 1 0
SCORE (RB) 5	Right Bank 10 9	8 7 6	5 (5) 4 3	2 1 0
Comments				
10. Riparian Vegetative Zone Width (score each bank.) Zone begins at top of bank.	Average width of riparian zone > 18 meters. Unpaved footpaths may score 9 if run-off potential is negligible.	Average width of riparian zone 12-18 meters. Score high if areas < 18 meters are small or are minimally disturbed.	Average width of riparian zone 6-11 meters. Score high if areas less than 12 meters are small or are minimally disturbed.	Average width of riparian zone <6 meters. Score high if areas less than 6 meters are small or are minimally disturbed.
SCORE (LB) 9	Left Bank 10 9 (9)	8 7 6	5 4 3	2 1 0
SCORE (RB) 7	Right Bank 10 9	8 7 6	5 4 3	2 (1) 0
Comments				

Total Score 145 Comparison to Ecoregion Guidelines (circle): ABOVE or BELOW
 If score is below guidelines, result of (circle): Natural Conditions or Human Disturbance
 Describe:

HABITAT ASSESSMENT FIELD SHEET- MODERATE TO HIGH GRADIENT STREAMS (FRONT)
 (See Protocol E for detailed descriptions and rank information)

DWR Station ID: RE00247MT		Habitat Assessment By: NJZ GTL		
Monitoring Location Name: Red Pine F		Date: 10-25-18	Time: 1115	
Monitoring Location: DS Port Royal Bridge		Field Log Number:		
HUC:	WS Group:	Ecoregion:	QC: <input type="checkbox"/> Duplicate <input checked="" type="checkbox"/> Consensus	
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Over 70% of stream reach has natural stable habitat suitable for colonization by fish and/or macroinvertebrates. Four or more productive habitats are present.	Natural stable habitat covers 40-70% of stream reach. Three or more productive habitats present. (If near 70% and more than 3 go to optimal.)	Natural stable habitat covers 20 -40% of stream reach or only 1-2 productive habitats present. (If near 40% and more than 2 go to suboptimal.)	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments	large river w/ cobble → Gravel, backwater, LTD, Veg-			
2. Embeddedness of Riffles	Gravel, cobble, and boulders 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. If near 25% drop to suboptimal if riffle not layered cobble.	Gravel, cobble and boulders 25-50% surrounded by fine sediment. Niches in bottom layers of cobble compromised. If near 50% & riffles not layered cobble drop to marginal.	Gravel, cobble, and boulders are 50-75% surrounded by fine sediment. Niche space in middle layers of cobble is starting to fill with fine sediment.	Gravel, cobble, and boulders are more than 75% surrounded by fine sediment. Niche space is reduced to a single layer or is absent.
SCORE	20 19 18 17 16	15 14 13 12 (11)	10 9 8 7 6	5 4 3 2 1
Comments	Surrounded by sand + silt			
3. Velocity/ Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow).	Only 3 of the 4 regimes present (if fast-shallow is missing score lower). If slow-deep missing score 15.	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime. Others regimes too small or infrequent to support aquatic populations.
SCORE	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments				
4. Sediment Deposition	Sediment deposition affects less than 5% of stream bottom in quiet areas. New deposition on islands and point bars is absent or minimal.	Sediment deposition affects 5-30% of stream bottom. Slight deposition in pool or slow areas. Some new deposition on islands and point bars. Move to marginal if build-up approaches 30%.	Sediment deposition affects 30-50% of stream bottom. Sediment deposits at obstruction, constrictions and bends. Moderate pool deposition.	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	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments				
5. Channel Flow Status.	Water reaches base of both lower banks and streambed is covered by water throughout reach. Minimal productive habitat is exposed.	Water covers > 75% of streambed or 25% of productive habitat is exposed.	Water covers 25-75% of streambed and/or productive habitat is mostly exposed.	Very little water in channel and mostly present as standing pools. Little or no productive habitat due to lack of water.
SCORE	20 (19) 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments				

HABITAT ASSESSMENT FIELD SHEET- MODERATE TO HIGH GRADIENT STREAMS (BACK)

