Threemile Creek Watershed TMDL Alternative: 2023 Progress Report

Reporting Period: October 2022 – October 2023

1.0 Summary

In October 2022, the Kentucky Division of Water (DOW) and EPA Region 4 accepted the Threemile TMDL Alternative Plan to Address Primary Contact Recreation (PCR) Impairments. This plan addresses the 303(d)–listed segment for PCR within Threemile Creek Watershed (Figure 1). A progress report is submitted to DOW biannually. The following sections provide an overview of the implementation that has occurred in the Threemile Creek and the results of monitoring during the current reporting period.

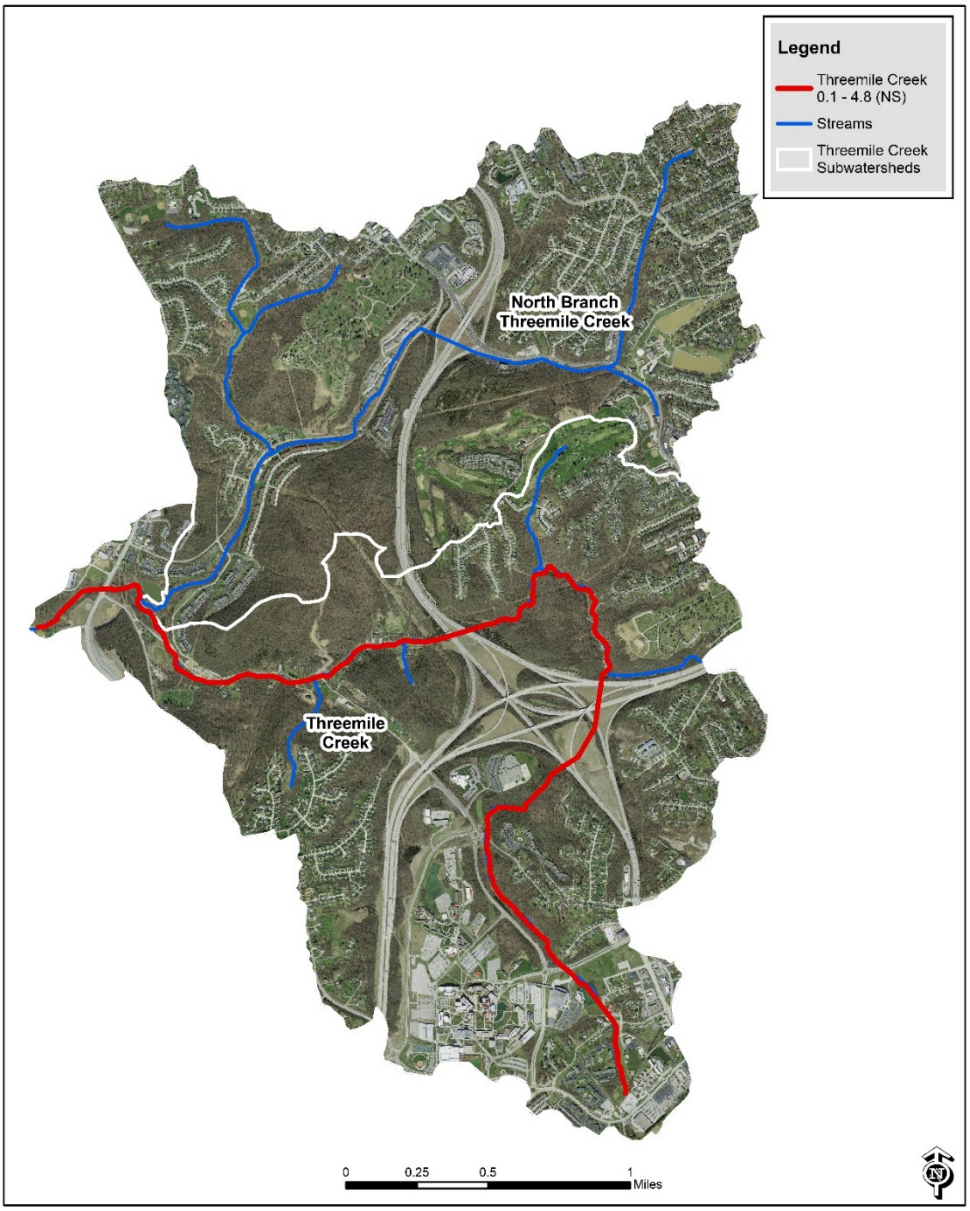

Figure 1.0: Threemile Creek Watershed and 303(d)-listed Segment for PCR (Non-support (NS))

2.0 Implementation

The Threemile Creek TMDL Alternative (TMDL Alt) outlines implementation measures for both subwatersheds, Threemile Creek mainstem and North Branch Threemile Creek, with the goal of improving water quality. As outlined in the TMDL Alt, the implementation primarily focuses on eliminating sanitary sewer overflows (SSOs) through the amended Northern Kentucky Consent Decree and the projects outlined in SD1's Updated Watershed Plan for Northern Kentucky.

The implementation measures and progress during this reporting period are identified in the sections below.

2.1 Consent Decree and Other Sanitary Improvements

Since the acceptance of the TMDL Alt, considerable progress was made on the Licking River Siphon (LRS) consent decree projects including the completion of the LRS EQ tank and Phase 1 of the conveyance piping. Ongoing inspection and maintenance were also completed as part of the CMOM program. The details are included in Table 2.1 and the figures below.

Table 2.1 Threemile Creek Watershed Implementation for Consent Decree and Other Sanitary Improvements (October 2022 – October 2023)

BMP Category	Action Items	Progress Report Updates (*October 2022 – October 2023*)
Consent Decree - SSO Elimination Projects 	1. Sewer improvements in the watershed	The LRS EQ tank, a 7.3 million gallon above ground tank, was completed in September 2022. There are multiple phases for the LRS conveyance piping portion of the project that will occur through 2040 as identified in Section 5.0 of the TMDL Alt. The TMDL Alt identified the lower portion to be completed by 2026. The updated completion date is 2028. This project includes sanitary sewer upsizing that will convey additional flow to the LRS EQ Tank and is sized for additional upstream improvements. The model predicts that one SSO on the North Branch and six SSOs on the mainstem will be reduced or eliminated through these improvements.
Other Sanitary Improvements 	1. Continue to implement the CMOM program in the SD1 service area 2. Document all repairs, improvements and upgrades for the sanitary system within the watershed	Over 26,000 feet of sanitary sewer and 55 sanitary structures were inspected and/or maintained during this reporting period.

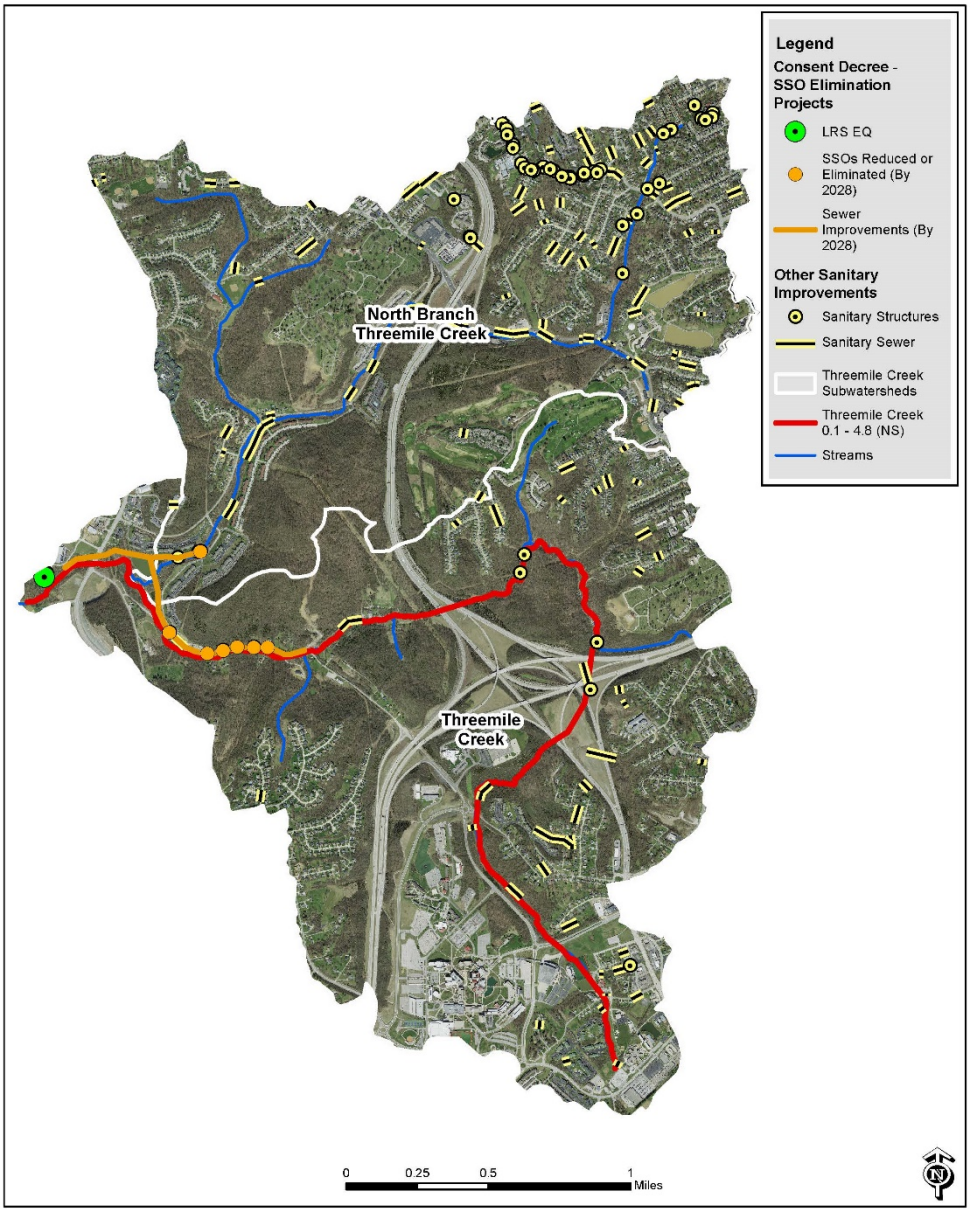

Figure 2.2.1: Location of Consent Decree Projects and Other Sanitary Improvements (October 2022 - October 2023)

Figure 2.3.2: The completed LRS EQ Tank

Figure 2.4.2 and 2.1.3: Installation of the LRS conveyance piping

2.2 Illicit Discharge Detection and Elimination Program Implementation

The entire Threemile Creek watershed is designated as a Phase II Municipal Separate Storm Sewer System (MS4) area. As noted in the TMDL Alt, SD1 implements an Illicit Discharge Detection and Elimination (IDDE) program to inspect storm sewer structures for the presence of illicit discharges. During this reporting period, SD1 inspected 16 structures as part of the Illicit Discharge Screening Factors (IDSF) program. No illicits were found during these inspections or through other mechanisms during this reporting period. The details are included in Table 2.2 and Figure 2.2.1 below.

Table 2.2 Threemile Creek Watershed IDDE Program Implementation (October 2022 – October 2023)

BMP Category	Action Items	Progress Report Updates (*October 2022 – October 2023*)
IDDE Program Implementation	1. Continue to implement the MS4 IDDE programs in SD1 Storm Water Service Areas.	SD1 continued to implement the IDDE program. 16 locations were inspected as part of the IDSF program. No illicits were found during this reporting period.
	2. Document and track eliminated illicit discharges associated with wastewater (failing septics, broken laterals, etc.)	

