TMDL Monitoring & Assessment Plan

City of North Augusta, SC
Small Municipal Separate Storm Sewer System (small MS4) Permit SCR030304

Prepared by

North Augusta
South Carolina's Riverfront

January 2015

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Table of Contents

Index of Tables

Index of Figures

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Acronyms and Abbreviations

CNA	City of North Augusta
CWA	Clean Water Act
DQO	data quality objective
MEP	Maximum Extent Practicable
NASM	North Augusta Stormwater Manager
NELAC	National Environmental Laboratory Accreditation Conference
NPDES	National Pollutant Discharge Elimination System
ORNW	Outstanding Natural Resource Waters
PM	project manager
POC	Pollutant of Concern
QA	quality assurance
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
QC	quality control
SC	South Carolina
SCDHEC	SC Dept. of Health & Environmental Control
SCDOT	SC Dept. of Transportation
sMS4	small municipal separate storm sewer system
SWPA	Source Water Protection Areas
TMDL	Total Maximum Daily Load
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WLA	Waste Load Allocation
WQMS	Water Quality Monitoring Station

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1. Introduction

On January 1, 2014, the SC Department of Health and Environmental Control (SCDHEC) re-issued to the City of North Augusta, a revised National Pollutant Discharge Elimination System (NPDES) small Municipal Separate Storm Sewer System (sMS4) permit. The new small sMS4 permit changes included the requirement of a Total Maximum Daily Load (TMDL) Monitoring and Assessment Plan and TMDL Implementation Plan requirement. These are two distinct requirements that build upon each other. First a TMDL Monitoring and Assessment Plan is to be submitted, reviewed and approved for implantation. Based on the results of the Monitoring and Assessment, the TMDL Implementation Plan will be developed demonstrating an implementation of BMPs (where practicable) to improve water quality in TMDL streams within the City of North Augusta's sMS4 jurisdiction. The plan being submitted today is the first part of the process, the TMDL Monitoring and assessment Plan.

The sMS4 Permit (Section 3-2 of the 2014 sMS4 permit) outlines the requirements of a TMDL Monitoring and Assessment Plan. The plan must incorporate the monitoring plan elements outlined in 3.2.1.2.1.of the permit. The time frame is also provided.

"…*develop and implement an approved monitoring plan 18 months after issuance", by* July 1, 2015.
It also stipulates that the monitoring plan
"…*must be submitted to the Department for review no later than 12 months from issuance…",* by January 1, 2015.

As part of those requirements, the City of North Augusta submits this TMDL Monitoring Plan to present the policies, objectives and practical activities/procedures for instream dry- and wet-weather monitoring of sensitive waters (defined in Section 1.3 of the permit) for Pollutants of Concern (POC) that may be indicated or their surrogates.

This monitoring plan will provide an analysis of where potential sampling would be required, an analysis of where sampling could help to identify stormwater discharge impacts to sensitive streams, identify locations to sample and what will be monitored, assess how monitoring could be effective to identify problems or characterize the city's sMS4 discharges, the procedures that will be used to collect and analyze samples, the methods for sample handling, recordkeeping, data analysis, and alternatives if necessary. The plan will also discuss the procedures the city will implement to analyze the results in an effort to determine when, where and how to develop the appropriate Best Management Practices (BMPs) that could be implemented, if needed, to improve water quality or reduce stormwater impacts to the Maximum Extent Practicable (MEP).

The City of North Augusta's TMDL Monitoring Plan addresses the monitoring requirements found in the permit and utilizes elements of US Environmental Protection Agency (EPA) requirements for sampling protocols, Quality Assurance and Quality Control (QA/QC), sampling standard methods, stormwater monitoring guidance and other information to outline project management, data generation and acquisition, assessment and oversight, and data validation and usability (see References for full outline).

The monitoring elements described in this Plan will be used to evaluate the city's progress at reducing the discharge of pollutants (or their surrogates if necessary) for existing *and future* TMDL or other sensitive waters, to the MEP to meet Wasteload Allocations (WLA) the streams. The approved TMDL Monitoring Plan will be reviewed and updated to meet new TMDLs or new requirements of a reissued small MS4 Permit. Any changes to the plan will be presented with the sMS4 Annual Reports.

1.1. Detail of sMS4 Permit Requirements for TMDL Monitoring Plans

As required by Section 3.1 and 3.2 of the sMS4 permit, the monitoring plan must incorporate the following objectives:

- **sMS4 Permit Section 3.1.1** Permittees shall determine whether their sMS4 discharges to receiving waters within a TMDL watershed or with a listing in the latest CWA §303(d) list of impaired waters that is associated with a water quality monitoring station (WQMS).
- **sMS4 Permit Section 3.1.1.1** Permittees shall refer to the most recent CWA §303(d) list approved by EPA to determine WQMS impairment status and to identify the pollutant(s) of concern (POC).
- **sMS4 Permit Section 3.1.1.2** For all TMDLs, permittees shall determine whether POC have potential to occur in sMS4 storm water discharges.
- **sMS4 Permit Section 3.2.1** Where a TMDL Wasteload Allocation (WLA) is assigned to point sources, permittees shall review its SWMP requirements for the control of stormwater discharges to WQMS identified in the TMDL. For sMS4 discharges of the pollutant(s) of concern to TMDL waters, permittees shall identify discharges located in the TMDL watershed draining to the impaired WQMS.
- The SWMP shall include a TMDL Monitoring and Assessment Plan.
- **sMS4 Permit Section 3.2.1.1** To be completed and submitted to the SC DHEC Bureau of Water, as follows; within **12 months** of the effective date of permit coverage for existing TMDL (in this case, the Pretty Run Creek plan must be submitted **by January 1, 2014).**
- **sMS4 Permit Section 3.2.1.2** Describe the activities permittees will conduct to address applicable WLA, including *at a minimum* the following elements.
- **sMS4 Permit Section 3.2.1.2.1**.i. The monitoring plan to measure the pollutant levels discharged from sMS4 outfalls to waters subject to TMDL shall include each item outlined in this section.
    - Samples and measurements taken for the purpose of the plan shall:
        1. Be representative of the sMS4 discharges
        2. Be reasonably distributed in time, while maintaining representative sampling
        3. Not be terminated for the purpose of preventing the analysis results from a permit or water quality violation
        4. Describe and consider frequency, mass and/or rate of discharge, as appropriate and,
        5. Be expressed in terms of units or measurements consistent with the requirements contained in the WLA
- ***See further details located in the*** **sMS4 Permit Section 3.2.1.2.1 ii.** *Plan elements*, **iii.** *sample locations*, **iv.** *sample protocols*, **& v.** *alternative protocols*; and all following sections respectively.

1.2. Monitoring Program Project Management:

The North Augusta Stormwater Manager (NASM) is the person responsible for developing the TMDL monitoring plan. The plan reflects the requirements of the NPDES small MS4 permit. The NASM is responsible for maintaining and once approved, implementing the plan.

1.3. Sensitive Waters

As required by the sMS4 Permit, for the purpose of this plan, listed **sensitive waters** in the plan are waters **defined as**:

- With a TMDL developed and approved, or established by EPA,
- Included in the most recent SC DHEC Bureau of Water Clean Water Act (CWA) Section 303(d) list approved by EPA,
- That pursuant to SC DHEC Bureau of Water Classifications & Standards (R.61-68) & Classified Waters (R.61-69) regulations are classified as either;
    - Outstanding National Resource Waters (ONRW)
    - Outstanding Resource Waters (ORW)
    - In Source Water Protection Areas (SWPA)

The existing TMDL and 303d listed waters are identified and analyzed for impacts by city sMS4 discharges in Section 2.2.

1.3.1 Newly classified sensitive waters

The City's adaptive management strategy will continue to utilize this TMDL Monitoring Plan for identifying actions and strategies to inform future decisions and direction of the stormwater program when additional sensitive waters are identified. When other sensitive waters are identified (new TMDL Development) within the city, we are required to do the following:

- **sMS4 Permit Section 3.2.1.1.3 Monitoring and Assessment Plans** shall be submitted within **<u>12 Months</u>** of EPA-approval or establishment of new TMDLs (from effective date of TMDL)
- **sMS4 Permit Section 3.2.1.2.1.iii:** Subsequently issued TMDLs shall include a schedule for monitoring activities to be initiated no more than **<u>18 months</u>** from the effective date of the TMDL.

Once approved, this plan will be the platform to use when needed, to collect data to support programmatic and environmental decisions in the city's stormwater program. This plan will also be used for future sensitive waters identified within the city jurisdiction. Revisions to the plan will be submitted for SCDHEC approval prior to full implementation. This will promote a quicker and more efficient process.

1.4. Updating the plan:

When a new approved TMDL or sensitive water is identified within the city jurisdiction, we will review the current approved TMDL Monitoring Plan and modify it where necessary, to meet the new requirements. Modifications to the plan will be additive so that the elements of the existing plan are retained as approved. If new methods, processes, or constituents are identified, those items will be added to the existing plan in addition to or as alternatives to the approved methods, unless existing methods are determined obsolete and require removal. If so, that information will be clearly identified in the plan. All modifications and changes to the plan will be noted in the plan along with the date of modification and approval. The date and plan Version Number (in the header) will be changed to reflect the changes and approvals for the *existing* plan behind the decimal. Additions to the plan when new sensitive water is identified, requires the number 1st digit in the Version Number to be updated to reflect a new location was added.

2. North Augusta Stream Assessments

Illicit discharge monitoring is important to the North Augusta stormwater program and has been part of its program since 2004. The baseline monitoring program was designed to assist the city in determining the existing conditions of receiving waters (at the time of program development) and to identify potential illicit discharges or sources and where they originated from. The data is used to determine where and what types of Best Management Practices (BMPS) could be implemented to address problems if they were identified or in order to effectively eliminate or reduce stormwater pollution. The staff in the stormwater program are experienced in stormwater and stream monitoring. Implementing the TMDL Monitoring Plan would not require additional training or personnel.

2.1 Prior North Augusta Illicit Discharge Tracking and Monitoring

Development of this TMDL Monitoring Plan was undertaken with consideration of the information from the existing database compiled from the city's long term illicit discharge tracking and monitoring program.

Activities in the program include;

- instream monitoring,
- targeted monitoring,
- physical assessments of streams,
- physical assessments of stormwater infrastructure,
- GIS mapping and analysis,
- BMP implementation and assessment
- and limited biological monitoring

These activities have been an integral part of the City's stormwater program. They have provided information to make better decisions and to determine the health of the receiving waters in our sMS4 boundary. They are one of the long-term assessment tools the city uses to determine if the overall sMS4 program is improving water quality in the city. Additionally, the data has provided insight into areas where potential problems exist within the sub basins, but also information on areas where little potential for problems exist.

The historical sampling data conducted in the Pretty Run Sub-basin (by the City of North Augusta) can be found in Appendix E. (AE Table 2) of this plan. It was summarized in two additional reports (described below). The reports and other information were reviewed to identify sample locations for this TMDL Monitoring Plan.

2.1.1 North Augusta's 2007 Baseline Assessment

From 2005-2007 a baseline assessment was conducted at the lowest point in each sub basin where commercial or residential density was prominent. In addition, a baseline assessment was conducted of a sub basin that was completely undeveloped with minimal impact from the community to serve as a representative basin within North Augusta. Several smaller or less densely populated (residential or commercial) sub basins were not monitored during the baseline assessment. The baseline assessment was completed in July 2007. A summary of the resulting data was compiled and used to prioritize the sub basins for stormwater program activities and used to consider development related discussions and decisions by the North Augusta Planning Commission. The information was compiled in a report that is referred to as the "2007 Baseline Assessment" for the city of North Augusta (2007, North Augusta Water Quality Baseline Assessment).

The sampling program looks at many parameters in the streams located in North Augusta sub basins. The monitoring was conducted as a non-regulatory activity for information purposes. The stormwater program evaluated the sub basins and located monitoring stations at the lowest instream point for each. The city added additional stations throughout the city.

2.1.2 North Augusta Stream Assessment Update (Monitoring 2007-2013)

Since the 2007 Baseline Assessment, the city has continued to sample the lowest point stations throughout the community and also added (and sampled) more locations higher in the sub-basins to acquire a better understanding of the receiving waters and physical integrity of the streams in the sub basins. The data generated from August 2007 to December 2013 has been reviewed and is currently being analyzed and compared to the 2007 Baseline Assessment data. The resulting comprehensive report will be completed in early 2015. Although the report is not completed, the data generated has been analyzed and considered in the development of this TMDL Monitoring Plan.

The full data set of monitoring activities in the city (from 2005-2014) is used to prioritize stormwater program work in the community. All data is located in the stormwater program files in three ring binders and electronically. Streams within the city's sub basins that could be impacted by stormwater discharges have been sampled for most of the following potential pollutants or indicators.

Table 1: Water Quality Parameters Monitored in North Augusta Streams

Many Sample Locations within Watershed 2004-2012	**Certified Lab (yes/no) and Methods** (methods could have changed or been updated during period)	**Sample types**
Total phosphorus	Yes - 365.1	Wet weather, dry weather, composite, grabs
Ammonia	Yes – 350.1	Wet weather, dry weather, composite, grabs
Nitrate/nitrite	Yes – 353.2	Wet weather, dry weather, composite, grabs
TKN	Yes – 351.2	Wet weather, dry weather, composite, grabs
Iron	Yes – 200.7	Wet weather, dry weather, composite, grabs
Lead	Yes – 200.7	Wet weather, dry weather, composite, grabs
Manganese	Yes – 200.7	Wet weather, dry weather, composite, grabs
Copper	Yes – 200.7	Wet weather, dry weather, composite, grabs
Zinc	Yes – 200.7	Wet weather, dry weather, composite, grabs
Fecal coliform	Yes – MPN	Wet weather, dry weather, grabs
Pesticides	Yes – 8081A	Wet weather, dry weather, composite, grabs
Herbicides	Yes – 8151A	Wet weather, dry weather, composite, grabs
VOCs	Yes – 8260B	Wet weather, dry weather, grabs
pH (field)	No	Wet weather, dry weather, grabs
Dissolved Oxygen (field)	No	Wet weather, dry weather, grabs
Temperature (field)	No	Wet weather, dry weather, grabs
Turbidity (field)	No	Wet weather, dry weather, grabs
Macroinvertebrates	No	Wet weather, dry weather, grabs
Chain of custody, field log books, calibrations of equipment, weather conditions, sampling staff, sample holding times and stabilization methods are adhered to and recorded.		

The City of North Augusta stormwater department is fully equipped and trained to successfully carry out the TMDL Monitoring Plan.

2.2 Identifying Sensitive Waters in North Augusta

To develop this TMDL Monitoring Plan, sensitive waters listed on the 303(d) list and those with approved TMDLs have been reviewed. The State of South Carolina's 2012 Integrated Report was used to generate a list of waterbodies within the City of North Augusta's jurisdiction that are on the 303d list or have a TMDL. The waterbodies within the City of North Augusta are summarized below:

Table 2: Listed 303d and TMDL Waterbodies in North Augusta

Station ID:	Waterbody:	Pollutant of Concern:	Status/Date	City Jurisdiction:
SV-250	Horse Creek	Fecal coliform	TMDL 1/20/06	Yes, final reach
RS-040544	Pretty Run Creek	Bio – Macro	303d, 2012	Yes
RS-040544	Pretty Run Creek	Fecal coliform	TMDL 2/27/07	Yes

The city assessed its impacts to the above streams in its development of this TMDL Monitoring Plan. It has been determined that the Pretty Run Creek sub-basin is impacted by the city stormwater discharges and will be included in this TMDL Monitoring Plan. Horse Creek on the other hand, is not impacted by stormwater discharges from the City of North Augusta.

2.2.2. Determination if Sensitive Waters are impacted

In the sMS4 permit, sensitive waters (see Section 1.3.) are required to be analyzed to determine if they are impacted by the city's stormwater discharges. Those assessments are below.

2.2.2.1 City Impact Assessment of Horse Creek

Horse Creek Sub-basin is predominately located within the Aiken County and City of Aiken small MS4 jurisdictional areas. Along the lower reach of the creek, the city limits border the stream. Therefore, only the final reach of the stream is located within the city's small MS4 jurisdiction. The monitoring station SV-250 is not located within the city limits, but is within Aiken County.

A review of the stormwater infrastructure within the city's small MS4 jurisdiction was conducted as it relates to Horse Creek. North Augusta stormwater system infrastructure does not directly discharge into Horse Creek at any given location. Prior to the stream, a vast river swamp exists. The swamp abuts up to and discharges into Horse Creek and the Savannah River. As you can see in Figure 1, the lowest reach of Horse Creek borders both the swamp. There is one residential neighborhood located near that location and a SC Department of Transportation (SCDOT) highway.

Figure 1 shows the Rivernorth Subdivision (located within the city limits) and the I-520 Palmetto Parkway Corridor (located within the city limits but owned, managed and within the SCDOT sMS4). The stormwater discharges from Rivernorth Subdivision stormwater system either is directly discharged to the Savannah River or it flows to a large stormwater filtration basin shown in Figure 1. Also shown is the overflow from the filtration basin where it enters into a stormwater pipe and discharges into the Savannah River (this basin rarely fills to overflow capacity).

In Figure 2, the remaining portions of Horse Creek from Atomic Road (SC Hwy 25) that are within the city jurisdiction are shown. An industrial facility (within the city) is located above the river swamp and has a stormwater filtration basin. The basin rarely discharges, if it does, the discharges go into the river swamp where it flows and comingles for a great distance prior to Horse Creek. The facility has an NPDES Industrial Stormwater Permit and is regulated by the state. No other residential or industrial facilities are located within the city jurisdiction in that area. The Aiken County sewer line is located in the swamp but it is managed and monitored for potential discharges by Aiken County. The city sewer line terminates at the metering station located at the entrance to Rivernorth Subdivsion.

Based on ground and recorded surveys, along with photographic and GIS infrastructure surveys, there are no discharges from the city stormwater system entering Horse Creek. Accordingly, based on the sMS4 permit requirements and instructions, the city does not have to include Horse Creek (a TMDL stream) in its TMDL Monitoring Plan.

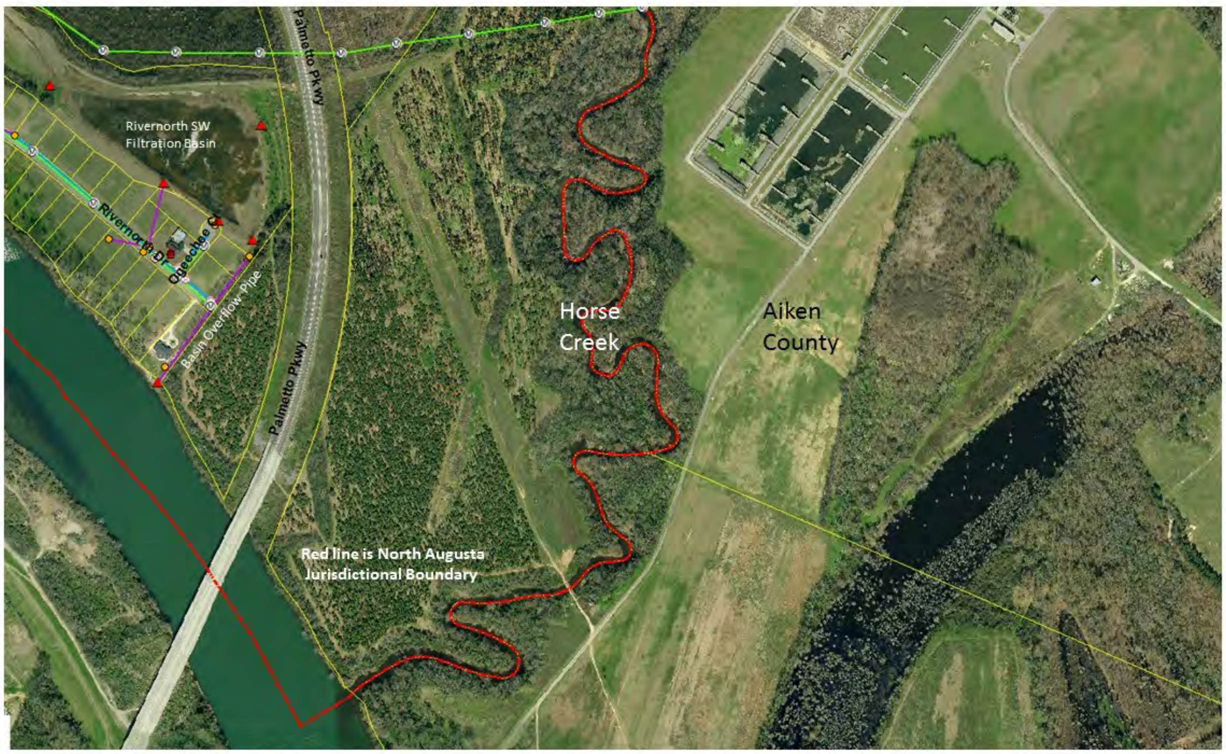


Figure 1: Horse Creek –North Augusta Reach 1: No sMS4 Stormsewer discharges

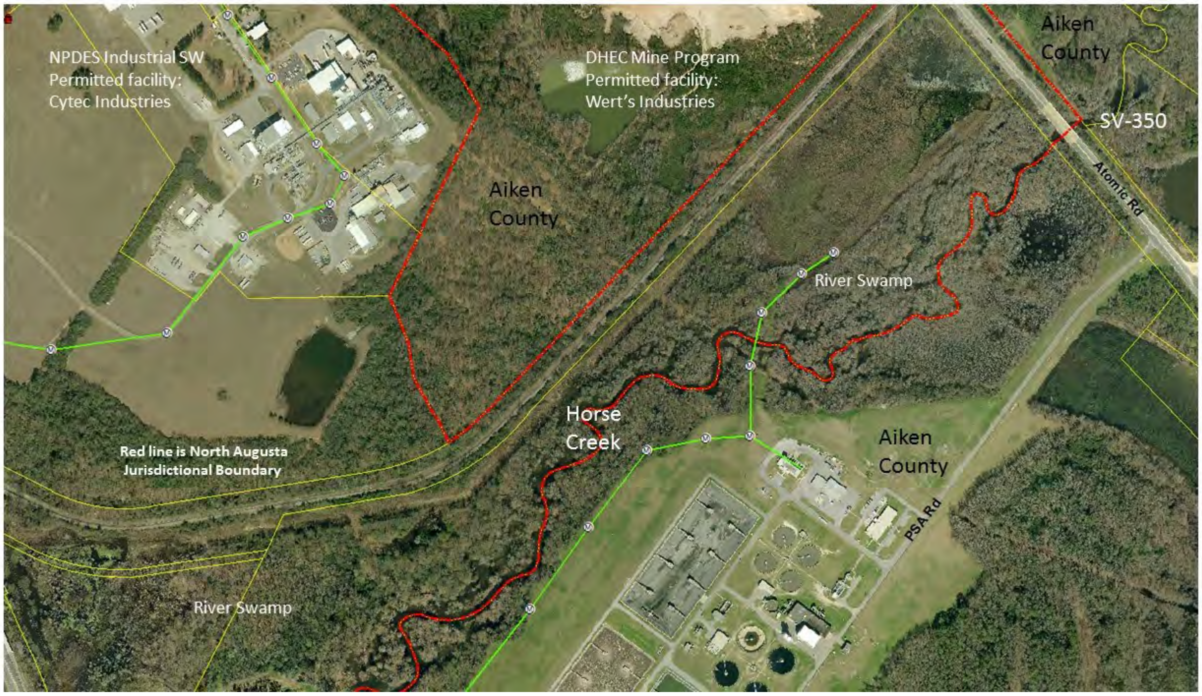


Figure 2: Horse Creek –North Augusta Reach 2: No sMS4 Stormsewer discharge

2.2.2.2. City Impact Assessment of Pretty Run Creek

Pretty Run Creek (aka Un-named tributary to Savannah River) is located within the city of North Augusta and it receives discharges from the city storm sewer system. This stream must be included for assessment in this TMDL Monitoring Plan.

