STREAM MONITORING ASSESSMENT

FOR

MANCHESTER MS4 COMPLIANCE

IN

MANCHESTER, TENNESSEE

AUGUST 2024

PREPARED BY:

St. John ENGINEERING, LLC
ENGINEERING • PLANNING • ENVIRONMENTAL CONSULTING
923 JACKSON STREET, MANCHESTER, TN 37355
PHONE: (931) 728–2638 FAX: (931)728–6357

TABLE OF CONTENTS

2024 STREAM MONITORING ASSESSMENT FOR MANCHESTER MS4 COMPLIANCE IN MANCHESTER, TENNESSEE

1.0 INTRODUCTION

Section 4.6 of the NPDES General Permit for Discharges from Small Municipal Separate Storm Sewer Systems requires the City of Manchester to perform analytical monitoring on certain streams within the city's jurisdiction. Specifically, the city is required to monitor all stream segments within the jurisdiction that have unavailable parameters for siltation, habitat alteration, or pathogens. Those streams with unavailable parameters for siltation and/or habitat alteration require biological stream sampling and habitat assessment utilizing the Semi-Quantitative Single Habitat (SQSH) Method. Those streams with unavailable parameters for pathogens require bacteriological stream sampling utilizing methods identified in the Division of Water Resources' Quality System Standard Operating Procedures for Chemical and Bacteriological Sampling of Surface Water. The city is required by the Permit to sample all affected stream segments within the five-year permit period.

2.0 ASSESSMENT DESCRIPTION

The City of Manchester contains stream segments that have unavailable parameters for pathogens and for unknown reasons. There are two segments of the Little Duck River within the city limits of Manchester. One of the segments contains unavailable parameters for pathogens and is also listed as being impaired for unknown reasons. The other contains unavailable parameters for pathogens only. Therefore, analytical monitoring was conducted on both of these stream segments, as required by the MS4 General Permit. The methods followed for the monitoring and all monitoring results are described within this report. Appendix A of this report contains a site location map showing the sampling locations on both stream segments.

3.0 SITE DESCRIPTIONS

3.1 Little Duck River (Upstream)

The Little Duck River is formed by the confluence of Hunt Creek and Huckleberry Creek within the city limits of Manchester. The Little Duck River flows through a significant portion of the city limits, running generally from south to north and then west. Almost the entirety of the Little Duck River is located within the city limits of Manchester. Shortly after leaving the city limits, the river enters the Duck River.

The upstream stream segment ID is TN06040002502_2000. This stream segment is listed as impaired for pathogens and for unknown reasons. Both e-coli and biological monitoring were performed on this stream segment. The monitoring activities were performed adjacent to Dave King Park. The monitoring station ID is LDUCK002.8CE. This point of the Little Duck River has a drainage area of approximately 36 square miles. The Little Duck River is located in Ecoregion 71g. The sampling point was located in an area adjacent to the greenway at the back of Dave King Park. Other than the park area, there is very little development in the immediate vicinity of the monitoring point. The stream at this location is approximately 30-40 feet wide and 6-24 inches deep. There was one concrete capped sewer line crossing located within the stream reach. Appendix B contains photographs of this Little Duck River stream segment.

3.2 Little Duck River (Downstream)

The downstream segment ID is TN06040002502_1000. This stream segment is listed as impaired for pathogens only. Therefore, only e-coli monitoring was performed at this location. The monitoring point was located at the Highway 41 bridge along the greenway that passes underneath the bridge. This point of the Little Duck River has a drainage area of approximately 41 square miles. The stream at this location is approximately 40 feet wide and 24 inches deep.

4.0 SAMPLING PROCEDURES

4.1 Little Duck River (Upstream)

The Little Duck River upstream sampling consisted of a biological assessment and habitat assessment of the stream reach as well as e-coli sampling. The habitat assessment was conducted immediately prior to the biological sampling. Water quality measurements were also taken for pH, conductivity, and temperature. The biological assessment consisted of a macroinvertebrate survey. All assessments and sampling were conducted in accordance with the 2021 TDEC SOP for Macroinvertebrate Stream Surveys. Biological samples were collected with a two-person square meter kick net with a 500-micron mesh. Samples were collected in riffle and run areas of the stream reach. Samples were collected in a labeled, plastic jar filled with 91% alcohol and were shipped to Aquatic Resources Laboratory in Nashville for invertebrate identification. All biological sampling of the Little Duck River was conducted on August 12, 2024. Stream Data Field Sheets and Habitat Assessment Data Sheets that were completed during the assessment are contained in Appendix B of this report.

The Little Duck River upstream e-coli sampling consisted of the collection of five samples for e-coli analysis. Samples were collected in accordance with the 2022 TDEC SOP for Chemical and Bacteriological Sampling of Surface Waters. All samples were collected in 120 mL sample containers with a 100 mL fill line. Colilert* reagent was added to each sample. The sample containers were labeled and immediately transported to the Manchester Water and Sewer Department wastewater plant for analysis. E-coli samples were collected on August 12th, August 13th, August 15th, August 16th, and August 21st of 2024.

4.2 Little Duck River (Downstream)

Likewise, the Little Duck River downstream e-coli sampling consisted of the collection of five samples for e-coli analysis. Samples were collected in accordance with the 2022 TDEC SOP for Chemical and Bacteriological Sampling of Surface Waters. All samples were collected in 120 mL sample containers with a 100 mL fill line. Colilert* reagent was added to each sample. The sample containers were labeled and immediately transported to the Manchester Water and Sewer Department wastewater plant for analysis. E-coli samples were collected on August 12th, August 13th, August 15th, August 16th, and August 21st of 2024.

5.0 SAMPLING RESULTS

5.1 Little Duck River (Upstream)

Biological Monitoring

The Tennessee Division of Water Resources has developed a macroinvertebrate index, based on seven biometrics for use in semi-quantitative macroinvertebrate surveys (Arnwine and Denton, 2001). The index is based on ecoregional reference data and calibrated by bioregion. The calibrated scoring criteria can be used in all streams that fit the sample criteria for that region and have at least 80% of their upstream drainage within the same bioregion.