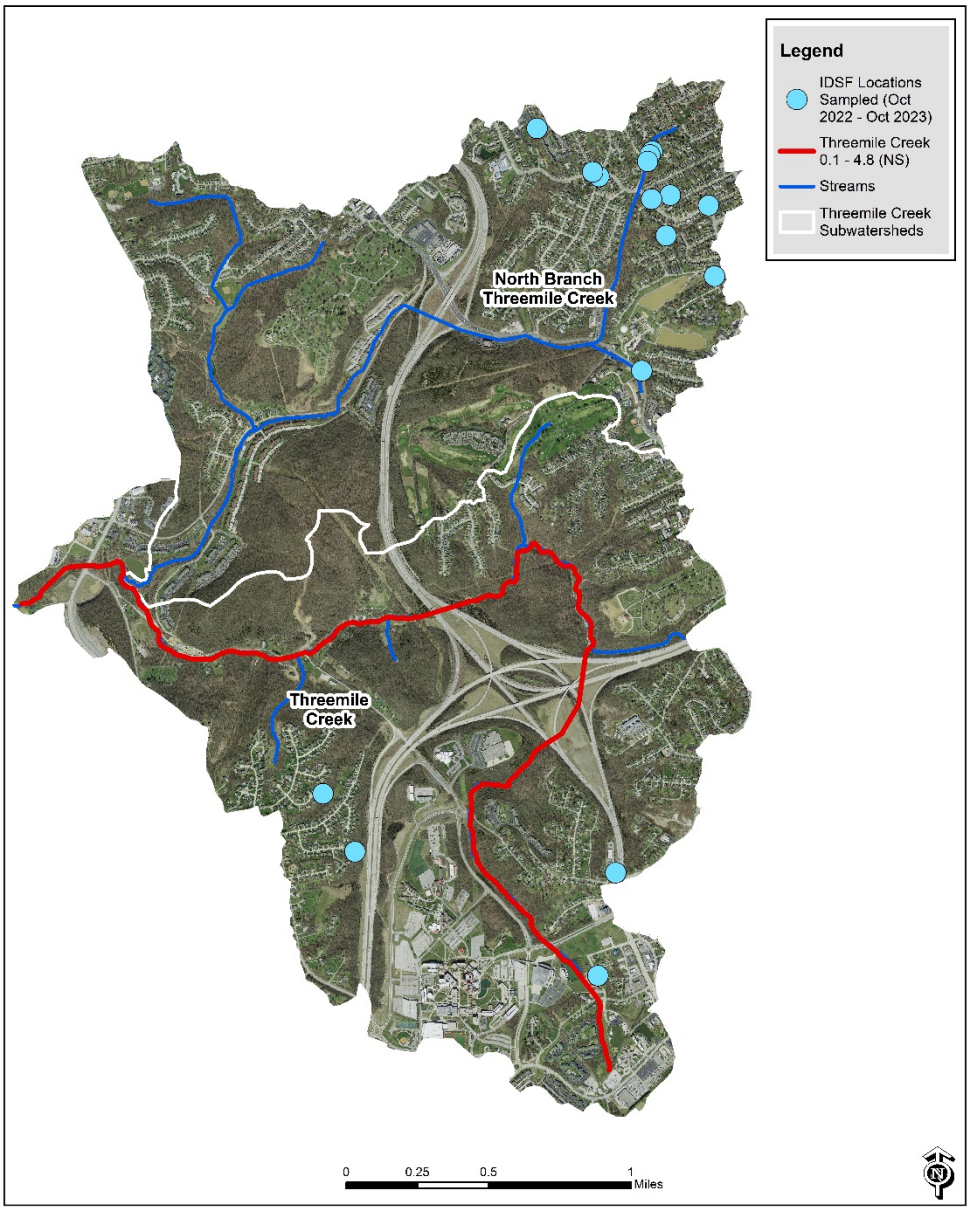

Figure 2.2.1: Location of IDSF Sample Locations in Threemile Creek Watershed (October 2022 – October 2023)

2.3 Pet Waste Management

The TMDL Alt identifies pet waste and wildlife as other possible contributors to the PCR impairment. Implementation to address this potential source focuses on pet waste management education and outreach. This effort is still under development with additional details and outreach planned for the upcoming years. See Table 2.3 and Figures 2.3.1 and 2.3.2 for additional information.

Table 2.3 Threemile Creek Watershed Pet Waste Management (October 2022 – October 2023)

BMP Category	Action Items	Progress Report Updates (*October 2022 – October 2023*)
Pet Waste Management	1. Develop educational materials and programing to inform and encourage the public to properly manage pet waste	Pet waste stations have been installed in multiple public parks in the watershed. Future efforts include developing education opportunities with partners (Cooperative Extension, City Parks) and identification of needed locations for additional pet waste stations.
	2. Establish pet waste disposal stations in key locations such as parks and community areas	
	3. Integrate the information into Campbell County Cooperative Extension programing	

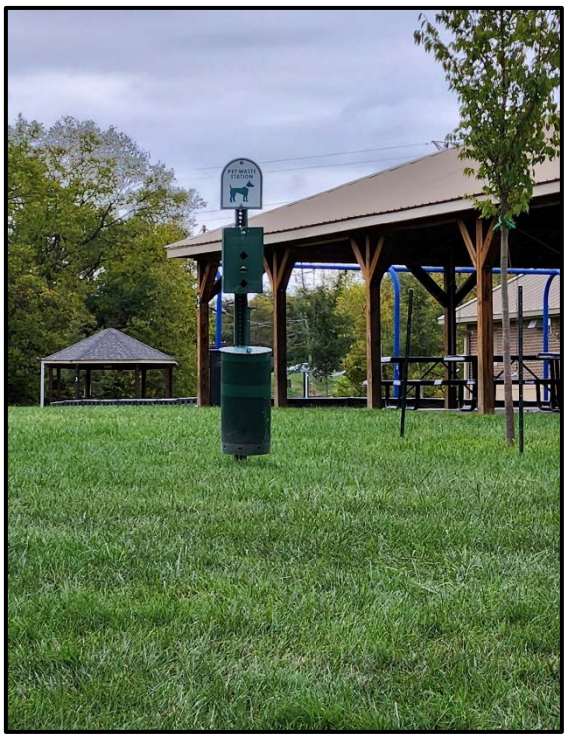

Figure 2.3.1 and 2.3.2 : Pet waste stations at Southgate Community Park and Highland Heights Civic Center

3.0 Monitoring

Monitoring the health of impaired streams involves measuring and tracking trends in stream conditions over time to show improvements in water quality and areas in need of new or additional implementation efforts. There are many types of monitoring for assessing overall stream health including water quality monitoring (measures the amount of pollutants in a stream), biological monitoring (identifying populations of macroinvertebrate and fish species to indicate water quality health), and assessing physical features of a stream (such as habitat and erosion). An important component of a TMDL Alt is to have a monitoring plan in place to evaluate the effectiveness of implementation efforts so that progress can be demonstrated and adaptive management can be applied where needed to stay on track for achieving water quality standards. Since the Threemile Creek TMDL Alt addresses the PCR impaired segment, the success monitoring is focused on analyzing the results of *E.coli* samples.

3.1 Monitoring Sites and Events

SD1 established three long-term monitoring sites within the Threemile Creek Watershed (Figure 3.1.1). Prior to 2021, all three sites were part of SD1's base flow characterization program and samples were conducted once during dry weather conditions (i.e., no precipitation in watershed 72 hours prior to event and prevailing dry weather conditions throughout event) during the PCR monitoring periods of 2007 – 2010, 2013 and 2017. Site THC 0.7 was part of SD1's ambient monitoring network and bi-weekly monitoring program, which resulted in samples collected under various weather and flow conditions during the PCR monitoring periods 2015 – 2021. The results of these events were used for the TMDL Alt and are presented and analyzed in Section 3.0 of the Threemile TMDL Alternative.

Since that time, SD1 updated the monitoring approach within the region, including the Threemile Creek Watershed. As a result, all three established sites in the watershed were sampled ten times from April through October in 2022. Beginning in 2023, Site THC 0.7 will be sampled 10 times every year. Sites NBT 0.8 and THC1.4 will be sampled 10 times every four years, with the next planned year in 2026 unless a more effective monitoring strategy is identified. Table 3.1.1 outlines the overall program and events.

Table 3.1.1 Summary of SD1 Monitoring in Threemile Creek Watershed (2022 - 2026 cycle)

Locations	Water Quality Monitoring				
Site ID	2022	2023	2024	2025	2026
THC 0.7	X	X	X	X	X
THC 1.4	X				X
NBT 0.8	X				X

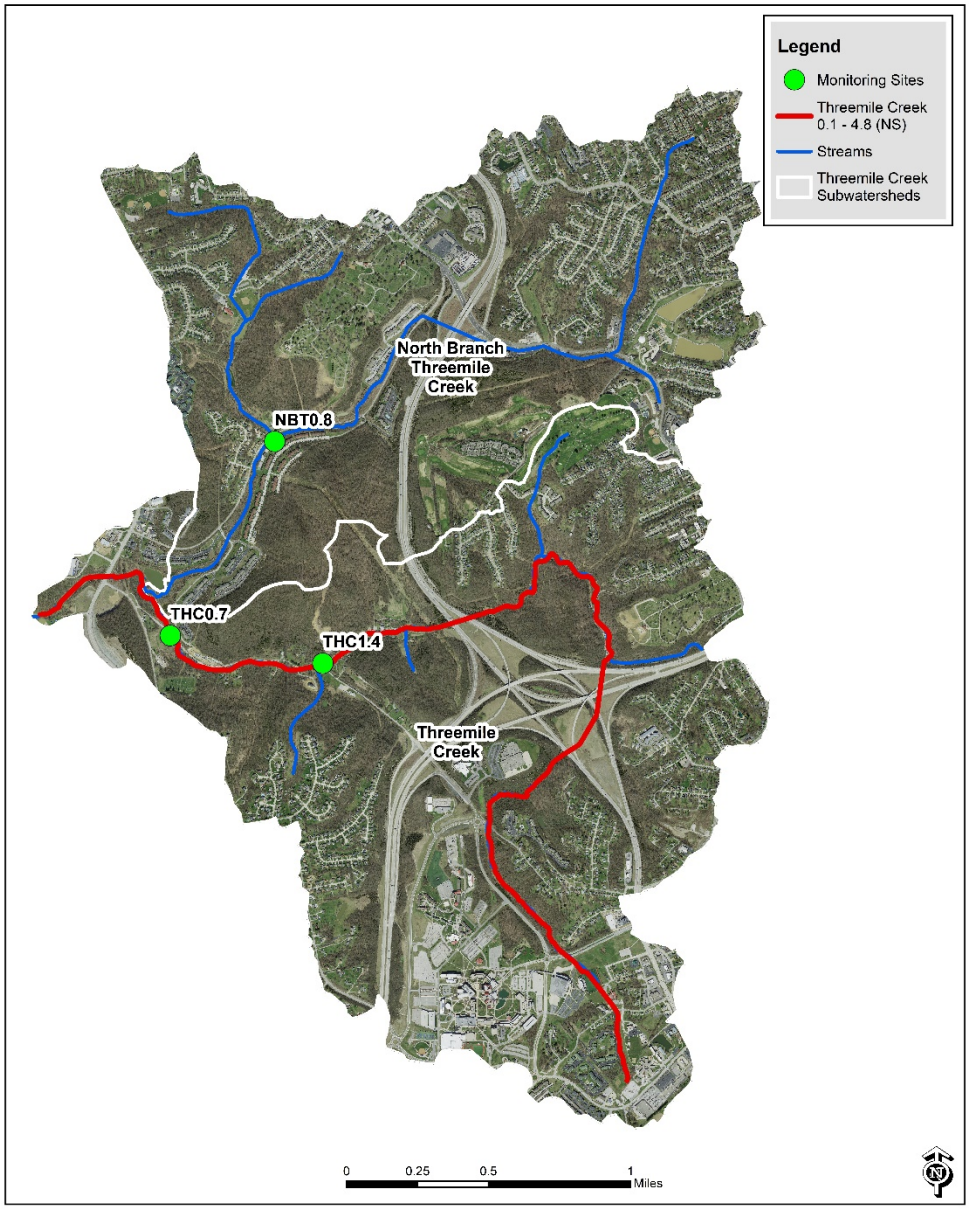

Figure 3.1.1 SD1 Sampling locations in Threemile Creek

This monitoring was conducted following the SD1 developed Field Monitoring and Sampling Plans (see Appendix B and C), which aligns with quality and quantity requirements used by KDOW. This includes specific grab sampling procedures, proper temperature regulation and holding times, and the use of blanks and duplicates for quality control. Samples are processed at SD1's Dry Creek lab, which is certified under the Kentucky Laboratory Certification Program (KLCP).

3.2 Monitoring Results and Analysis

Building upon the results provided in the TMDL Alt, the *E.coli* monitoring results for the three sites in 2022 and for site THC 0.7 in 2023 are included in this progress report. Water quality standards are from Kentucky Administrative Regulations defined in 401 KAR 10:031.

2022 Monitoring Results and Analysis

Table 3.2.1 provides a summary of the 2022 monitoring results for all three sites. The table includes the number of samples analyzed for each weather condition (#), the average of those sample results (AVG) and the percent of the samples that exceeded the water quality standard (%EX). Samples with no precipitation 72 hours prior to event and prevailing dry weather conditions throughout event are classified as dry and all others are classified as wet. Refer to Appendix A for the *E.coli* results of the 2022-2023 events.

Table 3.2.1 2022 Monitoring Results for Threemile Creek Sites

	Site								
	NBT0.8			THC0.7			THC1.4		
	#	AVG	%EX	#	AVG	%EX	#	AVG	%EX
ALL	10	2103	90%	10	839	60%	10	1458	50%
WET	3	2481	100%	3	2147	100%	3	3659	100%
DRY	7	1941	86%	7	279	43%	7	515	29%

Since more than six samples were collected within the PCR season for the 2022 year, the percent of samples exceeding the PCR water quality standard can be used to evaluate possible impairments based on the factors for non-support (34-100% of 6 or more samples exceed 240 colonies/mL) and partial support (20-33% of 6 or more samples exceed 240 colonies/mL). The results of this analysis are shown in Figure 3.2.1.

