

Bioassessment of Streams within the City of Goodlettsville, TN

*Report for Compliance with 2016 NPDES General Permit for
Discharges from Small Municipal Separate Storm Sewer Systems*

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Prepared by:



**This project was completed by
Western Kentucky University in partnership with the
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Author

Dr. Ritchie Taylor, Ph.D



**Western Kentucky University
College of Health and Human Services
Department of Public Health
Environmental and Occupational Health Science**

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INTRODUCTION

As part of the mission of academic excellence through research and community engagement, the WKU Department of Public Health, Environmental and Occupational Health Science Program assisted the City of Goodlettsville, Tennessee in a project to conduct bioassessments on streams within its Small Municipal Separate Storm Sewer Systems (MS4s) jurisdiction. Specifically, the bioassessments focused on those stream segments listed for “siltation and/or habitat alteration” (TDEC, 2010). This project was conducted in compliance with standards for analytical monitoring set forth by of the Tennessee Department of Environment and Conservation (TDEC) for Small MS4s (TDEC, 2010).

The purpose of the study was to assess the health of the watersheds within the City of Goodlettsville’s MS4, in particular Mansker Creek, Madison Creek, and Lumsley Fork. Madison Creek was included in the study as it was listed in the 2012 303(d) List for “loss of biological integrity due to siltation” with “Land Development” indicated as the source (TDEC, 2012). This bioassessment study had the following objectives that met the requirements of the City’s general permit (TDEC, 2010). Objectives of the study included the following:

- Completion of biological monitoring at stream sites within the City of Goodlettsville’s MS4.
 - Conduct biological monitoring, bioassessments, at three stream sites within the City of Goodlettsville’s MS4 by Semi-Quantitative Single Habitat (SQSH) Method for macroinvertebrates (TDEC, 2011).
 - *In situ* Water quality monitoring at all biological sampling sites for each sample collected.
 - Evaluation of habitat at each monitoring site (TDEC, 2011) as part of the visual watershed assessment protocol.
- Preparation of a report of the information collected and results.

METHODS

Methods for the bioassessment and associated measurements were conducted in agreement with TDEC methods (TDEC, 2011) (TDEC, 2011). Biological monitoring included macroinvertebrate semi-quantitative sampling, water quality measurements, and habitat assessment.

Biological Monitoring and Habitat Assessment

Specified requirements for biological sampling are to be performed in stream segments where a loss of biological integrity was identified and the MS4 has been determined to be the source of siltation and/or habitat alteration (TDEC, 2012). In these stream segments, as specified in the general NPDES permit, the Semi-Quantitative Single Habitat (SQSH) Method was performed to conduct biological stream sampling (TDEC, 2011). Specifically, Semi-Quantitative Riffle Kick (SQKICK) samples were collected according to Protocol G in Streams listed as having a loss of biological integrity and impaired for siltation and/or habitat alteration in the City of Goodlettsville's MS4 (TDEC, 2012). The streams sampled included a site on Mansker Creek, at Northcreek Park, Madison Creek upstream from Caldwell Drive, Lumsley Fork near the confluence with Mansker Creek, and Slaters Creek near the confluence with Mansker Creek (Figure 1). Madison Creek was included in the study as it is within the City's MS4 jurisdiction. However, the City of Goodlettsville's MS4 was not listed as the source of impairment (TDEC, 2012).

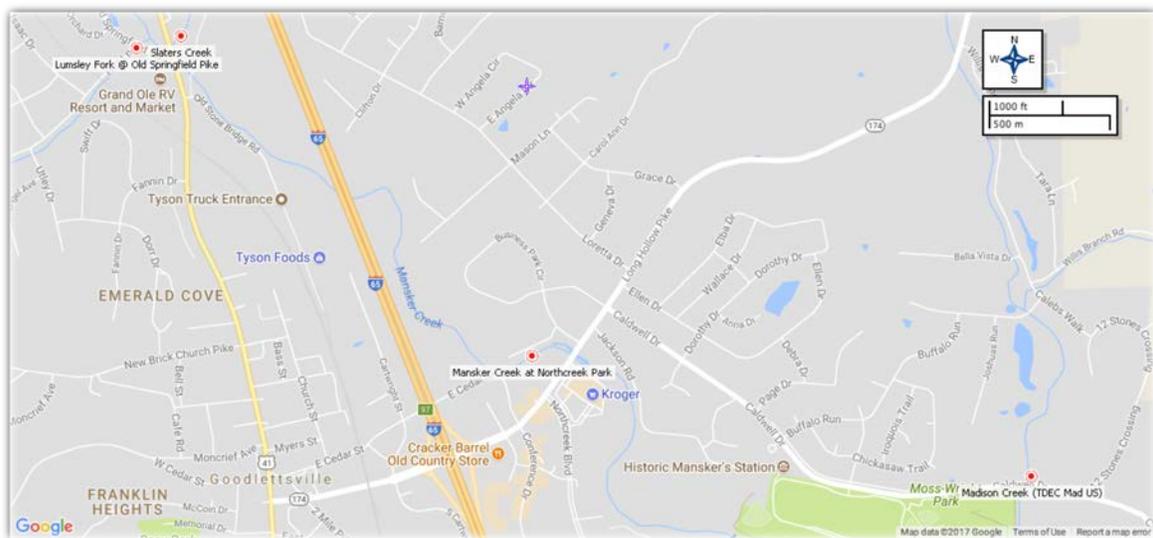


Figure 1. Location of bioassessment sites in the City of Goodlettsville MS4 jurisdiction.

Bioassessment samples were collected in August of 2016. A series of two SQKICK samples were collected at the sampling locations shown in Figure 1. Collection of two samples was performed at each site to ensure that the required 160-240 organisms would be achieved after sorting. SQKICK samples were taken in appropriate riffle habitats located in each sampling reach, according to the TDEC methodology (TDEC, 2011). A kick net was used for sample collection. At each location two semi-quantitative samples for macroinvertebrates were collected with the SQKICK method (TDEC, 2011). A habitat assessment was done at each location to quantify the physical condition of each stream reach. Habitat assessments were recorded on the appropriate forms (TDEC, 2011).

Water Quality

Water quality measurements were collected at each sample site to include dissolved oxygen (mg/L), pH (s.u.), specific conductance ($\mu\text{s}/\text{cm}$), temperature ($^{\circ}\text{C}$), and turbidity (NTU), as per standard TDEC protocols (2011). A YSI multi-probe water quality probe and interface was used to measure water quality. Measurements taken were recorded in a bound field notebook. The meter was calibrated at the beginning and end of the sampling day pursuant to standard methods (TDEC, DWPC, 2011).

Subsampling of Macroinvertebrate Samples

Sorting required that samples were cleaned of major debris and macroinvertebrates were removed from the sample. The general procedure was to reduce semi-quantitative samples to 160 – 240 organisms and produce a subsample. To begin, each sample was placed in a 500-micron sieve and rinsed. Once a sample was cleaned, it was moved to a gridded subsampler for collection of the required organisms. Each grid within the subsampler was numbered.

Grids for sampling were determined by selecting four grids randomly. All material and organisms were removed from each randomly selected grid in sequential order until a subsample of 160-240 organisms was achieved. The subsample was then sorted to remove organisms. If a subsample was determined to have more than the 240 organisms quota, then the sample was again subsampled until the 160-240 organisms quota was achieved.

Material from each subsample was then repeatedly transferred to a petri dish to sort organisms from the subsample. Macroinvertebrates were removed using a dissecting

microscope. Organisms sorted from the subsamples were preserved and stored in vials for later taxonomic identifications.