3 Monitoring Required for TMDL Stream Pretty Run Creek

Pretty Run Creek Sub basin is located within the city limits with the exception of the south western tip of the basin (see Figure 3, red dashed-lines are city limit boundaries). There are ten (10) feeder streams or groundwater seeps that flow to Pretty Run sub basin. Some are pond drainage areas that are fed by groundwater seeps, others are wet weather ditches such as along Five Notch Road. Ninety-three percent (93%) of the 1,799 acre drainage basin is located within the city boundary and small MS4 area. The remaining 7% (129 acres) is located in the Aiken County small MS4 area.

The city stormwater is discharged into Pretty Run Creek. The city is required to assess its stormwater discharges to determine if they are impacting the stream by discharging the POC into Pretty Run Creek.

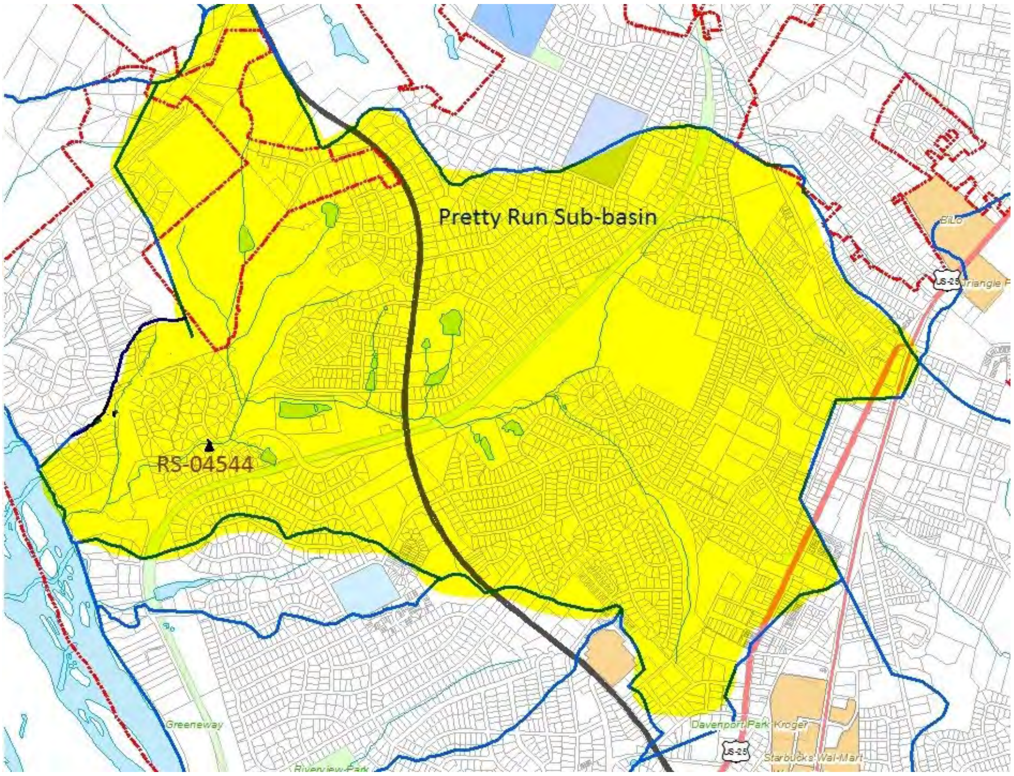


Figure 3: Pretty Run Sub-basin with streams and ponds shown.

3.1 Pretty Run TMDL

A Total Maximum Daily Load (TMDL) has been developed for the Pretty Run Creek. Pretty Run Creek was sampled in 2004 as a random station. It was the first time Pretty Run Creek had been sampled. The creek was listed on South Carolina's 2006 303(d) list of impaired waters due to the result of the sampling. Sample results determined that 67 % of the samples exceeded the standard for **fecal coliform** bacteria of 400 cfu/100 ml. The TMDL indicates that the likely sources of the fecal coliform bacterial pollution are urban runoff (including pets), leaking sewers, and failing septic systems.

In the Pretty Run TMDL, the load-duration curve methodology was used to calculate the existing loads and the TMDL loads for the creek. In the TMDL it states: *Load-duration curves were developed as a method of developing TMDLs that applies to all hydrologic conditions. The load-duration curve method uses the cumulative frequency distribution of stream flow and pollutant concentration data to estimate the existing and the TMDL loads for a water body.* Stream flow for Pretty Run Creek was generated by using a known stream flow at a similar stream (Butler Creek in Augusta, GA). The flow at RS-04544 was estimated by multiplying the measured daily flow rates from the USGS gauge by the ratio of the upstream drainage area to that of the ambient water quality monitoring site (0.2571). The flows were ranked from low to high and the values that exceed certain selected percentiles determined. Existing loads and TMDL loads are presented in Table Ab-1 of the approved TMDL (Appendix B). In order to reach the target load for Pretty Run Creek, reduction in the existing load to the creek of 31 % will be necessary. The TMDL describes the target daily concentration of *Fecal coliforms* for Pretty Run Creek to meet the WLA is **380 cfu/100 ml**.

Table 3: Total Maximum Daily Loads for the Pretty Run Creek.

Station ID	Stream TMDL (cfu/day)	Grab Only (cfu/day)	MOS (cfu/day)	WLA		LA (cfu/day)	Existing Load (cfu/day)	% Reduction to Meet Load Allocation[3]
				Continuous Sources[1] (cfu/day)	Intermittent Sources[2] (% Reduction)			
RS-04544	1.77E+10	380	8.84 E+08	NA	31 %	1.68 E+10	2.43 E+10	31%

Table Notes:

1 - WLA is expressed as total monthly average.

2 - Percent reduction applies to all NPDES-permitted stormwater discharges, including current and future MS4, construction and industrial discharges covered under permits numbered SCS & SCR. Stormwater discharges are expressed as a percentage reduction due to the uncertain nature of stormwater discharge volumes and recurrence intervals. Stormwater discharges are required to meet percentage reduction or the existing instream standard for pollutant of concern, whichever is less restrictive.

3 - Percent reduction applies to existing load; Where Percentage Reduction = (Existing Load-Load Allocation) / Existing Load

3.2 Pretty Run Sub-basin: Land Use and Areas of Concern

The Pretty Run sub basin is predominately made up of residential neighborhoods and streets (1,056 acres). Most are older well establish communities with older infrastructure. The public sewer line that services 98% of the homes runs along the lowest points of the basin or within the creeks and streams, the remaining homes have septic systems. There are approximately 139 acres that are devoted to light commercial businesses. They are dotted throughout the main travel corridors of the basin. Of the light commercial areas, there are a mix of restaurants, churches, doctor offices, parks & trails, stores, banks, and schools. No industrial facilities are located in the sub basin. Approximately 604 acres are undeveloped open space (Table 1).

Table 4: Pretty Run Basin Details and Land Use by Acre

Basin Name	Total Area (acres)	Total within City (acres)	% of Basin in City	Priority Ranking
Pretty Run Basin	1,799	1,670.0	93%	1
	Estimated Total acres	**Residential Acres (est.)**	**Commercial Acres (est.)**	**Undeveloped Acres (est.)**
	1,799	1,056	139	604

A detailed study of the topography and water movement in the basin resulted in a map that was produced in 1988 (see Figure 4). The study was conducted prior to city GIS and other software programs. It was a hand detailed study. The resulting data is estimated and has not been verified to date. For the purpose of this TMDL Monitoring Plan, the data is considered approximate. In Table 5, each smaller drainage area within the Pretty Run sub basin are described with identification map ID's corresponding to those in Figure 4. Drainage data is provided in acres and miles. The information was used to describe the proposed monitoring stations that are depicted on Figure 4 in blue.

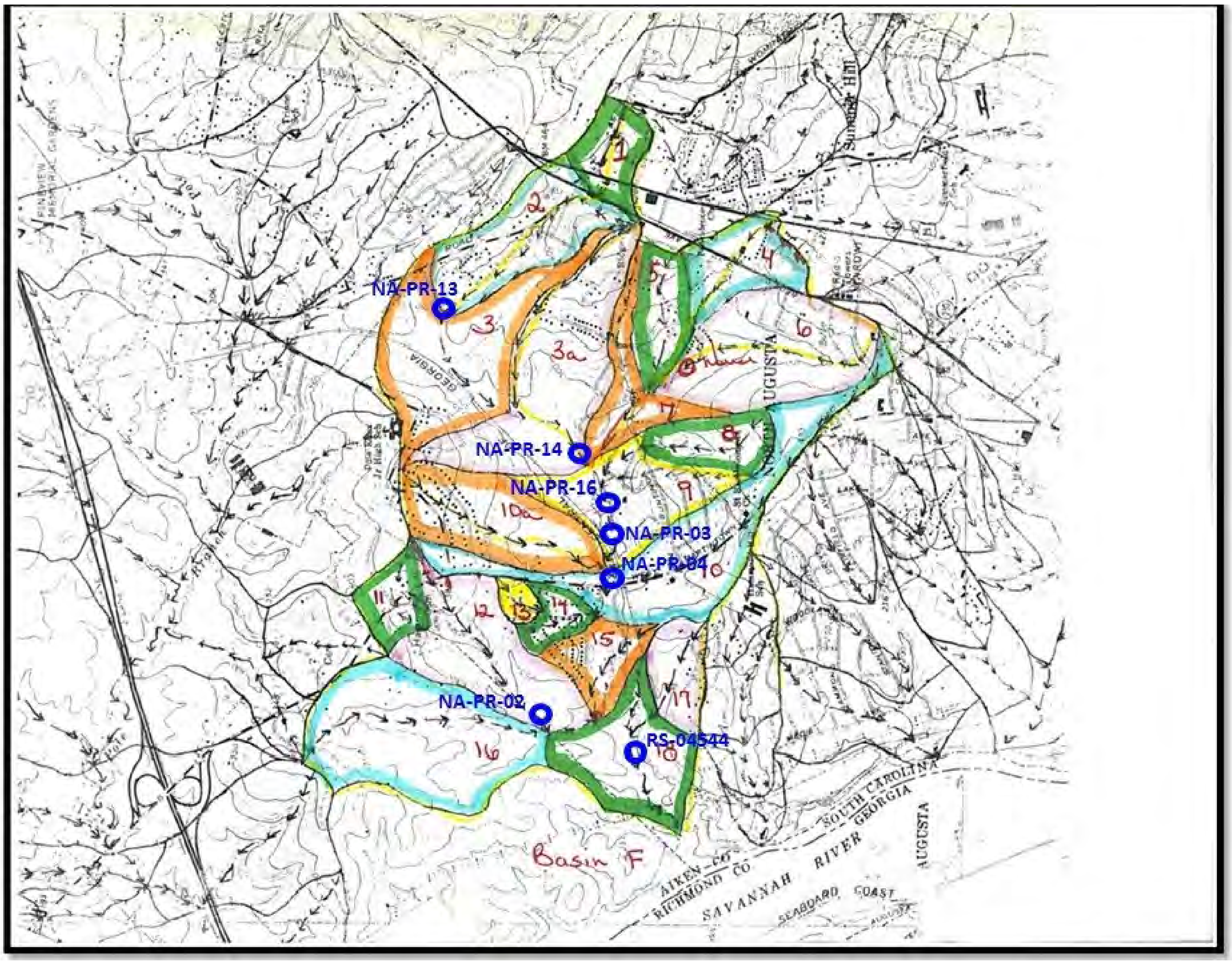


Figure 4: 1988 Study Map of Pretty Run Sub with proposed sample locations.

Table 5: Detailed List of Smaller Drainage Areas within Pretty Run Sub basin

Pretty Run Sub-basin drainage areas.

Data from City Basin Study conducted in 1988 (approximate measurements)

Sub Basin (Map ID)	Location Description	Drainage Area (acres)	Distance to Travel (ft.)	Drainage Area (miles)	Elevation Change	Slope
1	Bradleyville Rd. & Georgia Ave.	43.2	2000	0.0674	475-415	0.03
2	Rosemary, Five Notch, Dove & Hugh Streets	106.0	4400	0.1650	460-345	0.0261
3	White Pine, Green Forest, Greeneway, Edge of Paul Knox Middle Sch.	154.0	6200	0.2410	460-287	0.0279
3a	Upper Pisgah, Cascade, Mountside Drive	172.0	6000	0.2683	460-255	0.0342
4	Leigh Place pond, Parts of E Marion and Alpine, Bunting Park	40.4	3300	0.0631	460-340	0.0364
5	Jones, Plank and Lowe St in Lynnhurst	47.8	2600	0.0746	460-295	0.0635
6	Butler, Post office, part of Communigraphics, Summitt, Atlantis Ave	147.0	5000	0.2296	465-295	0.0340
7	Towee, Siskin Cir and Canary	54.2	4200	0.0847	455-255	0.0476
8	Part of Hidden Hills, Robin and Bobolink	45.0	2600	0.0703	480-290	0.0731
9	Bunting, Linnet Loop, Partridge & Oriole	98.3	4300	0.1535	460-230	0.0535
10a	Curtis, Courtney and lower Bolin Rd (includes ponds)	110.2	4300	0.1722	455-230	0.523
10	Martintown, to St. Barth to Tip of Hammond Dr., Hammond Place, Victory Baptist to Greenway overpass	160.7	7400	0.2511	465-220	0.0331
11	Portions of Byrnes Rd and Hammond Pond Rd	34.0	1900	0.0531	440-300	0.0737
12	Chanticlear to Rapids S/D to Riverbluff Drive (near RS04544)	123.0	5200	0.1923	440-185	0.0490
13	Leland Place to Brookgreen Dr	13.7	1000	0.0215	330-250	0.0800
14	Brookgreen, Wynyah, Wando Dr. Pond	27.5	1550	0.0430	275-220	0.0355
15	Waccamau Drive, lower Lakewood S/D, McKie Ponds by Greeneway	47.0	2500	0.0732	305-185	0.0480
16	Hammond Pond, Savannah Barony II, New Church properties (2)	186.0	4900	0.2898	410-200	0.0429
17	Breaks from Post Oak Ln. and along Campbellton Drive	41.3	1900	0.0646	325-230	0.0500
18	Lowest sub area: Riverbluff Rd (1/2 circle), Dunbarton Rd., Runnel View.	101.0	3700	0.1578	280-140	0.0378
	Approximate: TOTALS	1752.3		2.7361		

3.2.1 Location of Septic Tanks within Pretty Run

Within the basin, several studies have been conducted to determine if illicit discharges are present and releasing bacteria into the basin (described in Section 2). Septic tanks could become a problem over time or at any time. It is important to identify where they are located within the sub-basin. There are a few locations where septic tanks are in use and upsets in the systems have a potential impact through overland flow or to the storm sewers. The city has plotted the locations where potential septic tanks are by creating a spreadsheet of those customers that receive utility bills where sewer is not included. The map in Figure 5, shows these potential locations for septic tanks. In some instances, an address could be listed that is under construction and sewer has not been completed. The spreadsheet is updated annually.
To help determine if the POC is being released to the streams, the TMDL Monitoring Plan sampling locations are located in drainage areas where the septic tanks are upstream. This will help to determine if there are releases in certain segments in the basin near septic tanks.

In Figure 5, the septic tanks are identified within the Pretty Run Basin. It is important to note that just outside of the Pretty Run sub-basin (where you see the most septic tanks on Figure 5), that this location is in a different sub-basin and is also outside of the city limits. These septic tanks are located within an area that is not part of the city's small MS4 jurisdiction, but are in Aiken County's sMS4 jurisdiction. The red hatched lines on Figure 5 are the city limits. If you notice on the graphic, there are entire subdivisions that are on septic tanks in those areas. All surface flow in from them travel down and away from Pretty Run sub-basin to Pole Branch sub-basin. That being stated, there is a potential for a lateral groundwater impact from those concentrated septic tank located outside the city jurisdiction. A groundwater study is not in the scope of this plan, but research into groundwater flow will be conducted for the area and reported in the annual report.

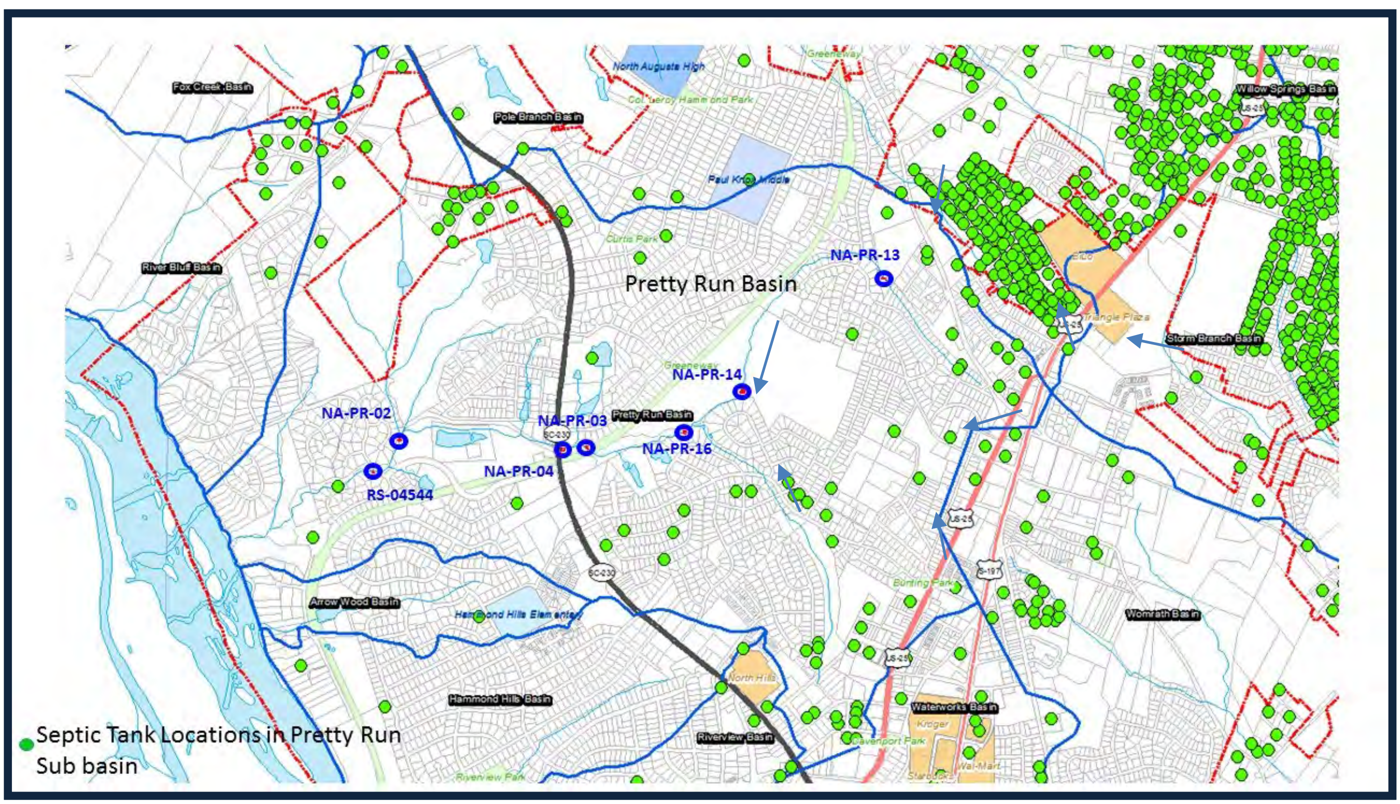


Figure 5: Septic Tanks within Pretty Run Sub basin with proposed sample locations
(green dots represent each septic tank, blue labels are proposed TMDL Monitoring Locations, red lines are city limits)

4. Instream Monitoring

4.1 Project Task Organization

Instream Monitoring is the monitoring of sMS4 receiving creeks, rivers and streams. Instream sampling will be scheduled five times per year representing seasonal patterns. In addition, the sampling will be conducted during wet and dry weather. The samples will be collected utilizing a grab sample methodology. The city determined the methods that will be employed by utilizing the EPAs 1992 Stormwater Sampling Manual. The methods described for surface water quality sampling along with methods described in the EPAs Final Draft 2009 Industrial Stormwater Monitoring and Sampling Guide are being used.

All required instream sample analysis will be conducted by a SCDHEC certified laboratory. Instream Monitoring will be conducted by the City's Stormwater Program Manager or their designee. All designees will be trained using the standard or referenced standard operating procedures by the Stormwater Program Manager prior to conducting instream sampling.