DWR Station ID	Date					Assessors																		
6. Channel Alteration	Optimal	Suboptimal					Marginal			Poor														
	Channelization, dredging rock removal or 4-wheel activity (past or present) absent or minimal; natural meander pattern. NO artificial structures in reach. Upstream or downstream structures do not affect reach.	Channelization, dredging or 4-wheel activity up to 40%. Channel has stabilized. If larger reach, channelization is historic and stable. Artificial structures in or out of reach do not affect natural flow patterns.					Channelization, dredging or 4-wheel activity 40-80% (or less that has not stabilized.) Artificial structures in or out of reach may have slight affect.			Over 80% of reach channelized, dredged or affected by 4-wheelers. Instream habitat greatly altered or removed. Artificial structures have greatly affected flow pattern.														
	SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1			
Comments																								
7. Frequency of re-oxygenation zones. Use frequency of riffle or bends for category. Rank by quality.	Occurrence of re-oxygenation zones relatively frequent; ratio of distance between areas divided by average stream width <7:1.					Occurrence of re-oxygenation zones infrequent; distance between areas divided by average stream width is 7 - 15.					Occasional re-oxygenation area. The distance between areas divided by average stream width is over 15 and up to 25.					Generally all flat water or flat bedrock; little opportunity for re-oxygenation. Distance between areas divided by average stream width >25.								
	SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1			
	Comments																							
8. Bank Stability (score each bank) 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. If approaching 30% score marginal if banks steep.					Moderately unstable; 30-60 % of bank in reach has areas of erosion; high erosion potential during floods, If approaching 60% score poor if banks steep.					Unstable; many eroded area; raw areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.								
	SCORE (LB)	Left Bank		10	9	8	7	6	5	4	3	Right Bank		10	9	8	7	6	5	4	3	2	1	0
	SCORE (RB)	Right Bank		10	9	8	7	6	5	4	3	Left Bank		10	9	8	7	6	5	4	3	2	1	0
Comments																								
9. Vegetative Protective (score each bank) includes vegetation from top of bank to base of bank. Determine left or right side by facing downstream	More than 90% of the bank covered by undisturbed vegetation. All 4 classes (mature trees, understory trees, shrubs, groundcover) are represented and allowed to grow naturally. All plants are native.					70-90% of the bank covered by undisturbed vegetation. One class may not be well represented. Disruption evident but not effecting full plant growth. Non-natives are rare (< 30%)					50-70% of the bank covered by undisturbed vegetation. Two classes of vegetation may not be well represented. Non-native vegetation may be common (30-50%).					Less than 50% of the bank covered by undisturbed vegetation or more than 2 classes are not well represented or most vegetation has been cropped. Non-native vegetation may dominate (> 50%)								
	SCORE (LB)	Left Bank		10	9	8	7	6	5	4	3	Right Bank		10	9	8	7	6	5	4	3	2	1	0
	SCORE (RB)	Right Bank		10	9	8	7	6	5	4	3	Left Bank		10	9	8	7	6	5	4	3	2	1	0
Comments																								
10. Riparian Vegetative Zone Width (score each bank.) Zone begins at top of bank.	Average width of riparian zone > 18 meters. Unpaved footpaths may score 9 if run-off potential is negligible.					Average width of riparian zone 12-18 meters. Score high if areas < 18 meters are small or are minimally disturbed.					Average width of riparian zone 6-11 meters. Score high if areas less than 12 meters are small or are minimally disturbed.					Average width of riparian zone <6 meters. Score high if areas less than 6 meters are small or are minimally disturbed.								
	SCORE (LB)	Left Bank		10	9	8	7	6	5	4	3	Right Bank		10	9	8	7	6	5	4	3	2	1	0
	SCORE (RB)	Right Bank		10	9	8	7	6	5	4	3	Left Bank		10	9	8	7	6	5	4	3	2	1	0
Comments																								

Total Score _____ Comparison to Ecoregion Guidelines (circle): ABOVE or BELOW
 If score is below guidelines, result of (circle): Natural Conditions or Human Disturbance
 Describe:



Microbac Laboratories, Inc., Nashville

CERTIFICATE OF ANALYSIS

N804270

Barge Design Solutions

Bradley D. Simpson
615 Third Avenue South
Nashville, TN 37210

Project Name: Water Testing

Project / PO Number: N/A
Received: 09/20/2018
Reported: 09/22/2018

Analytical Testing Parameters

Table with 2 columns: Parameter (Client Sample ID, Sample Matrix, Lab Sample ID) and Value (EFORK003.9MT, Water, N804270-01, Collected By: client, Collection Date: 09/20/2018 10:40)