Macroinvertebrate Taxonomy

Macroinvertebrate identifications followed taxonomic procedures specified in the TDEC (2011) procedure and was completed to the genus level, with the exceptions for family identification specified in the method and with *Baetidae* and *Chironomidae*. Organisms were identified following the appropriate keys. Macroinvertebrates were identified to the appropriate taxonomic level, genus or family, and all organisms of a genus (family) were placed in a specific vial. A label indicating the sample ID, date, and organism was placed in each vial. All data for taxonomic identifications were recorded on a bench sheet and stored in a database.

Following taxonomic identifications, macrovertebrate data analysis was completed for each sampling site based on biometrics calculated from the raw benthic data (TDEC, 2011). Metrics followed those specified by TDEC (2011). All data were then reduced to produce a Tennessee Macroinvertebrate Index (TMI) score. In this way, results were used to compare to the standard of 32 for meeting the biocriteria requirement. Also, data reduction allows that the sites can be evaluated.

RESULTS

Results of the study are presented in this section and in the appendices to the report. Analysis of taxonomic identifications resulted in determination of TMI scores to compare to biocriteria for Ecoregion 71h.

Water Quality and Habitat Assessments

Habitat Assessment data are presented in Appendix 1 and Water Quality and Field notes in Appendix 2. Scores for habitat assessments were compiled from the visual stream assessment. These data represent information for the entire study reaches. Habitat assessments were conducted within the 100-m study reaches as well as throughout the stream corridor. Compiled data provide a more detailed representation of the habitat throughout the stream segments in the City of Goodlettsville's jurisdiction and all assessments followed TDEC (2011a).

Macroinvertebrate Sorting and Taxonomic Identifications

Results of macroinvertebrate sorting are shown in Appendix 3. These are the raw sorting data. Accordingly, four random cells for picking material and organisms were selected for each sample and additional were selected randomly, if needed. However, the required numbers of organisms, 160 to 200, was typically attained after picking four randomly selected cells. This was the case with the exception of the Lumsley Fork sample.

Sorting followed prescribed methods. It can be noted that sorting produced a greater total number of organisms than was documented on the Taxonomic Bench Sheets. However, these differences were due to the counting of immature stage organisms during sorting that could not be identified to genus level and were therefore excluded.

Biometrics and TMI

Biometrics were calculated according to TDEC methods (TDEC, 2011). Results of these calculations are shown in Table 1. Taxa Richness values ranged from 10 to 12 and EPT Richness was 4, 3, 6, and 6, for Lumsley Fork at Old Springfield Pike, Madison Creek upstream from Caldwell Drive, Mansker Creek at Northcreek Park, and Slaters Creek at the confluence with Mansker Creek. These values showed slight variation between sites and were some of the lowest metric scores for the sites. Metric values for % Clinger showed low

Table 1. Biometrics for SQKICK Sites in the City of Goodlettsville's Stormwater Jurisdiction.

Metric	Lumsley Fork Near Mansker Creek Site TDEC Lum	TMI 71h	Madison Creek Upstream of Caldwell Drive Site TDEC Mad US	TMI 71h	Mansker Creek at North Creek Park Site TDEC Man NC	TMI 71h	Slaters Creek at Confluence Mansker Creek Site TDEC Sla DS	TMI 71h
Taxa Richness (TR)	11	2	11	2	12	2	10	2
EPT Richness (EPT)	4	2	3	0	6	2	6	2
% EPT-Cheum	68.9	6	41.0	4	61.6	6	25.8	2
% OC	14.0	6	34.8	4	20.7	6	9.6	6
NCBI	4.4	4	5.3	4	5.6	4	5.3	4
% Clingers	71.3	6	41.6	4	36.9	2	52.0	4
% TNutol	1.2	6	28.2	4	12.1	6	29.8	4
TMI Total		32		22		28		24
Target TMI = 32								

scores for Mansker Creek at Northcreek Park. Also, all sites showed low scores for Taxa Richness and EPT Richness, with Slaters Creek having a low value for %EPT. All other metrics calculated were within an acceptable range, as shown by the TMI ranks of 4 or greater.

Scores for biometrics were used to calculate the TMI score for each site. The target TMI score for each site in Ecoregion 71h is 32. The TMI scores calculated for the sites were 32, 22, 28, and 24 for the monitoring sites. These scores reflect the lower ranks for Taxa Richness, EPT Richness, and % Clingers, with % EPT having a low score of 2 for Slaters Creek. TMI scores for all sites sampled were below the Target TMI of 32, with exception to Lumsley Fork.

DISCUSSION

The primary points of discussion are the results for the biometric and TMI scores. Biometric values were below acceptable for Taxa Richness and EPT Richness for Sites all sites. Data for Mansker Creek at Northcreek Park and Madison Creek suggest there is still impairment for macroinvertebrate biodiversity due to siltation and habitat alteration. These stream segments have been listed as impaired for macroinvertebrate biodiversity due to siltation and habitat alteration. According to the 2012 303(d) list for Tennessee, a source of impairment is discharges from the City of Goodlettsville's MS4 (TDEC, 2012).

Scores for TMI reflect the lower values observed for Taxa Richness, EPT Richness, and % Clingers (Table 1), as well as %EPT for Slaters Creek. An influencing factor in all metrics calculated as a percentage or relative value was the fact that a significant proportion of samples had tolerant species. Madison Creek followed by Slaters Creek had the lowest TMI scores. Madison Creek scored a 0 for EPT richness, with only three genera of EPT found in the sample. Another factor that may have impacted Taxa Richness was the identification of *Chironomidae* only to family level.

Another sensitive metric in the bioassessment evaluation, as shown in Table 1, was % Clingers (Barbour, Gerritsen, Snyder, & Stribling, 1999). Scores for % Clingers ranked lower with exception to Lumsley Fork. All sites were compared to the TDEC scores from a reference site for Ecoregion 71h found in the TDEC methodology. This metric reflects environmental adaptations of macroinvertebrates, specifically indicating a presence of species that construct shelters (Barbour, Gerritsen, Snyder, & Stribling, 1999). Decreased values of this habitat metric indicate that a perturbation had impacted stream habitat. It is expected that this metric will be reduced when the habitat may not be adequate to support clinger taxa. Thus, there was a greater level of sediment and siltation in Mansker Creek and Madison Creek. Habitat scores were not indicative of the results of the bioassessment study. More information should be reviewed to determine sensitive habitat parameters. **Future bioassessments in the Mansker Creek and Madison Creek watersheds should evaluate this relationship more closely to assess if other habitat metrics are sensitive throughout the watershed in conjunction with bioassessment results.**

TMI scores for Mansker Creek and Madison Creek indicated that there exist habitat perturbations upstream, TMI values of 22, 28, and 24, as compared to Lumsley Fork, with a score of 32. A potential impact in the upstream areas of Mansker Creek, within the City of Goodlettsville jurisdiction, may be the influence of I-65 on stream water quality, and thus macroinvertebrate biodiversity. Additionally, another 303(d) listed stream, Slaters Creek, discharges into Mansker Creek and may influence the site at Northcreek Park. The influence of the City of Goodlettsville's MS4 should be more closely evaluated to determine segments that may contribute sediment. Likewise, the influence of I-65 should be investigated. **Future biological monitoring should focus on Mansker Creek and the habitat changes both upstream and downstream from I-65 and Slaters Creek.**