Instream monitoring activities are scheduled to begin in July 2015 to account for seasonal sampling schedule, resources and budget. Sample dates may be adjusted by the Stormwater Program Manager due to unforeseen scheduling conflicts or weather events.

When scheduling the instream monitoring events, the staff involved in sampling shall schedule events while complying with the following.

- The samples will be representative of the city sMS4 discharges
- The samples will be reasonably distributed in time, while maintaining representative sampling
- Sampling will not be terminated for the purpose of preventing the analysis results from a permit or water quality violation.
- Four samples will be collected during a wet weather representative rain event
- WLA Allocations for TMDLs for *Fecal coliform* will be converted to *E. coli* utilizing a translator equation established by SCDHEC (based on existing targets for TMDL *Fecal coliform*).
- Collected at locations representative of the % of sMS4 draining to the location (at least 25%).

4.2 Monitoring Objectives

The objectives of the TMDL Monitoring are to collect data to determine if the city sMS4 discharges are contributing POCs to the watershed. To determine if this is the case, we are conducting monitoring to:

- Evaluate the source(s) of the Pretty Run Creek TMDL listed pollutants of concern [*Fecal coliform* and/or *E. Coli* (see Section 2.5.1)] to the MEP;
- Use instream monitoring data to assess and characterize potential stormwater (based on land use type, seasonality, geography or other catchment characteristics) that discharges to the stream;
- Determine if water quality concentrations of the POC are within the TMDL WLA for Pretty Run Creek, if not and sMS4 discharges are contributing the POCs, develop and implement BMPs to the MEP to reduce loads from sMS4 stormwater discharges.
- Assess progress towards meeting TMDL pollutant load reduction benchmarks of 31% *Fecal coliform* in Pretty Run Creek.

The process the city intends to use to meet the objective is to:

- Collect *Fecal coliform* or *E. Coli* samples from the seven (7) proposed instream sample locations at Pretty Run Creek sub basin.
    - There will be five (5) seasonal sample events per year per station (four (4) wet weather, and (1) dry weather) for the year beginning July 1, 2015 and ending June 31, 2017;
- Conduct dry weather investigations to determine if, where and when other discharges are potentially responsible for the POC instream.
- Assess the resultant data to determine if the POCs are within the TMDL WLA, if not develop an implementation strategy to incorporate BMPs to protect the stream and improve water quality to the MEP.
- Literature review/research regarding groundwater flow patterns of adjacent sub basin (Pole Branch).

4.2.1 Monitoring Question

The principal monitoring question(s) that will be addressed by wet weather monitoring are:

1. What are the *Fecal coliform* or *E. coli* bacteria concentrations in Pretty Run Creek sub-basin receiving waters during dry or wet weather?
2. What are the characteristics of the average storm event concentrations at monitoring sites?
3. Are TMDL WLAs being met? And if not, assess, develop and implement a plan to control stormwater source discharges to the MEP.
4. Are the sMS4's stormwater discharges impacting the stream with the POCs?
5. How do the POC concentrations of storm events in North Augusta compare regionally to storms of similar land use and precipitation?

The monitoring objective is to collect sufficient data sets from each of the monitoring stations to determine concentration of *Fecal coliform* or *E. coli* at the sample locations. If the data generated indicates areas with high concentrations, we will then implement further detection strategies to determine the sources if possible. The information will provide the City with data for assessment that will support development of strategies for implementing BMPs that could improve water quality conditions. The data will also be used to identify if (in strategic focus areas of the sub-basin) direct impacts from stormwater discharges exist. These focus areas will help to identify or eliminate whether they contribute to the impairment at RS-04544. Groundwater flow patterns will be researched and considered for the upper reaches of Pretty Run sub basin.

Instream monitoring will contribute to meeting the objectives found in the small MS4 permit and help to develop and implement actions to meet TMDL WLA reductions (31%) for the stream. Our goals are to

- Evaluate Pretty Run Creek and also its tributary receiving waters for POCs (*Fecal coliform* or *E. coli* bacteria) to identify if the city's small MS4 discharges contain the POC further impacting the stream system.
- Determine if the integrity of the stormsewer system in the Pretty Run sub-basin is sound
- Conduct focused stormwater illicit discharge surveillance in the Pretty Run sub-basin where indicated

4.2.2 Monitoring Background

The City of North Augusta has been conducting non regulatory monitoring of water quality at monitoring stations around the city and conducting investigations of its watershed for nearly 10 years (fully described in Section 2). Two reports were generated, the North Augusta Baseline Water Quality Report, 2007; and the City of North Augusta Water Quality Update, 2014. The first is available on the city website, the second will be available on the website in March 2015.

The instream monitoring program is an integral part of the City's activities. From the monitoring activities, the City is able to use earlier data as a baseline, determine and assess trends (if any), and identify if and where targeted IDDE should be taking place within the city. Activities include dry weather, wet weather, grab sampling, composite sampling, field analysis of pH, DO, temp, turbidity, sediment sampling and macroinvertebrate assessments.

The city's monitoring stations were developed to voluntarily assess and establish baseline concentrations of pollutants in the city streams and also to observe water quality improvements, as the small MS4 permit program became fully established. The early monitoring program was completed in 2012. The city will continue to conduct random monitoring and illicit discharge detection monitoring throughout the city's jurisdictional boundaries as needed or required. The city will also implement this TMDL Monitoring Plan to focus attention on Pretty Run Creek, once approved.

4.2.3 Data Analysis Methodology

The City will continue to use standard data summary methods (i.e. mean, median, mode, Inter Quartile Range (IQR), skewness, variance, standard deviation) to describe the characteristics of data at derived from sampling stations (where enough data exists to accomplish these methods). The summary statistics will continue to be used in turn to describe the reliability of the data collected and possible trends in receiving water quality.

Since the City has almost 8 years of instream data (in many sub-basins in the city), local characterization data exists for many parameters and locations, including the TMDL stream Pretty Run. With prior sampling and surveys of the watershed, the city has a good understanding of the watershed and contributing factors that are present. These will help to support the choices for further sampling locations within Pretty Run. Some parameters, those typically with low detection limits and high variance, require a larger number of samples to adequately characterize the parameter. Due to budgetary constraints, large numbers of samples are not possible. The city pulls samples strategically based on previous analysis, age of infrastructure, residential or commercial density of the area, or results of illicit discharge detection investigations. These existing tools will help to prioritize sampling activities. The number of sampling events required to develop meaningful statistical analysis is considered and utilized where necessary. For this TMDL Monitoring Plan, that information will be considered.

The city uses the EPA generated statistical analysis software program PRO-UCL v5. The program provides several statistical methods that can be used to analyze data including the Seasonal Kendall-Test. Other programs will be used to assess appropriate BMPs to reduce impacts including the EPA's SWMM program. The city has reviewed the literature and developed a process for analyzing data generated in its monitoring program.

A full list of those references is available at the end of this plan.

4.2.4 Data Quality Criteria

Data Quality Objectives (DQOs) are the quantitative and qualitative statements describing the quality of data needed to support a specific decision or action. The five parameters commonly used to judge data quality:

- Precision
- Accuracy
- Representativeness
- Comparability
- Completeness

The City will continue to use these data quality objectives to implement this TMDL Monitoring Plan and to describe the instream monitoring data collected. Each DQO is described further below.

4.2.4.1 Precision

Precision is a measure of the reproducibility of the result and depends on how well we can compensate for random errors, such as instrumental error or sample variation. Precision will be measured by collecting duplicate samples as outlined in 5.3. Duplicate samples are collected as independent samples using the same sampling procedures. A duplicate field sample can consist of two samples collected at the same. The variability in the results obtained from duplicate samples is a sum of the sampling and analytical variability and variability inherent in the sample. For bacterial sampling, this variability is known to be high based on the literature. Duplicate sampling will be utilized for one sample location during each sample event.

The City of North Augusta will evaluate precision of in stream sampling by comparing duplicate samples with “primary” samples collected. In the case of bacterial sampling, this may or may not produce the expected outcome. For sampling other than bacteria, the city will compare the laboratory measurements of the duplicate sample with the primary sample. If they do not agree with those of the “primary” sample, the City will request the contract laboratory to reanalyze the duplicate (and/or primary) sample to confirm or deny the disagreement in results. Duplicate field measurements will be collected in the field. Any disagreement or re- measurements will be recorded on the field data sheet. All results will be recorded.

4.2.4.2 ***Accuracy***

Accuracy is a measure of how close the measured value is to the true value and depends on how well we can control systematic errors, such as faulty equipment calibration, sampling method, or sampler or observer bias. Some scientists use the term "bias" to reflect this error in the measurement system and to use "accuracy" as indicating both the degree of precision and bias. For the purpose of this document, the term "accuracy" will be used to encompass “bias”

For sampling events accuracy will be assessed by analyzing “blank” samples. This verifies that the measured or analyzed value is true and not influenced by the sampling method or equipment. One equipment blank sample will be used each sample event on regulatory sampling. Blank water will be obtained by the city water plant (laboratory). Blank water will be drawn from the deionizing system taps in the laboratory. Blank water will be processed and transported exactly as are regular samples.

All field water quality measurements, except dissolved oxygen, will be performed on blank samples and the city will evaluate the accuracy of the instream field measurements as well as laboratory results via a comparison of the blank water results to “analyzed” values when collected.

Bacteria can be difficult to sample and analyze, for many reasons. Natural bacteria levels in streams can vary significantly; bacteria conditions are strongly correlated with rainfall, and thus comparing wet and dry weather bacteria data can be a problem; many analytical methods have a low level of precision yet can be quite complex; and absolutely sterile conditions are required to collect and handle samples. For bacteria, field blanks should be collected at 10 percent of sample sites along with the regular samples. Sterile water in sterilized containers should be sent out with selected samplers. At a predetermined sample site, the sampler fills the usual sample container with this sterile water. This is labeled as a regular sample, but with a special notation (such as a "B") that indicates it is a field blank. It is then analyzed with the regular samples. Lab analysis should result in "0" bacteria counts for all blanks.

4.2.4.3 *Representativeness*

Technique: Collecting a sample representative of the true environmental conditions requires proper sampling, handling, preservation, and transport. For instream sampling, discrete grab samples will be collected to best represent instream conditions and standard procedures to prevent improper techniques will be used (EPA NPDES Stormwater Sampling Guidance).

Location: In this TMDL Monitoring Plan, representativeness also refers to the area being sampled. The locations sampled should be representative of the contributing watershed being investigated. See the individual sample location rational sections for more details on representativeness of the sample locations.

Rain event: The rain event sampled should be representative for the area. For this TMDL Monitoring Plan, a representative rain event is being proposed as described in the NPDES Stormwater Sampling Guidance document. For North Augusta, the calculation is based on exhibit 2-8 and 2-9 on pages 21 and 22 of the document.

Table 6. Representative Rain Event for North Augusta

Average depth of rainfall in the Southeast	= 0.75 inch
Average duration of rain events for the Southeast	= 8.7 hours
Range that is representative	= 50% to 150%
Volume	= 0.375 to 1.125 Inches of rainfall
Duration	= 4.25 to 13.05 hours of rainfall

4.2.4.4 *Comparability*

Data comparability is essential to interpret results from samples collected at different times and locations. Carefully following documented procedures is one of the most important steps in maintaining data comparability. Grab samples collected by the city during instream events will follow the TMDL Monitoring Plan exactly as described and approved.

4.2.4.5 *Completeness*

Completeness of a study is based on a comparison of the amount of valid data expected and the amount actually generated from the study. Completeness of sampling each year and over the permit required term will be evaluated.

Special conditions may prevent the instream samples from being collected. These circumstances include personnel illness, safety issues, vandalism and situations that are out of the control of the city (i.e. extreme weather conditions, emergency situations, etc.). If a situation out of the City's control, prevents the collection of discrete instream samples, the Stormwater Program Manager will record the information in a dedicated field notebook used for instream monitoring and reschedule the monitoring event if practicable.

Table 7 – Instream Field Parameter Quality Objectives (when sampled)

Field Analyte	Accuracy	Precision
Temperature	± 0.5°C	± 0.5°C
pH	± 0.5 SU	± 0.5 SU
Dissolved Oxygen	± 0.5 ppm	± 0.5 ppm
Turbidity	± 5% ppm or ntu	± 5% ppm or ntu

Data quality objectives of laboratory data will be outlined in the laboratory's quality manual.

4.2.5 Assumptions and Rationale

It is assumed that the instream data represents average ambient instream conditions within the city. Each of the monitoring locations are at the base of a selected stormwater watershed area within a sub-basin under investigation. That is specifically, a drainage area delineated by topographic and stormwater infrastructure that is draining to a point in the stream that can be sampled and be representative of the upstream drainage area. By determining areas of concern within a sub-basin and sampling in the stream at the point where this drainage area would impact (during dry and wet weather), an assumption can be made as to whether stormwater discharges are contributing the POCs to the stream from the area of concern. Dry weather monitoring within this plan is assumed to represent the ambient instream conditions of the areas when rainfall is not a factor. When POCs are found at high concentrations during dry weather, an assumption that either there is a point source such as failing infrastructure or other cause contributing to the problem that needs to be identified or depending on the POC, there is a natural source that should be identified. Wet weather monitoring within this plan is assumed to represent the ambient instream conditions during rain events and is directly affected by the contributing drainage area under investigation (upstream of the sample location). The sample locations are chosen for the monitoring plan based on the potential for them to contribute the POC. The rationale for the sample locations proposed is described in detail in Section 4.4.1.

4.3 Documentation and Record Keeping Procedures

The quality of data often depends on the documentation that accompanies the sample. Obvious examples are sample location, time, date, and required analyses. Corrections will be made by drawing a single line through the mistake, writing in the correction, and initialing the correction. Documentation of weather conditions and all anomalous conditions, such as extremely high or low flow, construction equipment in area, domestic or wildlife in the sample reach of the stream, etc. will be recorded. These notes should be described and is useful as part of the interpretation of instream monitoring data generated from monitoring. These record keeping procedures will be followed for each instream monitoring event.

4.3.1 Instrument Calibration Data

For this monitoring plan, instrument calibration data will be kept in dedicated notebooks for each field instrument in the office or laboratory. The City will also record field calibrations in the field log book. Field equipment will be calibrated in the office or laboratory prior to leaving out to sample. This will alert the staff of problems before leaving the office. Follow-up calibrations will be conducted at the first sample location and then after two more sample locations. Calibrations will be conducted according to the manufacturer's specifications and all required information to verify the accurateness of the instruments will be recorded in the dedicated notebooks and field log book.

4.3.2 Instream Field Analytical Data

The City uses Field Data Collection Sheets for each instream monitoring event (see Appendix E). The

Stormwater Program Manager or designee is responsible for collecting instream monitoring field data and is responsible for filling out the field data collection sheets during each sample event. This may be in a field log notebook or on loose sheets that will be incorporated into the field sample log book. All spaces on the field log sheet must be marked. Once all data is analyzed, the date results are available must be recorded on the field log sheet to signify that the information must be logged into the electronic database.

Staff shall contact the City's contract laboratory in advance of sampling when necessary to schedule sample bottle delivery to the city and also to schedule shipping of sample bottles back to the laboratory for analysis.

4.3.3 Chain of Custody

Current chain of custody (COC) forms for the City of North Augusta and one of the contract laboratories can be found in Appendix D. The *Chain-of-Custody Form (COC)* is used to record sample custody for instream samples. These forms are used with all sMS4 sampling activities where analysis has to be completed in a location other than instream. If samples are to be collected and removed from the stream for analysis at a different location, a COC must be filled out. A COC form is filled out for each sample event and kept with the samples at all times. One COC can be filled out for each sample day and more than one page can be used per day.

All staff responsible for collecting and shipping samples must read, understand, and implement the chain of custody procedures outlined by either the city or by the contract laboratory's quality manual. Sampling staff must be made aware and fully understand these procedures prior to conducting any stream sampling. There are potentially two procedures that will be used in this plan. Which procedures apply are dependent upon where the samples are analyzed.

When the city is the laboratory that will analyze the samples, the city laboratory quality manual will outline the policies and operational procedures associated with its laboratory. Specific protocols for sample handling, storage, chain-of-custody, laboratory analyses, data reduction, corrective action, and reporting are described.

The contract laboratory quality manual outlines the policies and operational procedures associated with the contract laboratory. Specific protocols for sample handling, storage, chain-of-custody, laboratory analyses, data reduction, corrective action, and reporting are described. All policies and procedures must be structured in accordance with the National Environmental Laboratory Accreditation Conference (NELAC) standards and applicable EPA requirements, regulations, guidance, and technical standards.

4.3.4 Field/Laboratory Results

Laboratory results from instream sampling events will be stored by fiscal year in three ring binders and archived according to the SCDHEC records retention requirement. Field and laboratory data will be entered into the city's Water Quality electronic database specifically designed for water quality data and hard copies of field data and laboratory reports will be archived in the binders.

4.4 Pretty Run Creek Monitoring Process/Study Design

4.4.1 Pretty Run Creek Monitoring Locations

Each of the chosen sample locations have the potential to help the city identify certain areas of the sub-basin for further investigation for the POC or its surrogates. If a sample event clearly indicates that an illicit discharge is occurring within that area (a sample that results in extremely high concentration), then an investigation will begin immediately to identify the illicit discharge and eliminate it to the MEP. The investigation may include walking the stream looking for obvious causes, sampling smaller tributaries (if they are identified discharging into the stream above the original sample event), tracing storm sewers and looking for dry weather flows, using techniques to identify if stormwater is causing the problem and or in some cases, conducting smoke or dye testing to verify if infrastructure problems exist. All of these activities will be documented in the field log book.

All data generated by the TMDL Monitoring Plan along with earlier data will be considered in the subsequent TMDL Implementation Plan to meet TMDL and permit requirements in the Pretty Run Sub-basin.

To determine the sample locations for the Pretty Run Creek sub basin, previous work was reviewed to make good decisions in preparation for this TMDL Monitoring Plan (specifically addressing Pretty Run sub basin). As part of the stormwater program, Pretty Run Creek has undergone extensive efforts to detect and eliminate illicit discharges including:

- instream water quality sampling during wet and dry weather,
- illicit discharge investigations,
- on the ground surveys of the entire sub-basin streams and infrastructure,
- aerial infrared surveys to identify impacts to the streams,
- monitoring of the sanitary sewer system within the sub-watershed (smoke testing, dye testing, sewer investigations based on complaints, septic tank review and assessments, etc.),
- targeting sampling of suspect areas,
- stormwater infrastructure inspection and repair,
- a targeted education campaign to alert citizens of the issues within the Pretty Run Creek sub-basin.

Table 8: Pretty Run Creek Proposed Instream Sample Locations

Site Description	Station ID	Watershed	Area ID fromT2
Pretty Run Creek RS04544	RS-04544 or *NA-PR-01*	Pretty Run	
Unnamed tributary East of RS04544	NA-PR-02	Pretty Run	
Pretty Run Creek at Martintown Rd	NA-PR-03	Pretty Run	
Pretty Run Creek above outfall at Bolin Rd.	NA-PR-04	Pretty Run	
Pretty Run Creek at Robin Rd below Lynnhurst tributary	NA-PR-16	Pretty Run	
Pretty Run Creek after Knollwood	NA-PR-14	Pretty Run	
Pretty Run Creek Five Notch prior to Independent Living	NA-PR-13	Pretty Run	

Figure 6 is a map of seven (7) sample locations that the city has identified for its TMDL Monitoring Plan for this stream (listed above in Table 8). Individual maps showing the infrastructure and aerial depictions for each sample station along with rational for the location are presented in the following pages.

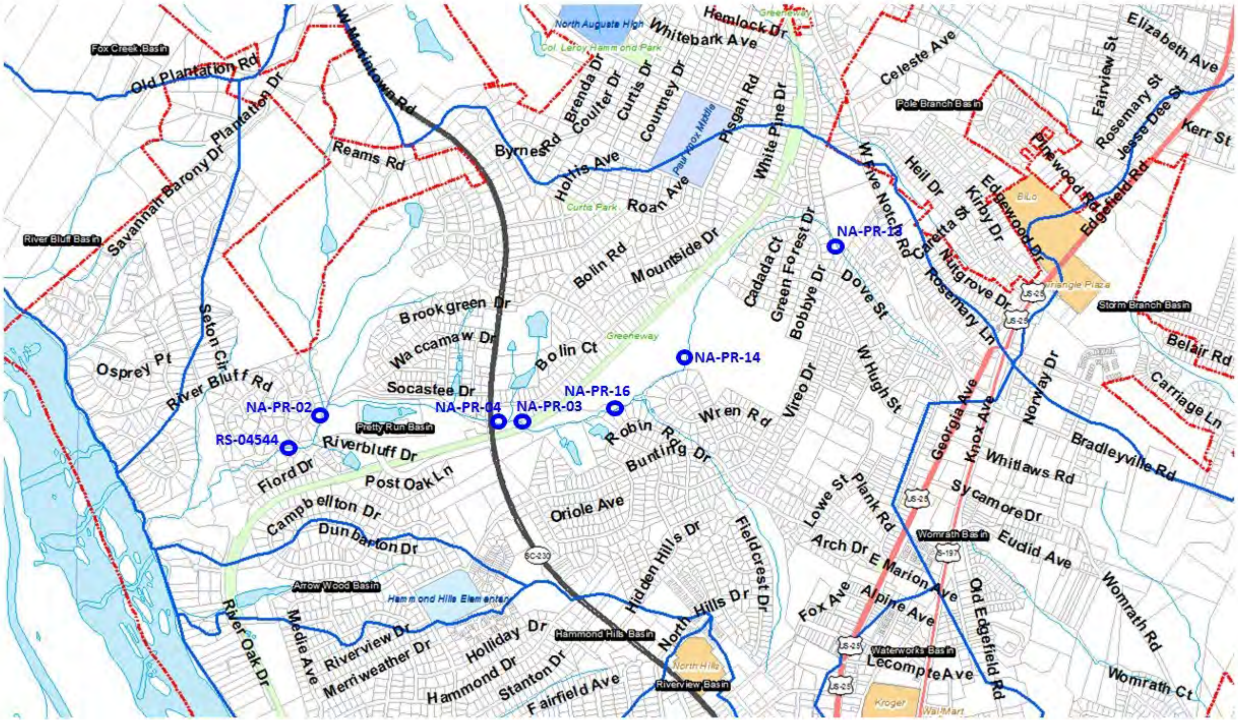


Figure 6: Pretty Run Sub-basin proposed TMDL Monitoring Locations

In an effort to determine if certain areas of the sub-basin (densely populated areas) are contributing to the *fecal coliform* concentrations, the city has conducted targeted sampling in the past. Figure 7 represents a sampling event and its results conducted in 2011 where certain reaches of the stream were sampled near Martintown Road. The data indicated no levels exceeding the TMDL WLA. The sampling was conducted during dry weather. The city will continue to target this location due to the density and age of the community and infrastructure that border the location and known concerns over the years from complaints received. The area will be sampled during dry and wet weather events.