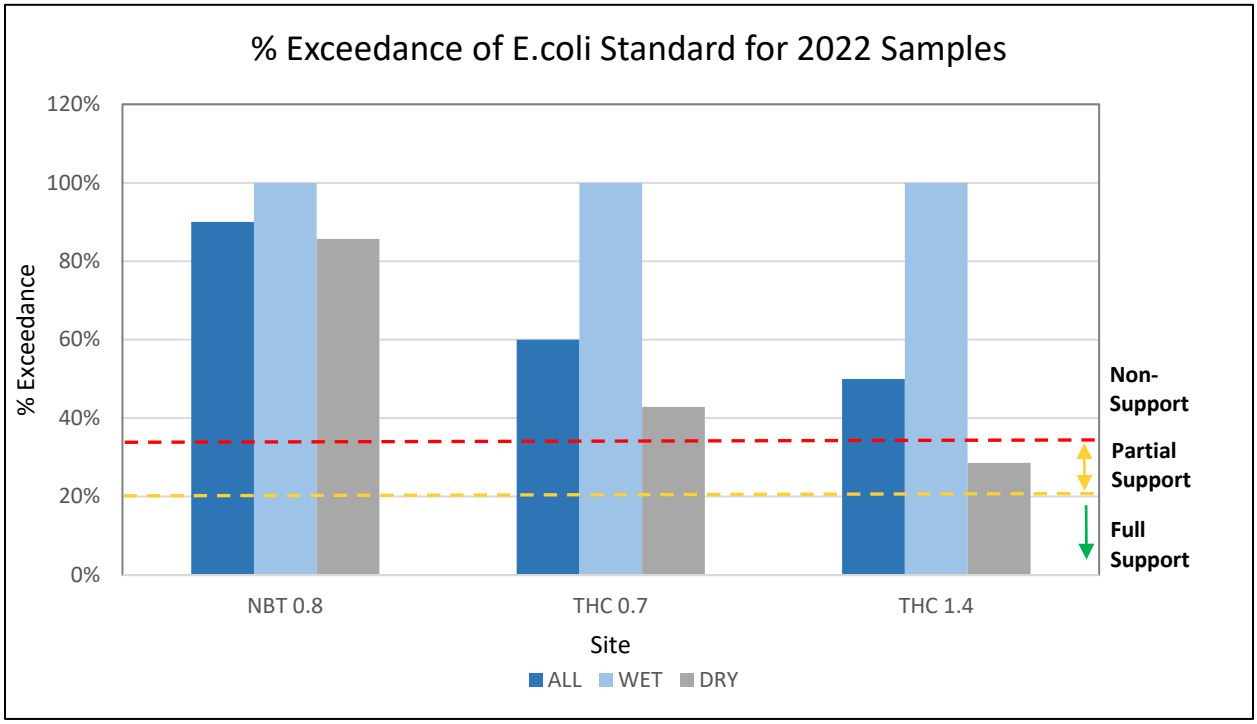

Figure 3.2.1 Percent Exceedance of E.coli Standard for 2022 Samples Collected in Threemile Creek

The percent exceedances for all sites and all conditions were in the non-support range for the PCR water quality standard, except for the dry condition samples for THC 1.4, which fell within the partial support range. Since 2022 was the first year that ten samples were collected from each

site, a previous comparison is not possible. However with the planned monitoring for all three sites again in 2026, a comparison and evaluation of any in-stream impacts resulting from implementation will be evaluated in that progress report.

2015 – 2023 THC 0.7 Monitoring Results

As noted in Section 3.1, site THC 0.7 was sampled at a greater frequency as part of the ambient and bi-weekly programs in 2015 – 2021 and remains an annually sampled site as part of SD1's monitoring program. Table 3.2.2 includes the results presented in the TMDL Alternative (2015 – 2021) with the additional results from 2022 and 2023. Refer to Appendix A for the *E.coli* results of the 2022-2023 events.

Table 3.2.2 Bi-weekly and Ambient *E. coli* Results for Site THC 0.7 - Number of Samples, Average and Percent of Samples Exceeding the Standard (excludes samples collected outside of the PCR Season)

		2015			2016			2017		
		#	AVG	%EX	#	AVG	%EX	#	AVG	%EX
THC 0.7	ALL	9	1750	78	13	1645	69	11	562	64
	WET	5	2930	100	5	3452	100	5	2982	60
	DRY	4	275	50	8	515	50	6	400	67
		2018			**2019**			**2020**		
		#	AVG	%EX	#	AVG	%EX	#	AVG	%EX
	ALL	9	438	67	9	432	56	9	202	11
	WET	5	562	80	2	1226	100	3	399	33
	DRY	4	283	50	7	205	43	6	104	0
		2021			**2022**			**2023**		
		#	AVG	%EX	#	AVG	%EX	#	AVG	%EX
	ALL	9	243	44	10	839	60	10	300	50
	WET	4	308	50	3	2147	100	2	630	100
	DRY	5	191	40	7	279	43	8	300	38

As with the 2022 results, more than six samples were collected within the PCR season for all nine years and the percent of samples exceeding the PCR water quality standard can be used to evaluate possible impairments. The results of this analysis are shown in Figure 3.2.2. Years 2022 and 2023 continue to fall into the non-support category for each category of events, with the wet events showing a greater exceedance. This is expected due to the high number of SSOs in the watershed. As implementation of the consent decree projects occurs, these percentages are expected to decrease and will continue to be assessed at this site annually.

Figure 3.2.3, a box and whisker plot comparing the data across years, shows a decrease in the range of the values as well as the mean except for year 2022. Table 3.2.2 shows the average of the wet samples at a much higher level (exceeding 2000), which hadn't occurred since 2017. Upon further evaluation, the 3 sample dates categorized as wet in 2022 had rainfall amounts

greater than an inch within 24 hours of the sample collection time. Model predicted SSOs also occurred within 24 hours of these events, which may be responsible for these higher averages.

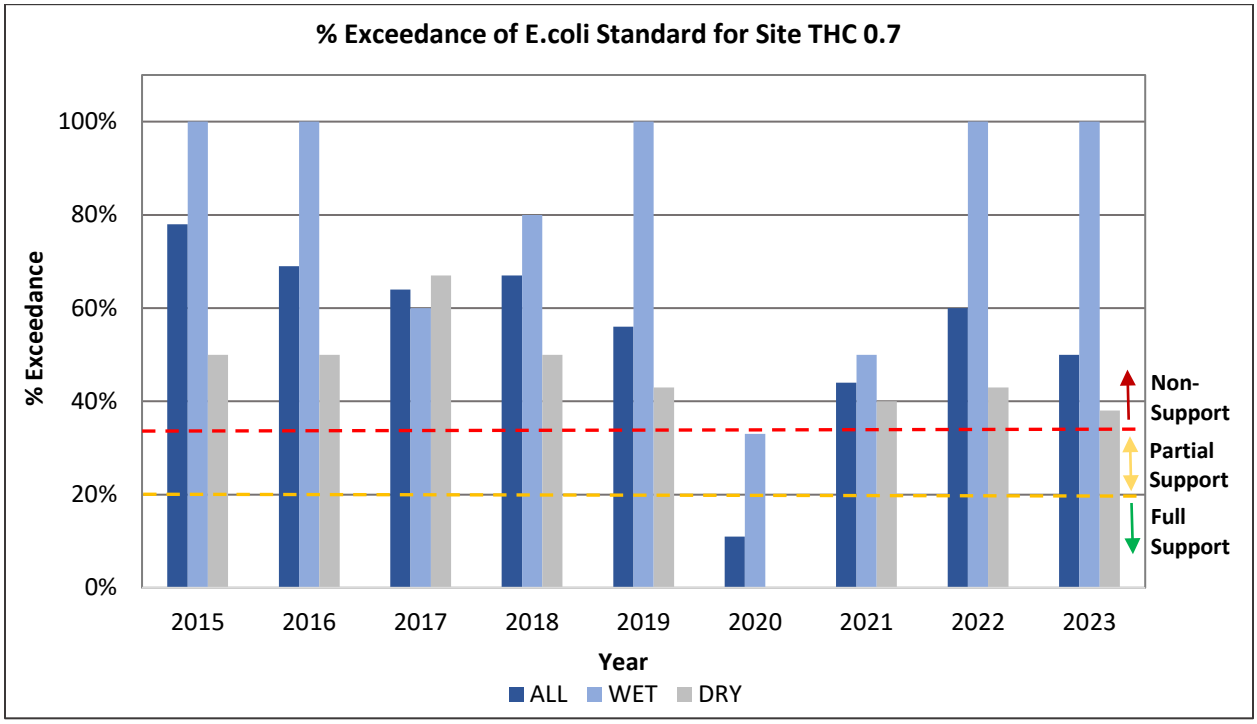

Figure 3.2.2 Percent Exceedance of E.coli Standard for Site THC 0.7

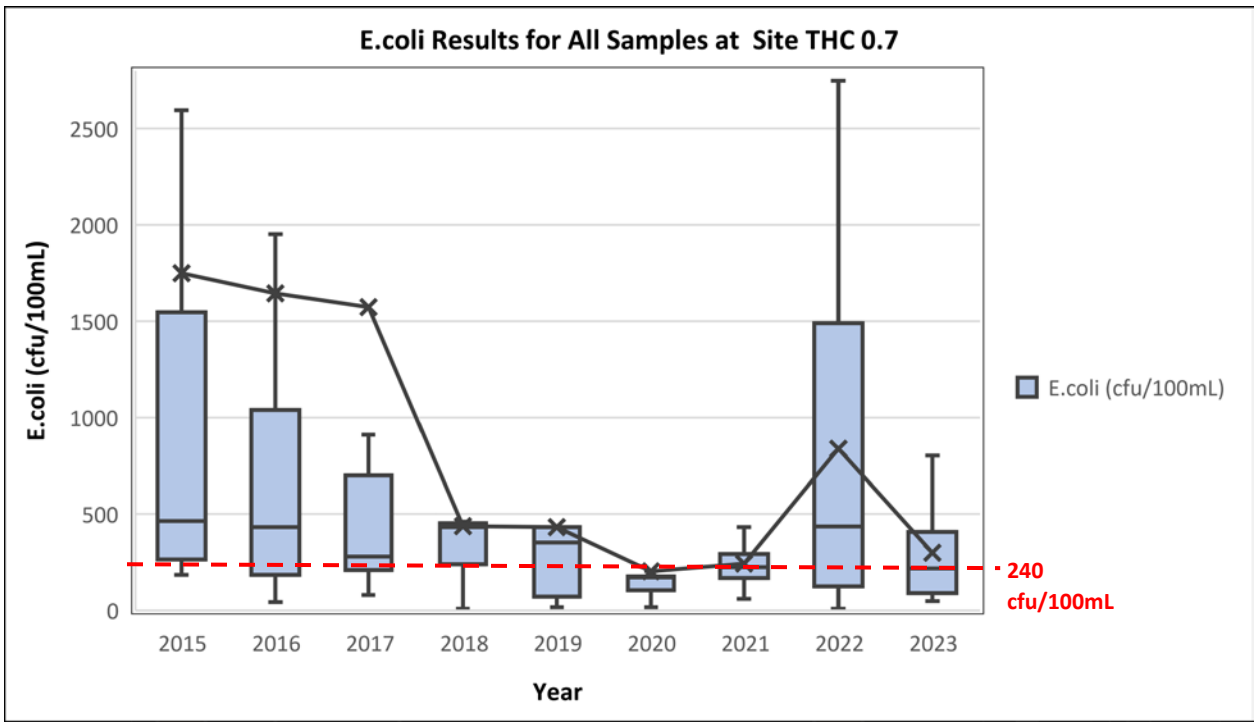

Figure 3.2.3 Box and Whisker Plot of All Samples at Site THC 0.7

Figure 3.2.4 and 3.2.5 SD1 Environmental Scientists Collecting Samples at Threemile Creek Site THC 0.7

3.4 Future Monitoring

SD1 will continue to sample Site THC 0.7 ten times every year with sites NBT 0.8 and THC1.4 planned for another round of sampling in 2026. Table 3.1.1 outlines the overall program and events. The results of these monitoring efforts will be reported and compared to previous results in future progress reports.

SD1 will continue to conduct all monitoring in accordance with established monitoring plans and standard operating procedures (SOPs). Any updates to the plans and SOPs will be provided in future progress reports.