Table with 8 columns: Microbiological Parameters, Result, RL, Units, Note, Prepared, Analyzed, Analyst. Row: E. Coli, 1700, 1, MPN/100 mL, 09/20/18 1417, TRG

Method: SM9223 B-1997

Table with 2 columns: Parameter (Client Sample ID, Sample Matrix, Lab Sample ID) and Value (REDO00.4MT, Water, N804270-02, Collected By: client, Collection Date: 09/20/2018 11:20)

Table with 8 columns: Microbiological Parameters, Result, RL, Units, Note, Prepared, Analyzed, Analyst. Row: E. Coli, 25, 1, MPN/100 mL, 09/20/18 1417, TRG

Method: SM9223 B-1997

Table with 2 columns: Parameter (Client Sample ID, Sample Matrix, Lab Sample ID) and Value (BMCAD004.9MT, Water, N804270-03, Collected By: client, Collection Date: 09/20/2018 12:35)

Table with 8 columns: Microbiological Parameters, Result, RL, Units, Note, Prepared, Analyzed, Analyst. Row: E. Coli, 130, 1, MPN/100 mL, 09/20/18 1417, TRG

Method: SM9223 B-1997

Definitions

RL: Reporting Limit

Report Comments

Samples were received in proper condition and the reported results conform to applicable accreditation standard unless otherwise noted.

The data and information on this, and other accompanying documents, represents only the sample(s) analyzed. This report is incomplete unless all pages indicated in the footnote are present and an authorized signature is included.

Reviewed and Approved By:

Brian Richard
Project Manager
brian.richard@microbac.com
09/22/2018 13:41

Microbac Laboratories, Inc.

2631 Grandview Ave | Nashville, TN 37211 | 615-242-1480 p | www.microbac.com

Chain of Custody Record

Microbac Laboratories, Inc., 2631 Grandview Ave, Nashville, TN 372



CoC No.: MontgomeryCo2018 -001
 Page: 1 of 1

Client Contact

Company Name	Barge Design	Project Manager	Matt Clabaugh
Address	615 3rd Ave S, Suite 700	Phone	(423) 723-8454
City/State/Zip	Nashville, TN 37210	Site Contact	Nick Carmean
Phone	(615) 252-4306	Phone	(614)-205-7225
Project Name	Montgomery County	Lab Contact	
Task Name	E:coll sample	Carrier	Hand deliver

Sample Identification	Sample Date	Sample Time	E:coll	Sample Matrix	Sample Containers	Analyses	Special Instructions
E:coll 003 9MT	9-20-18	1040	X			X	
E:coll 004 9MT	9-20-18	1130	X			X	
BMD0004 9MT	9-20-18	1235	X			X	
			X			X	
			X			X	
			X			X	
			X			X	
			X			X	
			X			X	
			X			X	
			X			X	
			X			X	
			X			X	
			X			X	

Possible Hazard Identification
 Non-Hazardous: Water

Special Instructions:

Turnaround Time: Standard Turnaround

Relinquished by: *[Signature]* Company: Barge Date/Time: 9-20-18/1318 Received by: *[Signature]* Company: Microbac Nashville, TN Date/Time: 9-20-18 1348

Temp 4.0°C



Microbac Laboratories, Inc., Nashville

CERTIFICATE OF ANALYSIS

N804555

Barge Design Solutions

Bradley D. Simpson
615 Third Avenue South
Nashville, TN 37210

Project Name: Water Testing

Project / PO Number: N/A
Received: 10/10/2018
Reported: 10/11/2018

Analytical Testing Parameters

Table with client sample details: Client Sample ID: RED000-4MT, Sample Matrix: Water, Lab Sample ID: N804555-01, Collected By: client, Collection Date: 10/10/2018 11:10

Microbiological Parameters table for RED000-4MT: E. Coli, Result: 34, RL: 1, Units: MPN/100 mL, Analyzed: 10/10/18 1546, Analyst: TNB