Using the raw benthic data from the semi-quantitative subsample, a numerical value was calculated for each of the seven biometrics. The numeric values are then compared to the values in the biocriteria tables for the applicable bioregion. The tables contain a score for a given range of numeric values for each biometric. The scores are all a 0, 2, 4 or 6 for each of the seven biometrics. Therefore, Tennessee Macroinvertebrate Index (TMI) scores can theoretically range from 0 to 42. The total cumulative score for the seven biometrics was then compared to the target TMI for the Bioregion. A summary of the seven biometrics is as follows:

1) TR (Taxa Richness)

The taxa richness score is based on the total number of distinct genera found in the sample. For Bioregion 71g, less than 10 genera in the sample receives a score of 0 and more than 28 genera receives a score of 6. The Little Duck River sampling site received a score of 6 for containing 31 genera.

2) EPT (Ephemeroptera Plecoptera Tricoptera Richness)

The EPT score is based on the total number of genera in the sample that are in the orders of Ephemeroptera, Plecoptera, and Tricoptera. For Bioregion 71g, less than 4 genera in the sample receives a score of 0 and more than 10 genera receives a score of 6. The Little Duck River sampling site received a score of 6 for containing 14 EPT genera.

3) % EPT-Cheum (EPT Abundance excluding *Cheumatopsyche*)

This biometric is based on the total number of EPT individuals collected excluding the *Cheumatopsyche* individuals as a percentage of all individuals in the sample. For Bioregion 71g, less than 16.8% receives a score of 0 and more than 50.2% receives a score of 6. The Little Duck River sample received a score of 6 for having a value of 62.1%.

4) %OC (Percent oligochaetes and chironomids)

This biometric is based on the number of oligochaetes and chironomids individuals as a percentage of all individuals collected. For Bioregion 71g, more than 75.5% receives a score of 0 and less than 26.7% receives a score of 6. The Little Duck River sample received a score of 6 for having a value of 4.7%.

5) NCBI (North Carolina Biotic Index)

This biometric uses tolerance values assigned in the North Carolina Biotic Index to calculate an average tolerance value for the specimens collected in the sample. A value of 0 to 10 is assigned to each organism based on their tolerance of water pollution. The higher the value assigned, the more tolerant they are to pollution within the stream. The value for the sample is calculated as a weighted average of all individuals contained in the sample. For Bioregion 71g, a value of more than 8.40 receives a score of 0 and a value of less than 5.21 receives a score of 6. The

Little Duck River sample received a score of 6 for having a value of 4.3.

6) % Clingers

Clingers are organisms that build fixed retreats or have adaptations to attach to surfaces in flowing water. This biometric is based on the percentage of individuals in the sample that are considered clingers. For Bioregion 71g, a value of less than 17.5% receives a score of 0 and a value of more than 52.4% receives a score of 6. The Little Duck River sample received a score of 6 for a value of 79.6%.

7) % TNUTOL (TN Nutrient Tolerant Organisms)

This biometric is based on the percentage of individuals in the sample that are *Cheumatopsyche, Stenelmis, Polypedilum, Cricotopus, Cricotopus/Orthocladius, Lirceus, Caenis, Elimia, Nais, Dero*, and undetermined immature *Tubificidae.* For Bioregion 71g, a value of greater than 77.1% receives a score of 0 and a value of less than 31.6% receives a score of 6. The Little Duck River sample received a score of 6 for a value of 19.4%.

The TMI Score for the Little Duck River sample collected in Manchester was 42. The target TMI score for Bioregion 71g is 32. Therefore, the stream segment passes biocriteria by having a TMI score of at least 32. A table of all taxa identified within the sample is contained in Appendix C of this report.

E-Coli Monitoring

The e-coli group of pathogens is used as an indicator for the presence of pathogens. They are commonly found in the lower intestines of warm-blooded animals and are capable of surviving for brief period of time in the environment, making them a good indicator of pathogen contamination. E-coli samples were collected in the upstream segment of the Little Duck River on five different days in the month of August and were analyzed by the Manchester Water and Sewer Department wastewater plant. A summary of the e-coli sample results is as follows:

Collection Date	Collection Time	E-Coli Count / 100 mL
August 12, 2024	11:15 am	209.8
August 13, 2024	2:25 pm	98.7
August 15, 2024	1:35 pm	74.4
August 16, 2024	2:30 pm	70.5
August 21, 2024	2:15 pm	74.9
	Geometric Mean =	96.0

According to Tennessee's general water quality criteria for recreation, which is the most stringent for pathogen levels, the concentration of the *E. coli* group shall not exceed 126 Colony Forming Units (CFU) per 100 mL as a geometric mean of five samples collected within 30 days (Tennessee Water Quality Control Board, 2007). Therefore, the results of the monitoring indicate that the upstream portion of the Little Duck River is passing criteria for pathogens at the time of this monitoring.

Individual sampling forms for the e-coli monitoring are contained in Appendix D of this report.

5.2 Little Duck River (Downstream)

E-coli samples were collected in the downstream segment of the Little Duck River on the same five days as the upstream segment and were analyzed at the Manchester Water and Sewer Department wastewater plant. A summary of the e-coli sample results is as follows:

Collection Date	Collection Time	E-Coli Count / 100 mL
August 12, 2024	11:35 am	131.4
August 13, 2024	2:40 pm	178.5
August 15, 2024	1:45	72.0
August 16, 2024	2:45	43.1
August 21, 2024	2:30 pm	62.0
	Geometric Mean =	85.3

According to Tennessee's general water quality criteria for recreation, which is the most stringent for pathogen levels, the concentration of the *E. coli* group shall not exceed 126 Colony Forming Units (CFU) per 100 mL as a geometric mean of five samples collected within 30 days (Tennessee Water Quality Control Board, 2007). Therefore, the results of the monitoring indicate that the downstream segment of the Little Duck River is also passing criteria for pathogens at the time of this monitoring.

