

**BENTHIC MACROINVERTEBRATE SURVEY  
MS4 PERMIT COMPLIANCE  
SPRING HILL, TENNESSEE**

**PREPARED FOR:  
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**CEC PROJECT 194-523**

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**Civil & Environmental Consultants, Inc.**

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## 1.0 INTRODUCTION

As part of the Municipal Separate Storm Sewer System (MS4) Small Municipal NPDES permit for Spring Hill, issued by the Tennessee Department of Environment and Conservation (TDEC), the city is required to perform benthic macroinvertebrate surveys in streams identified by TDEC as waters with unavailable parameters for siltation, habitat alteration, nutrients, and/or pathogens within a five-year permit cycle. There are four (4) stream locations within the cities MS4 jurisdiction that require benthic macroinvertebrate sampling: Grassy Branch, McCutcheon Creek, Rutherford Creek, and Crooked Creek. Sampling locations are identified on Figure 1. All sampling locations are located in the Lower Duck River (HUC-8 – 06040003). The sampling locations are all located within the Level IV Ecoregion 71i – Inner Nashville Basin. Sampling locations were chosen based on known TDEC water quality assessment monitoring sites located within Spring Hill City Limits.

## 2.0 METHODS

### 2.1 FIELD

Four benthic macroinvertebrate samples were collected on April 17, 2020 in accordance with the 2017 TDEC *Quality Stream Standard Operating Procedure for Macroinvertebrates Stream Surveys* (SOP). In each sampling reach (site), a square meter net (500- $\mu$ m mesh) was used to collect approximately one square meter of material from two locations in riffle habitat (SQKICK). The two samples were then composited. For smaller streams, four kick samples were collected using a modified one-person kick net, having a 500  $\mu$ m mesh. The four samples were then composited. All samples in this survey were collected with a 1m<sup>2</sup> net. The combined material collected at each site was emptied into a labeled heavy-duty plastic bag, and fixed with 80 percent ethanol. Appendix A contains photos of upstream and downstream views of each site.

In conjunction with the benthic macroinvertebrate sampling, habitat assessments were performed at each site, following the procedures outlined in the SOP. Parameters such as substratum, embeddedness, velocity, depth, bank characteristics, and land use were assessed and rated to determine if, and to what extent, the habitat is capable of supporting a diverse benthic community. Other site characteristics such as sketches of the site, important features, weather, sampling personnel, methods, and other aquatic life were recorded on TDEC's field data sheets. *In-situ* water quality measurements were taken for dissolved oxygen, pH, conductivity, and temperature using a YSI Professional Plus portable meter. Water velocity and depth at each specific sampling site were measured using a Marsh-McBirney flow meter. All meters were calibrated prior to field use. All data, including habitat assessments and sketches of each site, can be found in Appendix B.

### 2.2 LABORATORY

Each sample was washed using a U.S. Series No. 35 (500  $\mu$ m mesh) sieve to remove ethanol and excess detritus. The samples contained a large amount of material (detritus and organisms) and were, therefore, subsampled using the Caton (1991) method recommended by the SOP. This procedure consists of dividing a given sample into 30 equal portions (termed grids) using a specified subsampling device, then sorting at least four of these grids (which have been randomly selected) to obtain 200 $\pm$ 20 percent (160-240) organisms. If sorting a grid had been started, it was finished in its entirety. The benthic organisms removed from the sample were placed by major groupings (e.g., mayflies, worms, snails) into glass vials containing 70 percent ethanol. Each vial was labeled with information such as date of collection, location, specific sample identification, name of taxonomic group and number of organisms. The residue from the sorted portion of a sample was preserved separately from the portion that was not sorted for quality assurance/control purposes. Organisms were identified using either a dissecting or compound microscope. The compound microscope was used for identifying chironomids (midgefly larvae) and oligochaetes (aquatic segmented worms) after these organisms were mounted on microscope slides using CMCP mounting medium. Most organisms were identified to the generic level, unless the

specimens were too small or damaged to allow identification to this level. Identifications were recorded on laboratory bench sheets. The benthic laboratory data can be found in Appendix C.

## 2.3 DATA ANALYSIS

When identifications were complete, the raw benthic data were used to calculate values for seven individual metrics. The following metrics are required by the SOP and are all based on generic level identifications:

1. **TR** (Taxa Richness) – total number of distinct taxa identified.
2. **EPT** (Ephemeroptera Plecoptera Trichoptera) **Richness** – total number of genera of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera).
3. **%EPT-Cheum** (EPT abundance excluding *Cheumatopsyche* sp.) – total number of individuals of EPT taxa minus number of *Cheumatopsyche* sp., divided by the total number of individuals in the sample.
4. **%OC** (Percent Oligochaeta and Chironomidae) – total number of individuals in these two groups, divided by total number of individuals in the sample.
5. **NCBI** (North Carolina Biotic Index) – calculated as  $NCBI = \sum \frac{x_i t_i}{N}$  where:  
  
     $x_i$  = number of individuals in a taxon  
     $t_i$  = tolerance value of a taxon  
     $N$  = total number of individuals in sample that have an assigned tolerance value
6. **%Clingers-Cheum** (Percent Clingers excluding *Cheumatopsyche* sp.) – total number of individuals that build fixed retreats (or have adaptations to attach to surfaces in flowing water) excluding *Cheumatopsyche* sp., divided by the total number of individuals in the sample.
7. **%TNUTOL** (Percent TN Nutrient Tolerant Organisms) – total number of Tennessee nutrient tolerant organisms divided by the total number of organisms in the sample. The Tennessee nutrient tolerant organisms include *Cheumatopsyche*, *Stenelmis*, *Polypedilum*, *Cricotopus*, *Cricotopus/Orthocladus*, *Lirceus*, *Caenis*, *Elimia*, *Nais*, *Dero*, and undetermined (immature) tubificids.

Upon completion of the individual metric calculations, each metric is assigned a score of 0, 2, 4, or 6 based on comparison to the ecoregion reference database which is separated based on ecoregion, sampling period, and drainage area. The resulting total of all metric scores is the Tennessee Macroinvertebrate Index (TMI) score (TDEC 2017). The drainage area for all streams at the sampling locations, is >2.5 square miles.

### 3.0 RESULTS

Measurements of *in-situ* water quality parameters, flow, and habitat assessment are presented in Table 1 below.

<b>Table 1. <i>In-situ</i> Water Quality Monitoring and Habitat Assessment Spring Hill, TN</b>				
Site	Grassy Branch (GRASS001.4WI)	McCutcheon Creek (MCCUT000.1MY)	Rutherford Creek (RUTHE019.3MY)	Crooked Creek (CROOK000.2MY)
pH (su)	7.66	7.90	7.89	7.68
Conductivity ( $\mu$ S/cm)	367.9	306.2	315.2	377.4
Temperature ( $^{\circ}$ C)	13.5	13.2	13.9	15.0
Dissolved Oxygen (mg/L)	9.69	11.50	9.26	12.4
Flow (cfs)	3.26	11.85	48.47	0.82
Habitat Assessment	106	85	65	99
Turbidity (NTU)	5.86	5.12	6.79	9.87

*In-Situ* water quality parameters give a general sense of water quality at each of the benthic sampling locations. The pH ranged from 7.66 to 7.90 with Grassy Branch having the lowest (7.66) and McCutcheon Creek having the highest pH (7.90). The normal range for pH in freshwater streams is 6.5 to 8.5. Conductivity is the ability of water to carry an electric current and indicates the physical presence of dissolved electrolyte ions in the water. The conductivity readings ranged from 306.2 to 377.4 with Crooked Creek having the highest conductivity reading of 377.4. The ideal range of conductivity in freshwater streams to support diverse aquatic life is between 150 to 500  $\mu$ S/cm (River Watch Network 1997). Conductivity readings higher than 500  $\mu$ S/cm could indicate an elevated presence of chemicals in the water. Dissolved oxygen refers to the level of free oxygen in the stream. Aquatic life depends on dissolved oxygen to survive. The dissolved oxygen (mg/L) levels in the sampled streams ranged from 9.26 (Rutherford Creek) to 11.50 (McCutcheon Creek). Dissolved oxygen is produced primarily by agitation (riffles) of water and plant photosynthesis. There are three main factors that can be attributed to the higher dissolved oxygen numbers: lower water temperature, excessive algae, and the time of day in which the samples were taken. Likewise, factors causing lower dissolved oxygen numbers can be related to higher water temperatures and low flow or lack of agitation (riffles). Dissolved oxygen fluctuates daily and seasonally based on water temperature and photosynthetic activity of aquatic plants. Samples taken later in the day in streams with excessive algae can have higher dissolved oxygen

than samples taken early in the day. Colder water temperatures also increases the water's capacity for dissolved oxygen.

Results from the calculations of the biological measures are presented in Table 2, with the corresponding individual metric and TMI scores shown in Table 3.

<b>Table 2. Values for Biological Measures Spring Hill, TN</b>				
<b>Site</b>	<b>Grassy Branch (GRASS001.4WI)</b>	<b>McCutcheon Creek (MCCUT000.1MY)</b>	<b>Rutherford Creek (RUTHE019.3MY)</b>	<b>Crooked Creek (CROOK000.2MY)</b>
Total # of individuals	189	194	180	215
Taxa Richness	27	27	22	26
EPT Richness	3	4	4	5
Percent EPT- <i>Cheumatopsyche</i>	6.35	7.73	36.67	27.91
Percent Oligochaeta/ Chironomidae	60.85	71.13	31.11	14.42
NC Biotic Index	4.80	5.35	5.18	4.95
Percent Clingers- <i>Cheumatopsyche</i>	20.63	40.21	31.11	53.49
Percent Nutrient Tolerant	36.51	41.75	35.56	49.77

The total number of individuals identified ranged from 180 to 215 organisms. A total of 55 taxa were identified from the samples with a range of 22 to 27 taxa per sample. Eighteen taxa were categorized as intolerant (tolerance values < 4.51) and seven taxa were categorized as tolerant (tolerance values  $\geq 7.50$ ); those between these two values are considered facultative. Tolerance values ranged from 1 (*Rhyacophila sp*) to 10 (*Tubificinae w.o.h.c.*), and there were 14 taxa classified as clingers. A phylogenetic list of taxa identified from the benthic samples is provided in Appendix C.