Table with client sample details: Client Sample ID: EFORK003.9MT, Sample Matrix: Water, Lab Sample ID: N804555-02, Collected By: client, Collection Date: 10/10/2018 12:00

Microbiological Parameters table for EFORK003.9MT: E. Coli, Result: 1700, RL: 1, Units: MPN/100 mL, Analyzed: 10/10/18 1546, Analyst: TNB

Table with client sample details: Client Sample ID: BMCAD004.9MT, Sample Matrix: Water, Lab Sample ID: N804555-03, Collected By: client, Collection Date: 10/10/2018 13:30

Microbiological Parameters table for BMCAD004.9MT: E. Coli, Result: 150, RL: 1, Units: MPN/100 mL, Analyzed: 10/10/18 1546, Analyst: TNB

Definitions

RL: Reporting Limit

Report Comments

Samples were received in proper condition and the reported results conform to applicable accreditation standard unless otherwise noted.

The data and information on this, and other accompanying documents, represents only the sample(s) analyzed. This report is incomplete unless all pages indicated in the footnote are present and an authorized signature is included.

Reviewed and Approved By:

Brian Richard
Project Manager
brian.richard@microbac.com
10/11/2018 17:55

Microbac Laboratories, Inc.


2631 Grandview Ave | Nashville, TN 37211 | 615-242-1480 p | www.microbac.com

Chain of Custody Record
Microbac Laboratories, Inc., 2631 Grandview Ave, Nashville, TN 37211

Client Contact	
Company Name	Barge Design
Address	615 3rd Ave S, Suite 700
City/State/Zip	Nashville, TN 37210
Phone	(615) 252-4306
Project Name	Montgomery County
Task Name	E. coli sample
Project Manager	Matt Clabaugh
Phone	(423) 723-8454
Site Contact	Nick Carmean
Phone	(614) 205-7225
Lab Contact	
Carrier	Hand deliver

CoC No.: MontgomeryCo2018 / B/D - 001
 Page: 1 of 1

Sample Identification	Sample Date	Sample Time	Sample Matrix	Sample Containers	Analyses	Special Instructions
KE5D000-4MT	10-10-18	11:00	SW		E. coli	
EFOR6K00039MT	10-10-18	13:06	SW		X	
BMCHAD000419MT	10-10-18	13:30	SW		X	
					X	
					X	
					X	

N804555-01 Sampled: 10/10/2018 11:10
 Barge Design Solutions

 Special Instructions

Possible Hazard Identification: Non-Hazardous: Water

Special Instructions: Please send results to nick.carmean@bargedesign.com

Turnaround Time: Standard Turnaround	Company	Date/Time	Received by	Company	Date/Time
	Barge Design	10/03/2018	[Signature]	Microbac	10-10-18 @ 1503
Relinquished by:					

Temp 4.6°C



Microbac Laboratories, Inc., Nashville

CERTIFICATE OF ANALYSIS

N804562

Barge Design Solutions

Project Name: Montgomery County

Bradley D. Simpson
615 Third Avenue South
Nashville, TN 37210

Project / PO Number: N/A
Received: 10/11/2018
Reported: 10/15/2018

Analytical Testing Parameters

Client Sample ID:	RED000.4 MT	Collected By:	client
Sample Matrix:	Water	Collection Date:	10/11/2018 9:40
Lab Sample ID:	N804562-01		

Microbiological Parameters	Result	RL	Units	Note	Prepared	Analyzed	Analyst
Method: SM9223 B-1997							
E. Coli	37	1	MPN/100 mL			10/11/18 1606	TNB

Client Sample ID:	EFORK003.9 MT	Collected By:	client
Sample Matrix:	Water	Collection Date:	10/11/2018 11:15
Lab Sample ID:	N804562-02		

Microbiological Parameters	Result	RL	Units	Note	Prepared	Analyzed	Analyst
Method: SM9223 B-1997							
E. Coli	650	1	MPN/100 mL			10/11/18 1606	TNB

Client Sample ID:	BMCAD004.9 MT	Collected By:	client
Sample Matrix:	Water	Collection Date:	10/11/2018 12:20
Lab Sample ID:	N804562-03		

Microbiological Parameters	Result	RL	Units	Note	Prepared	Analyzed	Analyst
Method: SM9223 B-1997							
E. Coli	160	1	MPN/100 mL			10/11/18 1606	TNB

Definitions

RL: Reporting Limit

Report Comments

Samples were received in proper condition and the reported results conform to applicable accreditation standard unless otherwise noted.