In the 2011 study, NA-PR-HSP was sampled. It is a stormwater pipe that has wet and dry weather flow from pond that can overflow to it (located across Bolin Road). The mix of pond water and stormwater make it an unsuitable stormwater pipe to sample routinely. The pond acts as a BMP itself. To identify if the drainage area flowing to the pipe (Bolin, Mountside, Robinson and other streets), we propose to sample upstream and downstream of the pipe where it discharges to Pretty Run. The drainage area flowing to Pretty Run at this pipe is depicted on Figure 4 as area 10a and consists of 110 acres (Table 5). We are proposing two sample location NA-PR-03 upstream of the pipe and NA-PR-04 downstream of the pipe in Pretty Run creek.

Other locations such as NA-PR-14 and NA-PR-16 are also points that capture different drainage areas in an upstream downstream fashion. NA-PR-13 will determine what if any impacts the old neighborhoods along Hugh Street and the commercial facilities located at Georgia and Five Notch may contribute also. The final point is NA-PR-02, it is located along a main sewer line and a few older neighborhoods just upstream of RS-04544.

Utilizing all of the data collected by the City in Pretty Run Sub-basin, a rational was prepared for each of the proposed monitoring stations.

Figure 7: Targeted fecal coliform sampling in 2011 at Pretty Run sub-basin.

4.4.1.2 Rational for Sample point RS-04544 (aka NA-PR-01)

Rational for RS-04544: This is the SCDHEC monitoring station (RS-04544) for the sub basin (Figures 8). Historically, the city has identified this location as NA-PR-01. The city will monitor this point and will use both the city and the state id numbers in reports. This sample location is at the bottom end of the basin and most of the drainage area (approximately 1720 acres) is represented at this sample location (Figure 3 and 4). Each of the drainage areas, within the Pretty Run sub-basin, draining to this point are described in Table 5 and shown in Figure 4. This sample location represents approximately 98% of the Pretty Run TMDL Sub-basin drainage area. It is representative of all contributing drainage areas in Pretty Run Sub-basin.

In December 2005, a physical assessment was conducted of the stream (see Appendix E for datasheet). The overall score for this reach of Pretty Run Creek was 6.5 (fair). Any score below 6.0 is considered poor. The assessment indicated that the area was approximately 90% residential with 10% being open space. The channel width at RS-04544 is about 8 feet wide and the dominant substrate is boulder, rock and shale/slate in about 90% of the reach with approximately 10% being loose sediment and gravel. Today, the same conditions are prevalent.

Water quality at RS-04544 has been assessed by the city during dry and wet weather many times between 2005 and 2012. The results of the sampling are presented in Appendix E (AE Table 2). The data suggest that during the sampling period, *fecal coliform* is sometimes higher than the daily state standard of 400 col/100 ml with and also the TMDL daily maximum for the location, 380 col/100ml. Studies to identify if this is caused by infrastructure or stormwater contributions of the POC have been ongoing.

Nutrient sampling conducted during the period generally revealed average concentrations for streams in the area. Concentrations of Ammonia, Phosphorus, Nitrate/Nitrite and Total kjeldahl nitrogen (TKN) were lower than expected if an overflowing sewer line or septic tank were contributing as a point source upstream of the sample location. Pesticide & herbicide samples were not conducted at this location. Heavy metal sample analysis also was conducted and no concerns were raised by the results of the data. Hardness has also been analyzed for the stream twice at this location with results of 31 mg/l and 46 mg/l. Field parameters (pH, Dissolved oxygen, temperature and total chlorine) were normal. Total suspended solids (TSS) results during the period were generally low with one sample event resulting in 99 mg/l. This result could be expected after a heavy rain event due to the upstream reaches being predominantly sandy.

Macroinvertebrate studies have begun at NA-PR-01. In 2013, students looking at macroinvetebrates reported collecting *Trichoptera*, *Coleoptera*, *Collembola*, *Diptera*, and *Ephemeroptera* species at this location. Due to the limited sample size, there was not enough data generated to make a finding. Further studies are planned for this location.

In 2007, a complete survey of the Pretty Run sub-basin was conducted using aerial infrared imaging during one of the coldest winter nights in the city. The results of the fly-over revealed several suspected "hot" spots where warmer water was entering the stream channel. Each of those locations were verified with ground surveys to determine their origin. The ground surveys found that each of the hot spots identified were ground water seeps that were entering the streams.

Due to this location being the state sample point for the TMDL written for Pretty Run, it is included in the sampling plan. Further sampling may help to identify if the stream is still impaired, the TMDL WLA is being met, or that the stream is no longer impaired.

Figure 8: RS-04544 Sample Location – Summer

Figure 9: RS-04544 Sample Location - Winter

Figure 10: NA-PR-04 Pretty Run off Martintown

Figure 11: NA-PR-03 above outfall at Bolin

Figure 12: NA-PR-16 Bank stabilization in 2011

Figure 13: NA-PR-14 Sample Location downstream (looking at Lynnhurst Trib)

4.4.1.3 Rational for Sample point NA-PR-02

NA-PR-02: This sampling location is located on an unnamed tributary to Pretty Run Creek located east of Martintown Road (mapped in Figures 14 and 15). This location is representative of the drainage area that drains to Pretty Run Creek just above the RS-04544 sample location. The area is mostly undeveloped woodland. Two small Ponds are within this sub-watershed of Pretty Run sub-basin. One receives stormwater discharges into it from a residential neighborhood, the second is predominantly woodland area with little development and has little to no city stormwater discharges entering into it. There is a main sewer line that does traverse this reach of the stream. There are also a few septic tanks located within the drainage area (Figure 5). By sampling at the lowest point of this un-named tributary to Pretty Run, we can assess the 431 acre drainage area leading to the SCDHEC monitoring station (see Figures 14 & 15) RS-04544. Figure 14 is a GIS representation of sample point and the infrastructure within the area. The sample location NA-PR-02 represents approximately 25% of the 1799 acre Pretty Run sub basin. It is also representative of a collection of drainage areas contributing to Pretty Run Sub-basin (shown in Figure 4 and described Table 5 as the areas 11, 12, 13, 14, 15, and 16) just above the state sampling location.

There are no prior physical assessments, water quality sampling data, or macroinvertebrate sampling that has occurred at this sample location. This area has not been adequately assessed for possible stormwater discharges that carry the POC into the stream. The location is chosen within this sampling plan to analyze the discharges in this particular drainage area of Pretty Run sub-basin to determine if the POC is being discharged into Pretty Run Creek just above the RS-04544 (NA-PR-01) sample point. Using this sample location, we may be able to either eliminate this drainage area from an area of concern, or if the POC is present, it will provide us data to focus on a more intensive illicit discharge detection and elimination project for it (see Section 4.4.4).

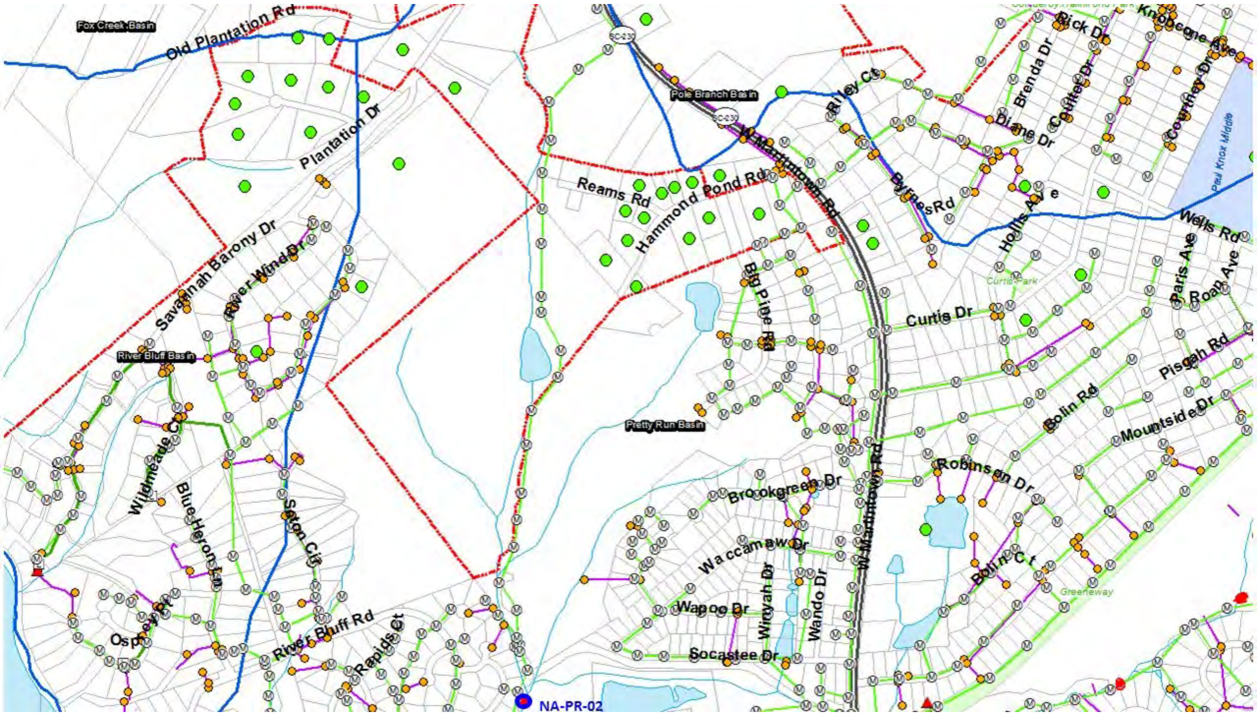


Figure 14: GIS Map of TMDL Monitoring Location NA-PR-02 with Infrastructure Shown
(Green lines with manholes = Sanitary Sewer, Pink lines with orange manholes = Storm sewer)

Figure 15: Aerial Image of TMDL Monitoring Location NA-PR-02 with Infrastructure Shown
(Green lines with manholes = Sanitary Sewer, Pink lines with orange manholes = Storm sewer, Blue = Drinking water)

4.4.1.4 Rational for Sample point NA-PR-03

NA-PR-03: This is a sample location instream of Pretty Run Creek (photo in Figure 11). On Figure 16, the sample location along with stormwater and wastewater infrastructure in the drainage area is shown. NA-PR-03 is representative of the drainage area that drains to Pretty Run Creek West of Martintown Road. The drainage is coming from a heavy residential areas with some commercial identified on Figure 4 as areas 1, 2, 3, 3a, 4, 5, 6, 7, 8 and 9. Approximately 907 acres (52%) of the Pretty Run Basin is draining to this point. This is an important sample location to monitor since it upstream of an additional drainage area coming into the Pretty Run stream just below this point. By sampling at NA-PR-03, we can possibly determine which (if any) of the two drainage areas being monitored is contributing the POC, or both. Just downstream from NA-PR-03 is a city stormwater pipe (NA-PR-HSP) that drains approximately 120 additional acres of older neighborhood adjacent to Bolin Road identified as part of 10 and 10a (Figure 4). All of the drainage areas are described more completely in Table 5. Upstream of NA-PR-03 has undeveloped woodland bordering the stream on both sides (Figure 17). Pretty Run Creek meanders in a braided fashion through the wooded area. There are two small Ponds located above this sample location and also a few septic tanks in the residential areas (Figure 5). Data can help to identify where in the stream the POC is present and if found, further investigation can be conducted (see Section 4.4.4). Also if found, data can be compared to NA-PR-16 to determine if the POCs are found upstream of NA-PR-03. The location will be able to provide important information about the impacts coming from the drainage areas. This sample location is representative of the Pretty Run sub basin drainage areas contributing to it.

NA-PR-03 has not been sampled in the past.

4.4.1.5 Rational for Sample point NA-PR-04

NA-PR-04: This is a sample location instream of Pretty Run Creek (photo in Figure 10). In Figures 16 & 17 you will see that this location is representative of most of the drainage area that drains upstream of Martintown Road. The drainage area consist of heavy residential and light commercial sections of town and some woodland areas. The areas are identified on Figure 4 as areas 1, 2, 3, 3a, 4, 5, 6, 7, 8, 9, 10 and 10a and represent approximately 1,178 acres (67%) of Pretty Run sub basin (full descriptions, Table 5). Figure 16, a GIS map shows infrastructure as well as sample location.

NA-PR-04 is a downstream sample point from NA-PR-03 and it will help to assess whether the drainage pipe located in between NA-PR-03 and NA-PR-04 is discharging POCs. The storm pipe (NA-PR-HSP, see Figure 8) drains the area shown in Figure 4 as part of 10 and 10a, also described in Table 5. Previous sampling at NA-PR-04 has occurred, the results can be found in Appendix E. Samples pulled during dry weather indicated no problems (see Figure 8). The city will pull wet and dry samples at this location to determine if the POC is from one or both of the drainage areas above it.

Figure 16: GIS Map of TMDL Monitoring Location NA-PR-03 and NA-PR-04 with Infrastructure

(Green lines with manholes = Sanitary Sewer, Pink lines with orange manholes = Storm sewer)

Figure 17: Aerial Image of TMDL Monitoring Location NA-PR-03 and NA-PR-04 with Infrastructure
(Green lines with manholes = Sanitary Sewer, Pink lines with orange manholes = Storm sewer)

4.4.1.6 Rational for Sample point NA-PR-16

NA-PR-16: This is a sample location instream of Pretty Run Creek (photo Figure 12). This location is representative of the drainage area leaving the Lynnhurst Subdivision and also business and residential areas above it at Georgia Avenue (Figures 18 and 19). Figure 18 shows the stormwater and wastewater infrastructure in the drainage area and Figure 19 is an aerial photo of the drainage areas. This sample location will pick up drainage from the drainage areas shown on Figure 4 as 1, 2, 3, 3a, 4, 5, 6, 7, 8 and 9. Approximately 52% of the Pretty Run Basin is draining to this point. Detailed descriptions can be found in Table 5. NA-PR-16 is located just below an unnamed tributary to Pretty Run that drains part of Lynnhurst Subdivision. This is a much older subdivision where concrete lined ditches serve as drainage ways instead of underground stormsewer lines. Parts of this community are not as well maintained as other communities within the city. Due to the open concrete lined ditches, residents may impact them with household waste or animal wastes. Another concern are septic tanks in areas where the water tables is possibly impacting them (Figure 5). The neighborhood backs up to the stream in many locations and fences are just at the edge of the creek. Pets that are confined to the fenced back yards. NA-PR-16 will be useful sample location to assess the discharge coming from this neighborhood via the unnamed tributary just above it.

This location has not been sampled specifically to assess the unnamed tributary. A secondary location downstream, NA-PR-15 (not shown on maps) has been sampled for a number of constituents. Composite samples have also been pulled at NA-PR-15, see Appendix E for data. NA-PR-16 is specifically a downstream point from NA-PR-14 to assess and isolate the unnamed tributary to determine if the POC is discharging from that tributary.

4.4.1.6 Rational for Sample point NA-PR-14

NA-PR-14: This is a sample location is instream of Pretty Run Creek (photo Figure 13). In Figure 18, the stormwater and wastewater infrastructure is shown. Figure 19 is an aerial photograph of the sample location. This location is representative of the 764 acres (44%) of the drainage area along the Lynnhurst, Knollwood and other subdivisions as shown as 1, 2, 3, 3a, 4, 5, 6 and 7. Each are described more completely in Table 5. This location was chosen to assess the drainage area of Knollwood, parts of Pisgah Road and the woodlands area before it reaches NA-PR-16. By comparing the data from NA-PR-14 with NA-PR-16, we may be able to evaluate if the POC is being contributed by one or both of these areas. These communities contain both older and newer housing units. There are also some septic tanks located in the area (Figure 5). The location will be useful in assessing the discharge coming from these locations prior to mixing with the older areas downstream at NA-PR-03 and NA-PR-04. This location is representative of drainage areas impacting Pretty Run Creek.

This location has not been sampled in the past.

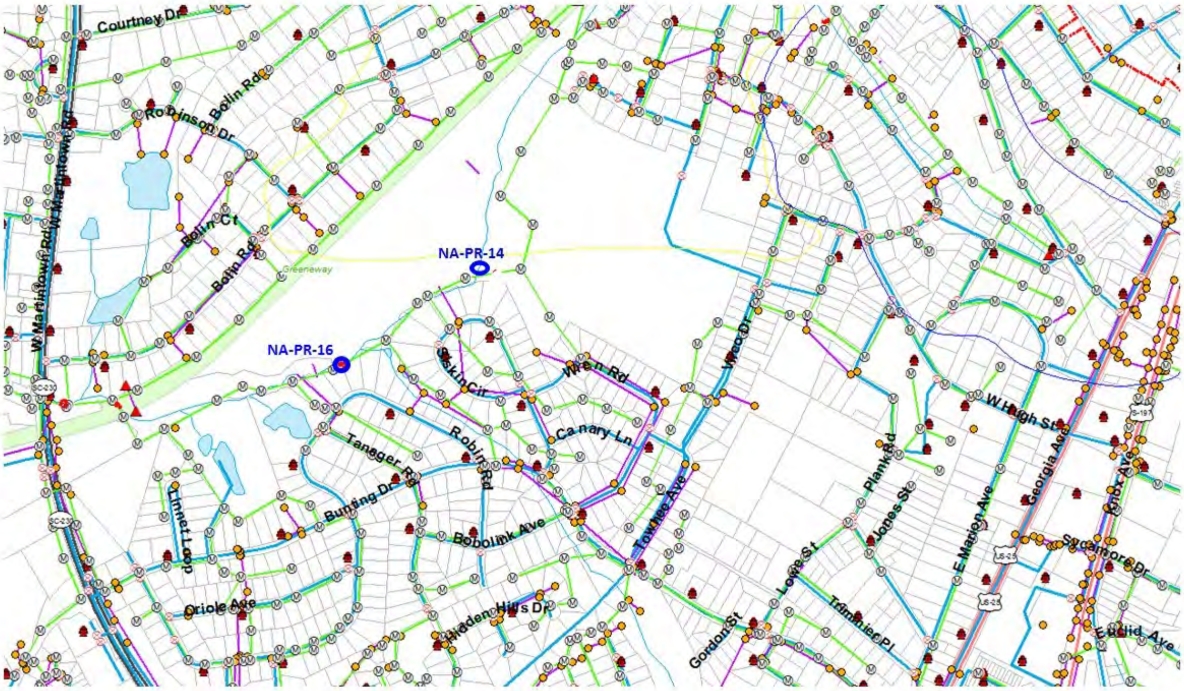


Figure 18: GIS Map of TMDL Monitoring Location NA-PR-16 and NA-PR-14 with Infrastructure
(Green lines with manholes = Sanitary Sewer, Pink lines with orange manholes = Storm sewer)

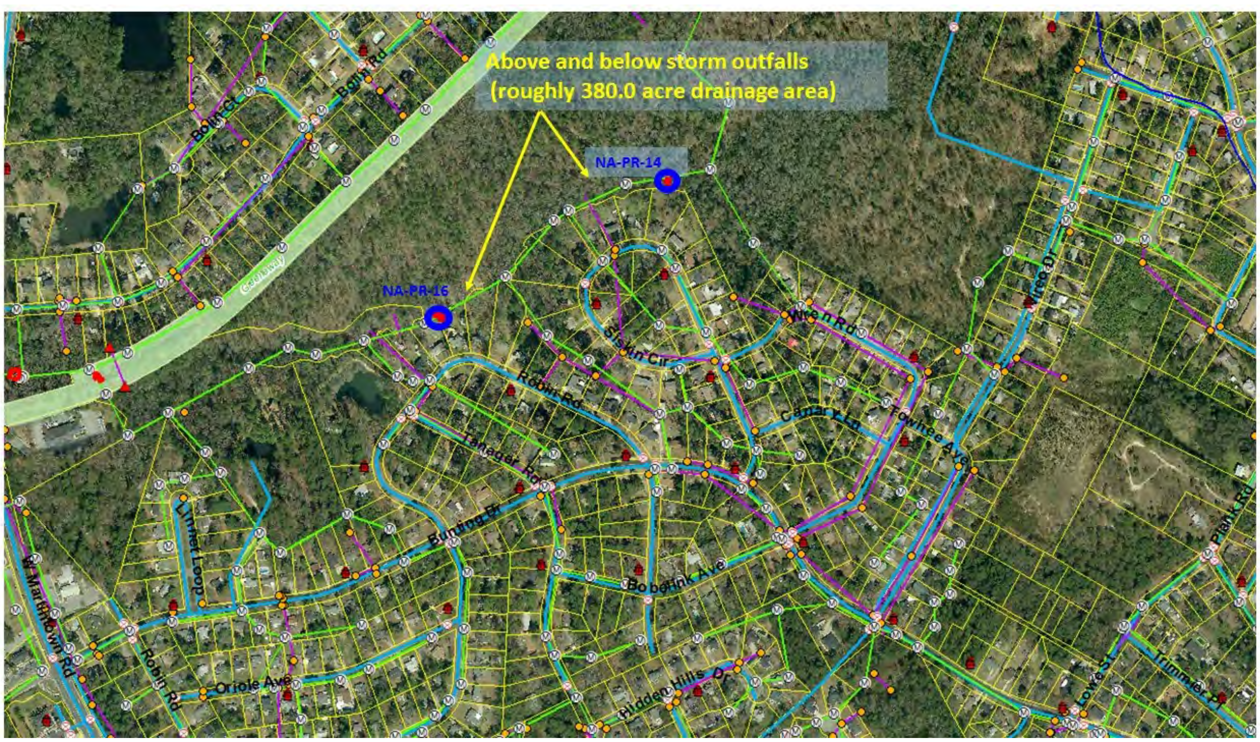


Figure 19: Aerial Image of TMDL Monitoring Location NA-PR-16 and NA-PR-14 with Infrastructure
(Green lines with manholes = Sanitary Sewer, Pink lines with orange manholes = Storm sewer)

4.4.1.6 Rational for Sample point NA-PR-13

NA-PR-13: This is a sample location instream of unnamed tributary/headwater to Pretty Run Creek. Figure 20 shows this sample location along with the stormwater and wastewater infrastructure in the drainage area. Figure 21 is an aerial view with NA-PR-13 identified. This location is representative of the drainage from one of the oldest neighborhoods located off of Dove & Hugh Streets and also the commercial areas located at Georgia and Knox Avenue. Figure 4 shows the drainage areas that lead to NA-PR-13, they are shown as 1, 2 and 3 and encompass approximately 475 acres (27%) of the sub-basin. They are more fully described in Table 5. This point will assess the drainage prior to it traveling through Knollwood and ultimately to NA-PR-14. The very beginning of this unnamed tributary is a drainage ditch leading to Knollwood along Five Notch Road. It is dry mostly but flows during rain events. Commercial facilities including restaurants, veterinarians, medical offices are located upstream of the sample point. The water samples will be indicative of stormwater drainage to Pretty Run Creek from this area of town. Septic tanks are located in the upper reaches of NA-PR-13 (see Figure 5). This location will be helpful in determining if the POC is coming from these parts of town where infrastructure is oldest and homes may have illicit discharges to the ditches. A literature research effort will take place regarding lateral groundwater flow from Pole Branch to Pretty Run Basin in this reach of the stream. It is possible that the POC may be traveling from across W. Five Notch Road neighborhood's numerous septic tanks (Figure 5). While all surface water flows to another basin, the possibility of groundwater flowing into Pretty Run exists.