Appendices

Appendix A – 2022 – 2023 *E.coli* Monitoring Results

Appendix B – 2022 Ambient Sampling Field Monitoring & Sampling Plan for Northern Kentucky Watersheds

Appendix C – 2023 Ambient Sampling Field Monitoring & Sampling Plan for Northern Kentucky Watersheds

Appendix A : 2022-2023 Threemile Creek E.coli Results

WShed_ID	Station_ID	RecWater_Name	RiverMile	Date	Time	Par_Name	Result	Meas_Units	Condition
Threemile Creek	NBT0.8	North Branch Threemile Creek	0.8	4/14/2022	9:15:00 AM	Ecoli	4110	#/100ml	WET
Threemile Creek	NBT0.8	North Branch Threemile Creek	0.8	5/12/2022	9:25:00 AM	Ecoli	452	#/100ml	DRY
Threemile Creek	NBT0.8	North Branch Threemile Creek	0.8	5/26/2022	9:25:00 AM	Ecoli	7700	#/100ml	DRY
Threemile Creek	NBT0.8	North Branch Threemile Creek	0.8	6/9/2022	9:30:00 AM	Ecoli	1380	#/100ml	WET
Threemile Creek	NBT0.8	North Branch Threemile Creek	0.8	7/14/2022	9:55:00 AM	Ecoli	3464	#/100ml	DRY
Threemile Creek	NBT0.8	North Branch Threemile Creek	0.8	7/28/2022	9:35:00 AM	Ecoli	1952	#/100ml	WET
Threemile Creek	NBT0.8	North Branch Threemile Creek	0.8	8/11/2022	9:30:00 AM	Ecoli	552	#/100ml	DRY
Threemile Creek	NBT0.8	North Branch Threemile Creek	0.8	8/25/2022	9:40:00 AM	Ecoli	888	#/100ml	DRY
Threemile Creek	NBT0.8	North Branch Threemile Creek	0.8	9/15/2022	10:20:00 AM	Ecoli	164	#/100ml	DRY
Threemile Creek	NBT0.8	North Branch Threemile Creek	0.8	10/20/2022	9:40:00 AM	Ecoli	364	#/100ml	DRY
Threemile Creek	THC0.7	Threemile Creek	0.7	4/14/2022	9:00:00 AM	Ecoli	2748	#/100ml	WET
Threemile Creek	THC0.7	Threemile Creek	0.7	5/12/2022	9:15:00 AM	Ecoli	124	#/100ml	DRY
Threemile Creek	THC0.7	Threemile Creek	0.7	5/26/2022	9:15:00 AM	Ecoli	508	#/100ml	DRY
Threemile Creek	THC0.7	Threemile Creek	0.7	6/9/2022	9:10:00 AM	Ecoli	1740	#/100ml	WET
Threemile Creek	THC0.7	Threemile Creek	0.7	7/14/2022	9:40:00 AM	Ecoli	744	#/100ml	DRY
Threemile Creek	THC0.7	Threemile Creek	0.7	7/28/2022	9:25:00 AM	Ecoli	1952	#/100ml	WET
Threemile Creek	THC0.7	Threemile Creek	0.7	8/11/2022	9:20:00 AM	Ecoli	364	#/100ml	DRY
Threemile Creek	THC0.7	Threemile Creek	0.7	8/25/2022	9:30:00 AM	Ecoli	128	#/100ml	DRY
Threemile Creek	THC0.7	Threemile Creek	0.7	9/15/2022	10:10:00 AM	Ecoli	76	#/100ml	DRY
Threemile Creek	THC0.7	Threemile Creek	0.7	10/20/2022	9:30:00 AM	Ecoli	8	#/100ml	DRY
Threemile Creek	THC1.4	Threemile Creek	1.4	4/14/2022	8:45:00 AM	Ecoli	6490	#/100ml	WET
Threemile Creek	THC1.4	Threemile Creek	1.4	5/12/2022	9:00:00 AM	Ecoli	80	#/100ml	DRY
Threemile Creek	THC1.4	Threemile Creek	1.4	5/26/2022	9:05:00 AM	Ecoli	212	#/100ml	DRY
Threemile Creek	THC1.4	Threemile Creek	1.4	6/9/2022	8:55:00 AM	Ecoli	2748	#/100ml	WET
Threemile Creek	THC1.4	Threemile Creek	1.4	7/14/2022	9:15:00 AM	Ecoli	1644	#/100ml	DRY
Threemile Creek	THC1.4	Threemile Creek	1.4	7/28/2022	9:10:00 AM	Ecoli	1740	#/100ml	WET
Threemile Creek	THC1.4	Threemile Creek	1.4	8/11/2022	9:05:00 AM	Ecoli	1304	#/100ml	DRY
Threemile Creek	THC1.4	Threemile Creek	1.4	8/25/2022	9:15:00 AM	Ecoli	84	#/100ml	DRY
Threemile Creek	THC1.4	Threemile Creek	1.4	9/15/2022	10:00:00 AM	Ecoli	112	#/100ml	DRY
Threemile Creek	THC1.4	Threemile Creek	1.4	10/20/2022	9:15:00 AM	Ecoli	168	#/100ml	DRY
Threemile Creek	THC0.7	Threemile Creek	0.7	4/19/2023	10:40:00 AM	Ecoli	76	#/100ml	DRY
Threemile Creek	THC0.7	Threemile Creek	0.7	5/10/2023	10:45:00 AM	Ecoli	260	#/100ml	DRY
Threemile Creek	THC0.7	Threemile Creek	0.7	5/24/2023	10:45:00 AM	Ecoli	48	#/100ml	DRY
Threemile Creek	THC0.7	Threemile Creek	0.7	6/13/2023	10:55:00 AM	Ecoli	456	#/100ml	WET
Threemile Creek	THC0.7	Threemile Creek	0.7	7/11/2023	10:50:00 AM	Ecoli	104	#/100ml	DRY
Threemile Creek	THC0.7	Threemile Creek	0.7	7/24/2023	10:55:00 AM	Ecoli	727	#/100ml	DRY
Threemile Creek	THC0.7	Threemile Creek	0.7	8/8/2023	10:35:00 AM	Ecoli	804	#/100ml	WET
Threemile Creek	THC0.7	Threemile Creek	0.7	8/22/2023	10:35:00 AM	Ecoli	176	#/100ml	DRY
Threemile Creek	THC0.7	Threemile Creek	0.7	9/12/2023	10:40:00 AM	Ecoli	264	#/100ml	DRY
Threemile Creek	THC0.7	Threemile Creek	0.7	10/17/2023	10:40:00 AM	Ecoli	84	#/100ml	DRY

AMBIENT SAMPLING
FIELD MONITORING & SAMPLING PLAN
FOR NORTHERN KENTUCKY WATERSHEDS

Northern Kentucky Sanitation District No.1
1045 Eaton Drive
Fort Wright, KY 41017

2022

TABLE OF CONTENTS

1. INTRODUCTION 1
   - 1.1 Program Overview 2
   - 1.2 Monitoring Team 3
2. MONITORING AND SAMPLING CRITERIA 4
3. STREAM CHARACTERIZATION 5
   - 3.1 On-Site Water Quality Measurements 6
   - 3.2 Ambient Sampling 7
   - 3.3 Summary 9
4. FIELD MEASUREMENTS 10
5. SAMPLING HANDLING AND CUSTODY 11
   - 5.1 Sample Labeling 11
   - 5.2 Sampling Collection, Handling and Transport 11
   - 5.3 Chain-of-Custody 12
   - 5.4 Field Logs and Records 12
   - 5.5 Sample Containers and Preservation 13
6. QUALITY ASSURANCE/QUALITY CONTROL PROGRAM 14
   - 6.1 Training 14
   - 6.2 Field Quality Control 15
   - 6.3 Equipment Cleaning Protocol 15
   - 6.4 QA/QC Samples 15
     - 6.4.1 Sample Duplicates 16
     - 6.4.2 Method Blanks 16
     - 6.4.3 Field Blanks 16
   - 6.5 Equipment Calibration 16
7. PROGRAM SAFETY 17
   - 7.1 General Safety Practices 17
   - 7.2 Health Hazards 18

FIGURES

Figure 1	Monitoring and Sampling Stations	3

TABLES

Table 1	Team Member Responsibilities	4
Table 2	Ambient Sampling Locations	6
Table 3	Ambient Monitoring Schedule	8
Table 4	Summary of Water Quality Monitoring and Sampling Program	9
Table 5	Summary of Number of Samples to be Collected	9
Table 6	Field Measurements	10
Table 7	Guidelines for Sample Container Preparation and Preservation	14
Table 8	QA/QC Sample Schedule	16
Table 9	Number of QA/QC Samples	16

APPENDICES

Appendix A	Standard Operating Procedures for Field Monitoring and Sampling
Appendix B	Northern KY Sanitation District No. 1 Chain of Custody
Appendix C	Northern KY Sanitation District No. 1 Field Data Sheet

1. INTRODUCTION

Sanitation District No. 1 (SD1) a clean water agency that serves over 30 communities in Campbell, Kenton and Boone Counties, Kentucky, as both the wastewater and storm water utility, is implementing a watershed management approach to cost-effectively meet numerous regulatory requirements (e.g., Combined Sewer Overflow (CSO) Program and Municipal Separate Storm Sewer System (MS4) Program). Additionally, SD1 has entered into a Consent Decree (CD) with state and federal environmental regulators to address sanitary overflows in these communities. In complying with these regulatory requirements, SD1 is applying an adaptive approach for identifying impairments and prioritizing areas for action. This approach will help ensure that available resources are most effectively used. SD1 has developed an Adaptive Watershed Management Plan that identifies Watershed Characterization in sixteen sub watersheds to relate in-stream conditions to watershed characteristics. The results of this Watershed Characterization will be used to identify impaired watersheds and prioritize them for consideration of control alternatives.

SD1 initiated a comprehensive watershed wide monitoring program in 2006 that involved the collection of instream water quality data in each of the sixteen watersheds in Northern Kentucky to characterize background conditions in the region. These sixteen watersheds represent varying conditions with respect to the amount of development, as well as sources of stream pollution. The variation in the stream conditions can range from undeveloped watersheds that have been categorized as “exceptional” waters by the State, while other watersheds are more highly developed and are identified as “impaired” by the State. As a result of the vast differences between these watersheds, SD1 implemented a biweekly sampling program over a two year period to further characterize stream conditions under a wide range of environmental conditions at 20 locations throughout Northern Kentucky.

After the biweekly sampling program concluded in June 2017, the ambient sampling program began in July 2017 as on ongoing sampling program. This sampling program has the same sampling protocol, but the schedule and sites have changed, instead of 20 locations there are 15. In 2020 after three years of sampling and an evaluation of the data, it was decided to add four reference sites to the schedule. In 2021 there was the decision to add core basin sites to the schedule. Each year beginning in the East Basin in 2021, Central Basin in 2022, North Basin in 2023 and West Basin in 2024 the core sites in that basin will be added. These sites will then rotate by basin each year.

The following ambient sampling *Field Monitoring and Sampling Plan* (FMSP) is designed to ensure that all monitoring activities undertaken result in representative data necessary to support the characterization of the watershed being sampled.

Monitoring and sampling stations have been selected to provide appropriate coverage to meet the assessment and modeling needs of the watershed characterization process.

1.1 Program Overview

This FMSP describes the water quality monitoring program for the ambient sampling of Northern Kentucky streams. The purpose of the FMSP is three fold:

- To supplement the Quality Assurance Project Plan (QAPP)
- To provide project and field staff with an understanding of the program and how to complete the base flow monitoring program; and,
- To define the level of effort and analytical needs.

The FMSP is intended to provide practical assistance in obtaining representative and reliable data in a technically sound and safe manner.

The procedures and protocols presented in this document address the following water quality and quantity monitoring program components:

- Monitoring and sampling criteria
- Stream water quality monitoring
- Sample handling and transportation
- QA/QC requirements
- Program Health and Safety

This program was designed to collect data that will be used to assess variation of water quality concerns identified in Northern Kentucky watersheds. The ambient data collected in Northern Kentucky streams is required to support water quality modeling, and pollutant source identification.

Figure 1 shows locations in the watersheds of the Northern Kentucky area that have been identified as monitoring and sampling stations. The sampling locations shown in Figure 1 are discussed in more detail in Section 3.

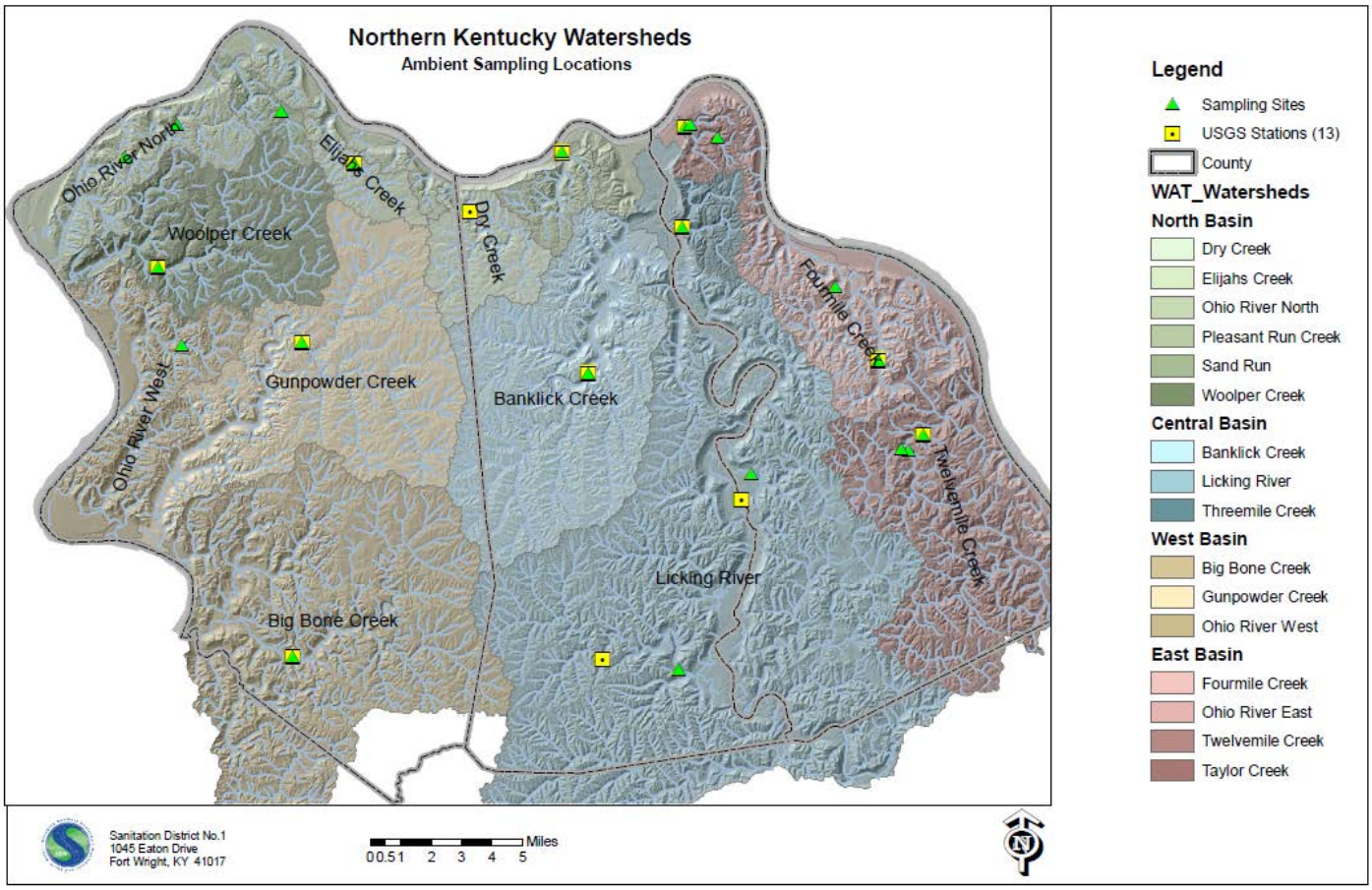

Figure 1 Monitoring and Sampling Stations

1.2 Monitoring Team

The monitoring team consists of the Project Manager, the Field Manager, and sampling crew. Responsibilities of key team members are listed in Table 1.