Individual sampling forms for the e-coli monitoring are contained in Appendix D of this report.

5.3 RUNNING DATA ANALYSIS

Little Duck River		
	2018 Monitoring	2024 Monitoring
Habitat Assessment Score	166	171
TMI Score	36	42
E-coli Geometric Mean (Upstream Samples)	395.8	96.0
E-coli Geometric Mean (Downstream Samples)	486.4	85.3

6.0 CONCLUSION

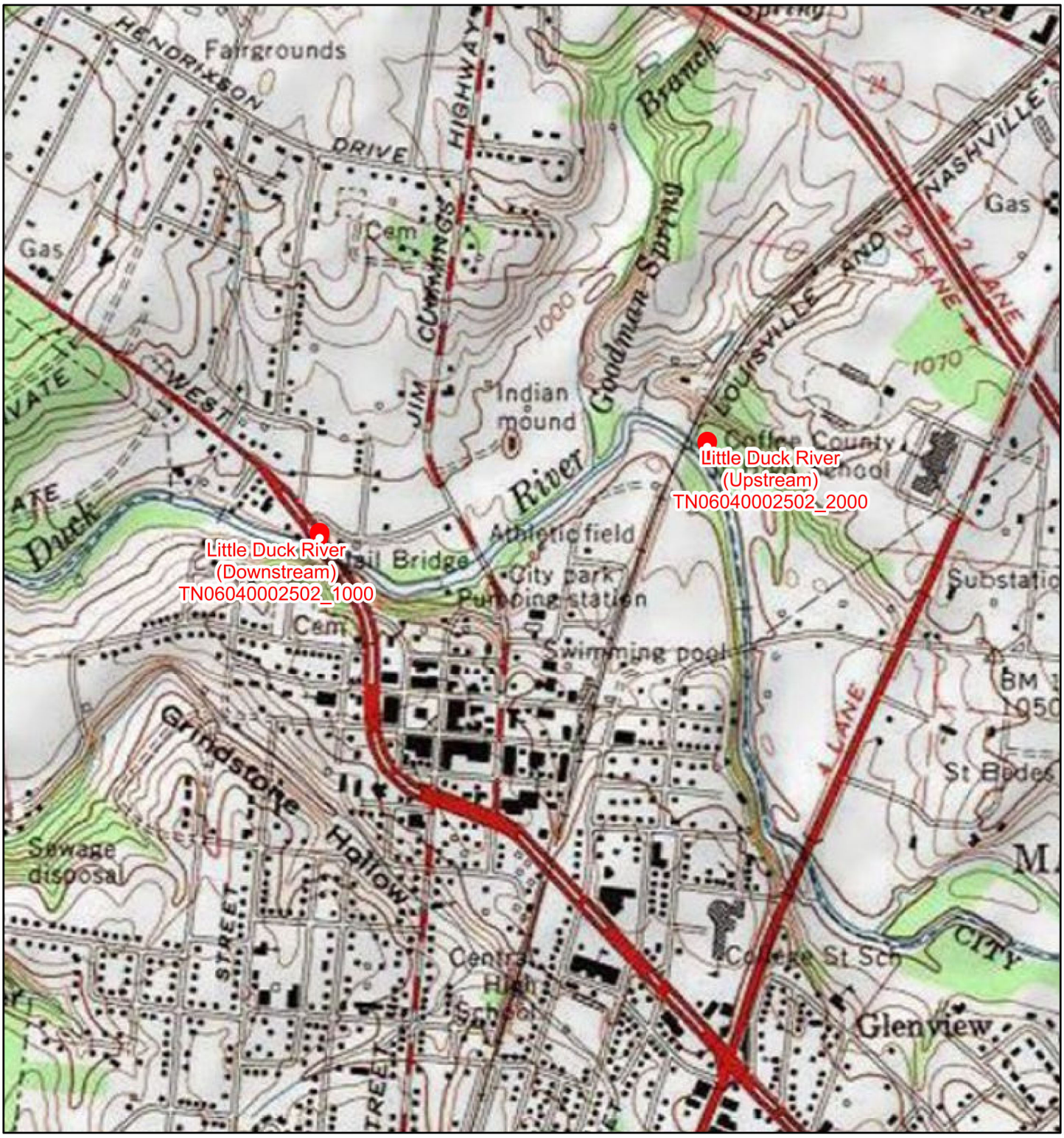
The results of the monitoring discussed in this report indicate that the Little Duck River is currently passing biological criteria and has slightly improved both Habitat Assessment score and TMI score since 2018. The results also show that the Little Duck River is passing bacteriological criteria, and the geometric means of both upstream and downstream E-coli samples have decreased significantly since 2018. Previous monitoring has shown the Little Duck River is impaired for pathogens and it is believed that the pathogen levels are primarily due to urban sources such as sanitary sewer overflows. Due to drought conditions, there were likely few, if any, sanitary sewer overflows in the months prior to this sampling. This may have skewed the E-coli samples, resulting in lower E-coli counts. Stream monitoring within these segments will continue as required by the Small MS4 General Permit.

All of the monitoring conducted for the completion of this report was conducted by or overseen by Jim Patterson of St. John Engineering, LLC. Mr. Patterson is the Environmental Manager at St. John Engineering, LLC and has 31 years of experience in water quality monitoring and compliance.