TMI scores did not meet target scores for Ecoregion 71h, with the exception of Lumsley Fork. TMI scores for sites sampled were 32, 22, 28, and 24 for Lumsley Fork, Madison Creek, Mansker Creek, and Slaters, respectively. **An interesting finding was that TMI scores did not coincide with habitat scores.** In fact, just the opposite was the case. The greatest TMI score, 32, was for Lumsley Fork, which had a mean habitat score of 95. Further research is needed to distinguish the metrics that are sensitive in this watershed and should be used to direct mitigation strategies. **These sampling results show that research is needed to address if habitat scores and selected macroinvertebrate metrics provide a better indication of habitat perturbations, and the influence of discharges from Small MS4s, in the watersheds within the City's jurisdiction.**

CONCLUSION

In summary, **four of the calculated biometrics proved to be the most sensitive for indicating habitat perturbations to macroinvertebrates collected in this study via the SQKICK method (TDEC, 2011).** Specifically, Taxa Richness, EPT Richness, %Clingers, and %EPT were metrics that provided sensitivity for distinguishing impacts to macroinvertebrate assemblages within the study area. As a result of these metrics, TMI scores for sites sampled within the City's MS4 jurisdiction did not meet the biocriteria target score of 32 for Ecoregion 71h, **with exception of Lumsley Fork.** Specific TMI scores were 32, 22, 28, and 24 for the monitoring sites. **Thus, the influence of the City of Goodlettsville's MS4 needs to be assessed in greater detail to determine stream segments that may increase perturbations on the system.**

This study indicated that research is needed within the watersheds of the City of Goodlettsville's MS4 jurisdiction to further appraise habitat and biological diversity. Research will further document impacts to water quality and biological diversity, assess sources of stressors, and evaluate metrics sensitive to determining and ranking stream segments for mitigation. Specifically, research is needed to address the following:

- **To evaluate habitat scores and macroinvertebrate metrics** that corresponds to these scores to assess the best indication of habitat perturbations, and the influence of discharges from Small MS4s, in the watersheds within the City's jurisdiction.
- **To determine the influence of I-65 and Slaters Creek** on habitat changes and biological diversity in Mansker Creek within the City of Goodlettsville's MS4 jurisdiction.
- **To assess the spatial habitat conditions in stream reaches** within the MS4 jurisdiction and assess the variability of biological diversity within individual stream reaches.
- **To document water quality conditions** that may cause temporal and spatial impacts to biological diversity.

REFERENCES

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APPENDICES

APPENDIX 1

Habitat Assessment Data for Lumsley Fork, Madison Creek, and Mansker Creek in the City of Goodlettsville's Jurisdiction

Compiled Habitat Scores for Lumsley Fork

EPA Combined Habitat Data															
Location: Goodlettsville		Habitat Assessed By: Matthew W. D'Arcy (MWS)				*Larger numbers indicate better stream health with a maximum score of 200									
Group: WLU		Stream: Lumsley				Date: [REDACTED]									
Site ID	Parameter Assessed By	1. Epifaunal Substrate	2. Channel Substrate	3. Pool Variability	4. Sediment Deposition	5. Channel Flow Status	6. Channel Alteration	7. Channel Stability	8. Bank Stability		9. Vegetative Protective		10. Riparian Vegetative Zone Width		Total
								Left Bank	Right Bank	Left Bank	Right Bank	Left Bank	Right Bank		
Lumsley0001	MWS	10	4	9	9	15	13	5	10	10	2	2	9	0	80
	UCV	10	5	11	13	15	13	6	9	9	3	3	0	0	97
	Mean	10.0000	4.5000	10.0000	11.0000	15.0000	13.0000	5.5000	9.5000	9.5000	2.5000	2.5000	0.0000	0.0000	93.0000
Lumsley0002	MWS	9	3	9	9	13	11	5	9	6	5	9	1	8	81
	UCV	8	4	8	10	12	10	10	8	1	3	9	2	9	94
	Mean	8.5000	4.0000	8.5000	9.0000	12.5000	11.5000	7.5000	8.5000	4.5000	4.0000	9.0000	1.5000	8.5000	98.0000
Lumsley0003	MWS	4	2	2	6	12	20	3	9	8	8	10	1	10	95
	UCV	5	2	2	6	11	20	4	7	6	7	9	1	9	99
	Mean	4.5000	2.0000	2.0000	6.0000	11.5000	20.0000	3.5000	8.0000	7.0000	7.5000	9.5000	1.0000	9.5000	97.0000
Lumsley0004	MWS	7	3	5	7	9	16	6	9	8	10	8	2	10	92
	UCV	9	4	5	10	10	19	9	9	8	9	8	1	1	102
	Mean	8.0000	4.0000	5.0000	8.5000	9.5000	17.5000	7.5000	9.0000	8.0000	9.5000	8.0000	1.5000	8.5000	97.0000