<b>Table 3. Biological Measure Scores (TMI scores) Spring Hill, TN</b>				
<b>Site</b>	<b>Grassy Branch (GRASS001.4WI)</b>	<b>McCutcheon Creek (MCCUT000.1MY)</b>	<b>Rutherford Creek (RUTHE019.3MY)</b>	<b>Crooked Creek (CROOK000.2MY)</b>
Drainage Area at Sampling Site (square miles)	2.51	11.41	39.41	2.99
Bioregion	71i	71i	71i	71i
Taxa Richness	6	6	4	6
EPT Richness	2	2	2	2
Percent EPT- <i>Cheumatopsyche</i>	0	0	6	4
Percent Oligochaeta/Chironomidae	2	2	6	6
NC Biotic Index	6	6	6	6
Percent Clingers- <i>Cheumatopsyche</i>	2	4	4	6
Percent Nutrient Tolerant	6	6	6	4
<b>Total (TMI)</b>	<b>24</b>	<b>26</b>	<b>34</b>	<b>34</b>

The values for Taxa Richness ranged from 22 to 27, resulting in TMI scores ranging from 4 to 6, with Rutherford Creek having the lowest number of taxa (22) resulting in a metric score of 4. EPT Richness values ranged from 3 to 5, resulting in TMI scores of 2 for all sampling sites. Percent EPT-*Cheumatopsyche* values ranges from 0-6 with Grassy Branch and McCutcheon Creek having the lowest value and Rutherford Creek having the highest value (6). Sampling locations scores ranged for Percent Oligochaeta + Chironomidae from 2-6. Grassy Branch and McCutcheon Creek had a TMI score of 2 and Rutherford Creek and Crooked Creek had a TMI score of 6. The NC Biotic Index had metric scores of 6 for all sampling locations. Percent of Clingers ranged from 20.63-53.49, resulting in TMI metric scores ranging from 2-6, with Grassy Branch having the lowest score of 2 and Crooked Creek having the highest score of 6. Percent nutrient tolerant ranged from 36.51 to 49.77, resulting in TMI scores of 4-6 with Crooked Creek having the lowest score and all other locations receiving a score of 6.

A determination of biological condition is determined from the TMI bio-criteria scores as follows:

- >32 – Non-impaired (Supporting)
- 21-31 – Slightly impaired (Partially Supporting)
- 10-20 – Moderately impaired (Partially Supporting)
- <10 – Severely impaired (Non-supporting)

The target TMI score for the bioregion evaluated (71i) is 32, which indicates no impairment. Two sites Grassy Branch and McCutcheon Creek fell into the 21-31 category of slightly impaired (Partially Supporting). The other sites at Rutherford Creek and Crooked Creek both had total TMI scores of 34 making them Non-impaired (Supporting). Grassy Branch was the smallest stream and flowed along a residential area, which could be the case for the lower score. All sampling locations were heavily impacted by residential areas or golf courses. All streams lacked adequate buffers in the areas sampled. However, having such a large watershed masks these impacts which are not as evident to the overall stream health.

#### **4.0 LITERATURE CITED**

Tennessee Department of Environment and Conservation. 2017. Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys, Nashville. 3 sections + appendices.

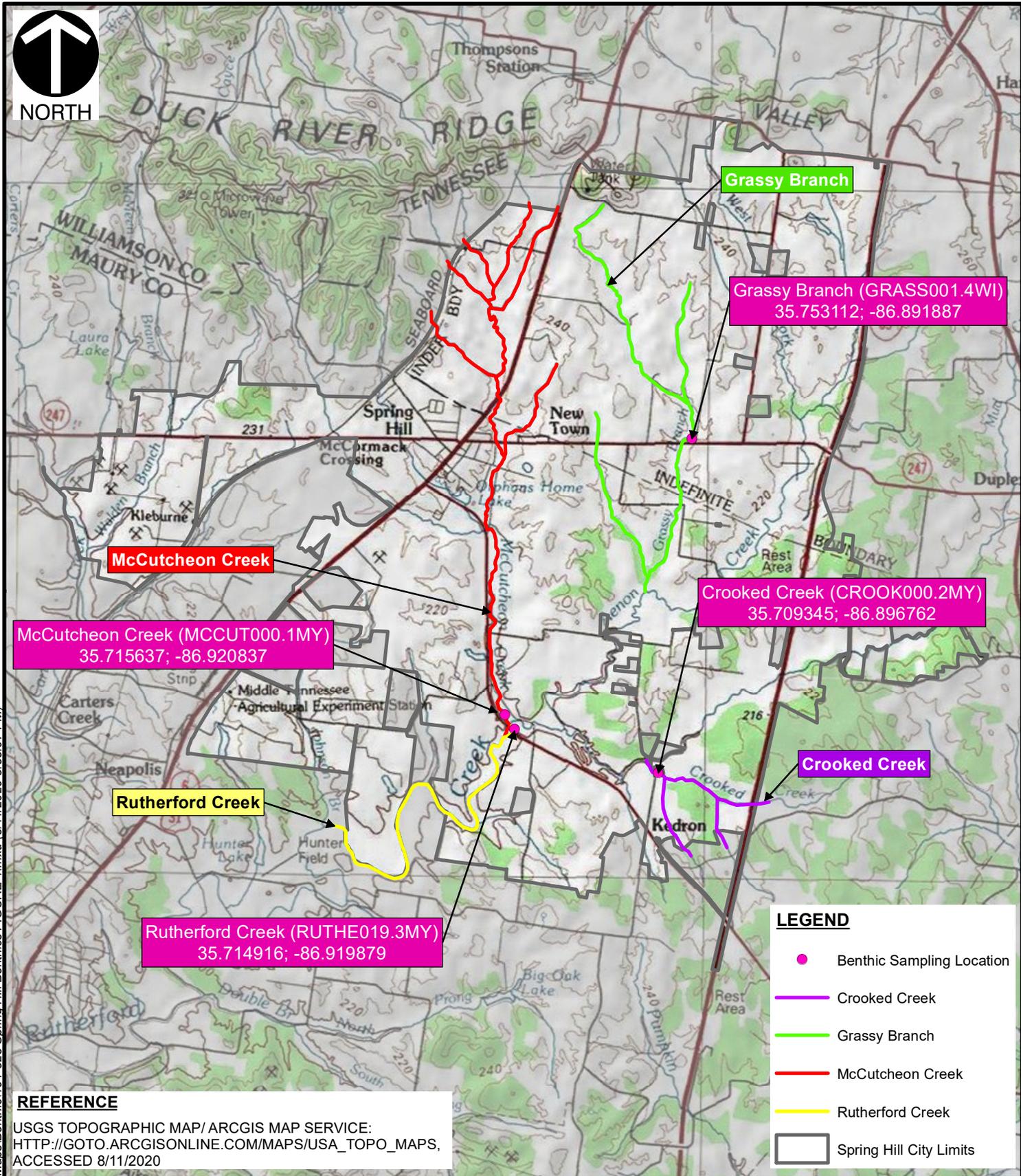
Caton, L.W. 1991. Improved subsampling methods for the EPA “Rapid Bioassessment” benthic protocols. Bull. N. Am. Benthol. Soc. 8:317-319.

*Testing the Waters: Chemical and Physical Vital Signs of a River* by Sharon Behar. Montpelier, VT: River Watch Network, 1997.

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## **FIGURES**

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McCutcheon Creek (MCCUT000.1MY)  
35.715637; -86.920837

Grassy Branch (GRASS001.4WI)  
35.753112; -86.891887

Crooked Creek (CROOK000.2MY)  
35.709345; -86.896762

Rutherford Creek (RUTHE019.3MY)  
35.714916; -86.919879

**LEGEND**

- Benthic Sampling Location
- Crooked Creek
- Grassy Branch
- McCutcheon Creek
- Rutherford Creek
- Spring Hill City Limits

**REFERENCE**  
USGS TOPOGRAPHIC MAP/ ARCGIS MAP SERVICE:  
[HTTP://GOTO.ARCGISONLINE.COM/MAPS/USA\\_TOPO\\_MAPS](http://gto.arcgis.com/maps/usa_topo_maps),  
ACCESSED 8/11/2020



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SPRING HILL MS4  
ANALYTICAL & NON-ANALYTICAL  
CITY OF SPRING HILL, TN

BENTHIC MACROINVERTEBRATE  
SAMPLING LOCATION MAP

DRAWN BY: CAD	CHECKED BY: LWK	APPROVED BY: * Hand signature on file TJN	FIGURE NO: 1
DATE: 8/11/2020	SCALE: 1" = 6,250'	PROJECT NO: 194-523	

I:\SVR-NA\SHI\194-523-GIS\Maps\Benthic\194-523 Spring Hill Benthics FIGURE 1.mxd (8/11/2020 3:55:07 PM)

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**APPENDIX A**  
**PHOTOGRAPHS OF SAMPLING SITES**

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Photo 1: View of Grassy Branch looking downstream.



Photo 2: Grassy Branch sampling location looking upstream.



Photo 3: View looking upstream of McCutcheon Creek..



Photo 4: View looking downstream of McCutcheon Creek.



Photo 5: View looking downstream of Rutherford Creek.



Photo 6: Rutherford Creek sampling location looking upstream.



Photo 7: View looking upstream of Crooked Creek.



Photo 8: Crooked Creek looking upstream.