APPENDIX A

STREAM SAMPLING LOCATION MAP

2024 Manchester Stream Monitoring Location



1/16/2025

St. John ENGINEERING, LLC
ENGINEERING • PLANNING •
ENVIRONMENTAL CONSULTING

923 JACKSON STREET
MANCHESTER, TN 37355
PHONE: (931) 728-2638 – FAX: (931) 728-6357
WWW.STJOHNENGINEERING.COM

1:15,000

0 0.1 0.2 0.4 mi

0 0.15 0.3 0.6 km

APPENDIX B

HABITAT ASSESSMENT AND STREAM SURVEY

Field Sheet for TDEC|DWR -

Consultant BioForm 8.0 - Revised 8/13/2024

Complete blue cells

Instructions

DWR Station ID:	**LDUCK002.8CE**	**Organization:**	St. John Engineering, LLC
Date:	8/12/2024	**Time:**	10:15AM
Samplers:	Jim Patterson/Justin Richardson	New Org. email:	jrichardson@stjohnengineering.com
Project Purpose:	MS4	Index Period:	FALL
Activity Type:	Sample-Routine		
DWR Permit Number:	TNS088331	**Field Log Number:**	LittleDuck8/12/2024
Waterbody (Stream|River) Name:	Little Duck River	Watershed Group:	4
Monitoring Location:	Little Duck River at Dave King Park		
County:	Coffee	Drainage Area:	36
Ecoregion:	71g	u/s ECO:	
Latitude:	35.487979	Longitude:	-86.081606
HUC:	06040002	WBID:	TN06040002502_2000

Spring = Jan. - June
Fall = July - Dec.

Confirm name, location and latitude/longitude.

To search for existing DWR Stations consult DWR Public Viewer Map or Ambient Data Viewer

Save with a unique name!

If the station is not available in the dropdown box above, complete the following information. After the new station information is completed, the DWR Station ID will be available in the dropdown box at the top. Minimally complete DWR Station ID, name, location, county, river mile and Latitude/Longitude below.

Next complete Stream Survey Tab (SS)

New Stations

Stations last updated **8/12/2024**. Add new stations below.

See Protocol B (page 44) of the **Macroinvertebrate SOP** for instructions for assigning new station ids.

New DWR Station ID:	LDUCK002.8CE		
Monitoring Location Name:	Little Duck River		
Monitoring Location:	Little Duck River at Dave King Park		
County:	Coffee	DWR Abbreviation:	CE
River Mile:	2.8		
Latitude:	35.487979		
Longitude:	-86.081606		
Ecoregion:	71g	Ecoregion Name:	Eastern Highland Rim
u/s ECO:		Ecoregion Name:	
HUC 8:	06040002	HUC Name:	Duck-Upper
Waterbody ID:	TN06040002502_2000		
HUC 12:	060400020102		
Drainage Area:	36.00	Square Miles	
TDEC Environment Field Office:	Columbia EFO		
Reservoir/Lake Name:			

Upon completion email workbook to TDEC.WatershedPlanning@tn.gov Include contact info.

TDEC|DWR Stream Survey Field Sheet

STREAM SURVEY INFORMATION (Revised 8/13/2024)

DWR Station ID: **LDUCK002.8CE**	Date: 8/12/2024	Time: 10:15AM
Samplers: Jim Patterson/Justin Richardson	Organization: St. John Engineering, LLC	
Project Name: MS4	Activity Type: Sample-Routine	
Field Log Number: LittleDuck8/12/2024	Ecoregion: 71g	
Waterbody Location Name: Little Duck River		
Monitoring Location: Little Duck River at Dave King Park		

See most recent Macroinvertebrate SOP Protocol E (page 99) for specific instruction for completing this information.

Complete blue cells

Green cells optional or additional information.

Sample Status:	Collected		
Flow Condition:	Moderate		

Samples Collected: "Yes" if collected:

SQKICK:	Yes	SQBANK:		

Field Parameters: (Note: mg/L = ppm) **Meters Used:** YSI Pro 1030

	1st	2nd	Check if Validated.	Describe meter/reading problem below
pH (su):	6.61		☐	
Conductivity (umhos):	223.2		☐	
Temperature (C°):	20		☐	
Dissolved Oxygen (mg/L):			☐	
Dissolved Oxygen %:				
Turbidity (NTU):				
TDS (mg/L):				
Flow (cfs):				

Weather:

Previous 48 hours precipitation:	None	Approx. Air Temperature (F°): 75

Physical Characteristics:

Gradient: High	**Avg. Stream Width:** Large (10-25 yd.)
	Max. Stream Depth: Medium (0.3-0.6 yd.)

Light Penetration:

% Canopy Cover Estimated for Reach:				60	%			
% Canopy Cover Measured (mid-reach) with spherical crown densiometer:								
		u/s +		d/s +		LDB +		RDB =

Channel Characteristics:

Bank Height: 2.0 yards	**High Water Mark:** 2.0 yards

Stream/Channel Characteristics: In the sections below select all that apply:

	Characteristic 1	Characteristic 2	Characteristic 3	Characteristic 4
LDB Bank Slope:	Gentle slope:			
RDB Bank Slope:	Gentle slope:			
Manmade Modifications:	None			
Sediment Deposits:	Slight	Is this rating the same as sediment deposition (#4) in habitat?		
Sediment Type:	Silt:			
Turbidity:	Clear			
Foam/Surface Sheen:	None			
Algae:	Moderate			
Algae Type:	Green:			

Dominant Substrate: (≥ 25%) Select up to 4:

	Riffle	Run	Pool
Dominant 1:	Cobble (2.5-10):	Cobble (2.5-10):	Bedrock:
Dominant 2:		Bedrock:	
Dominant 3:			
Dominant 4:			

Immediate Surrounding Land Uses (Select up to 4 ranking highest to lowest):

Landuse 1		Landuse 2		Landuse 3		Landuse 4
Forest:		Park:				

If applicable, choose up to 4 disturbances from the dropdown boxes below the appropriate severity of the impact.

Observed Human Disturbances:	Slight	Moderate	High	
Disturbance 1:	Riparian Loss:			
Disturbance 2:				
Disturbance 3:				
Disturbance 4:				

Stream description especially noting potential stressors and impacts.

No obvious stressors. Greenway impacts riparian width slightly.