Table 1 Team Member Responsibilities

Position	SD1 Team Member	Responsibilities
Project Manager	Mindy Scott	• Assess suitability of sampling events • Perform System Audits • Circulation of reports and results • Staff Training • Review Reporting • Ensure necessary resources are available • Creation of event reports • QA/QC review
Field Manager	Elizabeth Fet	• Implementation of FMSP • Initiate sampling events • Coordinate with laboratory • Mobilize field crews • Collection and review of field logs, lab results, and other program documentation • Ongoing management of field staff and equipment

Prior to the first sampling event, a flowchart will be created which contains all members of the different sampling crews and laboratory contacts along with their respective contact numbers (home, work, and/or cellular numbers). This will allow for a network of communication prior to and during the monitored events. A communication network for the sampling team is essential to the ability to adapt the sampling program to changing environmental or weather conditions and/or equipment malfunctions.

2. MONITORING AND SAMPLING CRITERIA

The objective of the ambient monitoring and sampling program is to represent varying conditions with respect to the amount of development, as well as sources of stream pollution in each watershed. SD1 is implementing this program to further characterize stream conditions under a wide range of environmental conditions.

The criteria used to define the ambient sampling include:

- Weather conditions will vary, but sampling will be conducted unless deemed unsafe

The goal will be to conduct the sampling in varying weather conditions. The sampling will be distributed throughout the monitoring period by basin to characterize Northern Kentucky streams during fluctuating flow conditions.

Local conditions may require these criteria to be modified as the study progresses. Best professional judgment will be necessary to assess the suitability of a particular Ambient sampling event.

3. STREAM CHARACTERIZATION

Stream monitoring and sampling will be conducted at designated stations along Northern Kentucky streams as shown in Figure 1. Water quality monitoring and sampling will be conducted as follows:

- Samples will be collected at all sites on the designated day as shown on the corresponding schedule according to the surface water quality monitoring program protocols;
- All sites will be characterized on-site for in-stream water quality measurements (temperature, dissolved oxygen, pH, conductivity and turbidity).

Table 2 describes each of the stations as depicted in Figure 1. Station selection was based on an initial watershed reconnaissance, which focused upon suitable site configuration for stream sampling and location relative to key pollutant source inputs. Once final sampling locations were identified, latitude and longitude coordinates were obtained with a Global Positioning System (GPS) unit and recorded.

Standard operating procedures (SOPs) referenced in the following sections are provided in Appendix A.

Table 2 Ambient Monitoring Locations

Basin	Watershed/Sites	Locations	Description
Central	Banklick (4)	BLC3.9	Eaton Drive Bridge
		BLC8.1	Richardson Road Bridge (USGS)
		BLC15.6	Maher Road Bridge
		BPC0.1	Bridge on Bullock Pen Road
	Threemile (3)	THC0.5-NBT0.8	Moock Rd - North Branch Three Mile
		THC0.7	Threemile Creek Road (USGS)
		THC1.4	Gibson Lane
	Cruises (1)	CRC2.5	Cruises Creek
East	Fourmile (1)	FMC6.9	Poplar Ridge Road (USGS)
	Twelvemile (1)	TMC3.0	Route 1997 (USGS)
	Taylor (1)	TYC0.6	Donnermeyer Drive under 471 (USGS)
North	Woolper (2)	WPC5.0	Woolper Road (USGS)
		DLC1.0	Double Lick (Reference Site)
	Elijahs (1)	EJC2.8	Elijah Creek Road (USGS)
	Dry Creek (1)	DRC1.4	Dry Creek WWTP (USGS)
	Pleasant Run (1)	PRC0.3	Bridge on Oak Street (USGS)
	Sand Run (1)	SDR4.0	Thornwilde Subdivision
	Garrison (1)	GAC1.7	Garrison Creek Road (Reference Site)
	Second (1)	SEC1.6	Second Creek Road (Reference Site)
West	Gunpowder (1)	GPC14.7	Camp Ernst Road (USGS)
	Big Bone (1)	MLC3.0	Bridge at US 42 (USGS)
	Middle (1)	MDC5.5	Middle Creek Road (Reference Site)
		22 total sites	

3.1 On-Site Water Quality Measurements

All sites will be subject to on-site measurements during sampling events. On-site measurements will include DO, pH, temperature, conductivity and turbidity.

On-site water quality instrumentation will be calibrated and maintained in accordance with *Standard Operating Procedures Hydrolab Series 5 Water Quality Instrumentation.*

3.2 Ambient Sampling

Most sampling locations are accessible by bridges or by wading. Table 3 presents the monitoring schedule for the surface water sampling program for ambient sampling. All sampling will be performed by SD1 staff. Ambient samples will be collected as grab samples in accordance with *Standard Operating Procedures for the Collection of Discrete Water Samples*. Ambient sampling events will be completed by day, utilizing two person crews as described in Table 3.

All grab samples will be collected with a sampling pole, stainless steel bucket or glove method. Sampling events will start at the downstream site and progress upstream. This approach to ambient sampling is designed to collect a representative sample of current conditions in the stream. Immediately after sample collection, on-site measurements will be taken as previously described.

Table 3 Ambient Monitoring Schedule

Day One		
Watershed	**Site**	**Description**
Big Bone	MLC3.0	Bridge at US 42 (USGS)
Gunpowder	GPC14.7	Camp Ernst Road (USGS)
Woolper	DLC1.0	Happy Jack (Reference Site)
Middle	MDC5.5	Middle Creek Road (Reference Site)
Woolper	WPC5.0	Woolper Road (USGS)
Second	SEC1.6	Second Creek Road (Reference Site)
Garrison	GAC1.7	Garrison Creek Road (Reference Site)
Elijahs	EJC2.8	Elijah Creek Road (USGS)
Sand Run	SDR4.0	Thornwilde Subdivision
Day Two		
Watershed	**Site**	**Description**
Banklick	BPC0.1	Bridge on Bullock Pen Road
Banklick	BLC8.1	Richardson Road Bridge
Banklick	BLC15.6	Maher Road Bridge
Cruises	CRC2.5	Hempfling Road
Twelvemile	TMC3.0	Route 1997 (USGS)
Fourmile	FMC6.9	Poplar Ridge Road (USGS)
Day Three		
Watershed	**Site**	**Description**
Banklick	BLC3.9	Eaton Drive Bridge
Threemile	THC0.5-NBT0.8	Moock Rd - North Branch Three Mile
Threemile	THC0.7	Threemile Creek Road (USGS)
Threemile	THC1.4	Gibson Lane
Taylor	TYC0.6	Donnermeyer Drive under 471 (USGS)
Pleasant Run	PRC0.3	Bridge on Oak Street (USGS)
Dry Creek	DRC1.4	Dry Creek WWTP (USGS)

3.3 Summary

Table 4 presents a summary of the field monitoring and sampling plan for Northern Kentucky watersheds.

Table 4 Summary of Water Quality Monitoring and Sampling Program

Type	Locations	Description	Parameters
Ambient Sampling	22 total locations, throughout Northern Kentucky 4 basins (North, Central, West, East)	♦ Samples collected one week per month (April, June, August, October) ♦ Samples collected twice per month (May, July, and September) ♦ 1 grab sample per site	♦ On-site measurements will include: ***temperature, dissolved oxygen, pH, conductivity and turbidity.*** ♦ Water quality parameters will include: ***bacteria (EC), nitrogen (TKN, NH_3, NO_3-NO_2), phosphorus, total suspended solids.***

Table 5 summarizes the number of samples to be collected exclusive of quality control protocols.

Table 5 Summary of Number of Samples to be Collected

Task	Day One	Day Two	Day Three
Day Sampled	Tuesday	Wednesday	Thursday
No. of Events per week	1	1	1
No. of Sites	9	6	7
Bacteria			
E. coli	9	6	7
Nutrients			
NH_3	9	6	7
NO_3- NO_2	9	6	7
TKN	9	6	7
Total Phosphorus	9	6	7
Ortho Phosphate (field filtered)	4	3	4
Solids			
TSS	9	6	7
Total Sample Load	**58**	**39**	**46**

4. *FIELD MEASUREMENTS*

In-stream dissolved oxygen, temperature, pH, conductivity, and turbidity will be measured using appropriate field instruments concurrent with sample collection at each of the sampling locations. Each on-site parameter will be measured at each location during each sampling event. Table 6 lists the parameters, location of measurement at each site, and method of measurement.

Field measurements will be conducted following the Standard Operating Procedures in Appendix A. Field instruments will be calibrated before initiating monitoring activities for each event. A post-monitoring calibration check will also be conducted at the end of each monitoring event. All calibration and maintenance activities will be documented on the Multiprobe Instrumentation Calibration and QA Sheet (see Appendix A).

Measurements will be documented on the Field Data Sheet (see Appendix C). Documentation will include: date/time, location, type of measurement, personnel, equipment and associated calibration specifications, and general site observations (e.g., weather conditions).

Table 6. Field Measurements

Parameter	Location of Measurement	Method
Temperature	Mid-channel, mid-depth where possible	Hydrolab
Conductivity		
pH		
Dissolved Oxygen		
Turbidity		

5. SAMPLING HANDLING AND CUSTODY

The following sections outlines the sample labeling procedures, sample handling, chain-of-custody and record keeping required.

5.1 Sample Labeling

All samples will be assigned a unique identification code such that all necessary information can be attained from the sample label. The labels will be available in an electronic template and can be printed once the information has been added to the template. The code will identify the following:

Label: ___ ___ ___ ___. ___

1 2 3 4 5

Characters 1-5: Sample Site ID

Example: FMC0.5

In addition to the label, the sample bottles will be clearly marked using waterproof ink with the following information:

- Client – SD1
- Analyses – List of requested analyses to be performed from the container
- Preservative – Preservative in sample container
- Date – Date sample was collected
- Time – Time sample was collected
- Crew – Crew identification

5.2 Sampling Collection, Handling and Transport

General guidelines for sample collection are listed below. Refer to *Standard Operating Procedures for the Collection of Discrete Water Samples* for detailed procedures.

- All samples collected in intermediate sampling containers should be transferred to their appropriate laboratory sample bottle as quickly as possible.
- Sampling location codes will be used to distinguish each distinct sampling location.
- Sample labels and chains of custody must be filled out completely.

The following procedures will be followed when handling and transporting samples:

- Samples will be preserved using ice and transported in sample coolers. It should be ensured that plenty of ice is used for each sample cooler to maintain the temperatures inside the cooler at approximately 4^{o} C.
- Laboratory chain-of-custody forms will be included with all sample submissions. Field staff will keep copies.
- Sample bottles and coolers should be handled with care to prevent breakage/spillage.
- All sample bottle labels must be properly completed and placed firmly on each bottle by the field sampling crews.

5.3 Chain-of-Custody

Field crews will complete chain-of-custody forms to document the transfer of sample custody to the designated custodian and subsequent personnel, see Appendix B. Signatures of all personnel involved in the collection, transport, and receipt of each sample will be recorded on the chain-of-custody forms.

In certain instances, sample custody will be transferred to runners to transport the samples directly to the laboratory at designated times during sampling to avoid missing holding times. The chain-of-custody form outlines sample location, identification, collection time and date, and specific parameters to be analyzed for each sample. A properly completed chain-of-custody form must accompany all samples.