The data and information on this, and other accompanying documents, represents only the sample(s) analyzed. This report is incomplete unless all pages indicated in the footnote are present and an authorized signature is included.

Reviewed and Approved By:

Brian Richard
Project Manager
brian.richard@microbac.com
10/15/2018 13:22

Microbac Laboratories, Inc.

2631 Grandview Ave | Nashville, TN 37211 | 615-242-1480 p | www.microbac.com

Chain of Custody Record
Microbac Laboratories, Inc., 2631 Grandview Ave, Nashville, TN 37211

Client Contact

Company Name	Barge Design	Project Manager	Matt Clabaugh
Address	615 3rd Ave S, Suite 700	Phone	(423) 723-8454
City/State/Zip	Nashville, TN 37210	Site Contact	Nick Carmean
Phone	(615) 252-4306	Phone	(614)-205-7225
Project Name	Montgomery County	Lab Contact	
Task Name	E.coli sample	Carrier	Hand deliver

Coc No.: MontgomeryCo2018 -001
 Page: 1 of 1

Sample Identification	Sample Date	Sample Time	Sample Matrix	Sample Containers	Analyses	Special Instructions
REDWOOD MT	10/11/18	0940	SW	1	X	
EFORK003A MT	10/11/18	1115	SW	1	X	
BMCAD004.9 MT	10/11/18	1720	SW	1	X	

N804562-01 Sampled: 10/11/2018 09:40
 Barge Design Solutions



62

Possible Hazard Identification
 Non-Hazardous: Water
 Sample Disposal

Special Instructions: Please send results to nick.carmean@bargedesign.com

Turnaround Time: Standard Turnaround						
Relinquished by:	Frank Lynch	Company	Barge Design	Received by:	Company	Date/Time
			Solutions, Inc.			10-11-18 1352
Temp upon delivery:						13.6°

Temp 1.6°



Microbac Laboratories, Inc., Nashville

CERTIFICATE OF ANALYSIS

N804590

Barge Design Solutions

Bradley D. Simpson
615 Third Avenue South
Nashville, TN 37210

Project Name: Water Testing

Project / PO Number: N/A
Received: 10/16/2018
Reported: 10/17/2018

Analytical Testing Parameters

Table with 2 columns: Parameter (Client Sample ID, Sample Matrix, Lab Sample ID) and Value (RED000.4MT, Water, N804590-01, Collected By: client, Collection Date: 10/16/2018 9:55)

Table with 8 columns: Microbiological Parameters, Result, RL, Units, Note, Prepared, Analyzed, Analyst. Row 1: Method: SM9223 B-1997, E. Coli, >2400, MPN/100 mL, 10/16/18 1404, TNB

Table with 2 columns: Parameter (Client Sample ID, Sample Matrix, Lab Sample ID) and Value (EFORK 003.9MT, Water, N804590-02, Collected By: client, Collection Date: 10/16/2018 11:15)

Table with 8 columns: Microbiological Parameters, Result, RL, Units, Note, Prepared, Analyzed, Analyst. Row 1: Method: SM9223 B-1997, E. Coli, 2900, MPN/100 mL, 10/16/18 1404, TNB

Table with 2 columns: Parameter (Client Sample ID, Sample Matrix, Lab Sample ID) and Value (BMCAD004.9MT, Water, N804590-03, Collected By: client, Collection Date: 10/16/2018 12:00)

Table with 8 columns: Microbiological Parameters, Result, RL, Units, Note, Prepared, Analyzed, Analyst. Row 1: Method: SM9223 B-1997, E. Coli, 1200, MPN/100 mL, 10/16/18 1404, TNB

Definitions

RL: Reporting Limit

Report Comments

Samples were received in proper condition and the reported results conform to applicable accreditation standard unless otherwise noted.

The data and information on this, and other accompanying documents, represents only the sample(s) analyzed. This report is incomplete unless all pages indicated in the footnote are present and an authorized signature is included.

Reviewed and Approved By:

Brian Richard
Project Manager
brian.richard@microbac.com
10/17/2018 18:03

Microbac Laboratories, Inc.