Mean Score 95.0000

Compiled Habitat Scores for Madison Creek

EPA Combined Habitat Data															
Ecoregion: Goodlettsville		Habitat Assessed By: Matthew W. Shirley (MWS)				J.R. Eastham (JRE)		*Larger numbers indicate better stream health with a maximum score of 200							
Group: W01		Randi J. Hunter (RH)				Umae (UM)									
Stream Station															
Site ID	Parameter Assessed By	1. Epifaunal Substrate	2. Channel Substrate	3. Pool Variability	4. Sediment Deposition	5. Channel Flow Status	6. Channel Alteration	7. Channel Stability	8. Bank Stability		9. Vegetative Protective Width		10. Riparian Vegetative Zone	Total	
									Left Bank	Right Bank	Left Bank	Right Bank	Left Bank		Right Bank
Madison001	MWS	15.0	12.0	12.0	11.0	14.0	18.0	7.0	9.0	10.0	9.0	7.0	0.0	1.0	125.0
	RJH	15.0	13.0	12.0	13.0	14.0	18.0	7.0	9.0	10.0	9.0	6.0	0.0	1.0	125.0
	Mean	15.0	12.5	12.0	11.0	14.0	18.0	7.0	9.0	10.0	9.0	6.5	0.0	1.0	125.0
Madison002	MWS	12.0	11.0	10.0	8.0	11.0	20.0	12.0	3.0	6.0	8.0	6.0	10.0	7.0	124.0
	RJH	13.0	11.0	10.0	20.0	11.0	20.0	15.0	3.0	6.0	8.0	6.0	10.0	6.0	127.0
	Mean	12.5	11.0	10.0	9.0	11.0	20.0	12.5	3.0	6.0	8.0	6.0	10.0	6.5	125.5
Madison003	MWS	17.0	10.0	11.0	7.0	15.0	20.0	6.0	10.0	9.0	7.0	7.0	3.0	4.0	133.0
	RJH	17.0	8.0	11.0	7.0	15.0	20.0	6.0	10.0	9.0	6.0	7.0	3.0	4.0	120.0
	Mean	17.0	9.0	11.0	7.0	15.0	20.0	6.0	10.0	9.0	6.5	7.0	3.0	4.0	126.5
Madison004	MWS	20.0	14.0	12.0	7.0	18.0	20.0	8.0	10.0	10.0	9.0	9.0	3.0	0.0	137.0
	RJH	19.0	14.0	10.0	8.0	13.0	20.0	8.0	9.0	10.0	9.0	9.0	3.0	0.0	129.0
	Mean	19.5	14.0	11.0	7.5	15.5	20.0	8.0	9.5	10.0	9.0	9.0	3.0	0.0	133.0
Madison005	MWS	19.0	6.0	11.0	8.0	13.0	18.0	6.0	9.0	10.0	2.0	2.0	3.0	2.0	106.0
	RJH	20.0	11.0	13.0	9.0	13.0	19.0	9.0	8.0	10.0	2.0	2.0	1.0	2.0	121.0
	Mean	19.5	8.5	12.0	8.5	13.0	18.5	7.5	8.5	10.0	2.0	2.0	2.0	2.0	113.5
Madison006	MWS	10.0	13.0	13.0	7.0	11.0	18.0	8.0	9.0	10.0	3.0	3.0	3.0	0.0	105.0
	RJH	12.0	15.0	18.0	13.0	10.0	10.0	9.0	9.0	9.0	1.0	1.0	1.0	0.0	110.0
	Mean	11.0	14.0	15.5	11.0	10.5	14.0	8.5	9.0	9.5	2.0	2.0	2.0	0.0	107.5
Madison007	MWS	15.0	7.0	7.0	9.0	9.0	16.0	6.0	6.0	9.0	8.0	6.0	6.0	6.0	114.0
	RJH	18.0	13.0	10.0	8.0	10.0	19.0	10.0	7.0	8.0	6.0	6.0	7.0	7.0	129.0
	Mean	16.5	10.0	8.5	8.5	9.5	17.5	8.0	6.5	8.0	7.5	7.0	6.5	6.5	121.5
Madison008	MWS	16.0	7.0	10.0	6.0	13.0	16.0	7.0	9.0	9.0	9.0	10.0	1.0	1.0	118.0
	RJH	18.0	5.0	12.0	9.0	13.0	15.0	20.0	5.0	8.0	5.0	8.0	3.0	3.0	119.0
	Mean	17.0	6.0	11.0	7.5	13.0	15.5	8.5	7.0	8.5	7.0	9.0	2.0	2.0	118.5
Madison009	MWS	14.0	6.0	10.0	3.0	8.0	16.0	6.0	9.0	10.0	8.0	10.0	3.0	10.0	112.0
	RJH	16.0	5.0	10.0	8.0	7.0	15.0	5.0	9.0	9.0	5.0	10.0	1.0	10.0	112.0
	Mean	15.0	5.5	10.0	4.5	7.5	15.5	5.5	9.0	9.5	6.5	10.0	2.0	10.0	112.0
Madison010	MWS	13.0	8.0	9.0	7.0	10.0	18.0	10.0	1.0	7.0	9.0	10.0	2.0	8.0	112.0
	RJH	14.0	10.0	10.0	7.0	11.0	17.0	7.0	2.0	6.0	9.0	10.0	10.0	10.0	123.0
	Mean	13.5	9.0	9.5	7.0	10.5	17.5	8.5	1.5	6.5	9.0	10.0	6.0	9.0	117.5
Madison011	MWS	11.0	11.0	11.0	6.0	10.0	13.0	6.0	8.0	7.0	10.0	9.0	1.0	9.0	112.0
	RJH	16.0	11.0	10.0	11.0	11.0	13.0	6.0	5.0	5.0	9.0	9.0	1.0	9.0	116.0
	Mean	13.5	11.0	10.5	8.5	10.5	13.0	6.0	6.5	6.0	9.5	9.0	1.0	9.0	114.0
Madison012	MWS	13.0	5.0	11.0	7.0	14.0	19.0	7.0	9.0	9.0	8.0	10.0	3.0	8.0	120.0
	RJH	15.0	6.0	8.0	13.0	13.0	15.0	6.0	3.0	5.0	8.0	7.0	1.0	8.0	112.0
	Mean	14.0	5.5	9.5	11.0	14.5	17.0	6.5	6.0	7.0	8.0	8.5	2.0	8.0	116.0
Madison013	MWS	11.0	9.0	13.0	8.0	10.0	15.0	7.0	9.0	9.0	10.0	10.0	3.0	2.0	116.0
	RJH	13.0	11.0	10.0	12.0	10.0	8.0	10.0			9.0	3.0	3.0	3.0	101.0
	Mean	12.0	10.0	11.0	10.0	10.0	11.5	8.5	9.0	9.0	9.5	9.5	4.0	2.5	117.5
Madison014	MWS	12.0	5.0	13.0	12.0	14.0	20.0	10.0	9.0	9.0	7.0	8.0	3.0	3.0	125.0
	UKY	12.0	4.0	11.0	14.0	9.0	19.0	10.0	9.0	10.0	8.0	9.0	3.0	3.0	121.0
	Mean	12.0	4.5	12.0	13.0	11.5	19.5	10.0	9.0	9.5	7.5	8.5	3.0	3.0	123.0
Madison015	MWS	9.0	3.0	6.0	12.0	12.0	15.0	5.0	10.0	9.0	10.0	9.0	10.0	2.0	112.0
	UKY	10.0	2.0	8.0	16.0	16.0	15.0	3.0	9.0	8.0	9.0	8.0	9.0	2.0	115.0
	Mean	9.5	2.5	7.0	14.0	14.0	15.0	4.0	9.5	8.5	9.5	8.5	9.5	2.0	113.5
Madison016	MWS	16.0	10.0	14.0	10.0	8.0	20.0	13.0	7.0	10.0	7.0	10.0	6.0	11.0	118.0
	UKY	14.0	11.0	4.0	12.0	8.0	20.0	20.0	6.0	1.0	6.0	5.0	8.0	2.0	117.0
	Mean	15.0	10.5	9.0	11.0	8.0	20.0	16.5	6.5	4.0	6.5	6.0	9.0	4.0	117.5

Mean Score 118.6

Compiled Habitat Scores for Mansker Creek

EPA Combined Habitat Data

Ecologist: Goodlettville
 Group: W32
 Stream: Mansker Creek
 Habitat Assessed By: (Stacie D. Taylor) (SDT)
 (Stephanie L. Louch) (SLL)
 (Matthew W. DeWine) (MWD)