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**APPENDIX B**  
**FIELD DATA SHEETS AND HABITAT ASSESSMENTS**

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**STREAM SURVEY INFORMATION**

DWR Station ID: <u>GRASS 001.4WT</u>	Samplers: <u>J. SCOTT, C. DUKE</u>	
Monitoring Location Name: <u>Grassy Branch</u>	Date: <u>4/17/20</u>	Time: <u>9:15</u>
Monitoring Location: <u>Spring Hill</u>	Organization: <u>CEC</u>	Drainage Area: <u>2.48 Sq mi</u>
County: <u>Williamson</u>	Ecoregion: <u>71i</u>	u/s ECO:
Latitude: <u>35.753112</u>	HUC: <u>26040005</u>	WS Grp:
Longitude: <u>-82.891887</u>	W3ID:	Field Log #:

Project Name:  Watershed  303(d)  Antideg  ECO  FECO  Other: M54

Project ID: TNPR

Activity Type:  Sample  QC Sample  Habitat  QC habitat  QC ID

Sample Status:  Collected  Seasonally Dry  Frequently Dry  No Channel  
 Too Deep (Not Wadeable)  Too Deep (Temporary)  Permanent Barrier  Fenced  
 Landowner Denial:  Temporary Barrier  Posted Plan to revisit?  Yes  No

Flow Conditions:  Dry  Isolated Pools  Stagnant  Low  Moderate  High  Bankful  Flooding

Sample	Collected?	Comment	Sample	Collected?	Comment
Biorecon			Periphyton		
SQKICK	<input checked="" type="checkbox"/>	<u>Sqkick</u>	Other		
SQBANK			Describe Other Sample:		

Chemicals/Bacteria:  None  Routine  Nutrient  Metals  E. coli  Organics  Other \_\_\_\_\_

Field Parameters: Meter(s) Used: YST

pH (su)	<u>7.66</u>	Dissolved Oxygen %	
Conductivity (umhos)	<u>387.9</u>	Turbidity (NTU)	<u>5.86</u>
Temperature (C°)	<u>13.5</u>	TDS (mg/L)	
Dissolved Oxygen (ppm = mg/L)	<u>7.67</u>	Flow (cfs)	

Meter Problems? NO

Photos Taken?  No  Yes: Description: \_\_\_\_\_

Previous 48 hours precipitation:  Unknown  None  Slight  Moderate  Heavy  Flooding

Air Temperature (°F) 59°

**Physical Characteristics & Light Penetration:**

Gradient (sample reach):  Flat  Low  Moderate  High  Cascades

Average Stream Width:  Very Small (<1.5yd)  Small (1.5-3yd)  Med. (3-10yd)  Large (10-25yd)  Very Large (>25yd)

Maximum Stream Depth:  Shallow (<0.3yd)  Medium (0.3-0.6yd)  Deep (0.6 - 1yd)  Very Deep (>1yd)

% Canopy Cover Estimated for Reach: 100 %

% Canopy Cover Measured (mid-reach): 100 u/s + 100 d/s + 100 LDB + 100 RDB = Total/384\*100 \_\_\_\_\_

**Channel Characteristics:**

Bank Height: 2.3 (yd.) High Water Mark: 1 (yd.)

Bank Slope LDB:  Deeply incised  Bluff/Wall  Undercut  Sloughing  Steep terrain  Gentle Slope

Bank Slope RDB:  Deeply incised  Bluff/Wall  Undercut  Sloughing  Steep terrain  Gentle Slope

Manmade Modification:  None  Rip-Rap  Cement  Gabions  Channelized  Dam  Dredging  Bridge  ATV

**Stream Characteristics:**

Sediment Deposits:  None  Slight  Moderate  Excessive  Blanket

Sediment Type:  None  Sand  Silt  Mud  Clay  Sludge  Mn Precipitant  Orange Flocculent

Turbidity:  Clear  Slightly Turbid  Muddy  Milky  Tannic  Planktonic Algae  Dyed

Foam/Surface Sheen:  None  Nutrient  Surfactant  Bacteria

Algae:  None  Slight  Moderate  High  Choking Type:  Diatoms  Green  Filamentous  Blue-green

**TDEC-DWR Stream Survey Field Sheet (Back)**

DWR Station ID: Grass001.4WF Date: 4/17/20 Assessors: Ca. JS

**Dominate Substrate:** (More than 25%) Check all that apply

- | Riffle  | Run  | Pool  |
|---|--|---|
| <input type="checkbox"/> Boulders (>10")              | <input type="checkbox"/> Boulders (>10")             | <input type="checkbox"/> Boulders (>10")              |
| <input checked="" type="checkbox"/> Cobble (2.5-10")  | <input checked="" type="checkbox"/> Cobble (2.5-10") | <input type="checkbox"/> Cobble (2.5-10")             |
| <input checked="" type="checkbox"/> Gravel (0.1-2.5") | <input type="checkbox"/> Gravel (0.1-2.5")           | <input type="checkbox"/> Gravel (0.1-2.5")            |
| <input type="checkbox"/> Bedrock                      | <input checked="" type="checkbox"/> Bedrock          | <input checked="" type="checkbox"/> Bedrock           |
| <input type="checkbox"/> Sand                         | <input type="checkbox"/> Sand                        | <input type="checkbox"/> Sand                         |
| <input type="checkbox"/> Silt (not gritty)            | <input type="checkbox"/> Silt (not gritty)           | <input checked="" type="checkbox"/> Silt (not gritty) |
| <input type="checkbox"/> Clay (Slick)                 | <input type="checkbox"/> Clay (Slick)                | <input type="checkbox"/> Clay (Slick)                 |

**Surrounding Land Uses** (list additional land uses under comments)

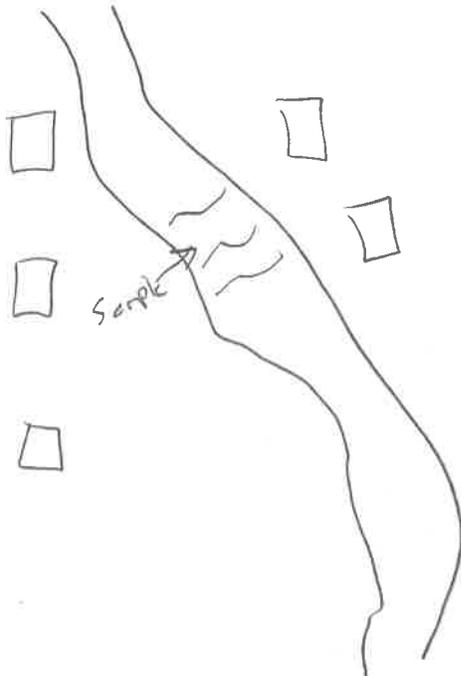
- |                                     |                                     |   |   |                                       |
|-------------------------------------|-------------------------------------|---|---|---------------------------------------|
| <input type="checkbox"/> Forest     | <input type="checkbox"/> Grazing    | <input type="checkbox"/> Stormwater             | <input type="checkbox"/> STP/WWTP                   | <input type="checkbox"/> Construction |
| <input type="checkbox"/> Wetland    | <input type="checkbox"/> Row Crops  | <input type="checkbox"/> Urban                  | <input type="checkbox"/> Industry                   | <input type="checkbox"/> Impoundment  |
| <input type="checkbox"/> Park       | <input type="checkbox"/> CAFO/Dairy | <input type="checkbox"/> Commercial             | <input checked="" type="checkbox"/> Mining/Dredging | <input type="checkbox"/> ATV/OHV      |
| <input type="checkbox"/> Hay/Fields | <input type="checkbox"/> Logging    | <input checked="" type="checkbox"/> Residential | <input checked="" type="checkbox"/> Road/Hwy/RR     | <input type="checkbox"/> Golf Course  |

**Observed Human Disturbance to Stream:** Blank (not observed) S (Slight) M (Moderate) H (High)

Riparian Loss	M	Logging		Industry		ATV/OHV	
Channelization		Urban		Mining/Dredging		Golf Course	
Active Grazing		Commercial		Road/Hwy/RR		Garbage Trash	
Row Crops		Residential	H	Construction	S	Landfill	
CAFO/Dairy		STP/WWTP		Impoundment		Water Withdrawal	

**Other Stream Information and Stressors:**

**Stream Sketch:** (include road name or landmark, flow direction, reach distance, distance from bridge or road, sampling points, tributaries, outfalls, livestock access, riparian, potential impacts, north arrow, immediate land use, buildings, etc.) Use additional sheet if necessary.



distance	depth	Flow
0	0	0
2 ft	0.2	0.10
4 ft	0.3	1.2
6 ft	0.65	3.30
8 ft	0.6	1.18
10 ft	0.3	0.08
12 ft	0.1	0.01
14 ft	0	0

edge

# HABITAT ASSESSMENT FIELD DATA SHEET – MODERATE TO HIGH GRADIENT STREAM (FRONT)

(Refer to Protocol E for detailed descriptions and rank information)

<b>PROJECT:</b> <i>Young Hill Boggy Creek</i>		<b>HABITAT ASSESSED BY:</b> <i>Gr Duke, J Scott</i>	
<b>STA:</b> <i>GRASSYDOL, 405</i>		<b>DATE:</b> <i>4/17/20</i>	
<b>STREAM NAME:</b> <i>Grassy Branch</i>		<b>TIME:</b> <i>7:15</i>	
<b>MAP LABEL:</b> <i>Grassy Branch</i>		<b>ECOREGION:</b> <i>711</i>	
<b>HUC:</b> <i>06040003</i>		<b>QC: Consensus / Duplicate</b>	

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
<b>1. Epifaunal Substrate / Available Cover</b>	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.
<b>SCORE</b>	20   19   18   17   16	15   14   13   12   11	10   9   8   7   6	5   4   3   2   1
Comments:				
<b>2. Embeddedness of Riffles</b>	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.
<b>SCORE</b>	20   19   18   17   16	15   14   13   12   11	10   9   8   7   6	5   4   3   2   1
Comments:				
<b>3. Velocity/ Depth Regime</b>	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.
<b>SCORE</b>	20   19   18   17   16	15   14   13   12   11	10   9   8   7   6	5   4   3   2   1
Comments:				
<b>4. Sediment Deposition</b>	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.
<b>SCORE</b>	20   19   18   17   16	15   14   13   12   11	10   9   8   7   6	5   4   3   2   1
Comments:				
<b>5. Channel Flow Status</b>	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.
<b>SCORE</b>	20   19   18   17   16	15   14   13   12   11	10   9   8   7   6	5   4   3   2   1
Comments:				