2631 Grandview Ave | Nashville, TN 37211 | 615-242-1480 p | www.microbac.com

Chain of Custody Record
Microbac Laboratories, Inc., 2631 Grandview Ave, Nashville, TN 37211

CoC No.: MontgomeryCo20181016 -001
 Page: 1 of 1

Client Contact		
Company Name	Barge Design	Project Manager
Address	615 3rd Ave S, Suite 700	Phone
City/State/Zip	Nashville, TN 37210	Site Contact
Phone	(615) 252-4306	Phone
Project Name	Montgomery County	Lab Contact
Task Name	E:coil sample	Carrier
		Hand deliver

Sample Matrix	Sample Containers	Analyses
		E:coil

Sample Identification	Sample Date	Sample Time	Sample Matrix	Sample Containers	Analyses	Special Instructions
REDDD04MT	10-16-18	0955	SW		X	
EEER-0039MT	10-16-18	115	SW		X	Plate of 10ml BE
BMCADD04.9MT	10-16-18	1200	SW		X	

N804590-01 Sampled: 10/16/2018 09:56
 Barge Design Solutions


Possible Hazard Identification: Non-hazardous: Water
 Special Instructions: Please send results to nick.carmean@bargedesign.com

Turnaround Time: Standard Turnaround	Company	Date/Time	Received by	Company	Date/Time
	BARGE	10/18/18			3:32
Relinquished by:					
Temp upon delivery:					



Microbac Laboratories, Inc., Nashville

CERTIFICATE OF ANALYSIS

N804609

Barge Design Solutions

Bradley D. Simpson
615 Third Avenue South
Nashville, TN 37210

Project Name: Water Testing

Project / PO Number: N/A
Received: 10/18/2018
Reported: 10/22/2018

Analytical Testing Parameters

Table with 2 columns: Parameter (Client Sample ID, Sample Matrix, Lab Sample ID) and Value (RED000.4MT, Water, N804609-01, etc.)

Table with 8 columns: Microbiological Parameters, Result, RL, Units, Note, Prepared, Analyzed, Analyst. Row: E. Coli, 780, 10, MPN/100 mL, 10/18/18 1433, TNB

Table with 2 columns: Parameter (Client Sample ID, Sample Matrix, Lab Sample ID) and Value (EFORK003.9MT, Water, N804609-02, etc.)

Table with 8 columns: Microbiological Parameters, Result, RL, Units, Note, Prepared, Analyzed, Analyst. Row: E. Coli, 980, 10, MPN/100 mL, 10/18/18 1433, TNB

Table with 2 columns: Parameter (Client Sample ID, Sample Matrix, Lab Sample ID) and Value (BMCAD004.9MT, Water, N804609-03, etc.)

Table with 8 columns: Microbiological Parameters, Result, RL, Units, Note, Prepared, Analyzed, Analyst. Row: E. Coli, 310, 1, MPN/100 mL, 10/18/18 1433, TNB

Definitions

RL: Reporting Limit

Report Comments

Samples were received in proper condition and the reported results conform to applicable accreditation standard unless otherwise noted.

The data and information on this, and other accompanying documents, represents only the sample(s) analyzed. This report is incomplete unless all pages indicated in the footnote are present and an authorized signature is included.

Reviewed and Approved By:

Brian Richard
Project Manager
brian.richard@microbac.com
10/22/2018 11:49

Microbac Laboratories, Inc.

2631 Grandview Ave | Nashville, TN 37211 | 615-242-1480 p | www.microbac.com

Chain of Custody Record
Microbac Laboratories, Inc., 2631 Grandview Ave, Nashville, TN 37211

Coc No.: MontgomeryCO20181018 -001
 Page: 1 of 1

Client Contact

Company Name	Barge Design	Project Manager	Matt Cabaugh
Address	615 3rd Ave S, Suite 700	Phone	(423) 723-8454
City/State/Zip	Nashville, TN 37210	Site Contact	Nick Carmean
Phone	(615) 252-4306	Phone	(614) 205-7225
Project Name	Montgomery County	Lab Contact	
Task Name	E-coll sample	Carrier	Hand deliver