*Larger numbers indicate better stream health with a maximum score of 200

Site ID	Assessed By	Habitat Assessed By							Bank Stability				Vegetative Protective		Riparian Vegetative Zone Width		Total
		1. Epifaunal Substrate	2. Channel Substrate	3. Pool Variability	4. Sediment Deposition	5. Channel Flow Status	6. Channel Alteration	7. Channel Sinuosity	Left Bank	Right Bank	Left Bank	Right Bank	Left Bank	Right Bank			
Mansker001	RLL	11	10	10	8	9	16	10	8	6	9	7	5	5	5	5	114
	RDT	11	10	9	8	9	16	11	8	6	9	7	5	5	5	114	
	MWS	11	10	8	8	9	16	11	6	8	9	7	5	5	5	113	
	Mean	11	10	9	8	9	16	11	7	7	9	7	5	5	5	114	
Mansker002	RLL	11	13	10	10	10	12	12	8	6	9	7	7	7	9	9	124
	RDT	12	14	8	13	12	16	11	7	7	9	8	9	10	9	10	126
	MWS	11	9	7	13	10	16	9	6	7	8	9	8	9	9	124	
	Mean	11	12	8	12	11	15	11	8	7	9	8	8	9	9	124	
Mansker003	RLL	18	10	16	15	15	13	17	3	2	7	9	2	4	4	4	119
	RDT	16	16	16	12	11	16	11	7	7	8	9	6	6	6	6	141
	MWS	11	10	16	11	15	14	10	8	9	8	9	5	5	5	129	
	Mean	15	12	16	13	12	14	9	6	6	8	9	4	5	5	130	
Mansker004	RLL	12	14	11	15	15	19	6	8	8	9	9	3	4	4	4	133
	RDT	8	12	8	9	8	17	11	7	7	8	8	3	4	4	113	
	MWS	10	10	8	10	8	16	10	7	7	8	8	4	4	4	110	
	Mean	11	12	9	11	10	17	9	7	7	8	8	3	4	4	119	
Mansker005	RLL	14	15	9	15	13	14	9	8	5	7	8	3	4	4	4	124
	RDT	15	15	10	11	11	17	12	7	7	8	8	4	4	4	4	129
	MWS	13	13	12	11	13	14	12	8	9	8	8	3	5	5	134	
	Mean	14	14	10	12	12	15	11	8	7	8	8	4	4	4	129	
Mansker006	RLL	16	14	10	13	13	13	9	9	7	7	7	7	7	7	7	132
	RDT	16	15	16	12	12	16	12	7	7	6	6	7	5	5	5	137
	MWS	13	14	12	12	12	13	13	9	8	9	9	6	6	6	133	
	Mean	15	14	13	12	12	14	11	8	7	7	7	7	6	6	135	
Mansker007	RLL	10	14	7	12	15	11	8	7	6	8	7	7	7	7	7	119
	RDT	10	10	8	11	10	15	7	8	8	7	5	3	3	3	103	
	MWS	8	8	7	7	12	11	5	8	8	9	9	4	3	3	99	
	Mean	9	11	7	10	12	12	7	8	7	8	7	5	4	4	100	
Mansker008	RLL	8	5	9	10	14	17	5	8	9	8	7	8	5	5	5	113
	RDT	9	10	9	8	8	18	7	7	7	9	8	8	7	7	110	
	MWS	7	6	9	8	13	18	8	9	9	9	9	5	4	4	114	
	Mean	8	7	9	9	12	18	7	8	8	9	8	7	5	5	115	
Mansker009	RLL	15	12	10	13	11	16	7	8	6	8	9	6	8	8	8	129
	RDT	14	12	16	13	10	19	8	7	8	8	9	7	8	8	139	
	MWS	15	10	9	9	11	15	11	8	9	7	6	6	8	8	124	
	Mean	15	11	12	12	11	17	9	8	8	8	8	6	8	8	131	
Mansker010	RLL	15	11	9	14	15	17	7	9	10	8	8	6	8	8	8	137
	RDT	14	11	10	12	12	18	8	9	9	9	9	8	9	9	139	
	MWS	13	7	11	7	16	15	8	9	9	9	9	6	7	7	126	
	Mean	14	10	10	11	14	17	8	9	9	9	9	7	8	8	134	
Mansker011	RLL	12	15	10	14	14	17	8	7	6	7	7	3	6	6	126	
	RDT	11	11	9	10	10	18	8	8	8	7	7	5	8	8	120	
	MWS	10	11	10	11	11	16	9	8	8	8	7	6	8	8	127	
	Mean	11	12	11	12	12	17	8	8	8	7	7	5	7	7	124	
Mansker012	RLL	13	18	17	9	17	16	10	8	6	8	6	5	5	5	138	
	RDT	11	12	16	8	10	16	7	6	6	7	7	7	7	7	120	

	MFS	14	9	12	8	12	16	8	9	8	9	8	8	8	130	
	Mean	12	13	13	8	12	16	8	7	8	7	7	7	7	129	
Monitor013	BLL	15	16	10	13	13	17	11	7	8	8	8	7	8	141	
	RFT	14	14	9	11	9	16	8	8	9	8	8	6	8	128	
	MFS	10	10	8	8	7	17	9	9	9	9	9	9	9	123	
	Mean	12	13	9	11	10	17	9	8	8	8	7	8	8	131	
Monitor014	BLL	10	17	16	13	14	16	10	8	7	7	7	5	6	136	
	RFT	12	15	16	14	11	18	7	7	7	7	5	5	8	136	
	MFS	15	7	12	8	15	17	5	9	9	9	8	7	9	131	
	Mean	14	13	15	12	13	17	7	8	8	7	6	6	8	134	
Monitor015	BLL	14	17	16	14	16	18	10	6	6	6	5	7	1	1	129
	RFT	15	16	16	11	12	18	8	6	6	6	6	4	6	130	
	MFS	14	11	12	10	15	16	7	9	7	9	8	8	6	132	
	Mean	14	15	15	12	14	17	8	7	6	7	7	4	4	130	
Monitor016	BLL	17	10	9	10	14	18	7	6	8	8	9	1	8	131	
	RFT	16	15	10	12	11	18	8	7	8	6	8	1	8	130	
	MFS	16	15	10	10	13	18	8	7	9	8	8	2	9	133	
	Mean	16	15	10	11	13	18	8	7	8	7	8	1	8	131	
Monitor017	BLL	17	13	17	14	12	18	11	5	7	5	8	12	9	138	
	RFT	16	14	17	10	8	19	11	5	8	5	9	1	10	133	
	MFS	18	11	16	13	11	18	8	5	8	4	8	1	10	131	
	Mean	17	13	17	12	10	18	10	5	8	5	8	1	10	134	
Monitor018	BLL	11	13	8	9	10	12	11	5	7	5	8	9	9	114	
	RFT	11	11	13	10	11	13	11	5	5	5	7	10	10	125	
	MFS	7	8	13	12	8	14	11	3	9	3	9	10	10	117	
	Mean	10	11	11	10	10	13	11	3	7	6	8	10	10	118	

Mean Score 126

Compiled Habitat Scores for Slaters Creek

EPA Combined Habitat Data

EcoRegion: Goodlettsville		Habitat Assessed By: Matthew W. Shirley (MWS)										*Larger numbers indicate better stream health with a maximum score of 200			
Group: WOU		Umar													
Stream: Slaters Creek															
Site ID	Parameter Assessed By	1. Epifaunal Substrate/	2. Channel Substrate	3. Pool Variability	4. Sediment Deposition	5. Channel Flow Status.	6. Channel Alteration	7. Channel Sinuosity	8. Bank Stability		9. Vegetative Protective		10. Riparian Vegetative Zone Width		Total
									Left Bank	Right Bank	Left Bank	Right Bank	Left Bank	Right Bank	
Slaters0001	MWS	10	9	7	6	7	14	6	7	8	9	7	10	7	107
	UKY	10	8	10	5	5	12	10	5	8	10	9	10	6	108
	Mean	10.0000	8.5000	8.5000	5.5000	6.0000	13.0000	8.0000	6.0000	8.0000	9.5000	8.0000	10.0000	6.5000	107.5000
Slaters0002	MWS	11	11	9	5	10	10	7	9	9	10	10	10	1	112
	UKY	13	11	7	5	10	10	7	6	7	8	7	10	2	103
	Mean	12.0000	11.0000	8.0000	5.0000	10.0000	10.0000	7.0000	7.5000	8.0000	9.0000	8.5000	10.0000	1.5000	107.5000
Slaters0003	MWS	13	8	11	6	10	12	6	9	9	10	10	10	5	119
	UKY	13	14	16	10	10	13	6	8	9	9	10	10	6	133
	Mean	13.0000	11.0000	13.5000	8.0000	10.0000	12.5000	6.0000	8.5000	9.0000	9.5000	9.5000	10.0000	5.5000	126.0000
Slaters0004	MWS	9	8	10	7	10	13	5	10	9	10	10	10	3	114
	UKY	10	9	10	4	7	12	7	9	8	10	10	9	5	110
	Mean	9.5000	8.5000	10.0000	5.5000	8.5000	12.5000	6.0000	9.5000	8.5000	10.0000	10.0000	9.5000	4.0000	112.0000

Mean Score 113.2500

APPENDIX 2

FIELD NOTES

WPC Stream Survey Field Sheet

City: Goodlettsville State: TN
 Station ID: IDECLan Assessors: MWS, MDT, JRB
 Stream Name: Lansley Date: 5/5/16 Time: _____
 Coordinates: _____

For Habitat data see the EPA Habitat and Maryland Data collected.