## HABITAT ASSESSMENT FIELD DATA SHEET – MODERATE TO HIGH GRADIENT STREAM (BACK)

MAP LABEL: <u>Crossy Branch</u>		DATE: <u>4/7/20</u>										ASSESSOR INITIALS: <u>CS</u>																		
<b>6. Channel Alteration</b>	<b>OPTIMAL</b>	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.					<b>SUBOPTIMAL</b>					<b>MARGINAL</b>					<b>POOR</b>													
	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. In-stream habitat greatly altered or removed. Artificial structures have greatly affected flow pattern.																			
<b>SCORE</b>		20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1									
Comments:																														
<b>7. Frequency of re-oxygenation zones.</b> Use frequency of riffles or bends for category. Rank by quality.	<b>OPTIMAL</b>	Occurrence of re-oxygenation zones relatively frequent; ratio of distance between areas divided by average stream width <7:1.					<b>SUBOPTIMAL</b>					<b>MARGINAL</b>					<b>POOR</b>													
	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.																			
<b>SCORE</b>		20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1									
Comments:																														
<b>8. Bank Stability (score each bank)</b> Determine left or right side by facing downstream.	<b>OPTIMAL</b>	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems <5% of bank affected.					<b>SUBOPTIMAL</b>					<b>MARGINAL</b>					<b>POOR</b>													
	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.																			
<b>SCORE (LDB)</b>		LEFT	10	9			8	7	6			5	4	3			2	1	0											
<b>SCORE (RDB)</b>		RIGHT	10	9			8	7	6			5	4	3			2	1	0											
Comments:																														
<b>9. Bank Vegetative Protection</b> (score each bank) include vegetation from top of bank to base of bank. Determine left or right side by facing downstream.	<b>OPTIMAL</b>	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.					<b>SUBOPTIMAL</b>					<b>MARGINAL</b>					<b>POOR</b>													
	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 banks 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%).																			
<b>SCORE (LDB)</b>		LEFT	10	9			8	7	6			5	4	3			2	1	0											
<b>SCORE (RDB)</b>		RIGHT	10	9			8	7	6			5	4	3			2	1	0											
Comments:																														
<b>10. Riparian Vegetative Zone Width</b> (score each bank.) Zone begins at top of bank.	<b>OPTIMAL</b>	Average width of riparian zone > 18 meters. Unpaved footpaths may score 9 if run-off potential is negligible.					<b>SUBOPTIMAL</b>					<b>MARGINAL</b>					<b>POOR</b>													
	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.																			
<b>SCORE (LDB)</b>		LEFT	10	9			8	7	6			5	4	3			2	1	0											
<b>SCORE (RDB)</b>		RIGHT	10	9			8	7	6			5	4	3			2	1	0											
Comments:																														
<b>TOTAL SCORE</b>		106																												
Comparison to Ecoregion Guidelines (circle): ABOVE or BELOW																														
If score is below guidelines, result of (circle)										Natural Conditions											Human Disturbance									
Comments:																														

**STREAM SURVEY INFORMATION**

DWR Station ID: <u>McCAT000.1M4</u>	Samplers: <u>C. Duke, J. Scott</u>	
Monitoring Location Name: <u>McCaulean Creek</u>	Date: <u>4/17/20</u>	Time: <u>11:00</u>
Monitoring Location: <u>Spring Hill</u>	Organization: <u>CFC</u>	Drainage Area: <u>11.14 sq mi</u>
County: <u>Maury</u>	Ecoregion: <u>711</u>	u/s ECO:
Latitude: <u>35.75637</u>	HUC: <u>06040003</u>	WS Grp:
Longitude: <u>-86.970837</u>	WBD:	Field Log #:
Project Name: <input type="checkbox"/> Watershed <input type="checkbox"/> 303(d) <input type="checkbox"/> Antideg <input type="checkbox"/> ECO <input type="checkbox"/> FECO <input type="checkbox"/> Other: <u>MSL</u>		

Project ID: TNPR

Activity Type:  Sample  QC Sample  Habitat  QC habitat  QC ID

Sample Status:  Collected  Seasonally Dry  Frequently Dry  No Channel  
 Too Deep (Not Wadeable)  Too Deep (Temporary)  Permanent Barrier  Fenced  
 Landowner Denial:  Temporary Barrier  Posted Plan to revisit?  Yes  No

Flow Conditions:  Dry  Isolated Pools  Stagnant  Low  Moderate  High  Bankful  Flooding

Sample	Collected?	Comment	Sample	Collected?	Comment
Biorecon			Periphyton		
SQKICK	X	<u>SQKICK</u>	Other		
SQBANK			Describe Other Sample:		

Chemicals/Bacteria:  None  Routine  Nutrient  Metals  E. coli  Organics  Other \_\_\_\_\_

Field Parameters: Meter(s) Used: YSI

pH (su)	<u>7.70</u>	Dissolved Oxygen %	
Conductivity (umhos)	<u>306.2</u>	Turbidity (NTU)	<u>5.12</u>
Temperature (C°)	<u>13.2°C</u>	TDS (mg/L)	
Dissolved Oxygen (ppm = mg/L)	<u>11.50</u>	Flow (cfs)	

Meter Problems? NO

Photos Taken?  No  Yes: Description: US/DS

Previous 48 hours precipitation:  Unknown  None  Slight  Moderate  Heavy  Flooding

Air Temperature (°F) 61

**Physical Characteristics & Light Penetration:**

Gradient (sample reach):  Flat  Low  Moderate  High  Cascades

Average Stream Width:  Very Small (<1.5yd)  Small (1.5-3yd)  Med. (3-10yd)  Large (10-25yd)  Very Large (>25yd)

Maximum Stream Depth:  Shallow (<0.3yd)  Medium (0.3-0.6yd)  Deep (0.6 - 1yd)  Very Deep(>1yd)

% Canopy Cover Estimated for Reach: 80 %

% Canopy Cover Measured (mid-reach): 80 u/s + 60 d/s + 40 LDB + 50 RDB = Total/384\*100

**Channel Characteristics:**

Bank Height: 8-10 (yd.) High Water Mark: 7 (yd.)

Bank Slope LDB:  Deeply incised  Bluff/Wall  Undercut  Sloughing  Steep terrain  Gentle Slope

Bank Slope RDB:  Deeply incised  Bluff/Wall  Undercut  Sloughing  Steep terrain  Gentle Slope

Manmade Modification:  None  Rip-Rap  Cement  Gabions  Channelized  Dam  Dredging  Bridge  ATV

**Stream Characteristics:**

Sediment Deposits:  None  Slight  Moderate  Excessive  Blanket

Sediment Type:  None  Sand  Silt  Mud  Clay  Sludge  Mn Precipitant  Orange Flocculent

Turbidity:  Clear  Slightly Turbid  Muddy  Milky  Tannic  Planktonic Algae  Dyed

Foam/Surface Sheen:  None  Nutrient  Surfactant  Bacteria

Algae:  None  Slight  Moderate  High  Choking Type:  Diatoms  Green  Filamentous  Blue-green

**TDEC-DWR Stream Survey Field Sheet (Back)**

DWR Station ID: MCCT000.1MY Date: 4/17/20 Assessors: CD, JS

**Dominate Substrate:** (More than 25%) Check all that apply

- | Riffle  | Run   | Pool  |
|---|---|---|
| <input type="checkbox"/> Boulders (>10")              | <input type="checkbox"/> Boulders (>10")              | <input type="checkbox"/> Boulders (>10")              |
| <input type="checkbox"/> Cobble (2.5-10")             | <input type="checkbox"/> Cobble (2.5-10")             | <input type="checkbox"/> Cobble (2.5-10")             |
| <input checked="" type="checkbox"/> Gravel (0.1-2.5") | <input checked="" type="checkbox"/> Gravel (0.1-2.5") | <input type="checkbox"/> Gravel (0.1-2.5")            |
| <input type="checkbox"/> Bedrock                      | <input checked="" type="checkbox"/> Bedrock           | <input checked="" type="checkbox"/> Bedrock           |
| <input type="checkbox"/> Sand                         | <input type="checkbox"/> Sand                         | <input type="checkbox"/> Sand                         |
| <input checked="" type="checkbox"/> Silt (not gritty) | <input checked="" type="checkbox"/> Silt (not gritty) | <input checked="" type="checkbox"/> Silt (not gritty) |
| <input type="checkbox"/> Clay (Slick)                 | <input type="checkbox"/> Clay (Slick)                 | <input type="checkbox"/> Clay (Slick)                 |

**Surrounding Land Uses** (list additional land uses under comments)

- |                                     |                                     |   |   |   |
|-------------------------------------|-------------------------------------|---|---|---|
| <input type="checkbox"/> Forest     | <input type="checkbox"/> Grazing    | <input type="checkbox"/> Stormwater             | <input type="checkbox"/> STP/WWTP               | <input type="checkbox"/> Construction           |
| <input type="checkbox"/> Wetland    | <input type="checkbox"/> Row Crops  | <input type="checkbox"/> Urban                  | <input type="checkbox"/> Industry               | <input type="checkbox"/> Impoundment            |
| <input type="checkbox"/> Park       | <input type="checkbox"/> CAFO/Dairy | <input type="checkbox"/> Commercial             | <input type="checkbox"/> Mining/Dredging        | <input type="checkbox"/> ATV/OHV                |
| <input type="checkbox"/> Hay/Fields | <input type="checkbox"/> Logging    | <input checked="" type="checkbox"/> Residential | <input checked="" type="checkbox"/> Road/Hwy/RR | <input checked="" type="checkbox"/> Golf Course |

**Observed Human Disturbance to Stream:** Blank (not observed) S (Slight) M (Moderate) H (High)

Riparian Loss	<input checked="" type="checkbox"/> Logging		Industry		ATV/OHV	
Channelization		Urban		Mining/Dredging		Golf Course M
Active Grazing		Commercial		Road/Hwy/RR	M	Garbage Trash
Row Crops		Residential	M	Construction		Landfill
CAFO/Dairy		STP/WWTP		Impoundment		Water Withdrawal

**Other Stream Information and Stressors:**

**Stream Sketch:** (include road name or landmark, flow direction, reach distance, distance from bridge or road, sampling points, tributaries, outfalls, livestock access, riparian, potential impacts, north arrow, immediate land use, buildings, etc.) Use additional sheet if necessary.



distance	depth	Flow
0	0	0
3 ft	0	0
4 ft	0.1	.11
6 ft	0.25	.15
8 ft	0.40	1.10
10 ft	0.5	3.16
12 ft	0.45	1.97
14 ft	0.3	1.76
16 ft	0.4	1.55
18 ft	0.6	2.78
20 ft	0.6	3.12
22 ft	0.5	2.88
24 ft	0.6	2.60
26 ft	0.3	1.88
28 ft	0.4	1.67
30 ft	0.35	0.57
32 ft	0.10	0.40
32.7	0	0

# HABITAT ASSESSMENT FIELD DATA SHEET – MODERATE TO HIGH GRADIENT STREAM (FRONT)

(Refer to Protocol E for detailed descriptions and rank information)

<b>PROJECT:</b> Springs Hill Branches MS4		<b>HABITAT ASSESSED BY:</b> JD JS	
<b>STA:</b> MCA0200, IMV		<b>DATE:</b> 4/17/20	<b>TIME:</b> 11:00
<b>STREAM NAME:</b> McCutcheon creek		<b>ECOREGION:</b> 711	
<b>MAP LABEL:</b> McCutcheon creek		<b>QC (Consensus) / Duplicate</b>	
<b>HUC:</b> 66040003			