NA-PR-13 has not been sampled in the past.

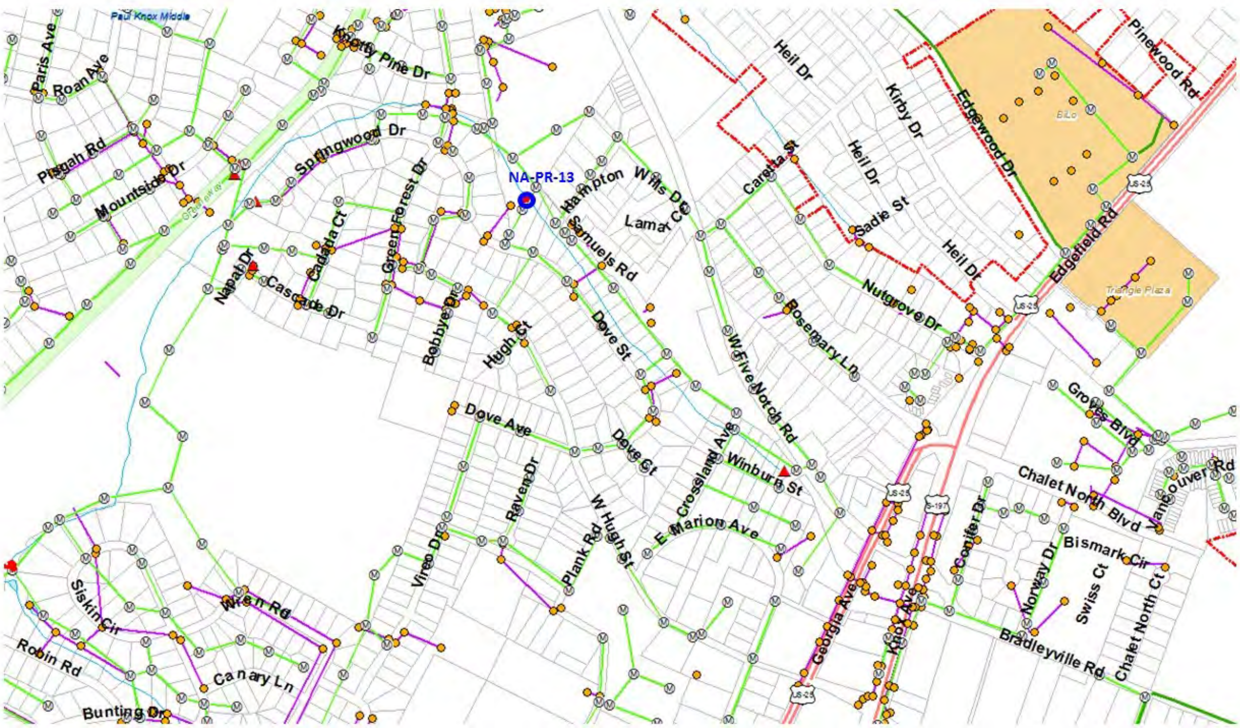


Figure 20: GIS Map of TMDL Monitoring Location NA-PR-13 with Infrastructure Shown
(Green lines with manholes = Sanitary Sewer, Pink lines with orange manholes = Storm sewer)

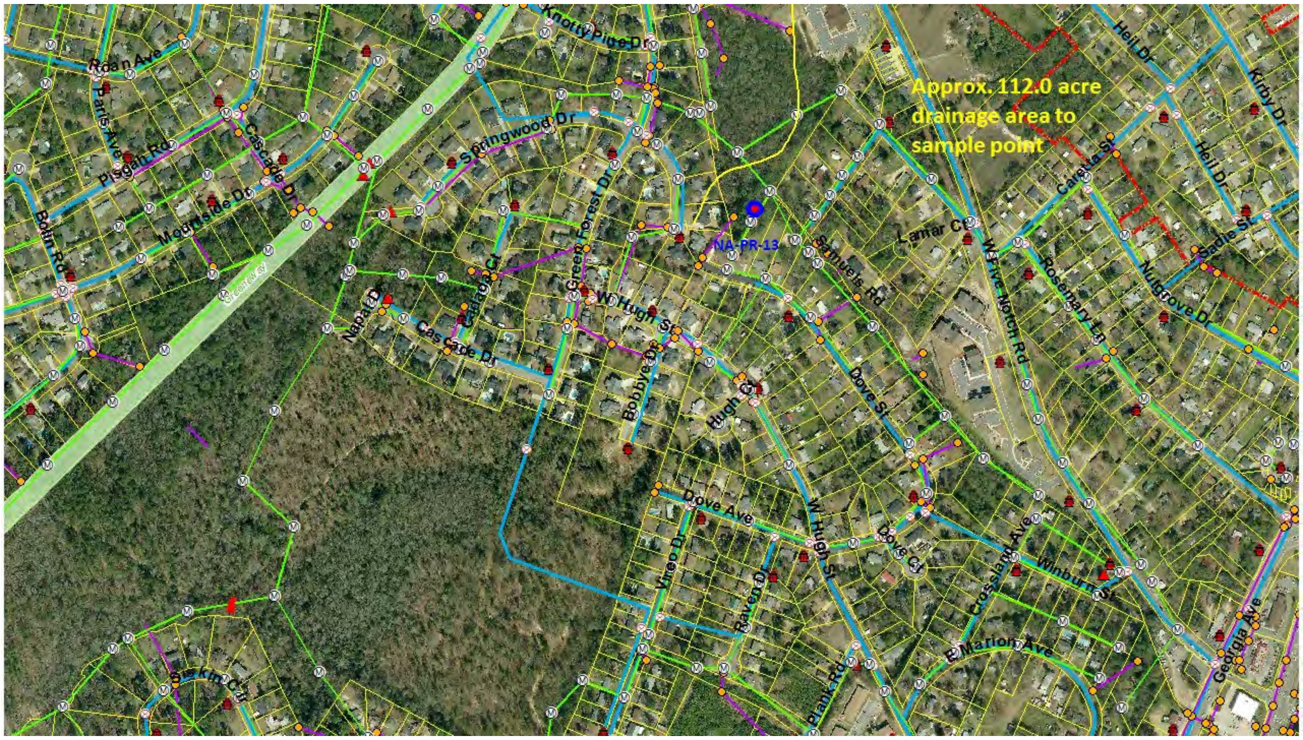


Figure 21: Aerial Image of TMDL Monitoring Location NA-PR-13 with Infrastructure Shown
(Green lines with manholes = Sanitary Sewer, Pink lines with orange manholes = Storm sewer)

4.4.2 Sample Event Criteria

Instream samples will be collected to represent the ambient instream conditions. Samples can be collected at any time of day. City staff will attempt to collect the samples throughout the Pretty Run sub-basin at or about the same time during each sample event. We feel this will be most representative of conditions that exist. Sample collection will occur during the normal business hours of 8am and 5pm Monday through Friday.

Wet weather samples will be collected at each location once per quarter (seasonally). Four (4) seasonal samples will be collected during rain events. Criteria for sampling during a rain event should represent the adequate rainfall duration and volume to be representative of conditions within the drainage area for this part of the state. Rain event sample collection must meet the criteria described as representative rain events provided in Table 6 of Section 4.2.4.3.

A dry weather sample at least one (1) per year, will be collected to determine baseline conditions at Pretty Run Creek. The dry weather sample will be conducted during a prolonged dry weather event in the summer of year one (2015) and in the fall or winter of year two (2016). Dry weather samples should be collected when dry weather has occurred for several weeks or more. The sample should be collected with soil conditions in mind. These sample events (dry weather) should be considered when conditions are dry enough that ground water tables and saturated soils are lower than during rainy seasons. The method to determine soil moisture and groundwater table conditions will be based only on the prolonged dry weather. During summer months (hot weather, no rain) that period could be less than a month. During fall and winter, that period should be at least 4 weeks, if possible. The data resulting from the dry weather sample events will be assessed and compared to wet weather events.

4.4.3 Monitoring Frequency and Duration

Sample collection requirements will be reviewed at the beginning of the season and scheduled to occur. The schedule will allow for resource or weather adjustments that may arise as the sample date draws near. Each season will be sampled to determine if seasonal variation exists in the concentration of the POC in the Pretty Run Basin (based on rainfall, soil moisture patterns including absorption or runoff conditions due to excessive rain or lack of rain). The seasonal weather patterns is known to effect stormwater discharge impacts to water bodies. Table 9 indicates the seasons and average temperatures in this region of the state. Rainfall patterns in the area were reviewed at the SC Department of Natural Resources (SCDNR) State Climate Office website. In Table 10, that data was compiled looking at years 1971-2010 for North Augusta and Columbia SC. A schedule will be completed for each season based on weather and representative rain event analysis (Table 11).

Table 9: Approximate Seasons in our Region

Seasons – Columbia SC	Average Temperatures (high/low °F)
Winter: November - February	59.8 / 37.5
Spring: March - May	64.0 / 51.4
Summer: June - August	90.4 / 70.1
Fall: September - October	80.3 / 58.1

Table 10: Rainfall Patterns in the North Augusta Area

Data Time Frame	1981-2010	1971-2000	1971-2000	1971-2000
Month	North Augusta Rainfall Averages in Inches for 1981-2010 (SCDNR)*	Normal # of Days with Rain (greater or equal to 0.01 inch) Columbia, SC*	Normal # of Days with Rain (greater or equal to 1 inch) Columbia, SC*	Monthly Normal Rainfall (Inches)*
January	4 to 5	10.5	1.3	4.66
February	4 to 5	9.4	1.2	3.84
March	4 to 5	10.2	1.4	4.59
April	3 to 7	7.8	0.9	2.98
May	3 to 4	9	1	3.17
June	4 to 6	9.9	1.4	4.99
July	4 to 5	11.3	1.9	5.54
August	4 to 6	10.3	2.2	5.41
September	3 to 4	7.2	1.2	3.94
October	3 to 4	6	1	2.89
November	3 to 4	6.9	1.1	2.88
December	3 to 4	9.2	1	3.38

**Data compiled from information located on the SCDNR - SC State Climate Office Website*

Table 11: City of North Augusta Sampling Schedule Worksheet

SEASON	**MONTHS**	**DATES (24 mos):**
• Summer Sampling	(June – August)	June 2015 and July 2016
• Fall Sampling	(September – October)	TBD 2015 and 2016
• Winter Sampling	(November – February)	TBD 2015 and 2016 or 2017
• Spring Sampling	(March – May)	TBD 2016 and 2017

Frequency of sampling is set at five (5) instream bacteria grab samples (testing for *F. coliform* or *E. Coli*) to be collected throughout the first year at each of the seven (7) stations listed in Table 8 and again during the second year of this assessment. Four of those samples will be conducted during wet weather, and one at each station will be conducted during dry weather. The resultant data will be reviewed to determine if further sampling during that time frame is necessary to assess the drainage area for each sample point.

- The minimum total number of bacteria samples that will be collected during **year one** of the study (June 2015 – to May 2016) is at least 35 samples.
- The minimum total number of bacteria samples that will be collected during **year two** (June 2016 – May 2017) is at least 35 samples.

4.4.4 Process and Schedule for Assessing Monitoring Data

Individual sample events: The sample results will be reviewed after each sample event. The data will be considered to determine if the WLA for Pretty Run Creek is being met. If data indicates extremely high bacterial counts at one location, further analysis may be initiated and an investigation of upstream infrastructure will take place. This will be to determine and locate if there is a point source contributing the POC to that sample point. The goal is to eliminate illicit discharges (if they are occurring from a point source) as soon as possible. If no point source is located during the investigation, additional sample points upstream of the TMDL Monitoring sample point may be identified and sampled to pinpoint if there is a point-source. The additional point will be identified in the Annual Report and the data will be provided. This additional sample location may or may not be added to the routine sample schedule. If the individual sample event data indicates multiple high bacterial counts throughout Pretty Run Creek, infrastructure will be systematically inspected to try to determine if a non-point source can be determined and eliminated, prior to the TMDL Implementation plan development. The individual sample event data will be considered in the development of a TMDL Implementation Plan.

Year 1 Monitoring Data: At the end of year one, all five of the sample events data will be reviewed. The data will be considered to determine if the WLA for Pretty Run Creek is being met. The data will be compared and combined with any other monitoring data generated during the TMDL Monitoring schedule to date. Historical data will also be considered. During the review of the data, if it is suspected that a certain location in the monitoring strategy warrants a full infrastructure evaluation, that evaluation will be initiated as soon as possible. This will be to determine if a point source or non-point source is present. If further sampling would help to make that determination, additional sample points may be identified and sampled to narrow down the investigation. If no point source is identified, based on the results of the analysis of all of the seasonal grab samples and additional samples, if any, all of the data will be utilized to create the TMDL Implementation Plan. The plan will identify BMPs that could be used to meet the WLA for Pretty Run Creek to the MEP.

During the creation of the TMDL Implementation plan, BMPs will be considered (if necessary) to limit the POC from impacting the stream from the city sMS4 Stormwater system to the MEP. Each BMP considered will be analyzed for the potential to improve water quality, the cost associated with its implementation, feasibility of the BMP placement, and short and long-term maintenance requirements and costs for the locations considered. Any other regulatory requirements of the plan will be included.

Year 2 Monitoring Data: At the end of year two, all five of the years sample events data will be reviewed and analyzed along with Year 1 data. The data will be compared and combined with any other monitoring data generated during the TMDL Monitoring schedule. Historical data will also be considered. The data will be considered to determine if the WLA for Pretty Run Creek is being met. During the review of the data, if it is suspected that a certain location in the monitoring strategy warrants a full infrastructure evaluation, that evaluation will be initiated as soon as possible. This will be to determine if a point source or non-point source is present. If further sampling would help to make that determination, additional sample points may be identified and sampled to narrow down the investigation. If no point source is identified, based on the results of the analysis of all of the seasonal grab samples and additional samples, if any, all of the data will be reviewed to help identify non-point sources that may be contributing the POC to the stream. The existing TMDL Implementation Plan may be updated based on the data generated by the second year of sampling. All data will be reported in the annual report. Any changes to either the TMDL Monitoring Plan or Implementation Plan will be identified and submitted for review with the annual report.

At the end of the year one sample events, statistical analysis of all of the data will be completed to determine if any there is statistically significant finding. As each sample event is conducted after that date, it will be included in statistical analysis. The result of the analysis will be included in the development or assessment of the TMDL Implementation Plan and reported on the annual report. One project goal is to gather enough data to make a statistically significant finding of whether the POC is being contributed by the sMS4 stormwater discharges. In bacterial sampling (grab sampling) this may or may not be feasible. The city may or may not be able to make a statistically significant finding based on many factors or exceptions when bacteria is the POC, including number of samples, unknown conditions such as wildlife seasonal patterns, weather patterns that are unknown at the time of setting up the monitoring plan, upsets that may occur in the sampling area that could skew the data one way or another, or other factors. With these issues in consideration of the outcome, the city will to the MEP, attempt meet this project goal.

At the end of the second year monitoring period, the expected full data set will be statistically analyzed. The number of samples and seasonal nature of the sampling, should be adequate to conduct statistical analysis (with the exceptions identified earlier). If any trend or significant findings are or are not identified, the information will be included in the development, modification or assessment of the TMDL Implementation Plan and reported on the annual report. It will be true that a determination of actual concentrations of bacteria (*Fecal coliform* or *E. coli*) at a given point in the stream at a given time will be available. That information will be valuable to implement investigations at the time they are encountered. That is the purpose for the targeted investigations taking place after each sample event where extremely high concentrations of the POC may be identified. Whether the cause is a point source or a non-point source, conducting immediate investigations to determine the source prove to be beneficial. The city will attempt to make assumptions about seasonality and wet or dry weather concentrations to the MEP as the permit requires. All findings from all investigations, sample analysis or statistical analysis will be reviewed to determine if the TMDL WLA for Pretty Run Creek is being met.

5 Sample Collection Methods and Handling/Custody Procedures

Sample collection involves following the applicable grab sample procedures for surface waters found as described by EPA. There are different procedures and protocols depending on the constituent or POC being sampled for. This section of the TMDL Monitoring Plan will break these protocols into sections. The sections for each type of sample required will be included.

At this time, the only TMDL in the city requiring monitoring is Pretty Run Creek and the POC is *Fecal coliform*. The bacterial indicator Fecal coliform has been eliminated for surface waters and replaced with *E. coli*. Therefore, this section will focus solely on collection of bacteria samples.

In the future, if other sensitive waters are identified and additional POCs are required to be monitored, the TMDL Monitoring Plan will be updated to add each new POC required.

5.1. Bacteria – EPA Background

Background on Bacteria Sampling

EXCERPTS FROM: (EPA Monitoring Fecal Bacteria 5.11) The most commonly tested fecal bacteria indicators *are total coliforms, fecal coliforms, Escherichia coli, fecal streptococci, and enterococci. All but E. coli are composed of a number of species of bacteria that share common characteristics such as shape, habitat, or behavior;* ***E. coli is a single species in the fecal coliform group.***

Total coliforms are a group of bacteria that are widespread in nature. All members of the total coliform group can occur in human feces, but some can also be present in animal manure, soil, and submerged wood and in other places outside the human body. Thus, the usefulness of total coliforms as an indicator of fecal contamination depends on the extent to which the bacteria species found are fecal and human in origin. For recreational waters, total coliforms are no longer recommended as an indicator.

Fecal coliforms*, a subset of total coliform bacteria, are more fecal-specific in origin. However, even this group contains a genus, Klebsiella, with species that are not necessarily fecal in origin. Klebsiella are commonly associated with textile and pulp and paper mill wastes. Therefore, if these sources discharge to your stream, you might wish to consider monitoring more fecal and human-specific bacteria. For recreational waters, this group was the primary bacteria indicator until relatively recently, when EPA began recommending E. coli and enterococci as better indicators of health risk from water contact. Fecal coliforms are still being used in many states as the indicator bacteria.*

E. coli is a species of fecal coliform bacteria that is specific to fecal material from humans and other warm-blooded animals. EPA recommends E. coli as the best indicator of health risk from water contact in recreational waters; some states have changed their water quality standards and are monitoring accordingly.

South Carolina is one of those states that has changed their water quality standard to ***E. coli*** or ***Enterococci.*** Due to the change from Fecal coliform to *E. coli*, the city will sample *E. coli* at Pretty Run Creek. The TMDL for Pretty Run is *Fecal coliform*. There has been little guidance on this change as it relates to TMDLs. The state has put out some information.

5.2 Regulatory Changes in South Carolina - *Fecal coliform* bacteria Regs.

This section is a compilation of "copied" regulatory language describing bacteria sampling changes and standards for freshwater streams in South Carolina.

Bacterial Standards: Copied from SCDHEC draft 2013 303d List
The degree to which the swimmable goal of the Clean Water Act is attained (Recreational Use Support) is based on the frequency of fecal coliform bacteria excursions. Standards for primary contact recreation were derived from public health data that estimate the potential risks to humans of contracting waterborne illnesses after swimming due to exposure to sewage-related pathogens. For all waters classified for recreational use support, South Carolina R.61-68 requires a geometric mean and instantaneous fecal coliform bacteria standard for both fresh and tidal salt waters;

"Not to exceed a geometric mean of 200/100ml, based on five consecutive samples during any 30 day period; nor shall more than 10% of the total samples during any 30 day period exceed 400/100 ml".

The standard is protective of primary contact recreational use; therefore, secondary contact recreational use is also protected.

For fecal coliform bacteria, if 10 percent or less of the samples exceed the instantaneous single sample maximum (SSM) criterion then recreational uses are said to be fully supported. A percentage of criteria excursions greater than 10% of the 400 cfu/100 ml criterion indicates impairment of recreational uses and the waterbody is listed. In most cases, insufficient data are collected to evaluate against the geometric mean component of the standard as prescribed in R. 61-68; therefore, evaluation against the instantaneous SSM criterion is necessary.

At the time of development of the 2012 §303(d) list of impaired waters, *South Carolina is proposing a change from fecal coliform bacteria to Escherichia coli (E. coli) bacteria as a primary contact recreational use standard in all freshwaters (Classes FW, TN, TPGT, and TPT).* If *E. coli* is promulgated in R.61-68 and becomes the applicable water quality standard for recreational use in freshwaters, all freshwater sites assessed for fecal coliform bacteria and included on the 2012 §303(d) list for recreational use impairment will become sites listed as impaired due to *E. coli* bacteria. A methodology for the assessment of *E. coli* bacteria in freshwaters is currently being drafted by the Department and will be used during development of future §303(d) lists, once sufficient *E. coli* bacteria data are collected by the Department.