Previous 48 hrs precipitation: Unknown None Slight Heavy Flooding

Ambient Weather: Sunny Cloudy Breezy Rain Snow

other

Field Measurements	
Air Temperature (°F)	93°F
pH	8.12
Conductivity (µS/cm)	447
Temperature (°C)	21.86
Dissolved Oxygen (%)	110.7%
Dissolved Oxygen (mg/L)	9.67
ORP	-67.9
Turbidity 1 (NTU)	1.28
Turbidity 2 (NTU)	1.44
Turbidity 3 (NTU)	2.17

Sediment Deposits: None Slight Moderate High Excessive Blanket

Sediment Type: Sludge Mud Sand Silt None Other: _____

Turbidity: Clear Slight Moderate High Opaque Color: _____

Surface Sheen/foam: Bacteria Nutrient Surfactant Other: None

Algae Present? None Slight Moderate High Choking

Type: Diatom Green Filamentous Blue-green Periphyton

Comments: 7 crawfish Rep 1
1 stone roller Rep 1

11 crawfish Rep 2

City of Goodlettsville

WPC STREAM SURVEY FIELD SHEET (Front)

STREAM SURVEY INFORMATION		
Station ID: <u>7DECN on NC</u>	Assessor: <u>URR, MJS, RDT</u>	
Stream Name: <u>Manter</u>	Date: <u>8/2/2016</u>	Time: <u>1:52 pm</u>
Station Location: <u>36.32977°N 86.70120°W</u>	Stream Order:	RM:
County:	Drainage Area (sq mi):	Watershed Group #
WBID/HUC:	Ecoregion:	US Eco:
Latitude DEC/DEG:	TOPO:	Gaz. Page:
Longitude DEC/DEG:	Drainage (Basin):	

PROJECT/PURPOSE (circle): Watershed 303(d) Antideg Reference Other (describe) NPDES small stream

SAMPLES COLLECTED		
Biocon EFO Log #	Periphyton EFO Log #	
SQCKICK EFO Log # <u>7DECN on NC R23 #2</u>	Fish EFO Log #	
SQBANK EFO Log #	Other Log #	

CHEM/BACTI (circle): None Routine Nutrients Metals Bacti Other

FIELD MEASUREMENTS		Meters Used:	
pH (no)	<u>8.18</u>	Dissolved Oxygen (ppm)	<u>131.5%</u> <u>U. 81%</u>
Conductivity (umhos)	<u>472 um/cm</u>		
Temperature (°C)	<u>20.5°C</u>		

Meter problems/comments:

Previous 48 hrs precipitation: Unknown None Slight Moderate Heavy Flooding
 Ambient Weather: Sunny Cloudy Breezy Rain Snow Air temp (°F): 91

WATERSHED CHARACTERISTICS Approx. % of Watershed Observed:

Upstream surrounding land use (estimated %):	
Pasture	Residential <u>100%</u>
Crops	Commercial <u>50%</u>
Forest	Urban <u>50%</u>
	Mining
	Impoundment

PHYSICAL STREAM CHARACTERISTICS Approx. Length of Stream Assessed (m):

Surrounding land use (estimated %):	
RDB	LDB
Pasture	Residential
Crops	Commercial
Forest	Urban
	Mining
	Wetland

Observed Human Disturbance to Stream: S (slight) M (moderate) H (high) Blank = not observed

ATV/OHV	Construction	Livestock	Residential
Industrial	Impoundment	STP/WWTP	Riparian Loss
Logging	Row Crop	Mining	Water withdrawal
Urban	Road/Hwy	Dredging	
Other (describe):			

% Canopy Cover: Estimated reach average: Open (0-10) Partly Shaded (11-45) Mostly Shaded (46-80) Shaded (> 80)
 Measured mid reach: ___ U/S ___ D/S ___ LB ___ RB ___ Total/384*100

Sediment Deposits: <u>None</u> Slight Moderate High Excessive Blanket
Sediment Type: Sludge Mud Sand Silt None Other
Turbidity: Clear Slight Moderate High Opaque Color
Surface Sheen/foam: Bacteria Nutrient Surfactant Other
Algae Present? <u>None</u> Slight Moderate High Choking Type: Diatom Green Filamentous Blue-green

Comments: ORP = -38.8
Turb₁ = 7.3 NTU
Turb₂ = 9.06 NTU
Turb₃ = 7.43 NTU

See Assessment form

See Habitat form

WPC STREAM SURVEY FIELD SHEET (Back)

Station ID	Date			Assessors		
<input type="checkbox"/>	Riffle	Run	Pool	Staff Gauge/Bench Hi		
Depth (m)				Flow (cfs)		
Width (m)				High Water Mark (m)		
Reach Length (m)				Bank Height (m)		

Flow Conditions: Dry Isolated Pools Low Moderate High Bankfull Flooding Other _____
 Gradient (sample reach): Flat Low Moderate High Cascade Other _____
 Size (stream width): V. small (< 1.5m) Small (1-5.3 m) Mod. (3-10 m) Large (10-25 m) V. Large (> 25m)

Substrate Percent (visual estimates):

<input type="checkbox"/>	Riffle	Run	Pool	<input type="checkbox"/>	Riffle	Run	Pool
Boulder (> 10")				Clay (Slick)			
Cobble (2.5-10")				Silt			
Gravel (0.1-2.5")				Detritus (CPOM)			
Bedrock				Muck-Mud (FPOM)			
Sand (Gritty)				Marl (Shell frags)			

Field Based Assessment			Info from other field sheets (optional)			
Biorecan Score if Applicable _____	Indicate level: Family Genus		BR	TR	EPT	INTOL
If SQSH not collected does benthic community appear impaired? Yes No			Habitat Score HG LG			

Describe basis for determination including possible sources of impairment:

Additional Stream Information

Photos? Yes No ID and Description _____
 Stream Sketch: (include flow direction, reach distance, distance from bridge, nearest road, sampling points, tribs, outfalls, livestock access, riparian area, potential impacts, etc. Use additional sheet if needed).

City of Goodlettsville

Division of Water Pollution Control
 QSDOP for Maculizochate Stream Survey
 Revision 5: Page 8 of 17
 Effective Date: July 1, 2011

WPC STREAM SURVEY FIELD SHEET (Front)

STREAM SURVEY INFORMATION		
Station ID: <u>T006 Main US</u>	Assessors: <u>UK, MJ, RDT</u>	
Stream Name: <u>Roanoke</u>	Date: <u>8/2/2016</u>	Time: <u>2:30</u>
Station Location: <u>Sg. 35832°N E6. 27469°W</u>	Stream Order:	RM:
County:	Drainage Area (sq mi):	Watershed Group #
WBD/HUC:	Recreation:	US Eco:
Latitude DEC/DEG:	TOPO:	Gez. Page:
Longitude DEC/DEG:	Drainage (Basin):	

PROJECT/PURPOSE (circle): Watershed 363(d) Antideg Reference Other (describe): NPOD - East Tennessee

SAMPLES COLLECTED	
Bioson EPO Log #	Periphyton EPO Log #
SQBACK EPO Log #	Fish EPO Log #
SQBANK EPO Log #	Other Log #

CHEM/BACTI (circle): None Routine Nutrients Metals Bacti Other

FIELD MEASUREMENTS		Meters Used:	
pH (m)	<u>8.14</u>	Dissolved Oxygen (ppm)	<u>17.9%</u> <u>10.85 mg/L</u>
Conductivity (umhos)	<u>418 uM/cm</u>		
Temperature (°C)	<u>19.37°C</u>		

Meter problems/comments:

Previous 48 hrs precipitation: Unknown None Slight Moderate Heavy Flooding
 Ambient Weather: Sunny Cloudy Breezy Rain Snow Air temp (°F): 71