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
<b>1. Epifaunal Substrate / Available Cover</b>	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.
<b>SCORE</b>	20   19   18   17   16	15   14   13   12   11	10   9   8   7   6	5   4   3   2   1
Comments:				

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
<b>2. Embeddedness of Riffles</b>	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.
<b>SCORE</b>	20   19   18   17   16	15   14   13   12   11	10   9   8   7   6	5   4   3   2   1
Comments:				

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
<b>3. Velocity/ Depth Regime</b>	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.
<b>SCORE</b>	20   19   18   17   16	15   14   13   12   11	10   9   8   7   6	5   4   3   2   1
Comments:				

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
<b>4. Sediment Deposition</b>	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.
<b>SCORE</b>	20   19   18   17   16	15   14   13   12   11	10   9   8   7   6	5   4   3   2   1
Comments:				

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
<b>5. Channel Flow Status</b>	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.
<b>SCORE</b>	20   19   18   17   16	15   14   13   12   11	10   9   8   7   6	5   4   3   2   1
Comments:				

## HABITAT ASSESSMENT FIELD DATA SHEET – MODERATE TO HIGH GRADIENT STREAM (BACK)

<b>MAP LABEL:</b> <i>McClatchey Creek</i>		<b>DATE:</b> <i>4/9/20</i>					<b>ASSESSOR INITIALS:</b> <i>CT</i>													
	<b>OPTIMAL</b>						<b>SUBOPTIMAL</b>						<b>MARGINAL</b>						<b>POOR</b>	
<b>6. Channel Alteration</b>	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. In-stream habitat greatly altered or removed. Artificial structures have greatly affected flow pattern.				
<b>SCORE</b>	20	19	18	17	15	15	14	13	12	<b>11</b>	10	9	8	7	6	5	4	3	2	1
Comments:																				
	<b>OPTIMAL</b>						<b>SUBOPTIMAL</b>						<b>MARGINAL</b>						<b>POOR</b>	
<b>7. Frequency of re-oxygenation zones.</b> Use frequency of riffles or bands 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.				
<b>SCORE</b>	20	19	18	17	16	15	14	13	12	<b>11</b>	10	9	8	7	6	5	4	3	2	1
Comments:																				
	<b>OPTIMAL</b>						<b>SUBOPTIMAL</b>						<b>MARGINAL</b>						<b>POOR</b>	
<b>8. Bank Stability (score each bank)</b> 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.				
<b>SCORE (LDB)</b>	LEFT	10	9			8	7	6			5	<b>4</b>	3			2	1	0		
<b>SCORE (RDB)</b>	RIGHT	10	9			8	7	6			5	4	<b>3</b>			2	1	0		
Comments:																				
	<b>OPTIMAL</b>						<b>SUBOPTIMAL</b>						<b>MARGINAL</b>						<b>POOR</b>	
<b>9. Bank Vegetative Protection</b> (score each bank) include 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 banks 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%).				
<b>SCORE (LDB)</b>	LEFT	10	9			8	7	6			5	4	3			<b>2</b>	1	0		
<b>SCORE (RDB)</b>	RIGHT	10	9			8	7	6			5	4	3			<b>2</b>	1	0		
Comments:																				
	<b>OPTIMAL</b>						<b>SUBOPTIMAL</b>						<b>MARGINAL</b>						<b>POOR</b>	
<b>10. Riparian Vegetative Zone Width</b> (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.				
<b>SCORE (LDB)</b>	LEFT	10	9			8	7	6			5	4	3			<b>2</b>	1	0		
<b>SCORE (RDB)</b>	RIGHT	10	9			8	7	6			5	4	3			<b>2</b>	1	0		
Comments:																				
<b>TOTAL SCORE</b>	<i>885</i>					Comparison to Ecoregion Guidelines (circle): ABOVE or <b>BELOW</b>														
If score is below guidelines, result of (circle)										Natural Conditions					Human Disturbance					
Comments:																				

**STREAM SURVEY INFORMATION**

DWR Station ID: <u>Rutherford 19.3MY</u>	Samplers: <u>Adelle, J. Scott</u>	
Monitoring Location Name: <u>Rutherford Creek</u>	Date: <u>4/17/20</u>	Time: <u>11:45</u>
Monitoring Location: <u>Spring Hill</u>	Organization: <u>LTC</u>	Drainage Area: <u>39.41 sq mi</u>
County: <u>Mauzy</u>	Ecoregion: <u>711</u>	u/s ECO:
Latitude: <u>35.714916</u>	HUC: <u>06040003</u>	WS Grp:
Longitude: <u>-80.919879</u>	W3ID:	Field Log #:

Project Name:  Watershed  303(d)  Antideg  ECO  FECO Other: MS4

Project ID: TNPP

Activity Type:  Sample  QC Sample  Habitat  QC habitat  QC ID

Sample Status:  Collected  Seasonally Dry  Frequently Dry  No Channel  
 Too Deep (Not Wadeable)  Too Deep (Temporary)  Permanent Barrier  Fenced  
 Landowner Denial:  Temporary Barrier  Posted Plan to revisit?  Yes  No

Flow Conditions:  Dry  Isolated Pools  Stagnant  Low  Moderate  High  Bankful  Flooding

Sample	Collected?	Comment	Sample	Collected?	Comment
Biorecon			Periphyton		
SQKICK	<input checked="" type="checkbox"/>	<u>SOKICK</u>	Other		
SQBANK			Describe Other Sample:		

Chemicals/Bacteria:  None  Routine  Nutrient  Metals  E. coli  Organics  Other \_\_\_\_\_

Field Parameters: Meter(s) Used: YSI

pH (su)	<u>7.89</u>	Dissolved Oxygen %	
Conductivity (umhos)	<u>315.2</u>	Turbidity (NTU)	<u>6.79</u>
Temperature (C°)	<u>15.9°</u>	TDS (mg/L)	
Dissolved Oxygen (ppm = mg/L)	<u>9.26</u>	Flow (cfs)	

Meter Problems? NO

Photos Taken?  No  Yes: Description: 115/125

Previous 48 hours precipitation:  Unknown  None  Slight  Moderate  Heavy  Flooding

Air Temperature (°F) 70

**Physical Characteristics & Light Penetration:**

Gradient (sample reach):  Flat  Low  Moderate  High  Cascades

Average Stream Width:  Very Small (<1.5yd)  Small (1.5-3yd)  Med. (3-10yd)  Large (10-25yd)  Very Large (>25yd)

Maximum Stream Depth:  Shallow (<0.3yd)  Medium (0.3-0.6yd)  Deep (0.6 - 1yd)  Very Deep (>1yd)

% Canopy Cover Estimated for Reach: 0 %

% Canopy Cover Measured (mid-reach): 0 u/s + 50 d/s + 0 LDB + 0 RDB = Total/384\*100

**Channel Characteristics:**

Bank Height: 4 (yd.) High Water Mark: 1 (yd.)

Bank Slope LDB:  Deeply incised  Bluff/Wall  Undercut  Sloughing  Steep terrain  Gentle Slope

Bank Slope RDB:  Deeply incised  Bluff/Wall  Undercut  Sloughing  Steep terrain  Gentle Slope

Manmade Modification:  None  Rip-Rap  Cement  Gabions  Channelized  Dam  Dredging  Bridge  ATV

**Stream Characteristics:**

Sediment Deposits:  None  Slight  Moderate  Excessive  Blanket

Sediment Type:  None  Sand  Silt  Mud  Clay  Sludge  Mn Precipitant  Orange Flocculent

Turbidity:  Clear  Slightly Turbid  Muddy  Milky  Tannic  Planktonic Algae  Dyed

Foam/Surface Sheen:  None  Nutrient  Surfactant  Bacteria

Algae:  None  Slight  Moderate  High  Choking Type:  Diatoms  Green  Filamentous  Blue-green

**TDEC-DWR Stream Survey Field Sheet (Back)**

DWR Station ID: BullE019, 3M4 Date: 4/7/20 Assessors: CD/JS

**Dominate Substrate:** (More than 25%) Check all that apply

- | Riffle  | Run   | Pool  |
|---|---|---|
| <input type="checkbox"/> Boulders (>10")              | <input type="checkbox"/> Boulders (>10")              | <input type="checkbox"/> Boulders (>10")              |
| <input type="checkbox"/> Cobble (2.5-10")             | <input type="checkbox"/> Cobble (2.5-10")             | <input type="checkbox"/> Cobble (2.5-10")             |
| <input checked="" type="checkbox"/> Gravel (0.1-2.5") | <input checked="" type="checkbox"/> Gravel (0.1-2.5") | <input checked="" type="checkbox"/> Gravel (0.1-2.5") |
| <input type="checkbox"/> Bedrock                      | <input type="checkbox"/> Bedrock                      | <input type="checkbox"/> Bedrock                      |
| <input type="checkbox"/> Sand                         | <input type="checkbox"/> Sand                         | <input type="checkbox"/> Sand                         |
| <input checked="" type="checkbox"/> Silt (not gritty) | <input checked="" type="checkbox"/> Silt (not gritty) | <input checked="" type="checkbox"/> Silt (not gritty) |
| <input type="checkbox"/> Clay (Slick)                 | <input type="checkbox"/> Clay (Slick)                 | <input type="checkbox"/> Clay (Slick)                 |