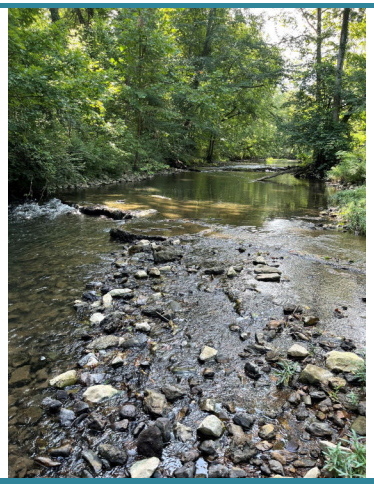
Photos and descriptions may be attached below:

Photos Taken?	Yes	Photo Description:	

Copy and paste pictures below and add descriptive labels under pictures.

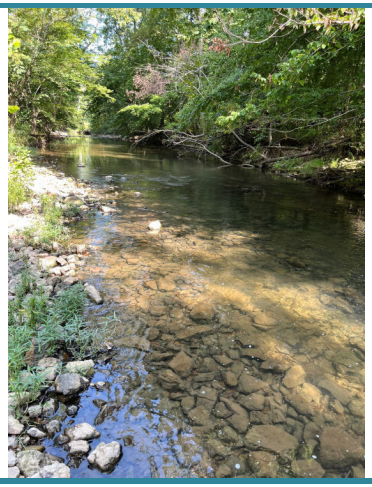
Save!

Insert and label pictures below:



Label: Upstream

Notes:



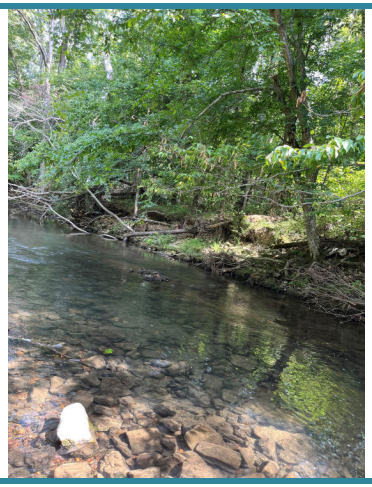
Label: Downstream

Notes:

Next complete either High Gradient Habitat (HG_Hab) tab if SQKICK is collected or Low Gradient Habitat (LG_Hab) tab if SQBANK is collected.

Label: Left Bank

Notes:



Label: Right Bank

Notes:

HABITAT ASSESSMENT FIELD SHEET- MODERATE TO HIGH GRADIENT STREAMS

Complete this habitat assessment if **SQKICK** is collected.

Revised 8/12/2024

DWR Station ID: **LDUCK002.8CE**			**Habitat Assessment By:** Jim Patterson/Justin Richardson
Waterbody Name: Little Duck River			Date: 8/12/2024 Time: 10:15AM
Monitoring Location: Little Duck River at Dave King Park			Field Log Number: LittleDuck8/12/2024
HUC: 06040002	WS Group: 4	Ecoregion: 71g	**QC Consensus:** ☐

Habitat Type: HG

If QA/QC 2 habitats are completed independently, check box above.

See most recent Macroinvertebrate SOP Protocol D-1 (page 62) for specific instructions for completing this information.

For each habitat parameter, type score or select from blue dropdown box. Add comments if needed in row below score.

		Optimal					Suboptimal					Marginal					Poor				
1. Epifaunal Substrate/ Available Cover		Over 70% of stream reach has natural stable habitat suitable for colonization by fish &/or macroinvertebrates. Four or more productive habitats are present.					Natural stable habitat covers 40-70% of stream reach. Three or more productive habitats present. (If near 70% and more than 3 go to optimal.)					Natural stable habitat covers 20 -40% of stream reach or only 1-2 productive habitats present. (If near 40% and more than 2 go to suboptimal.)					Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.				
Score	**17**	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
2. Embeddedness of Riffles		Gravel, cobble, and boulders 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. If near 25% drop to suboptimal if riffle not layered cobble.					Gravel, cobble and boulders 25-50% surrounded by fine sediment. Niches in bottom layers of cobble compromised. If near 50% & riffles not layered cobble drop to marginal.					Gravel, cobble, and boulder s are 50-75% surrounded by fine sediment. Niche space in middle layers of cobble is starting to fill with fine sediment.					Gravel, cobble, and boulders are more than 75% surrounded by fine sediment. Niche space is reduced to a single layer or is absent.				
Score	**18**	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Comment																					
3. Velocity/ Depth Regime		All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow).					Only 3 of the 4 regimes present (if fast-shallow is missing score lower). If slow-deep missing score 15.					Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).					Dominated by 1 velocity/depth regime. Others regimes too small or infrequent to support aquatic populations.				
Score	**15**	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
4. Sediment Deposition	Does this rating match sed. desc. in SS?	Sediment deposition affects less than 5% of stream bottom in quiet areas. New deposition on islands and point bars is absent or minimal.					Sediment deposition affects 5-30% of stream bottom. Slight deposition in pool or slow areas. Some new deposition on islands and point bars. Move to marginal if build-up approaches 30%.					Sediment deposition affects 30-50% of stream bottom. Sediment deposits at obstruction, constrictions and bends. Moderate pool deposition.					Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.				
Score	**18**	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
5. Channel Flow Status		Water reaches base of both lower banks and streambed is covered by water throughout reach. Minimal productive habitat is exposed.					Water covers > 75% of streambed or 25% of productive habitat is exposed.					Water covers 25-75% of streambed and/or productive habitat is mostly exposed.					Very little water in channel and mostly present as standing pools. Little or no productive habitat due to lack of water.				
Score	**18**	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
6. Channel Alteration		Channelization, dredging rock removal or 4-wheel or livestock activity (past or present) absent or minimal; natural meander pattern.					Channelization, dredging or 4-wheel or livestock activity up to 40%. Channel has stabilized. If larger reach, channelization is historic					Channelization, dredging or 4-wheel or livestock activity 40-80% (or less that has not stabilized.) Artificial structures in or out of reach					Over 80% of reach channelized, dredged or affected by 4-wheelers or livestock. Instream habitat greatly altered or removed.				