WATERSHED CHARACTERISTICS Approx. % of Watershed Observed:

Upstream surrounding land use (estimated %):			
Pasture	Residential	Industry	
Crops	Commercial	Mining	
Forest	Urban	Impoundment	

PHYSICAL STREAM CHARACTERISTICS Approx Length of Stream Assessed (m):

Surrounding land use (estimated %):											
	RDB	LDB	XXXXXXXXXX	RDB	LDB	XXXXXXXXXX	RDB	LDB	OTHERS	RDB	LDB
Pasture			Residential			Industry					
Crops			Commercial			Mining					
Forest			Urban			Wetland					

Observed Human Disturbance to Stream: S (slight) M (moderate) H (high) Blank = not observed

ATV/OHV	Construction	Livestock	Residential
Industrial	Impoundment	STP/WWTP	Riparian Loss
Logging	Row Crop	Mining	Water withdrawn
Urban	Road/Rwy	Dredging	
Other (describe):			

% Canopy Cover: Estimated reach average: Open (0-10) Partly Shaded (11-45) Mostly Shaded (46-80) Shaded (> 80)

Measured mid reach: ___ U/S ___ D/S ___ LB ___ RB ___ Total/364*100

Sediment Deposits:	None	Slight	Moderate	High	Excessive	Blanket
Sediment Type:	Silt	Mud	Sand	Silt	None	Other
Turbidity:	Clear	Slight	Moderate	High	Opaque	Color
Surface Shows/Signs:	Bacteria	Nutrient	Surfscum	Other		
Algae Present?	None	Slight	Moderate	High	Clotting	Type: Diatom Green Filamentous Blue-green

Comments: $Turb_1 = 8.39 NTU$
 $Turb_2 = 5.61 NTU$
 $Turb_3 = 17.1 NTU$

ORP = -62.3

Sample for 1 2³ crayfish
 Sample for 2 crayfish 111
green water death 1

WPC Stream Survey Field Sheet

City: Goodlettsville State: Tennessee
 Station ID: Madison001 Assessors: RJH, NSK, UJK
 Stream Name: Madison Date: 10-26-16 Time: 2:13PM
 Coordinates: _____

For Habitat data see the EPA Habitat and Maryland Data collected.

Previous 48 hrs precipitation: Unknown None Slight Heavy Flooding

Ambient Weather: Sunny Cloudy Breezy Rain Snow

_____ other

Field Measurements	
Air Temperature (°F)	84
pH	7.05
Conductivity (µS/cm)	631
Temperature (°C)	14.51
Dissolved Oxygen (%)	115.5
Dissolved Oxygen (mg/L)	11.68
ORP	11.3
Turbidity 1 (NTU)	2.26
Turbidity 2 (NTU)	2.56
Turbidity 3 (NTU)	2.87

Sediment Deposits: None Slight Moderate High Excessive Blanket
 Sediment Type: Sludge Mud Sand Silt None Other: _____
 Turbidity: Clear Slight Moderate High Opaque Color: _____
 Surface Sheen/foam: Bacteria Nutrient Surfactant Other: _____
 Algae Present? None Slight Moderate High Choking
 Type: Diatom Green Filamentous Blue-green

Comments:

WPC Stream Survey Field Sheet

City: Goodlettsville State: Tennessee
 Station ID: Madison001 Assessors: RSH, NSK, UYK, KSU
 Stream Name: Madison Date: 11/21/16 Time: 11:32AM
 Coordinates: _____

For Habitat data see the EPA Habitat and Maryland Data collected.

Previous 48 hrs precipitation: Unknown None Slight Heavy Flooding

Ambient Weather: Sunny Cloudy Breezy Rain Snow
 _____: other

Field Measurements	
Air Temperature (°F)	47
pH	7.04
Conductivity (µS/cm)	657
Temperature (°C)	1.93
Dissolved Oxygen (%)	127.0
Dissolved Oxygen (mg/L)	17.50
ORP	13.7
Turbidity 1 (NTU)	2.03
Turbidity 2 (NTU)	2.07
Turbidity 3 (NTU)	2.33

Sediment Deposits: None Slight Moderate High Excessive Blanket
 Sediment Type: Sludge Mud Sand Silt None Other: _____
 Turbidity: Clear Slight Moderate High Opaque Color: _____
 Surface Sheen/foam: Bacteria Nutrient Surfactant Other: _____
 Algae Present? None Slight Moderate High Choking
 Type: Diatom Green Filamentous Blue-green

Comments:

City of Goodlettsville

Division of Water Pollution Control
 QSDOP for Macroinvertebrate Stream Survey
 Revision 1: Page 4 of 17
 Effective Date: July 1, 2011

WPC STREAM SURVEY FIELD SHEET (Print)

STREAM SURVEY INFORMATION		
Station ID: <u>TR51A DS</u>	Agency: <u>ADT WPK</u>	
Stream Name:	Date: <u>8/27/2016</u>	Time: <u>15:20</u>
Station Location: <u>Sisters Creek end</u>	Stream Order:	RM:
County: <u>Sumner</u>	Drainage Area (sq mi):	Watershed Group #
WRMDFUC:	Basin:	USF No:
Latitude DEC/DEG: <u>36.339420N</u>	TOPO:	Geo. Page:
Longitude DEC/DEG: <u>86.777990W</u>	Drainage (Basin):	

PROJECT/PURPOSE (circle): Watershed 303(d) Antideg Reference MSF

SAMPLES COLLECTED	
Bioreson EFO Log #	Periphyton EFO Log #
SQKICK EFO Log # <u>TR51A DS Rep 1 & 2</u>	Fish EFO Log #
SQBANK EFO Log #	Other Log #

CHEM/BACTI (circle): None Routine Nutrients Metals Bact Other

FIELD MEASUREMENTS Meters Used:			
pH (mV)	<u>8.31</u>	Dissolved Oxygen (ppm)	<u>9.84</u>
Conductivity (umhos)	<u>2537</u>	<u>106.66</u>	<u>-70.8</u>
Temperature (°C)	<u>17.34</u>	<u>13.2</u>	

Meter problem/comments:

Previous 48 hrs precipitation: Unknown None Slight Moderate Heavy Flooding
 Ambient Weather: Sunny Cloudy Breezy Rain Snow Air temp (°F):

WATERSHED CHARACTERISTICS Approx. % of Watershed Observed:

Upstream surrounding land use (estimated %):			
Pasture	Residential	Industry	
Crops	Commercial	Mining	
Forest	Urban	Impoundment	

PHYSICAL STREAM CHARACTERISTICS Approx Length of Stream Assessed (m):

Surrounding land use (estimated %):											
	RDB	LDB		RDB	LDB		RDB	LDB	OTHERS	RDB	LDB
Pasture			Residential			Industry					
Crops			Commercial			Mining					
Forest			Urban			Wetland					

Observed Human Disturbance to Stream: S (slight) M (moderate) H (high) Blank = not observed

ATV/CHV	Construction	Livestock	Residential
Industrial	Impoundment	STP/WWTP	Riparian Loss
Logging	Row Crop	Mining	Water withdrawal
Urban	Road/ Hwy	Dredging	
Other (describe):			

% Canopy Cover: Estimated reach average: Open (0-10) Partly Shaded (11-45) Mostly Shaded (46-80) Shaded (> 80)

Measured mid reach: U/S D/S LB RB Total/364*100

Sediment Deposits: None Slight Moderate High Excessive Blanket

Sediment Type: Sludge Mud Sand Silt None Other

Turbidity: Clear Slight Moderate High Opaque Color

Surface Sheen/foam: Bacteria Nutrient Surfscum Other

Algae Present? None Slight Moderate High Choking Type: Diatom Green Filamentous Blue-green