Sample Identification	Sample Date	Sample Time	Sample Matrix	Sample Containers	Analyses	Special Instructions
RED0004MT	10-18-18	932	SW		X	
EGOR0039MT	10-18-18	1030	SW		X	
BMCAD0049MT	10-18-18	1130	SW		X	Dilute w/10ml DI Dilute w/10ml DI

N804609-01 Sampled: 10/18/2018 09:32
 Barge Design Solutions


Possible Hazard Identification
 Non-Hazardous: Water

Special Instructions: Please send results to nick.carmean@bargedesign.com

Turnaround Time: *Standard Turnaround*

Relinquished by	Company	Date/Time	Received by	Company	Date/Time
[Signature]	BARGE	10/18/18 1035	[Signature]	Microbac	10-18-18 01236

Tony E. 90c

Appendix 2

Photographs

Photo Summary

NPDES Phase II Permit Monitoring, Montgomery County, Tennessee

Page 1 of 10



Photo: 1
By: N. Carmean
Date: 19 Sept 2018
Feature: WALL000.6MT
Photo Location:
36.4964, -87.2994

View downstream of Wall Branch from near macroinvertebrate sampling location.



Photo: 2
By: N. Carmean
Date: 19 Sept 2018
Feature: WALL000.6MT
Photo Location:
36.4964, -87.2994

View upstream of Wall Branch from near macroinvertebrate sampling location.

Photo Summary

NPDES Phase II Permit Monitoring, Montgomery County, Tennessee

Page 2 of 10



Photo: 3
By: N. Carmean
Date: 16 Oct 2018
Feature:
EFORK003.9MT
Photo Location:
36.3996, -87.5276

Upstream view East Fork Creek near macroinvertebrate sampling location during elevated flows.



Photo: 4
By: N. Carmean
Date: 16 Oct 2018
Feature:
EFORK003.9MT
Photo Location:
36.3996, -87.5276

Downstream view East Fork Creek near macroinvertebrate sampling location during elevated flows.

Photo Summary

NPDES Phase II Permit Monitoring, Montgomery County, Tennessee

Page 3 of 10



Photo: 5
By: N. Carmean
Date: 19 Sept 2018
Feature: LOUIS001.8MT
Photo Location:
36.3592, -87.3061

Upstream view Louise Creek near macroinvertebrate sampling location.



Photo: 6
By: N. Carmean
Date: 19 Sept 2018
Feature: LOUIS001.8MT
Photo Location:
36.3592, -87.3061

Downstream view Louise Creek near macroinvertebrate sampling location.

Photo Summary

NPDES Phase II Permit Monitoring, Montgomery County, Tennessee



Photo: 7
By: N. Carmean
Date: 20 Sept 2018
Feature:
BMCAD004.9MT
Photo Location:
36.4617, -87.2744

Upstream view Big McAdoo Creek near macroinvertebrate sampling location.



Photo: 8
By: N. Carmean
Date: 20 Sept 2018
Feature:
BMCAD004.9MT
Photo Location:
36.4617, -87.2744

Downstream view Big McAdoo Creek near macroinvertebrate sampling location.

Photo Summary

NPDES Phase II Permit Monitoring, Montgomery County, Tennessee

Page 5 of 10



Photo: 9
By: N. Carmean
Date: 10 Oct 2018
Feature:
BARTE001.4MT
Photo Location:
36.5020, -87.5177

Upstream view Bartee
Branch near
macroinvertebrate
sampling location.



Photo: 10
By: N. Carmean
Date: 10 Oct 2018
Feature:
BARTE001.4MT
Photo Location:
36.5020, -87.5177

Downstream view Bartee
Branch near
macroinvertebrate
sampling location.

Photo Summary

NPDES Phase II Permit Monitoring, Montgomery County, Tennessee



Photo: 11
By: G. Lynch
Date: 9 Sept 2018
Feature: RED000.4MT
Photo Location:
36.5420, -88.3680

Downstream view Red River near water quality sample location.



Photo: 12
By: G. Lynch
Date: 9 Sept 2018
Feature: RED000.4MT
Photo Location:
36.5420, -88.3680

Upstream view Red River near water quality sample location.

Photo Summary

NPDES Phase II Permit Monitoring, Montgomery County, Tennessee

Page 7 of 10



Photo: 13
By: N. Carmean
Date: 25 Oct 2018
Feature: RED024.7MT
Photo Location:
36.5562, -87.1473

Upstream view Red River near macroinvertebrate sampling location.