6. Channel Alteration		NO artificial structures in reach. Upstream or downstream structures do not affect reach.					and stable. Artificial structures in or out of reach do not affect natural flow patterns.					may have slight affect.					Artificial structures have greatly affected flow pattern.				
Score	**18**	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
7. Frequency of re-oxygenation zones Use frequency of riffle or bends for category. Rank by quality.		Occurrence of re-oxygenation zones relatively frequent; ratio of distance between areas divided by average stream width <7:1.					Occurrence of re-oxygenation zones infrequent; distance between areas divided by average stream width is 7 - 15.					Occasional re-oxygenation area. The distance between areas divided by average stream width is over 15 and up to 25.					Generally all flat water or flat bedrock; little opportunity for re-oxygenation. Distance between areas divided by average stream width >25.				
Score	**16**	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
8. Bank Stability (score each bank) Determine left or right side by facing downstream.		Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems <5% of bank affected.					Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. If approaching 30% score marginal if banks steep.					Moderately unstable; 30-60 % of bank in reach has areas of erosion; high erosion potential during floods, If approaching 60% score poor if banks steep.					Unstable; many eroded area; raw areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
Score (Left Bank)	**9**		10		9		8		7		6	5		4		3	2		1		0
Score (Right Bank)	**8**		10		9		8		7		6	5		4		3	2		1		0
Comment																					
9. Vegetative Protective (score each bank) includes vegetation from		More than 90% of the bank covered by undisturbed vegetation. All 4 classes (mature trees, understory					70-90% of the bank covered by undisturbed vegetation. One class may not be well represented. Disruption					50-70% of the bank covered by undisturbed vegetation. Two classes of vegetation may not be well					Less than 50% of the bank covered by undisturbed vegetation or more than 2 classes are not well				

Includes vegetation from top of bank to base of bank. Determine left or right side by facing downstream.		trees, shrubs, groundcover) are represented and allowed to grow naturally. All plants are native.					evident but not effecting full plant growth. Non-natives are rare (< 30%).					represented. Non-native vegetation may be common (30-50%).					represented or most vegetation has been cropped. Non-native vegetation may dominate (> 50%).				
Score (Left Bank)	**9**		10		9		8		7		6	5		4		3	2		1		0
Score (Right Bank)	**8**		10		9		8		7		6	5		4		3	2		1		0
Comment																					
10. Riparian Vegetative Zone Width (score each bank.) Zone begins at top of bank.		Average width of riparian zone > 18 meters. Unpaved footpaths may score 9 if run-off potential is negligible.					Average width of riparian zone 12-18 meters. Score high if areas < 18 meters are small or are minimally disturbed.					Average width of riparian zone 6-11 meters. Score high if areas less than 12 meters are small or are minimally disturbed.					Average width of riparian zone <6 meters. Score high if areas less than 6 meters are small or are minimally disturbed.				
Score (Left Bank)	**7**		10		9		8		7		6	5		4		3	2		1		0
Score (Right Bank)	**10**		10		9		8		7		6	5		4		3	2		1		0
Comment																					
Total Score:	**171**																				

Ecoregion: 71g Drainage Area: 36

Comparison to Ecoregion Guidelines: ☑ Above ☐ Below

If score is below guidelines, result of ☐ Natural Condition ☐ Human Disturbance Describe:

Save!

Email completed workbook to TDEC.WatershedPlanning@tn.gov

Table 3: Habitat Assessment Guidelines

Values listed below are considered to meet regional guidelines. Guidelines are based on 75% of median reference value, adjusted up to lowest habitat score passing TMI in each ecoregion.

Ecoregion	Habitat Type	Streams > 2.5 sq. mile drainage		Headwater Streams ≤ 2.5 sq. mile drainage	
		Jan-June	July-Dec	Jan-June	July-Dec
65abei	Low Grad.	>109	≥ 98	>107	≥ 111
65j	High Grad.	≥ 148	≥ 169	≥ 152	≥ 157
66d	High Grad.	≥ 157	≥ 158	≥ 146	≥ 157
66e	High Grad.	≥ 158	≥ 152	≥ 143	≥ 148
66f	High Grad.	≥ 135	≥ 136	≥ 148	≥ 140
66g	High Grad.	≥ 140	≥ 140	≥ 150	≥ 124
66j	High Grad.	≥ 145	≥ 139	≥ 115	≥ 132
67f	High Grad.	≥ 131	≥ 128	≥ 133	≥ 123
67g	High Grad.	≥ 106	≥ 103	≥ 136	≥ 129
67h	High Grad.	≥ 156	≥ 148	≥ 125	≥ 146
67i	High Grad.	≥ 114	≥ 117	≥ 114	≥ 117
68a	High Grad.	≥ 135	≥ 145	≥ 139	≥ 128
68b	High Grad.	≥ 124	≥ 129	≥ 137	≥ 143
68c	High Grad.	≥ 131	≥ 124	≥ 163	≥ 155
69d	High Grad.	≥ 133	≥ 123	≥ 134	≥ 123
69e	High Grad.	≥ 127	≥ 122	≥ 151	≥ 136
71e	High Grad.	≥ 113	≥ 114	≥ 145	≥ 130
71f	High Grad.	≥ 126	≥ 123	≥ 129	≥ 126
71g	High Grad.	≥ 126	≥ 128	≥ 119	≥ 149
71h	High Grad.	≥ 115	≥ 114	≥ 132	≥ 123
71i	High Grad.	≥ 112	≥ 99	≥ 113	≥ 114
71i	Low Grad.	≥ 106	≥ 114	>100	NA
73a	Low Grad.	≥ 118	≥ 118	≥ 106	≥ 106
74a	High Grad.	≥ 124	≥ 122	≥ 108	≥ 116
74b	Low Grad.	≥ 108	≥ 108	≥ 134	≥ 113