**Surrounding Land Uses** (list additional land uses under comments)

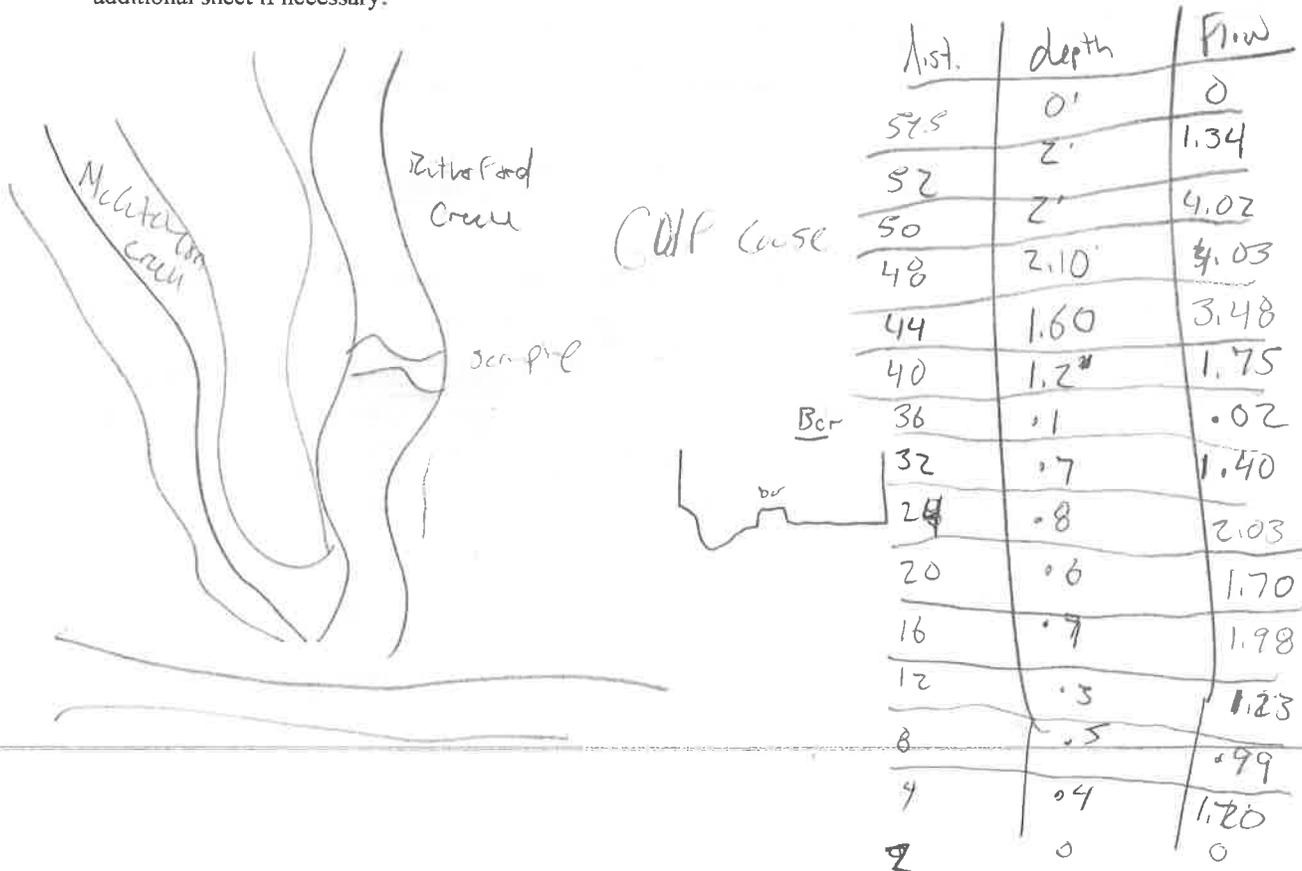
- |                                     |                                     |                                      |  |   |
|-------------------------------------|-------------------------------------|--------------------------------------|--|---|
| <input type="checkbox"/> Forest     | <input type="checkbox"/> Grazing    | <input type="checkbox"/> Stormwater  | <input type="checkbox"/> STP/WWTP        | <input type="checkbox"/> Construction           |
| <input type="checkbox"/> Wetland    | <input type="checkbox"/> Row Crops  | <input type="checkbox"/> Urban       | <input type="checkbox"/> Industry        | <input type="checkbox"/> Impoundment            |
| <input type="checkbox"/> Park       | <input type="checkbox"/> CAFO/Dairy | <input type="checkbox"/> Commercial  | <input type="checkbox"/> Mining/Dredging | <input type="checkbox"/> ATV/OHV                |
| <input type="checkbox"/> Hay/Fields | <input type="checkbox"/> Logging    | <input type="checkbox"/> Residential | <input type="checkbox"/> Road/Hwy/RR     | <input checked="" type="checkbox"/> Golf Course |

**Observed Human Disturbance to Stream:** Blank (not observed) S (Slight) M (Moderate) H (High)

Riparian Loss	Logging	Industry	ATV/OHV	
Channelization	Urban	Mining/Dredging	Golf Course	H
Active Grazing	Commercial	Road/Hwy/RR	Garbage/Trash	
Row Crops	Residential	S Construction	Landfill	
CAFO/Dairy	STP/WWTP	Impoundment	Water Withdrawal	

**Other Stream Information and Stressors:**

**Stream Sketch:** (include road name or landmark, flow direction, reach distance, distance from bridge or road, sampling points, tributaries, outfalls, livestock access, riparian, potential impacts, north arrow, immediate land use, buildings, etc.) Use additional sheet if necessary.



# HABITAT ASSESSMENT FIELD DATA SHEET – MODERATE TO HIGH GRADIENT STREAM (FRONT)

(Refer to Protocol E for detailed descriptions and rank information)

<b>PROJECT:</b> Spring Hill MS4																				
<b>STA:</b> Ruffin 19 3M4					<b>HABITAT ASSESSED BY:</b> CD JS															
<b>STREAM NAME:</b> Ruffin Road Creek					<b>DATE:</b> 4/17/20					<b>TIME:</b> 11:45										
<b>MAP LABEL:</b> Ruffin Road Creek					<b>ECOREGION:</b> 711															
<b>HUC:</b> 06040005					<b>QC: Consensus / Duplicate</b>															
	<b>OPTIMAL</b>					<b>SUBOPTIMAL</b>					<b>MARGINAL</b>					<b>POOR</b>				
<b>1. Epifaunal Substrate / Available Cover</b>	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.				
<b>SCORE</b>	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	<b>OPTIMAL</b>					<b>SUBOPTIMAL</b>					<b>MARGINAL</b>					<b>POOR</b>				
<b>2. Embeddedness of Riffles</b>	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.				
<b>SCORE</b>	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	<b>OPTIMAL</b>					<b>SUBOPTIMAL</b>					<b>MARGINAL</b>					<b>POOR</b>				
<b>3. Velocity/ Depth Regime</b>	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.				
<b>SCORE</b>	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	<b>OPTIMAL</b>					<b>SUBOPTIMAL</b>					<b>MARGINAL</b>					<b>POOR</b>				
<b>4. Sediment Deposition</b>	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.				
<b>SCORE</b>	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	<b>OPTIMAL</b>					<b>SUBOPTIMAL</b>					<b>MARGINAL</b>					<b>POOR</b>				
<b>5. Channel Flow Status</b>	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.				
<b>SCORE</b>	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				

**HABITAT ASSESSMENT FIELD DATA SHEET – MODERATE TO HIGH GRADIENT STREAM (BACK)**

<b>MAP LABEL:</b> <i>Rutherford Creek</i>		<b>DATE:</b> <i>4/16/20</i>		<b>ASSESSOR INITIALS:</b> <i>CD</i>																									
	<b>OPTIMAL</b>				<b>SUBOPTIMAL</b>					<b>MARGINAL</b>					<b>POOR</b>														
<b>6. Channel Alteration</b>	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. In-stream habitat greatly altered or removed. Artificial structures have greatly affected flow pattern.														
<b>SCORE</b>	20	19	18	17	15	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1									
Comments:																													
	<b>OPTIMAL</b>				<b>SUBOPTIMAL</b>					<b>MARGINAL</b>					<b>POOR</b>														
<b>7. Frequency of re-oxygenation zones.</b> Use frequency of riffles 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.														
<b>SCORE</b>	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1									
Comments:																													
	<b>OPTIMAL</b>				<b>SUBOPTIMAL</b>					<b>MARGINAL</b>					<b>POOR</b>														
<b>8. Bank Stability (score each bank)</b> 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.														
<b>SCORE (LDB)</b>	LEFT	10	9								8	7	6																
<b>SCORE (RDB)</b>	RIGHT	10	9								8	7	6																
Comments:																													
	<b>OPTIMAL</b>				<b>SUBOPTIMAL</b>					<b>MARGINAL</b>					<b>POOR</b>														
<b>9. Bank Vegetative Protection (score each bank)</b> include 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 banks 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%).														
<b>SCORE (LDB)</b>	LEFT	10	9								8	7	6																
<b>SCORE (RDB)</b>	RIGHT	10	9								8	7	6																
Comments:																													
	<b>OPTIMAL</b>				<b>SUBOPTIMAL</b>					<b>MARGINAL</b>					<b>POOR</b>														
<b>10. Riparian Vegetative Zone Width (score each bank.)</b> 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.														
<b>SCORE (LDB)</b>	LEFT	10	9								8	7	6																
<b>SCORE (RDB)</b>	RIGHT	10	9								8	7	6																
Comments:																													
<b>TOTAL SCORE</b> 0 <i>65</i>		Comparison to Ecoregion Guidelines (circle):    ABOVE    or    BELOW																											
If score is below guidelines, result of (circle)										Natural Conditions										Human Disturbance									
Comments:																													

**STREAM SURVEY INFORMATION**

DWR Station ID: <u>2800K0002ML</u>	Samplers: <u>C. Dille, J. Scott</u>	
Monitoring Location Name: <u>Crooked Creek</u>	Date: <u>4/17/20</u>	Time: <u>1:15</u>
Monitoring Location: <u>Spring Hill</u>	Organization: <u>CEC</u>	Drainage Area: <u>2.99 sq mi</u>
County: <u>MAHON</u>	Ecoregion: <u>471</u>	u/s ECO:
Latitude: <u>35.709345</u>	HUC: <u>06040003</u>	WS Grp:
Longitude: <u>-86.896762</u>	WBID:	Field Log #:

Project Name:  Watershed  303(d)  Antideg  ECO  FECO Other: MS4

Project ID: TNPP

Activity Type:  Sample  QC Sample  Habitat  QC habitat  QC ID

Sample Status:  Collected  Seasonally Dry  Frequently Dry  No Channel  
 Too Deep (Not Wadeable)  Too Deep (Temporary)  Permanent Barrier  Fenced  
 Landowner Denial:  Temporary Barrier  Posted Plan to revisit?  Yes  No

Flow Conditions:  Dry  Isolated Pools  Stagnant  Low  Moderate  High  Bankful  Flooding

Sample	Collected?	Comment	Sample	Collected?	Comment
Biorecon			Periphyton		
SQKICK	<input checked="" type="checkbox"/>	<u>S&amp;MICH</u>	Other		
SQBANK			Describe Other Sample:		