Use of the chain-of-custody form will terminate when laboratory personnel receive the samples and sign the form. The laboratory will open the sample coolers and carefully check the contents for evidence of leakage and to verify that samples were kept on ice. The laboratory will then verify that all information on the sample container label is correct and consistent with the chain-of-custody form. Any discrepancy between the sample bottle and the chain-of-custody form, any leaking sample containers, or any other abnormal situation will be reported to the Laboratory Manager. The Laboratory Manager will inform the Project Manager of any such problem, and corrective actions will be discussed and implemented.

5.4 Field Logs and Records

Field crews will document all activities associated with the monitoring program at each monitoring site, including unusual or anomalous conditions. In addition, a description of any problems encountered during the monitoring period and/or any deviations to the FMSP will also be documented. This information may subsequently be used for data interpretation and analyses.

All pertinent information will be recorded on Field Data Sheets which are included as Appendix C.

At the conclusion of each monitored event, all Field Data Sheets will be submitted to the Field Manager to serve as a chronological representation of the monitored event. At a minimum each data field sheet should include the following information:

- Project name, site/river name, sample type;
- Crew identification, date, start time/end time;
- Weather conditions, stream conditions, site conditions;
- Physical parameter data (on-site measurements);
- On-site water quality meter identification number used to measure physical parameter data;
- Field observations.

All entries will be completed with a permanent ink pen with no erasures, correction fluid, or tape used. Erroneous entries will be noted using a single line drawn through the mistake that is then dated and initialed.

5.5 Sample Containers and Preservation

Table 7 presents details of sample containers and preservatives to be used. The laboratory will provide all bottles pre-preserved.

Table 7 Guidelines for Sample Container Preparation and Preservation

Parameter	Container	Recommended Sample Volume	Preservation	Maximum Storage Time
Bacteria				
E. coli	Pre-Sterilized Polyethylene or Glass	120 ml	Add $Na_2S_2O_7$ [1] Refrigerate to 4°C	12 hours[2]
Nutrients				
NH_3 TKN NO_3-NO_2 Total Phosphorus	Polyethylene or Glass	1000 ml	Add H_2SO_4, pH<2 Refrigerate to 4°C	28 days
Ortho Phosphate	Polyethylene or Glass	120 ml	Field filter Refrigerate to 4°C	48 hours
Conventional				
TSS	Polyethylene or Glass	1000 ml	Refrigerate to 4°C	7 days

1. Sodium Thiosulfate ($Na_2S_2O_7$) prevents continuation of bacteriocidal action.
2. The maximum allowable holding time for bacteria samples will be 12 hours with a goal of 6 hours when practical.

6. QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

The purpose of any quality assurance/quality control (QA/QC) program is to ensure that all sampling protocols and procedures are followed such that samples are representative of the water quality to which they are associated. The program is designed to be a systematic process, which together with the laboratory QA/QC program ensures a high degree of confidence in the data collection. The proposed QA/QC program includes the following elements:

- Training of all field staff;
- Field quality control procedures;
- Equipment cleaning protocol;
- QA/QC samples; and,
- Equipment calibration.

6.1 Training

Training sessions will be carried out for all field staff on proper sampling, sample handling and submission and general field procedures. Specific emphasis will be placed on QA/QC issues as well as on health and safety. Field crews will receive

training involving the operation, maintenance and calibration of water quality meters, and all other on-site equipment used throughout the field program. SOPs for all program elements will be distributed to staff and available at all times.

6.2 Field Quality Control

The quality of data generated in a laboratory depends primarily on the integrity of the samples that arrive at the laboratory. Consequently, necessary precautions must be taken to protect samples from contamination and deterioration. Procedures detailed in *Standard Operating Procedures for the Collection of Discrete Water Samples* and *Standard Operating Procedures for Hydrolab Series 5 Water Quality Instrumentation* will be followed to ensure field quality control.

6.3 Equipment Cleaning Protocol

All sampling equipment (i.e. intermediate containers, sampling buckets, etc.) will follow the QA/QC protocol outlined in *Standard Operating Procedures for the Collection of Discrete Water Samples* to ensure representative sample collection. When using the sampling pole or stainless steel bucket, only step 2 (Blank Water Rinse) of the decontamination procedure needs to be utilized.

6.4 QA/QC Samples

The monitoring team will use three types of QA/QC samples collected in the field to assist in validating chemical data sets – sample duplicates, equipment blanks, and field blanks. Each type of QA/QC sample is described in the following sections. Tables 8 and 9 present the schedule and number of QA/QC samples to be collected during the field program.

Table 8 QA/QC Sample Schedule

Ambient Sampling			
Day	Tuesday	Wednesday	Thursday
	Dup*, FB, MB	Dup*, FB, MB	Dup*, FB, MB
MB= Method Blank Dup = Duplicate FB = Field Blank * = Dup will rotate between days			

Table 9 Number of QA/QC Samples

Ambient Sampling	Field Blanks[2]	Method Blanks[3]	Duplicate Samples[4]	Total per Event
Day 1	1	1	1	3
Day 2	1	1	0	2
Day 3	1	1	0	2
Totals	**3**	**3**	**1**	**7**

1. Each QA/QC sample set is performed on the complete series of samples submitted for laboratory analysis.
2. One set of field blanks per day will be collected during each day of the week.
3. One set of method blanks (at one site) per day will be collected during each day of the event.
4. One set of duplicates (at one site) will be collected during each week.

6.4.1 *Sample Duplicates*

Sample duplicates will be collected for laboratory analysis for each parameter. The purpose of these analyses is to evaluate sample collection precision by comparing the duplicate analytical results. One set of duplicate samples at a sampling location, randomly identified, will be collected by each field crew during the sampling event. Duplicates will be rotated among streams between sampling rounds. Approximately 10 percent of the samples will be collected in duplicate.

6.4.2 *Method Blanks*

Method blanks (MB) will be collected for laboratory analysis for orthophosphate only. The purpose of these analyses is to assess potential cross-contamination of samples by the method in which the sample was collected. These blanks will be taken at the conclusion of each sampling shift by each crew.

6.4.3 *Field Blanks*

Field blanks will be collected for laboratory analysis for all parameters. The purpose of these analyses is to determine if samples collected have been contaminated by field handling and cleaning methods. Each field crew will collect these blanks immediately following the collection of the AEB equipment blanks.

6.5 Equipment Calibration

On-site physical parameters will be measured in-stream by water quality meters and recorded on data sheets. These instruments will be calibrated each sampling day before use according to the manufactures operating manual as outlined in *Standard Operating Procedures for Hydrolab Series 5 Water Quality Instrumentation*.

At the conclusion of the sampling event, each meter will be checked with the standards used during calibration. The purpose of these readings is to evaluate the meter's precision (electronic drift) by comparing the readings recorded during calibration and the readings recorded during the check at the end of the sampling day.

At the conclusion of each sampling event, all Calibration Sheets will be submitted to the Field Manager to serve as a record of the meter's performance during the sampling event.

7. PROGRAM SAFETY

The most critical component of a sampling program is crew safety. Safety is of paramount importance as stream sampling can be extremely dangerous. The element of danger is accentuated if personnel are unfamiliar with their surroundings and/or procedures, consequently staff must be properly trained in both safety and monitoring procedures, following a well thought out program.

With stream monitoring, common sense is essential. Two hazards that field staff may face more often, especially if wet weather occurs during sampling, are high stream conditions and slippery footing. If stream levels are deemed to be too high or too fast, under no circumstances should any field staff enter the stream or operate near its banks. With surfaces being wet and slippery, special care must be taken when walking and working around bridges.

Wading is one of the easiest methods to collect samples from many streams, and it may also be extremely dangerous. Wading permits the investigator to examine stream flow and decide where to sample. Rubber boots or even chest-high waders are standard equipment. If the wader has any uncertainty about their ability to wade a stream, they should be attached by a rope to a rigid mooring and wear an approved floatation device.

If creek conditions are high and fast, field staff will wear a safety belt or harness and will be appropriately tethered when working in close proximity to the creek. Along with being attached by rope, field staff must wear an approved floatation device.

There must be a minimum of two field staff working together during any sampling event.

7.1 General Safety Practices

- Water depth during wading operations must be checked with a pole before steps are taken.
- When wading equipment is worn, the support straps must be outside the clothing.
- In all situations field parties are required to leave accurate sampling schedules and expected itineraries in the office.

- Sampling must never be carried out in weather that is considered by the Field Manager or field member to be hazardous to the well-being of the field staff and/or equipment.
- Field staff are required to wear approved floatation devices and be tethered if conditions warrant use.
- First aid kits will be issued to all field crews.
- Each field crew will have a cellular phone and have been instructed on emergency procedures and numbers.
- Each field crew will report upon leaving and returning from any sampling or field work to their Field Manager.
- Each field crew will have appropriate lights, markers, etc. to be able to perform their work safely under poor visibility/nightfall.
- Each field crew will have the appropriate road safety equipment as required.

7.2 Health Hazards

Disease causing bacteria, viruses, and parasites are always present in sewers and discharge streams. They occur in both liquid sewage and dry sludge which coats pipes, and other surfaces. The serious threats are Hepatitis A (virus), Hepatitis B (virus), Tetanus (bacteria), Typhoid (bacteria), and Polio (virus). Proper hygiene methods must be followed. Wash hands before eating or smoking. Protective clothing must be laundered and equipment kept clean. Workers should avoid touching their eyes to prevent an inflammation. Cuts and abrasions of the skin should be covered by bandages or gloves to minimize the chance of infection by organisms.

APPENDIX A

STANDARD OPERATING PROCEDURES FOR FIELD MONITORING AND SAMPLING

APPENDIX B

NORTHERN KY SANITATION DISTRICT NO.1
CHAIN OF CUSTODY

APPENDIX C

NORTHERN KY SANITATION DISTRICT NO.1
FIELD DATA SHEET

AMBIENT SAMPLING
FIELD MONITORING & SAMPLING PLAN
FOR NORTHERN KENTUCKY WATERSHEDS

Northern Kentucky Sanitation District No.1
1045 Eaton Drive
Fort Wright, KY 41017

2023

TABLE OF CONTENTS

1. INTRODUCTION....1
   - 1.1 Program Overview....2
   - 1.2 Monitoring Team....3
2. MONITORING AND SAMPLING CRITERIA....4
3. STREAM CHARACTERIZATION....5
   - 3.1 On-Site Water Quality Measurements....6
   - 3.2 Ambient Sampling....6
   - 3.3 Summary....9
4. FIELD MEASUREMENTS....10
5. SAMPLING HANDLING AND CUSTODY....11
   - 5.1 Sample Labeling....11
   - 5.2 Sampling Collection, Handling and Transport....11
   - 5.3 Chain-of-Custody....12
   - 5.4 Field Logs and Records....12
   - 5.5 Sample Containers and Preservation....13
6. QUALITY ASSURANCE/QUALITY CONTROL PROGRAM....14
   - 6.1 Training....14
   - 6.2 Field Quality Control....15
   - 6.3 Equipment Cleaning Protocol....15
   - 6.4 QA/QC Samples....15
     - 6.4.1 Sample Duplicates....16
     - 6.4.2 Method Blanks....16
     - 6.4.3 Field Blanks....16
   - 6.5 Equipment Calibration....16
7. PROGRAM SAFETY....17
   - 7.1 General Safety Practices....17
   - 7.2 Health Hazards....18

FIGURES

Figure 1	Monitoring and Sampling Stations	3

TABLES

Table 1	Team Member Responsibilities	4
Table 2	Ambient Sampling Locations	6
Table 3	Ambient Monitoring Schedule	8
Table 4	Summary of Water Quality Monitoring and Sampling Program	9
Table 5	Summary of Number of Samples to be Collected	9
Table 6	Field Measurements	10
Table 7	Guidelines for Sample Container Preparation and Preservation	14
Table 8	QA/QC Sample Schedule	16
Table 9	Number of QA/QC Samples	16

APPENDICES

Appendix A	Standard Operating Procedures for Field Monitoring and Sampling
Appendix B	Northern KY Sanitation District No. 1 Chain of Custody
Appendix C	Northern KY Sanitation District No. 1 Field Data Sheet

1. *INTRODUCTION*

Sanitation District No. 1 (SD1) a clean water agency that serves over 30 communities in Campbell, Kenton and Boone Counties, Kentucky, as both the wastewater and storm water utility, is implementing a watershed management approach to cost-effectively meet numerous regulatory requirements (e.g., Combined Sewer Overflow (CSO) Program and Municipal Separate Storm Sewer System (MS4) Program). Additionally, SD1 has entered into a Consent Decree (CD) with state and federal environmental regulators to address sanitary overflows in these communities. In complying with these regulatory requirements, SD1 is applying an adaptive approach for identifying impairments and prioritizing areas for action. This approach will help ensure that available resources are most effectively used. SD1 has developed an Adaptive Watershed Management Plan that identifies Watershed Characterization in sixteen sub watersheds to relate in-stream conditions to watershed characteristics. The results of this Watershed Characterization will be used to identify impaired watersheds and prioritize them for consideration of control alternatives.

SD1 initiated a comprehensive watershed wide monitoring program in 2006 that involved the collection of instream water quality data in each of the sixteen watersheds in Northern Kentucky to characterize background conditions in the region. These sixteen watersheds represent varying conditions with respect to the amount of development, as well as sources of stream pollution. The variation in the stream conditions can range from undeveloped watersheds that have been categorized as "exceptional" waters by the State, while other watersheds are more highly developed and are identified as "impaired" by the State. As a result of the vast differences between these watersheds, SD1 implemented a biweekly sampling program over a two year period to further characterize stream conditions under a wide range of environmental conditions at 20 locations throughout Northern Kentucky.