South Carolina is also proposing to remove fecal coliform as a primary contact recreational use standard in all tidal saltwaters (Classes SA, SB and SFH) while maintaining the ***enterococci*** recreational use standard as described below. If fecal coliform is removed from R.61- 68 as an applicable water quality standard for recreational use support in tidal saltwaters, all tidal saltwater sites assessed for fecal coliform bacteria and included on the 2012 §303(d) list for recreational use impairment will remain listed due to fecal coliform bacteria until such time that sufficient enterococci bacteria data are collected for assessment of impairment status.

EXCERPT FROM Published and Final: SCDHEC R61-68 WQ Standards - June 2012

Pursuant to South Carolina Code Sections 48-1-10, et seq. of the 1976 South Carolina Code of Laws, the Department of Health and Environmental Control shall promulgate regulations to implement the Pollution Control Act. R. 61-68, Water Classifications and Standards, establish appropriate classified water uses to be achieved and protected, establish general rules and specific water quality criteria to protect classified and existing water uses, establish antidegradation rules, protect the public health and welfare, and maintain and enhance water quality. The water quality standards also serve as a basis for decision making in other water quality program areas. National Pollutant Discharge Elimination System (NPDES) permit limitations for waste discharges are based upon the classifications and water quality standards of the receiving waters. This regulation also governs the control of toxic substances, thermal discharges, stormwater discharges, dredge and fill activities, and other water related activities.

In accordance with Section 303(c) of the Clean Water Act and 40 CFR 131, the United States Environmental Protection Agency (EPA) has approved these water quality standards on February, 28, 2013, for purposes of implementation of the Act.

Daily maximum (for bacterial indicators only) means the highest arithmetic average of bacterial samples collected [for each of the bacterial indicator species (i.e., E. coli, enterococci, and /or fecal coliform)] in any 24 hour period during a calendar month.

Monthly average (for bacterial indicators only) means the calendar month (i.e., 28 days, 29 days, 30 days, or 31 days) geometric mean of all bacterial samples collected [for each of the bacterial indicator species (i.e., E. coli, enterococci, and/or fecal coliform)] during that calendar month.

(14) TMDL(s), WLA(s), and LA(s) included in currently approved freshwater fecal coliform TMDL documents shall be converted to E. coli utilizing a translator equation established by the Department and shall be based upon existing targets included in approved freshwater fecal coliform bacteria TMDL documents.

(8) In order to protect recreational uses in freshwaters (including FW, and all types of Trout Waters) of the State, NPDES permit effluent limitations shall be specified as indicated below:

i. Monthly Average (E. coli)	126 MPN per 100 ml
ii. Daily Maximum (E. coli)	349 MPN per 100 ml (see c(12) below)
iii. Shellfish protection	Class SFH requirements for fecal coliform (see c(11)i. and c(11)ii. below may be specified (in addition to the limits above) for the protection of downstream waters (regardless of their individual classification) with shellfish uses.
iv. Municipal separate storm sewer systems	**For municipal separate storm sewer systems (as described in R.61-9.122.26.a.) compliance with the bacterial standards shall be determined in accordance with c(13) below.**
v. Protection of upstream and/or downstream waters	Permit limitations may include (in addition to the requirements listed in c(8)i. and c(8)ii. above) one or more bacterial limitations for fecal coliform, E. coli and/or enterococci to protect both uses in the specific receiving water body and also to protect any upstream and/or downstream uses that may be required. If more than one bacterial limit is required, the conditions associated with each section below shall apply independently regardless of the water classification at the point of discharge.
vi. Class ORW or ONRW protection	For Class ORW or ONRW waters, the bacterial requirements shall be those applicable to the classification of the waterbody immediately prior to reclassification to either ORW or ONRW, including consideration of natural conditions. See G.5 and G.7 for prohibitions.

c. Application of criteria for the derivation of permit effluent limitations.

(13) For waters of the State, where a permit has been issued pursuant to R.61-9.122.26 and R.61-9.122.34, the Department shall consider the permittee in compliance with the established bacterial (i.e., E. coli, enterococci, fecal coliform) criteria for recreational uses of the waterbody if the permittee is in compliance with their permit.

5.3 Bacteria Sample Collection Procedures

Once sampling stations have been identified and the date is scheduled, the following procedures for collecting grab samples for bacteria must be followed prior to leaving the office or laboratory.

TASK 1 Prepare sample containers

Factory-sealed bacterial sample containers will be used, no preparation is needed. If a preservative is required, it will be already supplied in the sealed container. No reuse of sample containers will be allowed. The city will be using pre-packaged sample containers supplied by the manufacturer of the sample method.

TASK 2 Prepare before leaving for the sampling site

Confirm sampling data and time, readying equipment, reviewing safety considerations, checking weather and review laboratory protocols from the lab SOP for bacterial sampling. Check sample equipment.

Bottles should have tape over the cap or some seal or marking to indicate that they have been sterilized. If any of the sample bottles are not numbered, number them according to the sample collection stations you will be visiting. If required, verify the preservative is still within the sample bottle prior to heading to site.

TASK 3 Collect the sample

Refer Task 2 – Once at the sample location, move equipment and coolers filled with ice to the sample location. Once there, verify that the bottles are labeled correctly on both the bottle and the log book or field log sheet. Don gloves prior to opening the bottle cap. Inspect the sample bottle to insure it has a valid seal (unbroken). Open the cap by unscrewing it from the bottle. Do not sit the cap down. Hold the cap face down in your gloved hand without touching it to the glove any more than necessary. This will help to prevent airborne or splashed water bacteria from collecting on to the inside of the lid of the cap prior to replacing it on the bottle. With the free hand, collect the sample from in the stream at the midpoint at a depth that does not completely cover the top of the bottle. Holding the bottle at an angle, slowly allow water to begin filling the bottle. Be extremely careful not to allow the water to flow into the bottle to the point that the preservative is washed out. If the bottle overfills displacing the preservative by any amount, discard that sample, label a new bottle prior to collecting the sample. Open the new bottle and try again. Once the bottle is filled to the indicator line, replace the lid quickly and tighten. Place the bottle in a cooler filled with ice and make all necessary notations for the sample in the field logbook and/or data sheets immediately. If field parameters are to be monitored, collect field measurements and log the data into the logbook or field data sheets. Remember to wash your hands thoroughly after collecting samples suspected of containing fecal contamination. Also, be careful not to touch your eyes, ears, nose, or mouth until you've washed your hands.

Collect QA/QC Samples:

Field quality assurance/quality control procedures include two types of samples for this monitoring plan.

Field Blanks. These should be collected at 10 percent of your sample sites along with the regular samples. Since there are seven (7) sites, collect at least one (1) field blank per sample event. Sterile water in sterilized containers should be sent out with selected samplers. At a predetermined sample site, the sampler fills the usual sample container with this sterile water. This is labeled as a regular sample, but with a special notation (such as a "B") that indicates it is a field blank. It is then analyzed with the regular samples. Lab analysis should result in "0" bacteria counts for all blanks. Blanks are used to identify errors or contamination in sample collection and analysis. Log the sample in the logbook and/or the field log sheet, and the Chain of Custody.

Internal Field Duplicates. These should be collected at 10 percent of your sampling sites along with the regular samples. At least one (1) field duplicate must be collected per sample event. A field duplicate is a duplicate stream sample collected at the same time and at the same place either by the same sampler or by another sampler. This is labeled as a regular sample, but with a special notation (such as a "D") that indicates it is a duplicate. It is then analyzed with the regular samples. Lab analysis should result in comparable bacteria counts per 100 mL for duplicates and regular samples collected at the same site. Duplicates are used to estimate sampling and laboratory analysis precision. Log the sample in the logbook and/or the field log sheet, and the Chain of Custody.

TASK 4 Return the field data sheets and all of the samples to the lab or drop-off point

Samples for bacteria must be analyzed within **6 hours** of collection. Keep the samples on ice and take them to the lab or drop-off point as soon as possible. Leave a completed Chain of Custody form with the laboratory showing you have relinquished the sample to the lab.

5.4 Analytical Methods

The laboratory will be determined prior to the sample collection and the laboratory will be notified prior to collection to determine what time best suits the staff at the laboratory to meet their protocols for the sample preparation and analysis.

The city will use a certified laboratory using the Colilert Quantitray method 9223B (Enzyme Substrate Test) to analyze all bacteria samples collected as part of the TMDL Monitoring Plan. Results must be quantified (absence/presence is not sufficient). The city will either use its own certified laboratory to analyze *Fecal coliform* or *E. coli* samples, or it will use the certified Aiken County Public Service Authority Laboratory or another contract laboratory. Any lab used must be certified to conduct the Enzyme Substrate Coliform Test: Method 9223B Enzyme Substrate Test.

5.5. Data Management

Data management is as important to a project as is sampling and analysis. Improperly handled data can result in misreporting or omission of data, ultimately leading to misinformed water quality management decisions. "Data Management" includes time spent collecting and recording sample project and sample event meta-data, creating new stations in the database, entering field and laboratory data into the water quality database, verifying data, performing QA/QC checks on data, and transferring data between various databases.

Instream sampling data are kept in the City's stormwater management water quality database. The administration of this database is the responsibility of the City's Stormwater Program Manager. Hard copies of laboratory reports are kept in a three ring binder. Three ring binders are organized by fiscal year. Electronic copies of laboratory reports are stored in the City's water quality database also. Laboratory data is transcribed and transferred into the water quality database. Field data are recorded on field data sheets are also kept in the three ring binders and data is transcribed into the water quality database by the Stormwater Program Coordinator or designee.

5.5.1 Review

Sample events are entered into the City's stormwater water quality database when laboratory results are available from the contract laboratory. Field data and laboratory results are reviewed by the Stormwater Program Coordinator for errors and omissions as well as data that may indicate outliers. Errors and omissions are noted in the water quality database. Laboratory QC data is included with laboratory reports and QC flags are noted in the water quality database.

5.5.2 Validation and Verification

Instream data field data is validated by the Stormwater Program Manager. Final review and verification shall be performed also. Field Data and chain of custody information will be reviewed and verified after data is entered into the water quality database.

Laboratory data that is outside the historical range of data collected will be flagged in the water quality database and the contract laboratory QC information will be reviewed. QC information from the contract laboratory will be included in the data entered into the City's water quality database.

5.6 Documentation and Record Keeping Procedures

The record keeping procedures for each of the TMDL monitoring event are outlined below.

5.6.1 Instrument Calibration Data

All field equipment calibration records must be entered on the field log sheet and recorded in the designated instrument logbook each time they are used in the field. This includes pH meters, temperature probes, turbidity meters and dissolved oxygen meters.

5.6.2 Stormwater -Wet Weather Field and Analytical Data

Paper copies field data, sampler data, laboratory results and other data collected as part of TMDL Monitoring will be kept in three ring binders. Field Data will be transferred to the water quality monitoring database.

Any flow measurements taken will be recorded in the log books on the day of the measurements. The city will use the bucket/stop-watch method according to the EPA protocols.

5.7 Storm Event Prediction and Sampling

5.7.1 Storm Event Staff Deployment

Field crews will be fully equipped and prepared (i.e. appropriate staff is available to sample and maintain equipment, personal protective gear ready, and equipment is ready to be initiated, etc.) prior to deployment when a qualifying storm event has been forecasted. The City will use the National Oceanic and Atmospheric Administration's Northwest River Center-10 Day Meteorological Forecasts web page (NOAA, 2012) to initially identify potential storms that will meet the storm event criteria outlined in 4.2.4.3 and Table 6.

Within 24 hours of a forecasted storms arrival, staff will be notified of deployment and equipment will be prepared. Staff will perform field checks of any required equipment.

All site activities will be logged in the field notebook.

5.7.2 Grab Samples (E.coli)

E. coli samples will be collected as discrete samples (grab sample) during the sample event and delivered within holding times to the contract laboratory. Sample collection will follow the procedures outlined in the SOPs (Appendix C). Staff shall contact the City's contract laboratory and mail service in advance of sampling to schedule bottle receipt and schedule shipping of sample bottles.

5.7.3 Chain of Custody

The *Chain-of-Custody Form* is used to record sample custody. These forms are always used with MS4 sampling activities. A chain of custody is filled out for each sample event and kept with the samples at all times. All staff responsible for collecting and shipping samples must read, understand, and implement the chain of custody procedures outlined by the contract laboratory's quality manual. The contract laboratory quality manual outlines the policies and operational procedures associated with the contract laboratory. All policies and procedures must be structured in accordance with the National Environmental Laboratory

Accreditation Conference (NELAC) standards and applicable EPA requirements, regulations, guidance, and technical standards.

5.8 Quality Control Procedures

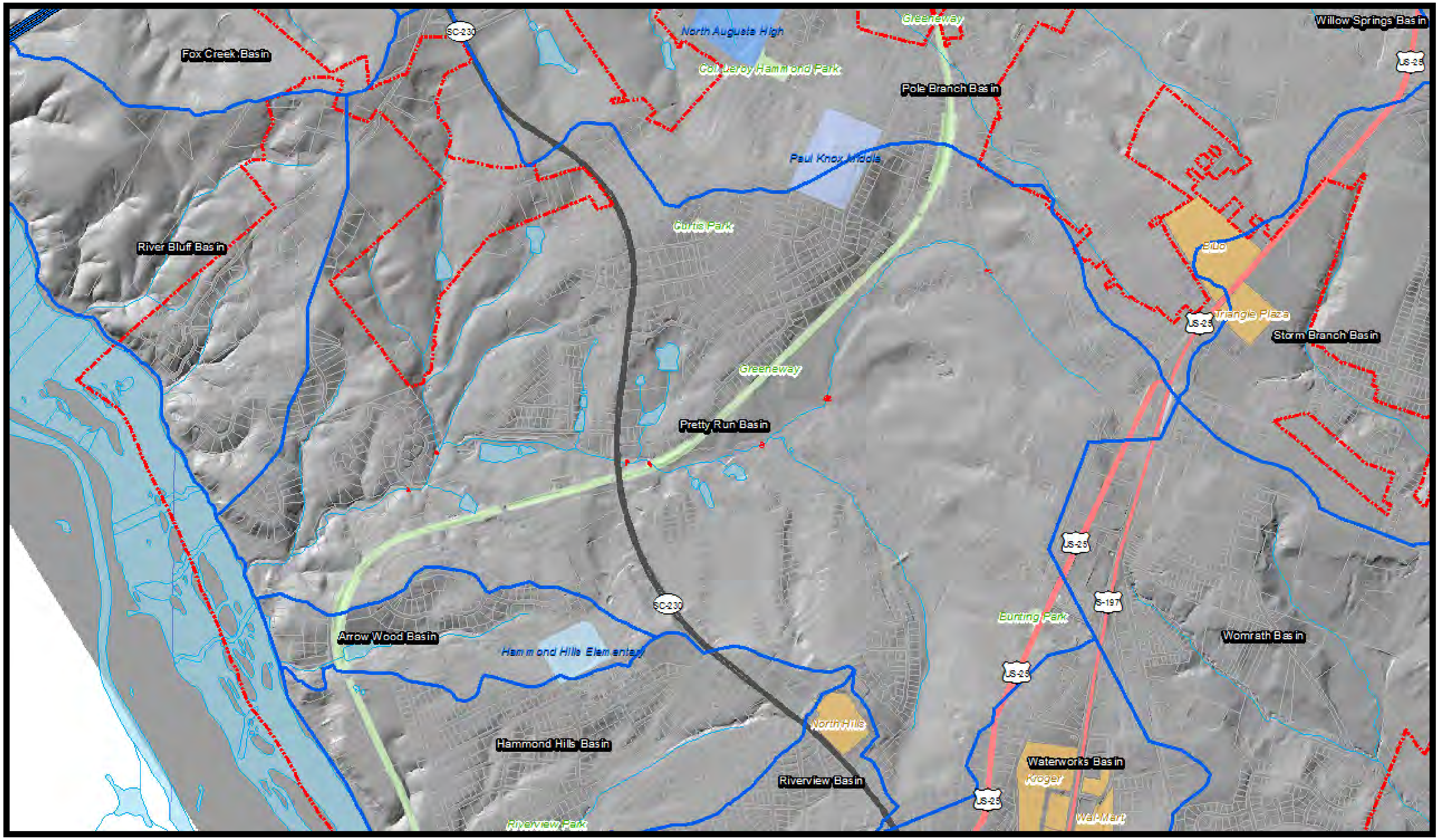
5.8.1 Internal Duplicate sample collection

Duplicate samples will be collected once per sampling event. Collection of duplicate samples will be conducted at the same time.

5.8.2 Calibration of Instrumentation and Equipment

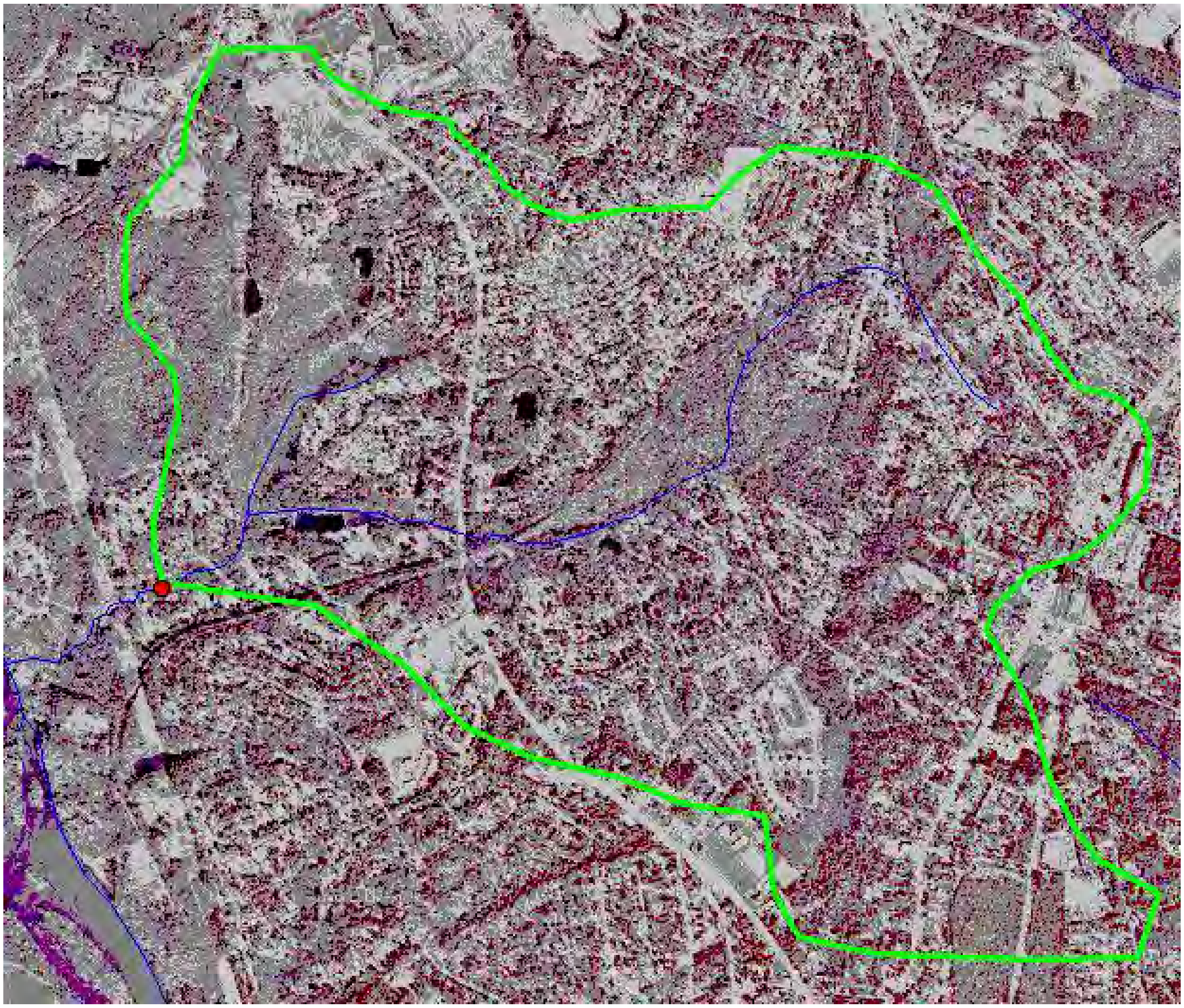
When used, calibration of instrumentation and equipment will follow manufacturer's recommendations and logged in the field data log sheet, field log book, and dedicated instrument log book.

Appendix A- Map of Pretty Run Sub Watershed (Surface Topo)



Appendix B-Pretty Run TMDL

Total Maximum Daily Load Document: Pretty Run Creek
(Hydrologic Unit Code: 03060106-06-01) Station RS-04544
Fecal Coliform Bacteria, Indicator for Pathogens



November 27, 2006
Bureau of Water

D H E C
PROMOTE PROTECT PROSPER

Abstract

A Total Maximum Daily Load (TMDL) has been developed for the Pretty Run Creek, which is a tributary of the Savannah River in Aiken County, SC. Pretty Run Creek was sampled in 2004 as a random station and has apparently never been sampled before. This urban creek, which is mostly in North Augusta, is listed on South Carolina's 2006 303(d) list of impaired waters, because 67 % of the samples exceeded the standard for fecal coliform bacteria of 400 cfu/100 ml. The likely sources of the fecal coliform bacterial pollution are urban runoff (including pets), leaking sewers, and failing septic systems.

The load-duration curve methodology was used to calculate the existing loads and the TMDL loads for the creek. Existing loads and TMDL loads are presented in Table Ab-1. In order to reach the target load for Pretty Run Creek, reduction in the existing load to the creek of 31 % will be necessary. Resources and several TMDL implementation strategies to bring about these reductions are suggested.

Table Ab-1. Total Maximum Daily Loads for the Pretty Run Creek.