Chemicals/Bacteria:  None  Routine  Nutrient  Metals  E. coli  Organics  Other \_\_\_\_\_

Field Parameters: Meter(s) Used: YSI

pH (su)	<u>7.68</u>	Dissolved Oxygen %	
Conductivity (umhos)	<u>377.4</u>	Turbidity (NTU)	<u>9.87</u>
Temperature (C°)	<u>15°c</u>	TDS (mg/L)	
Dissolved Oxygen (ppm = mg/L)	<u>12.4</u>	Flow (cfs)	

Meter Problems? NO

Photos Taken?  No  Yes: Description: US/DS

Previous 48 hours precipitation:  Unknown  None  Slight  Moderate  Heavy  Flooding

Air Temperature (°F) 73

**Physical Characteristics & Light Penetration:**

Gradient (sample reach): <input type="checkbox"/> Flat <input type="checkbox"/> Low <input type="checkbox"/> Moderate <input type="checkbox"/> High <input type="checkbox"/> Cascades
Average Stream Width: <input type="checkbox"/> Very Small (<1.5yd) <input type="checkbox"/> Small (1.5-3yd) <input checked="" type="checkbox"/> Med. (3-10yd) <input type="checkbox"/> Large (10-25yd) <input type="checkbox"/> Very Large (>25yd)
Maximum Stream Depth: <input type="checkbox"/> Shallow (<0.3yd) <input checked="" type="checkbox"/> Medium (0.3-0.6yd) <input type="checkbox"/> Deep (0.6 - 1yd) <input type="checkbox"/> Very Deep(>1yd)
% Canopy Cover Estimated for Reach: <u>100</u> %
% Canopy Cover Measured (mid-reach): <u>100</u> u/s + <u>100</u> d/s + <u>100</u> LDB + <u>100</u> RDB = Total/384*100

**Channel Characteristics:**

Bank Height: <u>1</u> (yd.) High Water Mark: <u>15</u> (yd.)
Bank Slope LDB: <input type="checkbox"/> Deeply incised <input type="checkbox"/> Bluff/Wall <input type="checkbox"/> Undercut <input type="checkbox"/> Sloughing <input type="checkbox"/> Steep terrain <input checked="" type="checkbox"/> Gentle Slope
Bank Slope RDB: <input type="checkbox"/> Deeply incised <input type="checkbox"/> Bluff/Wall <input type="checkbox"/> Undercut <input type="checkbox"/> Sloughing <input type="checkbox"/> Steep terrain <input checked="" type="checkbox"/> Gentle Slope
Manmade Modification: <input checked="" type="checkbox"/> None <input type="checkbox"/> Rip-Rap <input type="checkbox"/> Cement <input type="checkbox"/> Gabions <input type="checkbox"/> Channelized <input type="checkbox"/> Dam <input type="checkbox"/> Dredging <input type="checkbox"/> Bridge <input type="checkbox"/> ATV

**Stream Characteristics:**

Sediment Deposits: <input type="checkbox"/> None <input checked="" type="checkbox"/> Slight <input type="checkbox"/> Moderate <input type="checkbox"/> Excessive <input type="checkbox"/> Blanket
Sediment Type: <input type="checkbox"/> None <input type="checkbox"/> Sand <input checked="" type="checkbox"/> Silt <input type="checkbox"/> Mud <input type="checkbox"/> Clay <input type="checkbox"/> Sludge <input type="checkbox"/> Mn Precipitant <input type="checkbox"/> Orange Flocculent
Turbidity: <input type="checkbox"/> Clear <input checked="" type="checkbox"/> Slightly Turbid <input type="checkbox"/> Muddy <input type="checkbox"/> Milky <input type="checkbox"/> Tannic <input type="checkbox"/> Planktonic Algae <input type="checkbox"/> Dyed
Foam/Surface Sheen: <input checked="" type="checkbox"/> None <input type="checkbox"/> Nutrient <input type="checkbox"/> Surfactant <input type="checkbox"/> Bacteria
Algae: <input type="checkbox"/> None <input checked="" type="checkbox"/> Slight <input type="checkbox"/> Moderate <input type="checkbox"/> High <input type="checkbox"/> Choking Type: <input type="checkbox"/> Diatoms <input checked="" type="checkbox"/> Green <input type="checkbox"/> Filamentous <input type="checkbox"/> Blue-green

**TDEC-DWR Stream Survey Field Sheet (Back)**

DWR Station ID: Cookles@.7M Date: 9/17/20 Assessors: CD, JS

**Dominant Substrate:** (More than 25%) Check all that apply

- | Riffle  | Run   | Pool  |
|---|---|---|
| <input type="checkbox"/> Boulders (>10")              | <input type="checkbox"/> Boulders (>10")              | <input type="checkbox"/> Boulders (>10")    |
| <input checked="" type="checkbox"/> Cobble (2.5-10")  | <input checked="" type="checkbox"/> Cobble (2.5-10")  | <input type="checkbox"/> Cobble (2.5-10")   |
| <input checked="" type="checkbox"/> Gravel (0.1-2.5") | <input checked="" type="checkbox"/> Gravel (0.1-2.5") | <input type="checkbox"/> Gravel (0.1-2.5")  |
| <input type="checkbox"/> Bedrock                      | <input checked="" type="checkbox"/> Bedrock           | <input checked="" type="checkbox"/> Bedrock |
| <input type="checkbox"/> Sand                         | <input type="checkbox"/> Sand                         | <input type="checkbox"/> Sand               |
| <input type="checkbox"/> Silt (not gritty)            | <input type="checkbox"/> Silt (not gritty)            | <input type="checkbox"/> Silt (not gritty)  |
| <input type="checkbox"/> Clay (Slick)                 | <input type="checkbox"/> Clay (Slick)                 | <input type="checkbox"/> Clay (Slick)       |

**Surrounding Land Uses** (list additional land uses under comments)

- |                                     |                                     |   |   |                                       |
|-------------------------------------|-------------------------------------|---|---|---------------------------------------|
| <input type="checkbox"/> Forest     | <input type="checkbox"/> Grazing    | <input type="checkbox"/> Stormwater             | <input type="checkbox"/> STP/WWTP               | <input type="checkbox"/> Construction |
| <input type="checkbox"/> Wetland    | <input type="checkbox"/> Row Crops  | <input type="checkbox"/> Urban                  | <input type="checkbox"/> Industry               | <input type="checkbox"/> Impoundment  |
| <input type="checkbox"/> Park       | <input type="checkbox"/> CAFO/Dairy | <input type="checkbox"/> Commercial             | <input type="checkbox"/> Mining/Dredging        | <input type="checkbox"/> ATV/OHV      |
| <input type="checkbox"/> Hay/Fields | <input type="checkbox"/> Logging    | <input checked="" type="checkbox"/> Residential | <input checked="" type="checkbox"/> Road/Hwy/RR | <input type="checkbox"/> Golf Course  |

**Observed Human Disturbance to Stream:** Blank (not observed) S (Slight) M (Moderate) H (High)

Riparian Loss	S	Logging		Industry		ATV/OHV	
Channelization		Urban		Mining/Dredging		Golf Course	
Active Grazing		Commercial		Road/Hwy/RR		Garbage/Trash	
Row Crops		Residential	M	Construction		Landfill	
CAFO/Dairy		STP/WWTP		Impoundment		Water Withdrawal	

**Other Stream Information and Stressors:**

**Stream Sketch:** (include road name or landmark, flow direction, reach distance, distance from bridge or road, sampling points, tributaries, outfalls, livestock access, riparian, potential impacts, north arrow, immediate land use, buildings, etc.) Use additional sheet if necessary.



dist	depth	Flow
1 ft	0	0
3 ft	0.5	0.30
5 ft	0.6	0.15
7 ft	0.5	0.30
9 ft	0.45	0.21
11 ft	0.45	0.15
13 ft	0.45	0.11
15 ft	0.35	0.24
17 ft	0.30	0.19
19 ft	0.20	0.22
21 ft	0.25	0.05
23 ft	0.30	0.03
25 ft	0.30	0.05
27 ft	0.20	0.01
28.3 ft	0	0

**HABITAT ASSESSMENT FIELD DATA SHEET – MODERATE TO HIGH GRADIENT STREAM (BACK)**

<b>MAP LABEL:</b> <u>Crooked Creek</u>		<b>DATE:</b> <u>4/12/20</u>										<b>ASSESSOR INITIALS:</b> <u>CS</u>									
	<b>OPTIMAL</b>	<b>SUBOPTIMAL</b>					<b>MARGINAL</b>					<b>POOR</b>									
<b>6. Channel Alteration</b>	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. In-stream habitat greatly altered or removed. Artificial structures have greatly affected flow pattern.									
<b>SCORE</b>	20	19	18	17	16	<u>15</u>	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
Comments:																					
	<b>OPTIMAL</b>	<b>SUBOPTIMAL</b>					<b>MARGINAL</b>					<b>POOR</b>									
<b>7. Frequency of re-oxygenation zones.</b> Use frequency of riffles or bands 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.									
<b>SCORE</b>	20	19	18	17	16	15	14	<u>13</u>	12	11	10	9	8	7	6	5	4	3	2	1	
Comments:																					
	<b>OPTIMAL</b>	<b>SUBOPTIMAL</b>					<b>MARGINAL</b>					<b>POOR</b>									
<b>8. Bank Stability (score each bank)</b> 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.									
<b>SCORE (LDB)</b>	LEFT	10	9	8	7	6	<u>5</u>	4	3	2	1	0	2	1	0						
<b>SCORE (RDB)</b>	RIGHT	10	9	8	7	6	<u>5</u>	4	3	2	1	0	2	1	0						
Comments:																					
	<b>OPTIMAL</b>	<b>SUBOPTIMAL</b>					<b>MARGINAL</b>					<b>POOR</b>									
<b>9. Bank Vegetative Protection</b> (score each bank) include 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 banks 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%).									
<b>SCORE (LDB)</b>	LEFT	10	9	8	7	6	5	4	3	<u>2</u>	1	0	2	1	0						
<b>SCORE (RDB)</b>	RIGHT	10	9	8	7	6	5	4	3	<u>2</u>	1	0	2	1	0						
Comments:																					
	<b>OPTIMAL</b>	<b>SUBOPTIMAL</b>					<b>MARGINAL</b>					<b>POOR</b>									
<b>10. Riparian Vegetative Zone Width</b> (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.									
<b>SCORE (LDB)</b>	LEFT	10	9	8	7	6	5	4	3	<u>2</u>	1	0	2	1	0						
<b>SCORE (RDB)</b>	RIGHT	10	9	8	7	6	5	4	3	<u>2</u>	1	0	2	1	0						
Comments:																					
<b>TOTAL SCORE</b>	<u>0 99</u>										Comparison to Ecoregion Guidelines (circle): <u>ABOVE</u> or <u>BELOW</u>										
If score is below guidelines, result of (circle)										Natural Conditions <u>Human Disturbance</u>											
Comments:																					