APPENDIX C

MACROINVERTEBRATE TAXA LISTING

					Little Duck River	Tolerance Value	Clingers	Nutrient Tolerant
Phylum	Class	Order	Family	Taxon				
Annelida	Clitellata	Enchytraeida	Enchytraeidae	Enchytraeidae	1	10		x
Annelida	Clitellata	Hirundinea	Erpobdellidae	Erpobdella		8.6		x
Annelida	Clitellata	Hirundinea	Glossiphoniidae	Placobdella		8.55		x
Annelida	Clitellata	Tubificida	Naididae	Tubificinae: bifid chaetae		10		x
Arthropoda	Arachnida	Trombidiformes	Sperchontidae	Sperchon	1	6		
Arthropoda	Crustacea	Amphipoda	Crangonyctidae	Crangonyx	1	7.2		
Arthropoda	Crustacea	Decapoda	Cambaridae	Cambaridae	1	7.5		
Arthropoda	Crustacea	Decapoda	Cambaridae	Cambarus		7.5		
Arthropoda	Crustacea	Decapoda	Cambaridae	Faxonius	1	2.7		
Arthropoda	Crustacea	Isopoda	Asellidae	Caecidotea		8.4		x
Arthropoda	Insecta	Coleoptera	Elmidae	Dubiraphia		5.5	x	
Arthropoda	Insecta	Coleoptera	Elmidae	Optioservus	1	2.6	x	
Arthropoda	Insecta	Coleoptera	Elmidae	Stenelmis	2	5.6	x	x
Arthropoda	Insecta	Coleoptera	Haliplidae	Peltodytes		8.4		
Arthropoda	Insecta	Coleoptera	Psephenidae	Psephenus	15	2.3	x	
Arthropoda	Insecta	Diptera	Chironomidae	Ablabesmyia		6.4		
Arthropoda	Insecta	Diptera	Chironomidae	Brillia	1	5.7		
Arthropoda	Insecta	Diptera	Chironomidae	Cladotanytarsus		4		
Arthropoda	Insecta	Diptera	Chironomidae	Clinotanypus		7.8		
Arthropoda	Insecta	Diptera	Chironomidae	Conchapelopia		8.7		
Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum	4	6.7		x
Arthropoda	Insecta	Diptera	Chironomidae	Procladius		8.8		
Arthropoda	Insecta	Diptera	Chironomidae	Rheotanytarsus	4	6.5	x	
Arthropoda	Insecta	Diptera	Chironomidae	Stempellinella	1	5.6		
Arthropoda	Insecta	Diptera	Chironomidae	Zavrelimyia		8.6		
Arthropoda	Insecta	Diptera	Simuliidae	Simulium	5	4.9	x	
Arthropoda	Insecta	Diptera	Tipulidae	Tipula		7.5		
Arthropoda	Insecta	Ephemeroptera	Baetidae	Acerpenna	2	3.7		
Arthropoda	Insecta	Ephemeroptera	Baetidae	Baetis	12	4.18		
Arthropoda	Insecta	Ephemeroptera	Baetidae	Diphetor		1.1		
Arthropoda	Insecta	Ephemeroptera	Baetidae	Procloeon		1.9		
Arthropoda	Insecta	Ephemeroptera	Caenidae	Caenis	7	6.8		x
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Teloganopsis	11	2.6	x	
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Maccaffertium	24	3.4	x	
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Stenacron	2	4.6	x	
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Stenonema	2	3.4	x	
Arthropoda	Insecta	Ephemeroptera	Isonychiidae	Isonychia	5	3.6		
Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae	Choroterpes		4	x	
Arthropoda	Insecta	Megaloptera	Corydalidae	Corydalus	6	5.2	x	
Arthropoda	Insecta	Megaloptera	Corydalidae	Nigronia	2	5.35	x	
Arthropoda	Insecta	Odonata	Aeshnidae	Basiaeshna		7.7		
Arthropoda	Insecta	Odonata	Coenagrionidae	Argia	5	8.3		
Arthropoda	Insecta	Odonata	Gomphidae	Gomphidae		4.2		
Arthropoda	Insecta	Plecoptera	Perlidae	Perlidae	1	1.8	x	
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	28	6.6	*	x
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsyche	55	3.3	x	
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsychidae	8	3.03	x	
Arthropoda	Insecta	Trichoptera	Hydroptilidae	Hydroptilla		6.5	x	
Arthropoda	Insecta	Trichoptera	Philopotamidae	Chimarra	1	3.3	x	
Arthropoda	Insecta	Trichoptera	Polycentropodidae	Plectrocnemia	1	3.1	x	
Mollusca	Bivalvia	Veneroida	Corbiculidae	Corbicula		6.6		
Mollusca	Bivalvia	Veneroida	Pisidiidae	Pisidiidae		6.9		
Mollusca	Bivalvia	Veneroida	Pisidiidae	Pisidium		6.6		
Mollusca	Bivalvia	Veneroida	Pisidiidae	Sphaerium		7.2		
Mollusca	Gastropoda	Basommatophora	Physidae	Physa		8.7		x
Mollusca	Gastropoda	Neotaenioglossa	Pleuroceridae	Pleurocera (Elimia)		5.75		x
Platyhelminthes	Turbellaria	Tricladida	Planariidae	Planariidae	1	6		
				Total	211			

Bioregion 71fgh Season: January-June (Spring) Target TMI = 32 Scoring calibrated to 160-240 organism sample			Method = SQKICK Drainage > 2.5 sq miles Genus Level Identification	
Metric	6	4	2	0
Taxa Richness (TR)	> 28	20 - 28	10 - 19	< 10
EPT Richness (EPT)	> 11	8 – 11	4 – 7	< 4
% EPT-Cheum	> 49.3	32.9 – 49.3	16.5 – 32.8	< 16.5
% OC	< 31.1	31.1 - 54	54.1 - 77	> 77.0
NCBI	< 4.89	4.89 – 6.59	6.6 – 8.29	> 8.29
% Clingers-Cheum	> 50.5	33.7 – 50.5	16.9 – 33.6	< 16.9
% TNutol	< 29.3	29.3 – 52.8	52.9 – 76.4	> 76.4