After the biweekly sampling program concluded in June 2017, the ambient sampling program began in July 2017 as on ongoing sampling program. This sampling program has the same sampling protocol, but the schedule and sites have changed, instead of 20 locations there are 15. In 2020 after three years of sampling and an evaluation of the data, it was decided to add four reference sites to the schedule. In 2021 there was the decision to add core basin sites to the schedule. Each year beginning in the East Basin in 2021, Central Basin in 2022, North Basin in 2023 and West Basin in 2024 the core sites in that basin will be added. These sites will then rotate by basin each year.

The following ambient sampling *Field Monitoring and Sampling Plan* (FMSP) is designed to ensure that all monitoring activities undertaken result in representative data necessary to support the characterization of the watershed being sampled.

Monitoring and sampling stations have been selected to provide appropriate coverage to meet the assessment and modeling needs of the watershed characterization process.

1.1 Program Overview

This FMSP describes the water quality monitoring program for the ambient sampling of Northern Kentucky streams. The purpose of the FMSP is three fold:

- To supplement the Quality Assurance Project Plan (QAPP)
- To provide project and field staff with an understanding of the program and how to complete the base flow monitoring program; and,
- To define the level of effort and analytical needs.

The FMSP is intended to provide practical assistance in obtaining representative and reliable data in a technically sound and safe manner.

The procedures and protocols presented in this document address the following water quality and quantity monitoring program components:

- Monitoring and sampling criteria
- Stream water quality monitoring
- Sample handling and transportation
- QA/QC requirements
- Program Health and Safety

This program was designed to collect data that will be used to assess variation of water quality concerns identified in Northern Kentucky watersheds. The ambient data collected in Northern Kentucky streams is required to support water quality modeling, and pollutant source identification.

Figure 1 shows locations in the watersheds of the Northern Kentucky area that have been identified as monitoring and sampling stations. The sampling locations shown in Figure 1 are discussed in more detail in Section 3.

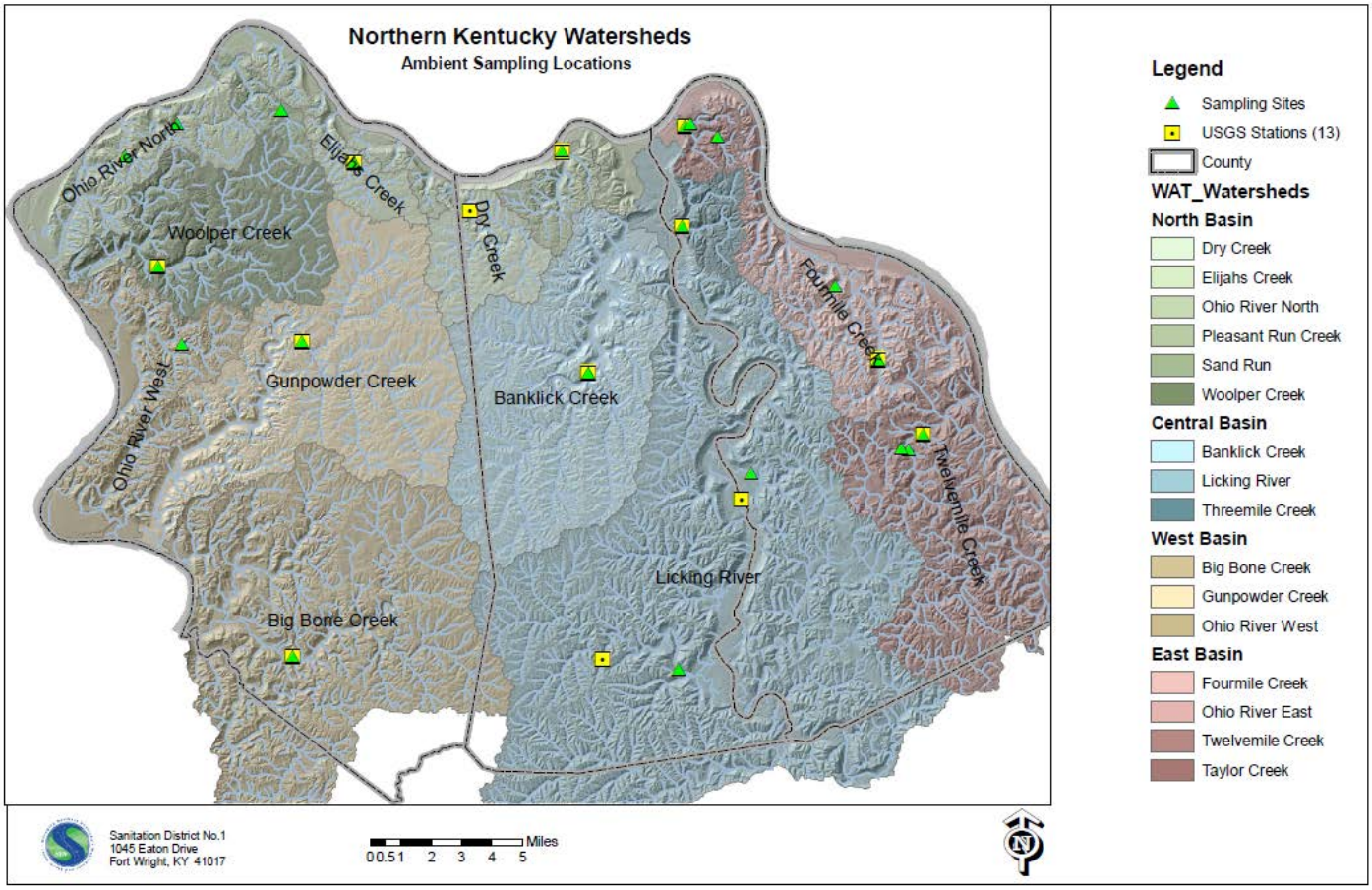

Figure 1 Monitoring and Sampling Stations

1.2 Monitoring Team

The monitoring team consists of the Project Manager, the Field Manager, and sampling crew. Responsibilities of key team members are listed in Table 1.

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Position	SD1 Team Member	Responsibilities
Project Manager	Mindy Scott	• Assess suitability of sampling events • Perform System Audits • Circulation of reports and results • Staff Training • Review Reporting • Ensure necessary resources are available • Creation of event reports • QA/QC review
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Prior to the first sampling event, a flowchart will be created which contains all members of the different sampling crews and laboratory contacts along with their respective contact numbers (home, work, and/or cellular numbers). This will allow for a network of communication prior to and during the monitored events. A communication network for the sampling team is essential to the ability to adapt the sampling program to changing environmental or weather conditions and/or equipment malfunctions.

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Stream monitoring and sampling will be conducted at designated stations along Northern Kentucky streams as shown in Figure 1. Water quality monitoring and sampling will be conducted as follows:

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- All sites will be characterized on-site for in-stream water quality measurements (temperature, dissolved oxygen, pH, conductivity and turbidity).

Table 2 describes each of the stations as depicted in Figure 1. Station selection was based on an initial watershed reconnaissance, which focused upon suitable site configuration for stream sampling and location relative to key pollutant source inputs. Once final sampling locations were identified, latitude and longitude coordinates were obtained with a Global Positioning System (GPS) unit and recorded.

Standard operating procedures (SOPs) referenced in the following sections are provided in Appendix A.

Table 2 Ambient Monitoring Locations

Basin	Watershed/Sites	Locations	Description
Central	Banklick (1)	BLC8.1	Richardson Road Bridge (USGS)
	Threemile (1)	THC0.7	Threemile Creek Road (USGS)
	Cruises (1)	CRC2.5	Cruises Creek
East	Fourmile (1)	FMC6.9	Poplar Ridge Road (USGS)
	Twelvemile (1)	TMC3.0	Route 1997 (USGS)
	Taylor (1)	TYC0.6	Donnermeyer Drive under 471 (USGS)
North	Woolper (4)	WPC5.0	Woolper Road (USGS)
		DLC1.0	Double Lick (Reference Site)
		ALF0.1	Huffman-Clifford Bridge on Easton Lane
		WPC8.8	Bridge on Route 338
	Elijahs (2)	EJC0.3	Bridge on Route 8
		EJC2.8	Elijah Creek Road (USGS)
	Dry Creek (3)	DRC1.4	Dry Creek WWTP (USGS)
		DRC3.0-WFD1.5	Bridge on Erlanger Road from Houston Road
		DRC4.4	On Eubanks Road from Anderson Road
	Pleasant Run (2)	PRC0.3	Bridge on Oak Street (USGS)
		PRC2.0	Bridge over Bromley Crescent Springs Road
	Sand Run (2)	SDR0.6	End of Route 8
		SDR4.0	Thornwilde Subdivision
	Garrison (1)	GAC1.7	Garrison Creek Road (Reference Site)
	Second (1)	SEC1.6	Second Creek Road (Reference Site)
West	Gunpowder (1)	GPC14.7	Camp Ernst Road (USGS)
	Big Bone (1)	MLC3.0	Bridge at US 42 (USGS)
	Middle (1)	MDC5.5	Middle Creek Road (Reference Site)

3.1 On-Site Water Quality Measurements

All sites will be subject to on-site measurements during sampling events. On-site measurements will include DO, pH, temperature, conductivity and turbidity.

On-site water quality instrumentation will be calibrated and maintained in accordance with *Standard Operating Procedures Hydrolab Series 5 Water Quality Instrumentation.*

3.2 Ambient Sampling

Most sampling locations are accessible by bridges or by wading. Table 3 presents the monitoring schedule for the surface water sampling program for ambient sampling. All sampling will be performed by SD1 staff. Ambient samples will be collected as grab samples in accordance with *Standard Operating Procedures for the Collection of*

Discrete Water Samples. Ambient sampling events will be completed by day, utilizing two person crews as described in Table 3.

All grab samples will be collected with a sampling pole, stainless steel bucket or glove method. Sampling events will start at the downstream site and progress upstream. This approach to ambient sampling is designed to collect a representative sample of current conditions in the stream. Immediately after sample collection, on-site measurements will be taken as previously described.

Table 3 Ambient Monitoring Schedule

Day One

Watershed	Site	Description
Big Bone	MLC3.0	Bridge at US 42 (USGS)
Gunpowder	GPC14.7	Camp Ernst Road (USGS)
Middle	MDC5.5	Middle Creek Road (Reference Site)
Woolper	WPC5.0	Woolper Road (USGS)
Second	SEC1.6	Second Creek Road (Reference Site)
Woolper	DLC1.0	Happy Jack (Reference Site)
Woolper	WPC8.8	Bridge on Route 338
Woolper	ALF0.1	Huffman-Clifford Bridge on Easton Lane
Elijahs	EJC2.8	Elijah Creek Road (USGS)

Day Two

Watershed	Site	Description
Banklick	BLC8.1	Richardson Road Bridge
Cruises	CRC2.5	Hempfling Road
Twelvemile	TMC3.0	Route 1997 (USGS)
Fourmile	FMC6.9	Poplar Ridge Road (USGS)
Threemile	THC0.7	Threemile Creek Road (USGS)
Taylor	TYC0.6	Donnermeyer Drive under 471 (USGS)
Pleasant Run	PRC0.3	Bridge on Oak Street (USGS)
Dry Creek	DRC1.4	Dry Creek WWTP (USGS)

Day Three

Watershed	Site	Description
Pleasant Run	PRC2.0	Bridge over Bromley Crescent Springs Road
Dry Creek	DRC4.4	On Eubanks Road from Anderson Road
Dry Creek	DRC3.0-WFD1.5	Bridge on Erlanger Road from Houston Road
Garrison	GAC1.7	Garrison Creek Road (Reference Site)
Sand Run	SDR4.0	Thornwilde Subdivision
Sand Run	SDR0.6	End of Route 8
Elijahs	EJC0.3	Bridge on Route 8

3.3 Summary

Table 4 presents a summary of the field monitoring and sampling plan for Northern Kentucky watersheds.

Table 4 Summary of Water Quality Monitoring and Sampling Program

Type	Locations	Description	Parameters
Ambient Sampling	24 total locations, throughout Northern Kentucky 4 basins (North, Central, West, East)	♦ Samples collected one week per month (April, June, August, October) ♦ Samples collected twice per month (May, July, and September) ♦ 1 grab sample per site	♦ On-site measurements will include: ***temperature, dissolved oxygen, pH, conductivity and turbidity.*** ♦ Water quality parameters will include: ***bacteria (EC), nitrogen (TKN, NH_3, NO_3-NO_2), phosphorus, total suspended solids.***

Table 5 summarizes the number of samples to be collected exclusive of quality control protocols.