# HABITAT ASSESSMENT FIELD DATA SHEET – MODERATE TO HIGH GRADIENT STREAM (FRONT)

(Refer to Protocol E for detailed descriptions and rank information)

<b>PROJECT:</b> Spring Hill MS4																								
<b>STA:</b> N/A		<b>HABITAT ASSESSED BY:</b> CDJS																						
<b>STREAM NAME:</b> Crooked Creek		<b>DATE:</b> 9/17/24									<b>TIME:</b> 1:15													
<b>MAP LABEL:</b> Crooked Creek		<b>ECOREGION:</b> 71																						
<b>HUC:</b> 06040003		<b>QC: Consensus / Duplicate</b>																						
	<b>OPTIMAL</b>						<b>SUBOPTIMAL</b>						<b>MARGINAL</b>						<b>POOR</b>					
<b>1. Epifaunal Substrate / Available Cover</b>	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.								
<b>SCORE</b>	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1				
Comments:																								
	<b>OPTIMAL</b>						<b>SUBOPTIMAL</b>						<b>MARGINAL</b>						<b>POOR</b>					
<b>2. Embeddedness of Riffles</b>	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.								
<b>SCORE</b>	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1				
Comments:																								
	<b>OPTIMAL</b>						<b>SUBOPTIMAL</b>						<b>MARGINAL</b>						<b>POOR</b>					
<b>3. Velocity/ Depth Regime</b>	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.								
<b>SCORE</b>	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1				
Comments:																								
	<b>OPTIMAL</b>						<b>SUBOPTIMAL</b>						<b>MARGINAL</b>						<b>POOR</b>					
<b>4. Sediment Deposition</b>	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.								
<b>SCORE</b>	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1				
Comments:																								
	<b>OPTIMAL</b>						<b>SUBOPTIMAL</b>						<b>MARGINAL</b>						<b>POOR</b>					
<b>5. Channel Flow Status</b>	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.								
<b>SCORE</b>	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1				
Comments:																								

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**APPENDIX C**  
**TAXA LIST**

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PAI ID NO				53717	53718	53719	53720
STATION				GRASS001.4WI	MCCUT00.1M4	RUTHE019.3M4	CROOK000.2M4
DATE				4/17/2020	4/17/2020	4/17/2020	4/17/2020
FRACTION				1/24	1/32	1/20	1/3
SPECIES	T.V.	F.F.G.	CL				
<b>PLATYHELMINTHES</b>							
<b>Turbellaria</b>		P					
<b>Tricladida</b>		P					
Planariidae	6.3	O					
<i>Girardia sp.</i>	7.1	P		2			
<b>MOLLUSCA</b>							
<b>Gastropoda</b>							
<b>Mesogastropoda</b>							
Pleuroceridae	6						
<i>Elimia sp.</i>	2.7	SC		11	9		26
<b>Basommatophora</b>							
Ancylidae	6.6	SC					
<i>Ferrissia sp.</i>	6.6	SC				2	
Physidae	8.7						
<i>Physella sp.</i>	8.8	CG					5
Planorbidae	7.1	SC					
<i>Menetus sp.</i>	7.6	SC					3
<b>ANNELIDA</b>							
<b>Clitellata</b>							
<b>Oligochaeta</b>	8	CG					
<b>Tubificida</b>							
Enchytraeidae	9.8	CG		1			
Naididae		CG					
Naidinae	8	CG					
<i>Nais sp.</i>	8.7	CG		1			
Tubificinae w.o.h.c.	10	CG				1	
<b>ARTHROPODA</b>							
<b>Arachnoidea</b>							
<b>Acariformes</b>	5.5				2		
Lebertiidae	5.5						
<i>Lebertia sp.</i>	5.5						1
Sperchontidae	5.5						
<i>Sperchon sp.</i>	5.5				2	5	12
<b>Crustacea</b>							
<b>Isopoda</b>							
Asellidae	7.4						
Asellidae	7.9	SH					
<i>Lirceus sp.</i>	7.4	CG		13	4	2	4
<b>Amphipoda</b>							
Crangonyctidae	7.2						
<i>Crangonyx sp.</i>	7.2	CG			3		
<b>Decapoda</b>							
Decapoda	6						
Cambaridae	6						

PAI ID NO				53717	53718	53719	53720
STATION				GRASS001.4WI	MCCUT00.1M4	RUTHE019.3M4	CROOK000.2M4
DATE				4/17/2020	4/17/2020	4/17/2020	4/17/2020
FRACTION				1/24	1/32	1/20	1/3
SPECIES	T.V.	F.F.G.	CL				
<i>Faxonius sp.</i>	2.7	SH		1	1		3
<b>Insecta</b>							
<b>Ephemeroptera</b>							
Baetidae	6	CG					12
<i>Acentrella sp.</i>	2.5	CG		10			
<i>Baetis sp.</i>	6	CG				9	
<i>Plauditus sp.</i>	4	CG			6	45	
Caenidae	6	CG					
<i>Caenis sp.</i>	6.8	CG			8	12	
<b>Plecoptera</b>							
Perlidae	2	P	CL				
<i>Perlesta sp.</i>	2.9	P	CL				11
Perlodidae	2.2	P	CL				
<i>Isoperla sp.</i>	3.2	P	CL				1
<b>Trichoptera</b>							
Hydropsychidae	4.1	FC	CL				35
<i>Cheumatopsyche sp.</i>	6.6	FC	CL	5	6	3	
Philopotamidae	2.2	FC	CL				
<i>Chimarra sp.</i>	3.3	FC	CL	2	1		
Rhyacophilidae	1	P	CL				
<i>Rhyacophila sp.</i>	1	P	CL				1
<b>Coleoptera</b>							
Elmidae	4.41	CG	CL	1			
<i>Optioservus sp.</i>	2.1	SC	CL	1			
<i>Stenelmis sp.</i>	5.60	SC	CL	7	12	26	59
Psephenidae	3.3	SC	CL				
<i>Psephenus sp.</i>	2.3	SC	CL		2	2	
<b>Diptera</b>							
Ceratopogonidae	6.8	P				5	
Chironomidae							
<i>Brillia sp.</i>	5.7	SH			1		
<i>Conchapelopia sp.</i>	8.4	P		2			1
<i>Cricotopus sp.</i>	7.44	CG	CL	9	39	11	3
<i>Dicrotendipes sp.</i>	7.2	CG		1	1		4
<i>Eukiefferiella devonica gp.</i>	3.45	CG		3	12	8	
<i>Hydrobaenus sp.</i>	9.2	SC			1		
<i>Micropsectra sp.</i>	2.4	CG		7			
<i>Microtendipes sp.</i>	4.6	CG	CL		19		
<i>Orthocladius sp.</i>	4.4	CG		2	6	12	1
<i>Parametriocnemus sp.</i>	3.9	CG		52	24	7	8
<i>Phaenopsectra sp.</i>	6.85	SC	CL		1		
<i>Polypedilum sp.</i>	6.1	SH		22	3	7	7

PAI ID NO				53717	53718	53719	53720
STATION				GRASS001.4WI	MCCUT00.1M4	RUTHE019.3M4	CROOK000.2M4
DATE				4/17/2020	4/17/2020	4/17/2020	4/17/2020
FRACTION				1/24	1/32	1/20	1/3
SPECIES	T.V.	F.F.G.	CL				
<i>Potthastia sp.</i>	5.4	CG		2			1
<i>Rheocricotopus sp.</i>	4.7	CG		2		2	
<i>Rheotanytarsus sp.</i>	6.5	FC	CL	2	4	4	
<i>Stempellinella sp.</i>	5.6	CG					1
<i>Stictochironomus sp.</i>	5.4	CG			9		1
<i>Sublettea sp.</i>	1.4				6	1	
<i>Tanytarsus sp.</i>	6.6	FC			11	1	
<i>Tvetenia sp.</i>	3.55	CG		9	1	2	4
Empididae	7.6	P					5
<i>Hemerodromia sp.</i>	6	P		3			
Muscidae	5.3			1			
Pericomaniini							1
Simuliidae	4.7	FC	CL				
<i>Simulium sp.</i>	4.9	FC	CL	17		13	5
<b>TOTAL NO. OF ORGANISMS</b>				<b>189</b>	<b>194</b>	<b>180</b>	<b>215</b>
<b>TOTAL NO. OF TAXA</b>				<b>27</b>	<b>27</b>	<b>22</b>	<b>26</b>
<sup>a</sup> <b>TOTAL NO. OF TAXA</b>				<b>26</b>	<b>27</b>	<b>22</b>	<b>26</b>
<b>EPT</b>				<b>3</b>	<b>4</b>	<b>4</b>	<b>5</b>
<b>%OC</b>				<b>60.85%</b>	<b>71.13%</b>	<b>31.11%</b>	<b>14.42%</b>
<b>%EPT-CHEUM</b>				<b>6.35%</b>	<b>7.73%</b>	<b>36.67%</b>	<b>27.91%</b>
<b>NCBI</b>				<b>4.80</b>	<b>5.35</b>	<b>5.18</b>	<b>4.95</b>
<b>%TNUTOL</b>				<b>36.51%</b>	<b>41.75%</b>	<b>35.56%</b>	<b>49.77%</b>
<b>% CLINGERS-CHEUM</b>				<b>20.63%</b>	<b>40.21%</b>	<b>31.11%</b>	<b>53.49%</b>

	6	6	4	6
EPT	2	2	2	2
%OC	2	2	6	6
%EPT-CHEUM	0	0	6	4
NCBI	6	6	6	6
%TNUTOL	6	6	6	4
% CLINGERS-CHEUM	2	4	4	6

**Cell:** A117

**Comment:** a Organisms identified to order, family and subfamily are not included in total taxa or EPT counts (marked in bold) if an organism is identified to genera under that order, family or subfamily unless it exhibits characteristics indicating it is not one of the genera listed.