Little Duck River: 42

Bioregion 71fgh Season: July-December (Fall) Target TMI = 32 Scoring calibrated to 160-240 organism sample			Method = SQKICK Drainage > 2.5 sq miles Genus Level Identification	
Metric	6	4	2	0
Taxa Richness (TR)	> 28	19 – 28	10 – 18	< 10
EPT Richness (EPT)	> 10	7 - 10	4 - 6	< 4
% EPT-Cheum	> 50.2	33.5 – 50.2	16.8 – 33.4	< 16.8
% OC	< 26.7	26.7 – 51.1	51.2 – 75.5	> 75.5
NCBI	< 5.21	5.21 – 6.80	6.81 – 8.40	> 8.40
% Clingers-Cheum	> 52.4	35 – 52.4	17.5 – 34.9	< 17.5
% TNutol	< 31.6	31.6 - 54.4	54.5 – 77.1	> 77.1

Bioregion: 71fgh Season: January-June (Spring) Target TMI = 32 Scoring calibrated to 160-240 organism sample			Headwater Method = SQKICK Drainage ≤ 2.5 sq miles Genus Level Identification	
Metric	6	4	2	0
Taxa Richness (TR)	> 28	19 - 28	10 - 18	< 10
EPT Richness (EPT)	> 11	8 - 11	4 – 7	< 4
% EPT-Cheum	> 57.7	38.5 – 57.7	19.3 – 38.4	< 19.3
% OC	< 28.9	28.9 – 52.6	52.7 – 76.2	> 76.2
NCBI	< 4.69	4.69 – 6.46	6.47 – 8.22	> 8.22
% Clingers-Cheum	> 41.3	27.6 – 41.3	13.8 – 27.5	< 13.8
% TNutol	< 28.1	28.1 - 52.1	52.2 - 76	> 76

APPENDIX D

E-COLI SAMPLING FORMS

St. John Engineering, LLC
923 Jackson Street
Manchester, Tennessee 37355
931-728-2638

Jim Patterson
jpatterson@stjohnengineering.com

Project No. 102-109.02

Project Name Manchester 7154

Collection Date	Sample Identification	Location	Preservative	No. of Containers	No. of slides	Type of Analyses Requested: E.Coli					Log No.
8/12/24	Duck #1	Softball Park	✓	1		✓					
8/12/24	Duck #2	Shelton Ave Greenway	✓	1		✓					

Relinquished by:	Date/Time	Received by:	Date/Time	Received by:	Date/Time
[signature]	8/12/24 11:45				
Relinquished by:	Date/Time	Received by:	Date/Time	Received by:	Date/Time

St. John Engineering, LLC
923 Jackson Street
Manchester, Tennessee 37355
931-728-2638

Jim Patterson
jpatterson@stjohnengineering.com

Project No.

Project Name: Manchester- 2024 Stream Monitoring

Collection Date	Sample Identification	Location	Preservative	No. of Containers	No. of slides	Type of Analyses Requested: E.Coli					Log No.
8/13/24	Duck -3	Dave King Park	Yes	1		✓					
8/13/24	Duck -4	Shelton's Heating + Cooling	Yes	1		✓					

Relinquished by:	Date/Time	Received by:	Date/Time	Received by:	Date/Time
Jim D Patterson	8/13/24 2:50pm				
Relinquished by:	Date/Time	Received by:	Date/Time	Received by:	Date/Time

St. John Engineering, LLC
923 Jackson Street
Manchester, Tennessee 37355
931-728-2638

Jim Patterson
jpatterson@stjohnengineering.com

Project No.

Project Name: Manchester 2024 Stream Monitoring

Type of Analyses Requested

Collection Date	Sample Identification	Location	Preservative	No. of Containers	No. of slides	E.Coli					Log No.
8/15/24	Dock-5	Dave King Park	Yes	1		✓					
8/15 24	Dock-6	Shelton's Heating + Cooling	Yes	1		✓					

Relinquished by:	Date/Time	Received by:	Date/Time	Received by:	Date/Time
[signature]	8/15/24 1:55 PM				
Relinquished by:	Date/Time	Received by:	Date/Time	Received by:	Date/Time

St. John Engineering, LLC
923 Jackson Street
Manchester, Tennessee 37355
931-728-2638

Jim Patterson
jpatterson@stjohnengineering.com

Project No.

Project Name: Manchester 2024 Stream Monitoring

Type of Analyses Requested

Collection Date	Sample Identification	Location	Preservative	No. of Containers	No. of slides	E.Coli					Log No.
8/16/24	Duck-7	Dave King Park		1		✓					
8/16/24	Duck-8	Shelter's Heating + Cooling		1		✓					

Relinquished by:	Date/Time	Received by:	Date/Time	Received by:	Date/Time
Jt Dill	8/16/24 2:53pm				
Relinquished by:	Date/Time	Received by:	Date/Time	Received by:	Date/Time

St. John Engineering, LLC
923 Jackson Street
Manchester, Tennessee 37355
931-728-2638

Jim Patterson
jpatterson@stjohnengineering.com

Project No.

Project Name: Manchester 2024 Stream Monitoring

Collection Date	Sample Identification	Location	Preservative	No. of Containers	No. of slides	Type of Analyses Requested: E.Coli					Log No.
8/21/24	Duck-9	Dave King Park		1		✓					
8/21/24	Duck-10	Shelton's Heating & Cooling		1		✓					

Relinquished by:	Date/Time	Received by:	Date/Time	Received by:	Date/Time
[signature]	8/21/24 2:40 pm				
Relinquished by:	Date/Time	Received by:	Date/Time	Received by:	Date/Time