Photo: 14
By: N. Carmean
Date: 25 Oct 2018
Feature: RED024.7MT
Photo Location:
36.5562, -87.1473

Downstream view Red River near macroinvertebrate sampling location.

Photo Summary

NPDES Phase II Permit Monitoring, Montgomery County, Tennessee



Photo: 15
By: N. Carmean
Date: 19 Sept 2018
Feature: SPRIN006.9MT
Photo Location:
36.6154, -87.2876

Upstream view Spring Creek near macroinvertebrate sampling location.



Photo: 16
By: N. Carmean
Date: 19 Sept 2018
Feature: SPRIN006.9MT
Photo Location:
36.6154, -87.2876

Downstream view Spring Creek near macroinvertebrate sampling location.

Photo Summary

NPDES Phase II Permit Monitoring, Montgomery County, Tennessee

Page 9 of 10



Photo: 17
By: N. Carmean
Date: 3 Oct 2018
Feature:
SPRIN13.7T0.4MT
Photo Location:
36.6361, -87.2113

Upstream view Unnamed Trib to Spring Creek near macroinvertebrate sampling location.



Photo: 18
By: N. Carmean
Date: 3 Oct 2018
Feature:
SPRIN13.7T0.4MT
Photo Location:
36.6361, -87.2113

Downstream view Unnamed Trib to Spring Creek near macroinvertebrate sampling location.

Photo Summary

NPDES Phase II Permit Monitoring, Montgomery County, Tennessee



Photo: 19
By: N. Carmean
Date: 19 Sept 2018
Feature: SPRIN009.8MT
Photo Location:
36.6170, -87.2535

Upstream view Spring
Creek near
macroinvertebrate
sampling location.



Photo: 20
By: N. Carmean
Date: 19 Sept 2018
Feature: SPRIN009.8MT
Photo Location:
36.6170, -87.2535

Downstream view Spring
Creek near
macroinvertebrate
sampling location.

Appendix 3
Scientific Collection Permit



TENNESSEE WILDLIFE RESOURCES AGENCY

ELLINGTON AGRICULTURAL CENTER
P. O. BOX 40747
NASHVILLE, TENNESSEE 37204

Scientific Collection Permit : 1696 Issue date: 9/13/2018 Expiration date: 9/13/2019

Pursuant to authority of T.C.A. 70-2-213:
Nicholas Carmean

and the following additional permittees:
Grant Lynch Nicholas Carmean

are granted permission to take the following species:
Any macroinvertebrate species collected. Crayfish will be released.

Restricted to the following locations:
Sampling will occur at two locations on the Ocoee River in Polk County. The locations are at River Miles 35.1 and 37.6. 11 locations will be sampled, all of which in Montgomery County, within the Lower Cumberland and Red River Watersheds. Sites are scattered around Clarksville, TN. DWR STATION IDs: WALL000.6MT, EFORK000.39MT, LOUIS001.8MT, BMCAD004.9MT, BARTE001.4MT, RED000.4MT, RED024.7MT, RED025.5MT, SPRIN00.69MT, SPRIN13.7T0.4MT, and SPRIN009.8MT.,

Restricted to the following collection methods:
In the current work plan, a kick net/riffle kick is the prescribed method. The 2017 TDEC SOP for macroinvertebrate collection will be followed as a guide.

Subject to the following rules:
Wildlife may not be held longer than 24 hours without prior approval. All containers and equipment utilized in the collection of amphibians and reptiles shall be decontaminated and disinfected for ranavirus and other pathogens. This permit is invalid unless accompanied by all applicable federal permits.
No species listed by TWRA as endangered, threatened, in need of management, or of greatest conservation need may be taken without approval; release these species immediately. Report the occurrence of endangered or threatened species to TWRA within five days.
Prior to collecting in the field, you are required to notify the TWRA Regional Dispatcher with the name(s) of person(s) doing the collecting, where, when and what species you will be collecting. Contact information is attached.

9/13/2018

Executive Director, Tennessee Wildlife Resources Agency

Date

The State of Tennessee
AN EQUAL OPPORTUNITY EMPLOYER