Station ID	TMDL (cfu/day)	MOS (cfu/day)	WLA		LA (cfu/day)	Existing Load (cfu/day)	% Reduction to Meet Load Allocation[3]
			Continuous Sources[1] (cfu/day)	Intermittent Sources[2] (% Reduction)			
RS-04544	1.77E+10	8.84 E+08	NA	31 %	1.68 E+10	2.43 E+10	31%

Table Notes:

1 - WLA is expressed as total monthly average.

2 - Percent reduction applies to all NPDES-permitted stormwater discharges, including current and future MS4, construction and industrial discharges covered under permits numbered SCS & SCR. Stormwater discharges are expressed as a percentage reduction due to the uncertain nature of stormwater discharge volumes and recurrence intervals. Stormwater discharges are required to meet percentage reduction or the existing instream standard for pollutant of concern, whichever is less restrictive.

3 - Percent reduction applies to existing load; Where Percentage Reduction = (Existing Load-Load Allocation) / Existing Load

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Table of Contents

Tables

Figures

INTRODUCTION

1.1 Background

Fecal coliform bacteria is widely used as an indicator of **pathogens** in surface waters and wastewater. Acute gastrointestinal illnesses affect millions of people in the United States and cause billions of dollars of costs each year (Gaffield et al, 2003). Of these illnesses many are caused by contaminated drinking water. Untreated stormwater runoff has been associated with a number of disease outbreaks, most notably the outbreak in Milwaukee that caused many deaths.

Though occurring at low levels from natural sources, the concentration of fecal coliform bacteria can be elevated in water bodies as the result of pollution. Sources of fecal coliform bacteria are usually diffuse or nonpoint source, such as stormwater runoff, failing septic systems, and leaking sewers. Occasionally, the source of the pollutant is a point source. Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop total maximum daily loads (TMDLs) for water bodies that are not meeting designated uses under technology-based pollution controls. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a water body based on the relationship between pollution sources and in stream water quality conditions so that states can establish water quality-based controls to reduce pollution and restore and maintain the quality of water resources (USEPA 1991).

1.2 Watershed Description

Pretty Run Creek in North Augusta (Aiken County) is a small urban stream (Figure 1). This area is in the Southeastern Plains Ecoregion of western South Carolina. Figure 2 shows the location of the watershed within Aiken County and South Carolina. Most of the watershed is in the City of North Augusta and is developed. Approximately 5100 people live in the watershed in 2200 households (2000 US Census). This TMDL concerns the portion of the watershed upstream of water quality station RS-04544. Information about the watershed is given in Table 1.

Table 1. Pretty Run Creek water quality monitoring site description.

Watershed	Station ID	Sampling Station Description	Drainage Area (hectares)	(acres)	Population
Pretty Run Creek	RS-04544	Pretty Run Creek at River Bluff Drive	693	1712	5123

Land use data for the watershed are from the NLCD 2001 database (Figure 3; Table 2). At the time of the data collection (2001), forest was the principal land use in the watershed - 48 %. Urban land uses accounted for most of the rest - 39 %. Transitional land was a distant third in percentage at 6%. Transitional land use suggests land being developed.

Examination of the sewer line database for this watershed shows that most of the watershed has sewer lines. Septic systems are likely rare in this watershed.

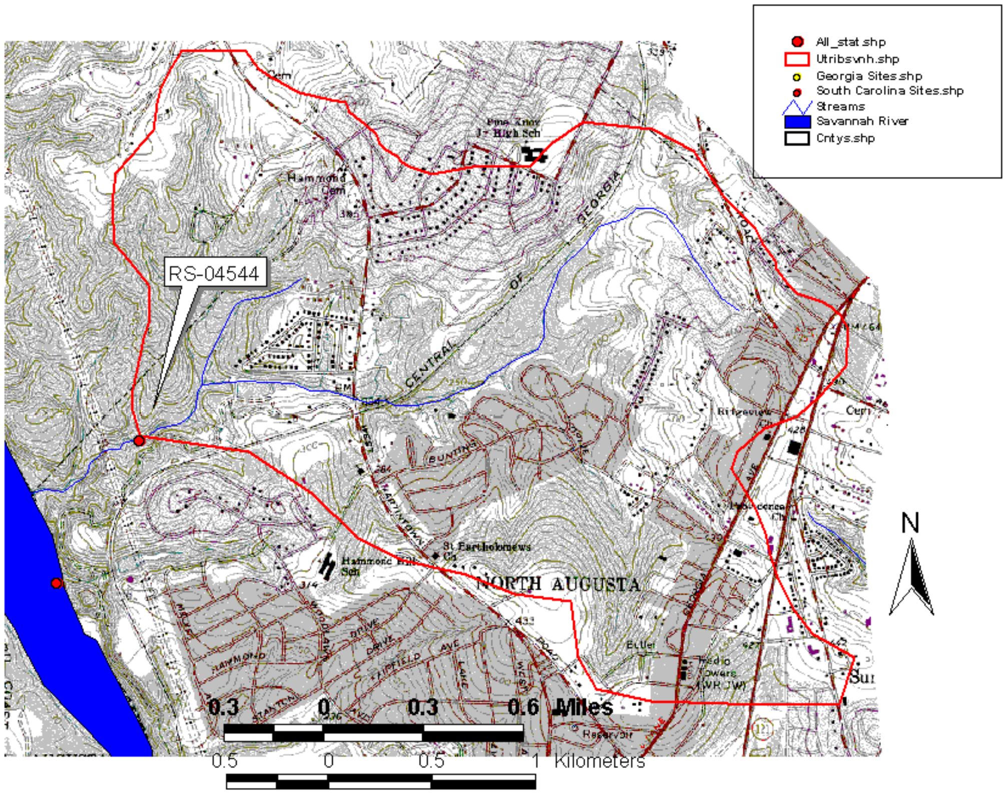

Figure 1. Map of Pretty Run Creek watershed, Savannah Basin.

1.3 Water Quality Standard

This Pretty Run Creek is designated as Class Freshwater. Waters of this class are described as follows:

> "Freshwaters suitable for primary and secondary contact recreation and as a source for drinking water supply after conventional treatment in accordance with the requirements of the Department. Suitable for fishing and the survival and propagation of a balanced indigenous aquatic community of fauna and flora. Suitable also for industrial and agricultural uses." (R.61-68)

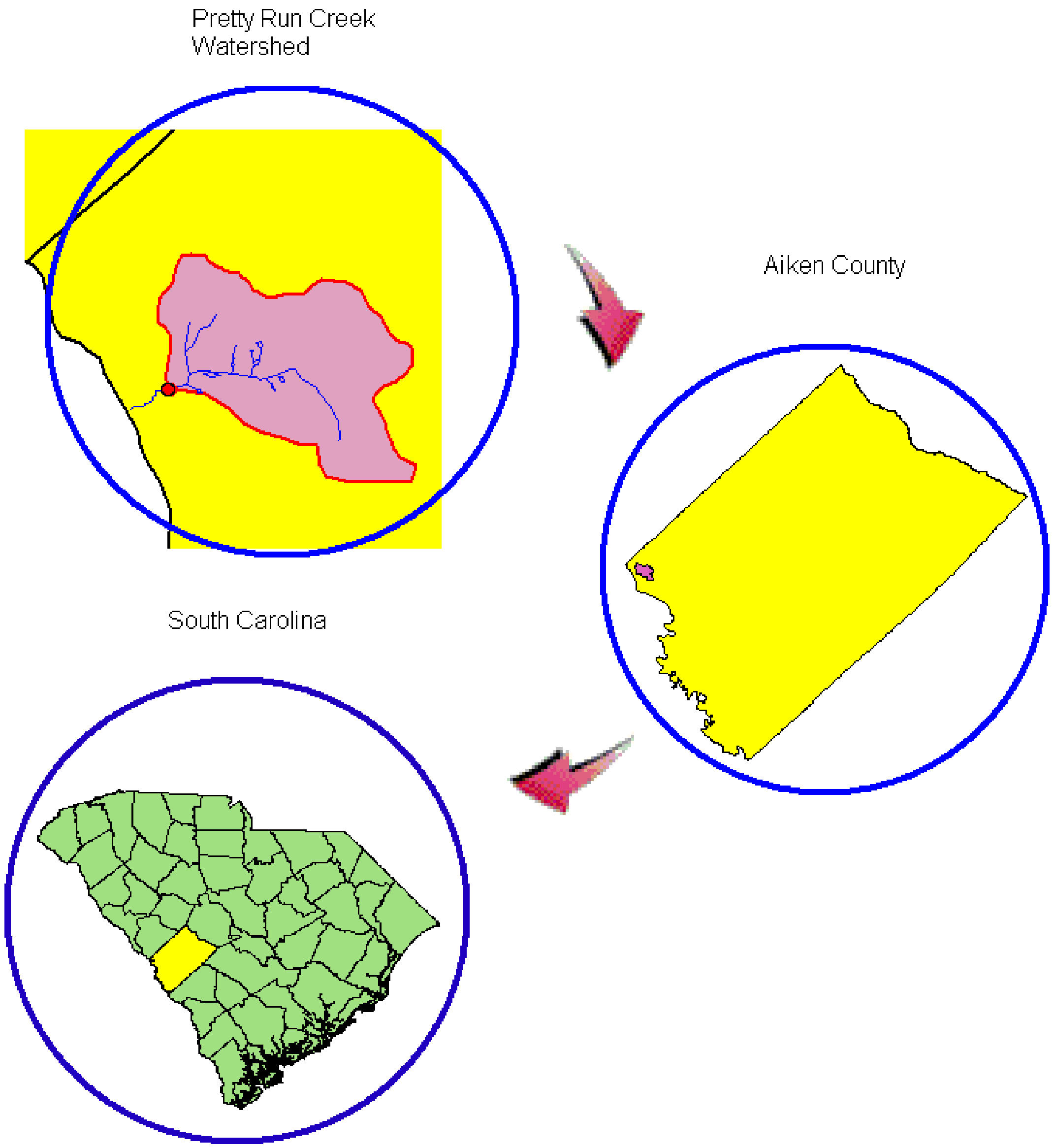

Figure 2. Location of Pretty Run Creek watershed in Aiken County, South Carolina.

South Carolina's standard for fecal coliform in Freshwater is:

"Not to exceed a geometric mean of 200/100 ml, based on five consecutive samples during any 30 day period; nor shall more than 10% of the total samples during any 30 day period exceed 400/100 ml."(R.61-68).

Primary contact recreation is not limited to large streams and lakes. Even streams that are too small to swim in, will allow small children the opportunity to play and immerse their hands and faces. Essentially all perennial streams should therefore be protected from pathogen impairment.

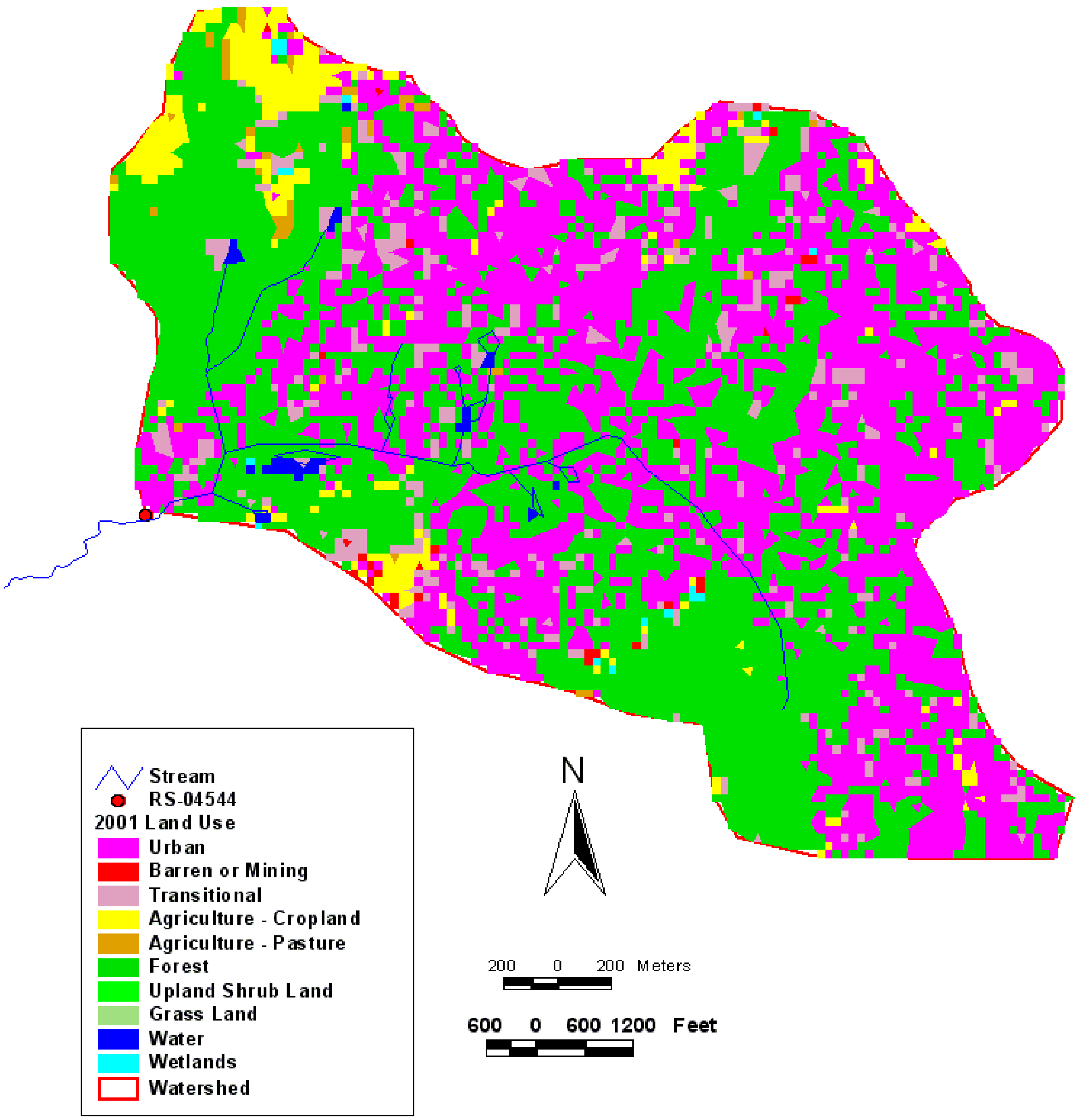

Figure 3. Map showing land uses in Pretty Run Creek watershed in 2001.

Table 2. 2001 land uses in Pretty Run Creek watershed at RS-04544.

Land Use Group	Land Use Class	Area		
		Hectares	Acres	Percent
Water		3.2	8	0.5%
	Low Intensity Residential	193.1	477	
	High Intensity Residential	41.9	104	
	Commercial/Industrial	36.9	91	
Urban		**272.0**	**672**	**39.2%**
Barren or Mining	Bare Rock/Sand/Clay	2.7	7	
Transitional		**41.8**	**103**	**6.0%**
	Deciduous Forest	38.4	95	
	Evergreen Forest	213.2	527	
	Mixed Forest/Shrubland	85.1	210	
Forest		**336.7**	**832**	**48.5%**
	Pasture/Hay	4.6	11	
	Urban/Recreational Grasses	3.6	9	
Agricultural Grasslands		8.2	20	1.2%
Agricultural Cropland	Row Crops	27.5	68	4.0%
	Woody Wetlands	1.5	4	
	Emergent Herbaceous Wetlands	0.1	0	
Wetlands		1.6	4	0.2%
Totals		**693.7**	**1714**	**100.0%**

2.0 WATER QUALITY ASSESSMENT

The water quality monitoring station on Pretty Run Creek (Table 1 and Figure 1) is a random site sampled during 2004. An assessment of the water quality data from this site for the 2006 303(d) list indicated that it was impaired for recreational use. Waters in which no more than 10% of the samples collected over a five year period are greater than 400 fecal coliform counts or cfu/100 ml are considered to comply with the South Carolina water quality standard for fecal coliform bacteria. Waters with more than 10 percent of samples greater than 400 cfu/100 ml are considered impaired for fecal coliform bacteria and placed on South Carolina's 303(d) list. Descriptive statistics for the data at this location is provided in Appendix A Table A-1. All of the data is provided in Appendix A Table A-2. The percentage of samples exceeding the standard of 400 cfu/100ml during 2004 was 67 %. The geometric mean for fecal coliform bacteria in Pretty Run creek was 433 cfu/100 ml.

There appears to be little relationship between fecal coliform bacteria and precipitation in this creek (Figure 4). As would be expected if precipitation did not affect fecal coliform counts there was little relationship between turbidity and fecal coliform bacteria (Figure 5). Therefore the sources of fecal coliform bacteria in Pretty Run Creek would appear to be continual and not precipitation-event related. Likely sources in this urbanized watershed are failing urban runoff, septic systems, illicit discharges, and leaking sewers.

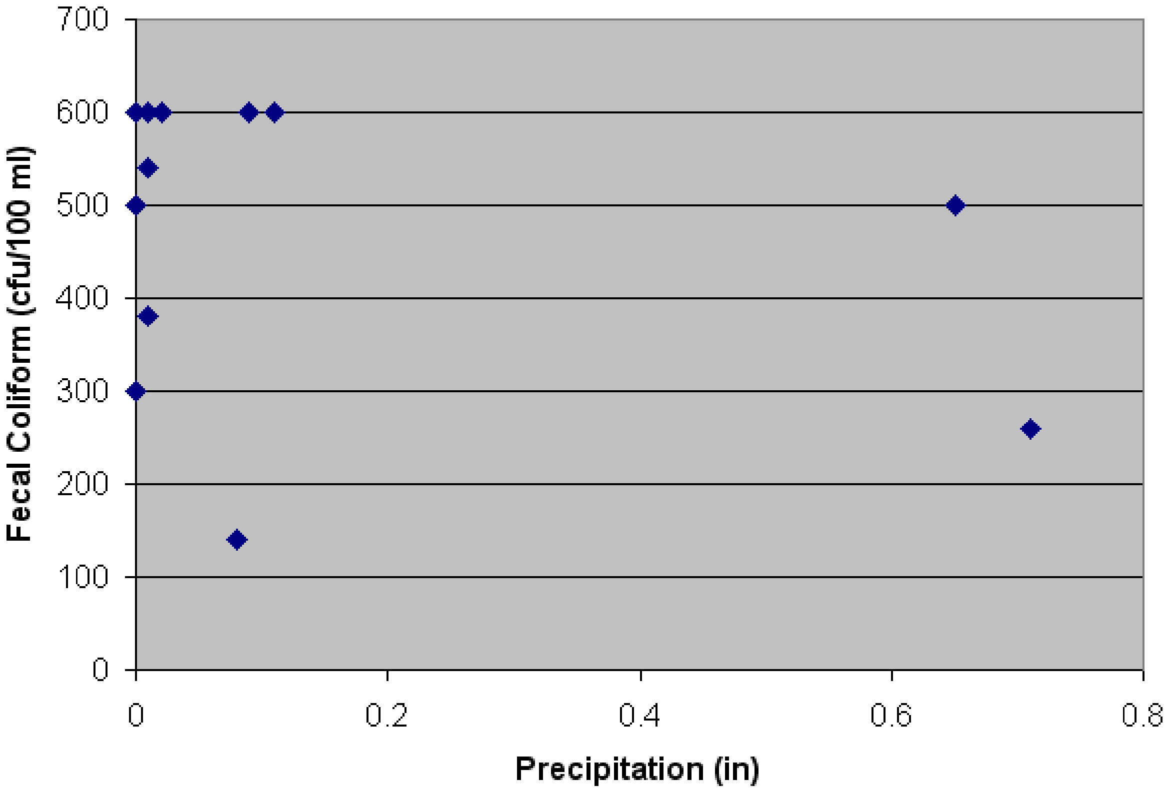

Figure 4. Plot of the relationship between precipitation (measured at Aiken) and fecal coliform bacteria in Pretty Run Creek.

As would be expected in stream where there was no apparent relationship between precipitation and fecal coliform bacteria, there is no apparent relationship between fecal coliform concentrations and turbidity (Figure 6). The lack of a correlation between fecal coliform concentrations and either precipitation or TSS suggests that most of the exceedences of the fecal coliform standard are due to continual sources as leaking sewers, illicit discharges, or failing septic systems. Urban runoff and sewer overflows are less likely to be significant sources.

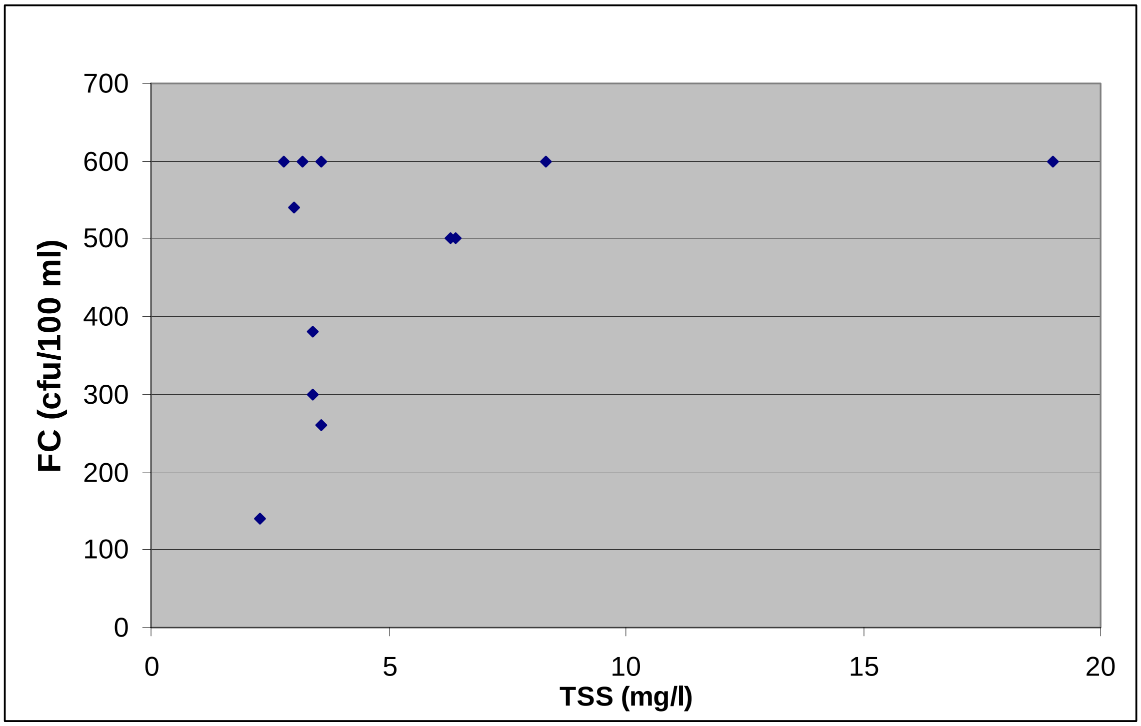

Figure 5. Plot of the relationship between turbidity and fecal coliform bacteria in Pretty Run Creek.