Comments:

See Stream Assessment forms

Turbidity 6.68 NTU 2 Crawfish each sample
 5.91 NTU
 5.13 NTU

APPENDIX 3

MACROINVERTEBRATE SAMPLE SORTING BENCH SHEET

Bioassessment Sample Sorting for Goodlettsville, TN

Bioassessment Sorting Form:

Project: City of Goodlettsville, TN Bioassessment

Method: TDEC

Date	Time	Site ID	WKUEHL	Sample Site	Date Sampled	Total #	Total #	Rand 1	# Organisms	Rand 2	# Organisms	Rand 3	# Organisms	Rand 4	# Organisms	Rand 5	# Organisms
Sorted			Taxonomic ID														
8/4/2016	14:45:00	TDEC Man NC	20160001	Manskers Creek, Northcreek Park (TDEC Site), (TDEC Man NC)	8/2/2016	206	206	3	76	34	43	17	48	21	39		
8/18/2016	15:30:00	TDEC Sla DS	20160002	Slaters Creek at confluence with Mansker Creek	8/2/2016	204	204	12	53	27	62	14	52	23	37		
8/19/2016	8:14:00	TDEC Mad US	20160003	Madison Creek near Moss-Wright Park @ Caldwell Drive	8/17/2016	174	174	29	78	13	38	9	25	22	33		
8/19/2016	12:16:00	TDEC Lums	20160004	Lumsley Fork @ Old Springfield Pike	8/2/2016	181	181	31	52	20	22	1	43	39	34	13	29

APPENDIX 4

MACROINVERTEBRATE TAXONOMIC BENCH SHEETS

Macroinvertebrate Taxonomic Identifications Bench Sheet

STATION ID: TDEC Lum (TDEC sample location)		LOG NUMBER: TDEC Lums 201608	
SOURCE: Lumsley Fork		COL. BY: UKY,MS	
LOCATION: Near confluence with Mansker Creek		DATE COL: August 5, 2016	
SAMPLE TYPE: SQKICK		TIME: 8:20	
ECOREGION: 71h		TAXONOMIST: RDT DATE: 20170203	
Order	Family	Genus	Count
Ephemeroptera	Heptageniidae	Stenonema	89
Ephemeroptera	Caenidae	Caenis	0
Ephemeroptera	Isonychiidae	Isonychia	0
Ephemeroptera	Baetidae	und. Spp.	15
Plecoptera	Perlodidae	Isoperla	0
Isopoda	Asellidae	Lirceus	2
Coleoptera	Psephenidae	Psephenus	12
Coleoptera	Psephenidae	Ectopria	5
Amphipoda	Gammaridae	Gammarus	2
Lymnophila	Lymnaeidae	Lymnaea	0
Trichoptera	Hydropsychidae	Ceratopsyche	2
Trichoptera	Polycentropodidae	Cymellus	7
Diptera	Chironomidae		23
Lumbriculida	Lumbriculidae		0
Coleoptera	Elmidae	Neoselmis	7

Key: Merritt and Cummins, 1995 and 2008

Total

154

Macroinvertebrate Taxonomic Identifications Bench Sheet

STATION ID: TDEC Mad US(TDEC sample location)		LOG NUMBER: MadUS 20160802	
SOURCE: Madison Creek		COL. BY: UKY,MS	
LOCATION: Madison Creek at Caldwell Drive		DATE COL: August 2, 2016	
SAMPLE TYPE: SQKICK		Date and TIME: 20170802 11:46	
ECOREGION: 71h		TAXONOMIST: RDT DATE: 20170204	
Order	Family	Genus	Count
Ephemeroptera	Heptageniidae	Stenonema	36
Ephemeroptera	Caenidae	Caenis	27
Ephemeroptera	Isonychiidae	Isonychia	0
Ephemeroptera	Baetidae	und. Spp.	3
Plecoptera	Perlodidae	Isoperla	0
Isopoda	Asellidae	Lirceus	2
Coleoptera	Psephenidae	Psephenus	3
Coleoptera	Psephenidae	Ectopria	4
Amphipoda	Gammaridae	Gammarus	1
Lymnophila	Lymnaeidae	Lymnaea	0
Trichoptera	Hydropsychidae	Ceratopsyche	0
Trichoptera	Polycentropodidae	Cymellus	0
Diptera	Chironomidae		56
Lumbriculida	Lumbriculidae		4
Coleoptera	Elmidae	Neoelmis	24
Mulusca	Heterodonta	Corbicula	1

Key: Merritt and Cummins, 1995 and 2008

Total

161

STATION ID: TDEC Man NC(TDEC sample location)		LOG NUMBER: ManNC 20160802	
SOURCE: Mansker Creek		COL. BY: UKY,MS	
LOCATION: Mansker Creek at North Creek Park		DATE COL: August 2, 2016	
SAMPLE TYPE: SQKICK		TIME: 14:10	
ECOREGION: 71h		TAXONOMIST: RDT DATE: 20170205	
Order	Family	Genus	Count
Ephemeroptera	Heptageniidae	Stenonema	44
Ephemeroptera	Caenidae	Caenis	24
Ephemeroptera	Isonychiidae	Isonychia	0
Ephemeroptera	Baetidae	und. Spp.	44
Plecoptera	Perlodidae	Isoperla	1
Isopoda	Asellidae	Lirceus	0
Coleoptera	Psephenidae	Psephenus	8
Coleoptera	Psephenidae	Ectopria	0
Amphipoda	Gammaridae	Gammarus	0
Lymnophila	Lymnaeidae	Lymnaea	9
Trichoptera	Hydropsychidae	Ceratopsyche	4
Trichoptera	Polycentropodidae	Cymellus	5
Diptera	Chironomidae		41
Lumbriculida	Lumbriculidae		0
Coleoptera	Elmidae	Neoelmis	11
Odonata	Coenagrionidae	Argia	4
Mulusca	Heterodonta	Corbicula	3

Key: Merritt and Cummins, 1995 and 2008

Total

198

Macroinvertebrate Taxonomic Identifications Bench Sheet

STATION ID: TDEC Sla DS (TDEC sample location)		LOG NUMBER: Sla DS 20160802	
SOURCE: Slaters Creek		COL. BY: UKY,MS	
LOCATION: Slaters Creek at confluence with Mansker Creek		DATE COL: August 2, 2016	
SAMPLE TYPE: SQKICK		TIME: 14:00	
ECOREGION: 71h		TAXONOMIST: RDT DATE: 20170206	
Order	Family	Genus	Count
Ephemeroptera	Heptageniidae	Stenonema	30
Ephemeroptera	Caenidae	Caenis	1
Ephemeroptera	Isonychiidae	Isonychia	2
Ephemeroptera	Baetidae	und. Spp.	14
Plecoptera	Perlodidae	Isoperla	2
Isopoda	Asellidae	Lirceus	58
Coleoptera	Psephenidae	Psephenus	48
Coleoptera	Psephenidae	Ectopria	0
Amphipoda	Gammaridae	Gammarus	1
Lymnophila	Lymnaeidae	Lymnaea	0
Trichoptera	Hydropsychidae	Ceratopsyche	0
Trichoptera	Polycentropodidae	Cyrnellus	2
Diptera	Chironomidae		0
Lumbriculida	Lumbriculidae		19
Coleoptera	Elmidae	Neoelmis	21
Odonata	Coenagrionidae	Argia	0
Mulusta	Heterodonta	Corbicula	0

Key: Merritt and Cummins, 1995 and 2008

Total

198