Table 5 Summary of Number of Samples to be Collected

Task	Day One	Day Two	Day Three
Day Sampled	Tuesday	Wednesday	Thursday
No. of Events per week	1	1	1
No. of Sites	9	6	7
Bacteria			
E. coli	9	6	7
Nutrients			
NH_3	9	6	7
NO_3- NO_2	9	6	7
TKN	9	6	7
Total Phosphorus	9	6	7
Ortho Phosphate (field filtered)	4	3	4
Solids			
TSS	9	6	7
Total Sample Load	**58**	**39**	**46**

4. *FIELD MEASUREMENTS*

In-stream dissolved oxygen, temperature, pH, conductivity, and turbidity will be measured using appropriate field instruments concurrent with sample collection at each of the sampling locations. Each on-site parameter will be measured at each location during each sampling event. Table 6 lists the parameters, location of measurement at each site, and method of measurement.

Field measurements will be conducted following the Standard Operating Procedures in Appendix A. Field instruments will be calibrated before initiating monitoring activities for each event. A post-monitoring calibration check will also be conducted at the end of each monitoring event. All calibration and maintenance activities will be documented on the Multiprobe Instrumentation Calibration and QA Sheet (see Appendix A).

Measurements will be documented on the Field Data Sheet (see Appendix C). Documentation will include: date/time, location, type of measurement, personnel, equipment and associated calibration specifications, and general site observations (e.g., weather conditions).

Table 6. Field Measurements

Parameter	Location of Measurement	Method
Temperature	Mid-channel, mid-depth where possible	Hydrolab
Conductivity		
pH		
Dissolved Oxygen		
Turbidity		

5. SAMPLING HANDLING AND CUSTODY

The following sections outlines the sample labeling procedures, sample handling, chain-of-custody and record keeping required.

5.1 Sample Labeling

All samples will be assigned a unique identification code such that all necessary information can be attained from the sample label. The labels will be available in an electronic template and can be printed once the information has been added to the template. The code will identify the following:

Label: ___ ___ ___ ___. ___

1 2 3 4 5

Characters 1-5: Sample Site ID

Example: FMC0.5

In addition to the label, the sample bottles will be clearly marked using waterproof ink with the following information:

- Client – SD1
- Analyses – List of requested analyses to be performed from the container
- Preservative – Preservative in sample container
- Date – Date sample was collected
- Time – Time sample was collected
- Crew – Crew identification

5.2 Sampling Collection, Handling and Transport

General guidelines for sample collection are listed below. Refer to *Standard Operating Procedures for the Collection of Discrete Water Samples* for detailed procedures.

- All samples collected in intermediate sampling containers should be transferred to their appropriate laboratory sample bottle as quickly as possible.
- Sampling location codes will be used to distinguish each distinct sampling location.
- Sample labels and chains of custody must be filled out completely.

The following procedures will be followed when handling and transporting samples:

- Samples will be preserved using ice and transported in sample coolers. It should be ensured that plenty of ice is used for each sample cooler to maintain the temperatures inside the cooler at approximately 4° C.
- Laboratory chain-of-custody forms will be included with all sample submissions. Field staff will keep copies.
- Sample bottles and coolers should be handled with care to prevent breakage/spillage.
- All sample bottle labels must be properly completed and placed firmly on each bottle by the field sampling crews.

5.3 Chain-of-Custody

Field crews will complete chain-of-custody forms to document the transfer of sample custody to the designated custodian and subsequent personnel, see Appendix B. Signatures of all personnel involved in the collection, transport, and receipt of each sample will be recorded on the chain-of-custody forms.

In certain instances, sample custody will be transferred to runners to transport the samples directly to the laboratory at designated times during sampling to avoid missing holding times. The chain-of-custody form outlines sample location, identification, collection time and date, and specific parameters to be analyzed for each sample. A properly completed chain-of-custody form must accompany all samples.

Use of the chain-of-custody form will terminate when laboratory personnel receive the samples and sign the form. The laboratory will open the sample coolers and carefully check the contents for evidence of leakage and to verify that samples were kept on ice. The laboratory will then verify that all information on the sample container label is correct and consistent with the chain-of-custody form. Any discrepancy between the sample bottle and the chain-of-custody form, any leaking sample containers, or any other abnormal situation will be reported to the Laboratory Manager. The Laboratory Manager will inform the Project Manager of any such problem, and corrective actions will be discussed and implemented.

5.4 Field Logs and Records

Field crews will document all activities associated with the monitoring program at each monitoring site, including unusual or anomalous conditions. In addition, a description of any problems encountered during the monitoring period and/or any deviations to the FMSP will also be documented. This information may subsequently be used for data interpretation and analyses.

All pertinent information will be recorded on Field Data Sheets which are included as Appendix C.

At the conclusion of each monitored event, all Field Data Sheets will be submitted to the Field Manager to serve as a chronological representation of the monitored event. At a minimum each data field sheet should include the following information:

- Project name, site/river name, sample type;
- Crew identification, date, start time/end time;
- Weather conditions, stream conditions, site conditions;
- Physical parameter data (on-site measurements);
- On-site water quality meter identification number used to measure physical parameter data;
- Field observations.

All entries will be completed with a permanent ink pen with no erasures, correction fluid, or tape used. Erroneous entries will be noted using a single line drawn through the mistake that is then dated and initialed.

5.5 Sample Containers and Preservation

Table 7 presents details of sample containers and preservatives to be used. The laboratory will provide all bottles pre-preserved.

Table 7 Guidelines for Sample Container Preparation and Preservation

Parameter	Container	Recommended Sample Volume	Preservation	Maximum Storage Time
Bacteria				
E. coli	Pre-Sterilized Polyethylene or Glass	120 ml	Add $Na_2S_2O_7$ [1] Refrigerate to 4°C	12 hours[2]
Nutrients				
NH_3 TKN NO_3-NO_2 Total Phosphorus	Polyethylene or Glass	1000 ml	Add H_2SO_4, pH<2 Refrigerate to 4°C	28 days
Ortho Phosphate	Polyethylene or Glass	120 ml	Field filter Refrigerate to 4°C	48 hours
Conventional				
TSS	Polyethylene or Glass	1000 ml	Refrigerate to 4°C	7 days

1. Sodium Thiosulfate ($Na_2S_2O_7$) prevents continuation of bacteriocidal action.
2. The maximum allowable holding time for bacteria samples will be 12 hours with a goal of 6 hours when practical.

6. QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

The purpose of any quality assurance/quality control (QA/QC) program is to ensure that all sampling protocols and procedures are followed such that samples are representative of the water quality to which they are associated. The program is designed to be a systematic process, which together with the laboratory QA/QC program ensures a high degree of confidence in the data collection. The proposed QA/QC program includes the following elements:

- Training of all field staff;
- Field quality control procedures;
- Equipment cleaning protocol;
- QA/QC samples; and,
- Equipment calibration.

6.1 Training

Training sessions will be carried out for all field staff on proper sampling, sample handling and submission and general field procedures. Specific emphasis will be placed on QA/QC issues as well as on health and safety. Field crews will receive

training involving the operation, maintenance and calibration of water quality meters, and all other on-site equipment used throughout the field program. SOPs for all program elements will be distributed to staff and available at all times.

6.2 Field Quality Control

The quality of data generated in a laboratory depends primarily on the integrity of the samples that arrive at the laboratory. Consequently, necessary precautions must be taken to protect samples from contamination and deterioration. Procedures detailed in *Standard Operating Procedures for the Collection of Discrete Water Samples* and *Standard Operating Procedures for Hydrolab Series 5 Water Quality Instrumentation* will be followed to ensure field quality control.

6.3 Equipment Cleaning Protocol

All sampling equipment (i.e. intermediate containers, sampling buckets, etc.) will follow the QA/QC protocol outlined in *Standard Operating Procedures for the Collection of Discrete Water Samples* to ensure representative sample collection. When using the sampling pole or stainless steel bucket, only step 2 (Blank Water Rinse) of the decontamination procedure needs to be utilized.

6.4 QA/QC Samples

The monitoring team will use three types of QA/QC samples collected in the field to assist in validating chemical data sets – sample duplicates, equipment blanks, and field blanks. Each type of QA/QC sample is described in the following sections. Tables 8 and 9 present the schedule and number of QA/QC samples to be collected during the field program.

Table 8 QA/QC Sample Schedule

Ambient Sampling			
Day	Tuesday	Wednesday	Thursday
	Dup*, FB, MB	Dup*, FB, MB	Dup*, FB, MB
MB= Method Blank Dup = Duplicate FB = Field Blank * = Dup will rotate between days			

Table 9 Number of QA/QC Samples

Ambient Sampling	Field Blanks[2]	Method Blanks[3]	Duplicate Samples[4]	Total per Event
Day 1	1	1	1	3
Day 2	1	1	0	2
Day 3	1	1	0	2
Totals	**3**	**3**	**1**	**7**

1. Each QA/QC sample set is performed on the complete series of samples submitted for laboratory analysis.
2. One set of field blanks per day will be collected during each day of the week.
3. One set of method blanks (at one site) per day will be collected during each day of the event.
4. One set of duplicates (at one site) will be collected during each week.

6.4.1 *Sample Duplicates*

Sample duplicates will be collected for laboratory analysis for each parameter. The purpose of these analyses is to evaluate sample collection precision by comparing the duplicate analytical results. One set of duplicate samples at a sampling location, randomly identified, will be collected by each field crew during the sampling event. Duplicates will be rotated among streams between sampling rounds. Approximately 10 percent of the samples will be collected in duplicate.

6.4.2 *Method Blanks*

Method blanks (MB) will be collected for laboratory analysis for orthophosphate only. The purpose of these analyses is to assess potential cross-contamination of samples by the method in which the sample was collected. These blanks will be taken at the conclusion of each sampling shift by each crew.

6.4.3 *Field Blanks*

Field blanks will be collected for laboratory analysis for all parameters. The purpose of these analyses is to determine if samples collected have been contaminated by field handling and cleaning methods. Each field crew will collect these blanks immediately following the collection of the AEB equipment blanks.

6.5 Equipment Calibration

On-site physical parameters will be measured in-stream by water quality meters and recorded on data sheets. These instruments will be calibrated each sampling day before use according to the manufactures operating manual as outlined in *Standard Operating Procedures for Hydrolab Series 5 Water Quality Instrumentation*.

At the conclusion of the sampling event, each meter will be checked with the standards used during calibration. The purpose of these readings is to evaluate the meter's precision (electronic drift) by comparing the readings recorded during calibration and the readings recorded during the check at the end of the sampling day.

At the conclusion of each sampling event, all Calibration Sheets will be submitted to the Field Manager to serve as a record of the meter's performance during the sampling event.

7. PROGRAM SAFETY

The most critical component of a sampling program is crew safety. Safety is of paramount importance as stream sampling can be extremely dangerous. The element of danger is accentuated if personnel are unfamiliar with their surroundings and/or procedures, consequently staff must be properly trained in both safety and monitoring procedures, following a well thought out program.

With stream monitoring, common sense is essential. Two hazards that field staff may face more often, especially if wet weather occurs during sampling, are high stream conditions and slippery footing. If stream levels are deemed to be too high or too fast, under no circumstances should any field staff enter the stream or operate near its banks. With surfaces being wet and slippery, special care must be taken when walking and working around bridges.

Wading is one of the easiest methods to collect samples from many streams, and it may also be extremely dangerous. Wading permits the investigator to examine stream flow and decide where to sample. Rubber boots or even chest-high waders are standard equipment. If the wader has any uncertainty about their ability to wade a stream, they should be attached by a rope to a rigid mooring and wear an approved floatation device.

If creek conditions are high and fast, field staff will wear a safety belt or harness and will be appropriately tethered when working in close proximity to the creek. Along with being attached by rope, field staff must wear an approved floatation device.

There must be a minimum of two field staff working together during any sampling event.

7.1 General Safety Practices

- Water depth during wading operations must be checked with a pole before steps are taken.
- When wading equipment is worn, the support straps must be outside the clothing.
- In all situations field parties are required to leave accurate sampling schedules and expected itineraries in the office.

- Sampling must never be carried out in weather that is considered by the Field Manager or field member to be hazardous to the well-being of the field staff and/or equipment.
- Field staff are required to wear approved floatation devices and be tethered if conditions warrant use.
- First aid kits will be issued to all field crews.
- Each field crew will have a cellular phone and have been instructed on emergency procedures and numbers.
- Each field crew will report upon leaving and returning from any sampling or field work to their Field Manager.
- Each field crew will have appropriate lights, markers, etc. to be able to perform their work safely under poor visibility/nightfall.
- Each field crew will have the appropriate road safety equipment as required.

7.2 Health Hazards

Disease causing bacteria, viruses, and parasites are always present in sewers and discharge streams. They occur in both liquid sewage and dry sludge which coats pipes, and other surfaces. The serious threats are Hepatitis A (virus), Hepatitis B (virus), Tetanus (bacteria), Typhoid (bacteria), and Polio (virus). Proper hygiene methods must be followed. Wash hands before eating or smoking. Protective clothing must be laundered and equipment kept clean. Workers should avoid touching their eyes to prevent any inflammation. Cuts and abrasions of the skin should be covered by bandages or gloves to minimize the chance of infection by organisms.

APPENDIX A

STANDARD OPERATING PROCEDURES FOR FIELD MONITORING AND SAMPLING

APPENDIX B

NORTHERN KY SANITATION DISTRICT NO.1
CHAIN OF CUSTODY

APPENDIX C

NORTHERN KY SANITATION DISTRICT NO.1
FIELD DATA SHEET