3.0 SOURCE ASSESSMENT AND LOAD ALLOCATION

Fecal coliform bacteria are used by the State of South Carolina as the indicator for pathogens in surface waters. Pathogens, which are usually difficult to detect, cause disease and make full body contact recreation in lakes and streams risky. Indicators such as fecal coliform bacteria, enteroccoci, or E. *Coli* are easier to measure, have similar sources as pathogens, and persist a similar or longer length of time in surface waters. These bacteria are not in themselves usually disease causing.

There are many sources of pathogen pollution in surface waters. In general these sources may be classified as point and nonpoint sources. With the implementation of technology-based controls, pollution from point sources, such as factories and wastewater treatment facilities, has been greatly reduced. These point sources are required by the Clean Water Act to obtain a NPDES permit. In South Carolina NPDES permits require that dischargers of sanitary wastewater must meet the state standard for fecal coliform at the point of discharge. Municipal and private sanitary wastewater treatment facilities may occasionally be sources of pathogen or fecal coliform bacteria pollution. However, if these facilities are discharging wastewater that meets their permit limits, they are not causing the impairment. If one of these facilities is not meeting its permit limits, enforcement of the permit limit is required. A TMDL is not necessary for this purpose. Pathogen or fecal coliform TMDLs are therefore essentially nonpoint source TMDLs even though the TMDL may include a wasteload allocation for a point source.

3.1 Point Sources

3.1.1 Continuous Point Sources

There is no NPDES discharger or point source in this small watershed.

The City of North Augusta has a sewage collection system within the watershed. Sewage collection systems typically are placed adjacent to waterways. At these locations, there is a potential for collection system leaks which could result in elevated instream concentrations of fecal coliform bacteria. Sanitary sewer overflows (SSOs) are also a potential source, particularly after periods of intense rainfall. This source is associated with infrequent events, limited in duration and likely to have an insignificant long-term impact on recreational use. Identified collection system and/or SSO problems are addressed by SCDHEC through compliance and enforcement mechanisms.

3.1.2 Intermittent Point Sources

The City of North Augusta and Aiken County has been designated as Municipal Separate Storm Sewer Systems or MS4s under NPDES Phase II Stormwater rules. Most of this watershed is within the North Augusta MS4 and two small areas appear to be in the Aiken County MS4 (Figure 6). These permitted sewer systems will be treated as point sources in the TMDL calculations below. Runoff from developed land that is collected by storm sewers and discharged untreated into streams is potentially a major source of fecal coliform bacteria to this small creek. Construction activities may also be a source of fecal coliform and are covered by the NPDES Storm Water Construction General Permit from DHEC (SCR100000). Where the construction has the potential to affect water quality of a water body with a TMDL, the Storm Water Pollution Prevention Plan (SWPPP) for the site must address any pollutants of concern and adhere to any wasteload allocations in the TMDL. This small watershed is primarily residential and is unlikely to have any industrial sites that are covered by the NPDES Storm Water Industrial General Permit (SCR000000).

3.2 Nonpoint Sources

3.2.1 Wildlife

In this suburban watershed, wildlife (mammals and birds), which is a source of fecal coliform bacteria, can be a significant contributor of fecal coliform bacteria. Wildlife in this area typically includes deer, squirrels, raccoons, and other mammals as well as a variety of birds. Wildlife wastes are carried into nearby streams by runoff following rainfall or deposited directly in streams. Waterfowl also may be a significant contributor of fecal coliform bacteria in this watershed because there appear to be several ponds (See Figure 4 aerial photo), which often provide a desirable habitat for geese and ducks.

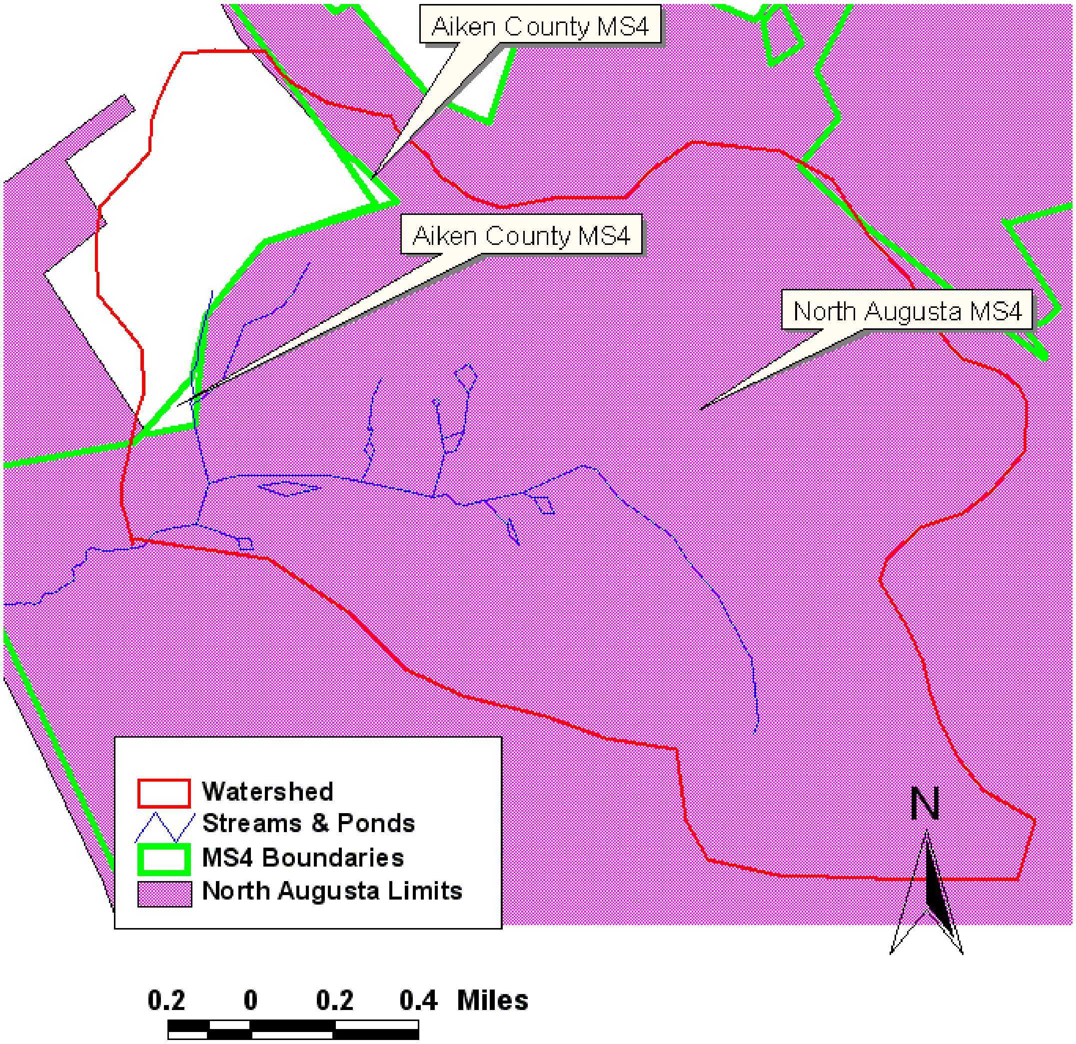

Figure 6. Map of Pretty Run Creek watershed showing areas designated as MS4s.

3.2.2 Leaking Sanitary Sewers and Illicit Discharges

This small watershed has numerous sewer lines (Figure 7). The creek is crossed in several places by sewer lines and sewer lines are adjacent to the creek in others. A leak in one of the sewer lines near the creek would likely reach the creek. Direct pipes from homes are also a possible source. Since the high fecal coliform counts are unrelated to stream flow, continual sources such as these are the most likely.

3.2.3 Failing Septic Systems

Because this small watershed is crisscrossed with sewer lines, septic systems are probably rare. However there may be a small number of septic systems from homes built prior to sewer lines being extended here. Older septic systems are more likely to fail if they have not been properly maintained. Failing or improperly functioning systems may leak sewage unto the land surface where it can reach nearby streams. Observed 'dry' weather fecal coliform violations indicate the likelihood of continual sources such as failing septic systems.

3.2.4 Urban Nonpoint Sources

As previously mentioned, the City of North Augusta and Aiken County have been designated as Municipal Separate Storm Sewer Systems or MS4s under NPDES Phase II Stormwater rules. The high percentage of impervious surfaces in built-up areas tends to increase runoff and reduce infiltration. The additional runoff compared to undeveloped land increases the amount of pollutants that are carried into streams. Dogs, cats, and other domesticated pets are the primary source of fecal coliform deposited on the urban landscape. There are also 'urban' wildlife, squirrels, raccoons, pigeons, and other birds, all of which contribute to the fecal coliform load.

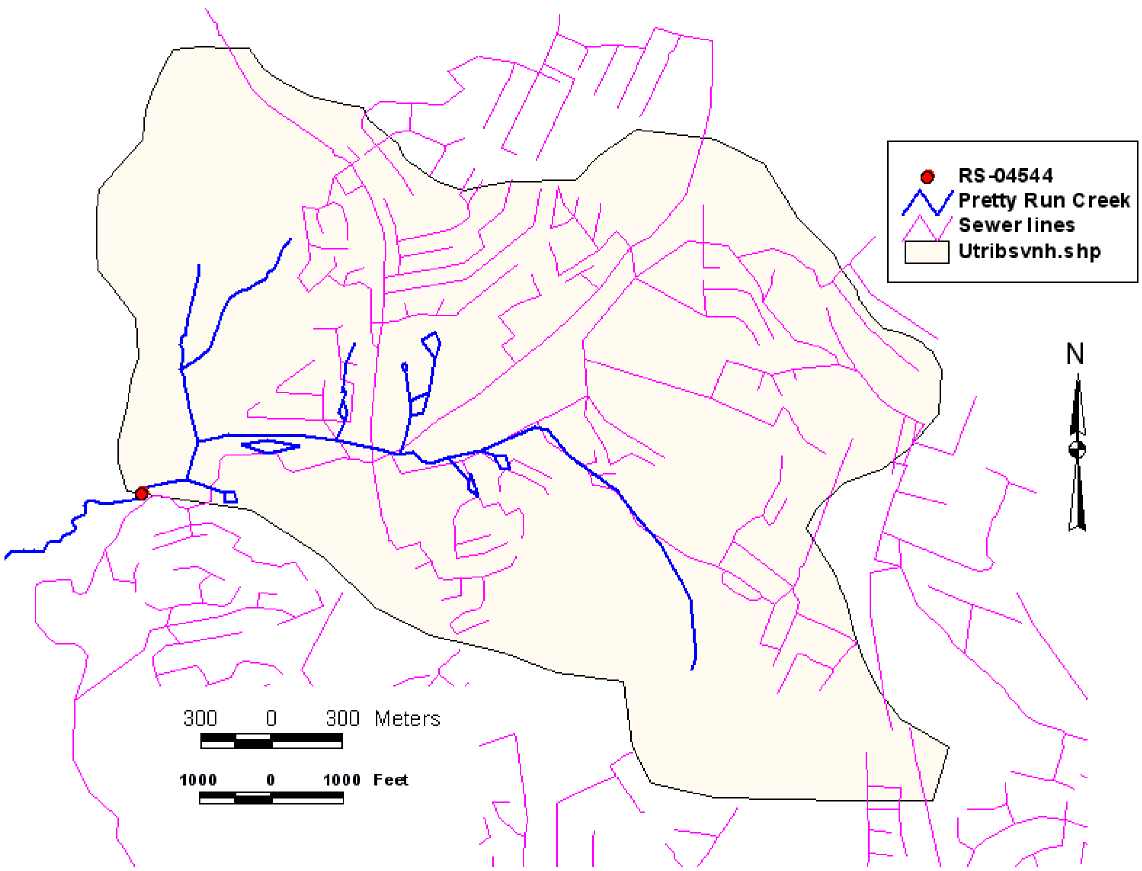

Figure 7. Map of Pretty Run Creek watershed showing location of sanitary sewer lines.

4.0 LOAD-DURATION CURVE METHOD

Load-duration curves were developed as a method of developing TMDLs that applies to all hydrologic conditions. The load-duration curve method uses the cumulative frequency distribution of stream flow and pollutant concentration data to estimate the existing and the TMDL loads for a water body. Development of the load-duration curve is described in this chapter.

The load-duration curve method depends on an adequate period of record for flow data. Usually small streams are not gauged and one must estimate the flow from a similar nearby stream. Pretty Run Creek is not gauged. A larger sized stream on Fort Gordon, just west of the Savannah River, Butler Creek, has been gauged (USGS 02196835). The difference in drainage areas (Butler Creek 10.5 mi^2; Pretty Run Creek 2.7 mi^2) is larger than is preferred. However, the creeks are not far apart and have similar land uses. The Butler Creek gauge operated from March 28, 2001 through April 1, 2001 and from October 1, 2001 through September 30, 2005. The mean daily flows from Butler Creek (http://sc.water.usgs.gov/) were used to generate the flow-duration curve for station RS-04544 on Pretty Run Creek.

The flow at RS-04544 was estimated by multiplying the measured daily flow rates from the USGS gauge by the ratio of the upstream drainage area to that of the ambient water quality monitoring site (0.2571). The flows were ranked from low to high and the values that exceed certain selected percentiles determined. The load-duration curve was generated by calculating the load from the observed fecal coliform concentrations, the flow rate that corresponds to the date of sampling, and a conversion factor. The load was plotted against the appropriate flow recurrence interval to generate the curve (Figure 8). A target line was created by calculating the allowable load from the flow and the appropriate fecal coliform standard concentration in the same manner (Table D-2). Sample loads above this line are violations of the standard, while loads below the line are in compliance.

The water quality target was set at 380 cfu/100ml for the instantaneous criterion, which is five percent lower than the water quality criteria of 400 cfu/100ml. A five percent explicit Margin of Safety (MOS) was reserved from the water quality criteria in developing the load-duration curves. The instantaneous criterion was targeted as a conservative approach and should be protective of both the instantaneous and 30-day geometric mean fecal coliform bacteria standards.

A trend line was determined for sample loads that exceeded the standard at RS-04544. The trend line for this station was an exponential function (Figure 8). The r^2 (coefficient of determination or a measure of variance explained by the regression equation) for RS-04544 is 0.8737. The existing load to the creek at RS-04544 was calculated from the mean of all loads that were roughly between the 10 % and 90 % flow recurrence intervals (Table D-1). The exponential trend line matched their respective target line better than the alternatives.

The TMDL load is calculated from the target line. Load values at 5 % occurrence intervals along the target line from 10 to 90 % were averaged. The Load Allocation (LA) values are derived from the 380 cfu/100ml water quality target, which includes the explicit Margin of Safety. Calculations for both existing and TMDL loads are provided in Appendix D.

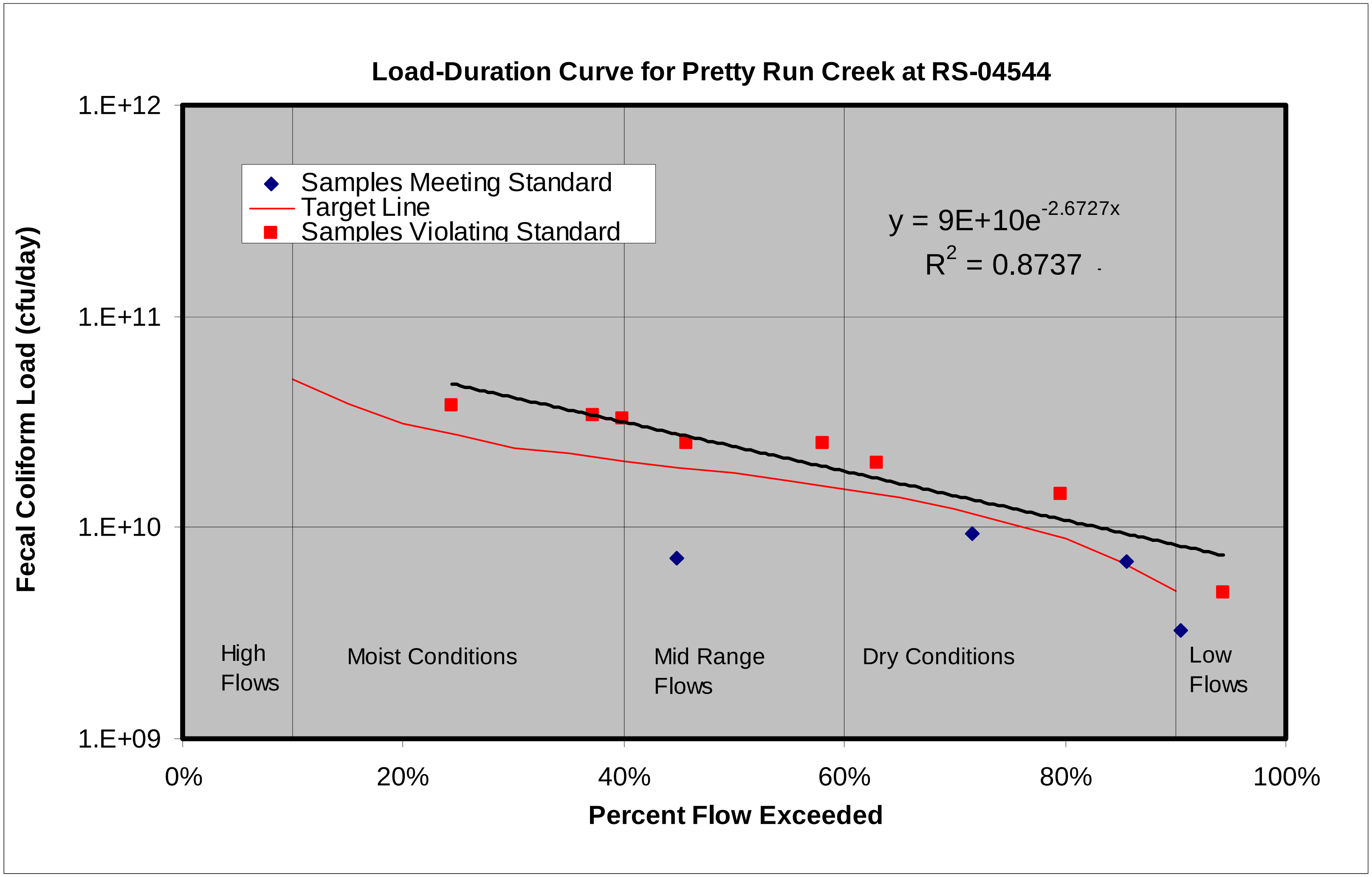

Figure 8. Load-Duration Curve for Pretty Run Creek.

5.0 DEVELOPMENT OF TOTAL MAXIMUM DAILY LOAD

A total maximum daily load (TMDL) for a given pollutant and water body is comprised of the sum of individual wasteload allocations (WLAs) for point sources, and load allocations (LAs) for both nonpoint sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving water body. Conceptually, this definition is represented by the equation:

$$TMDL = \Sigma\, WLAs + \Sigma\, LAs + MOS$$

The TMDL is the total amount of pollutant that can be assimilated by the receiving water body while still achieving water quality standards. In TMDL development, allowable loadings from all pollutant sources that cumulatively amount to no more than the TMDL must be established and thereby provide the basis to establish water quality-based controls.

For most pollutants, TMDLs are expressed as a mass load (e.g., kilograms per day). For bacteria, however, TMDLs are expressed in terms of number (#), cfu, or organism counts (or resulting concentration), in accordance with 40 CFR 130.2(l).

5.1 Critical Conditions

This TMDL is based on the flow recurrence interval between 20 % and 80 %. This encompasses 60 % of flows in Pretty Run Creek. Only flows that are characterized as ‘High’ or ‘Low’ flows in Figure 7 are not included in the analysis. For these TMDLs critical conditions are this range of the flow recurrence interval.

5.2 Wasteload Allocation

The wasteload allocation (WLA) is the portion of the TMDL allocated to point sources (US EPA, 1999).

5.2.1 Continuous Point Sources

There are no continuous point sources in this watershed.

5.2.2 Intermittent Point Sources

Intermittent point sources include all NPDES-permitted stormwater discharges, including current and future MS4, construction and industrial discharges covered under permits numbered SCS & SCR. The City of North Augusta and adjacent urbanized areas in Aiken County are designated as MS4s. The reduction percentages in this TMDL apply also to the fecal coliform waste load attributable to those areas of the watershed which are covered or will be covered under NPDES MS4 (Municipal Separate Storm Sewer System) permits. Compliance by an entity with responsibility for the MS4, with the terms of its individual MS4 permit will fulfill any obligations it has towards implementing this TMDL. Stormwater discharges are expressed as a percentage reduction instead of a numeric loading due to the uncertain nature of stormwater discharge volumes and recurrence intervals. Stormwater discharges are required to meet the percentage reduction or the existing instream standard for the pollutant of concern, whichever is less restrictive. The percent reduction applied is the same as that applied to the existing load, 31 %.

5.3 Load Allocation

The Load Allocation applies to the nonpoint sources of fecal coliform bacteria and is expressed both as a load and as a percent reduction. The load allocation for Pretty Run Creek is 1.68 E+10 cfu/day or a reduction of 31 %.

5.4 Existing Load

The existing loads were calculated from the trend lines of observed values that exceeded the water quality standard and were roughly between the 10 and 90 % recurrence limits. Loadings from all sources are included in this value: urban runoff, cattle-in-streams, leaking sewers, and failing septic systems. The existing load for RD-04544 on Pretty Run Creek is provided in Table 3.

5.5 Margin of Safety

The margin of safety (MOS) may be explicit and/or implicit. The explicit margin of safety is 5 % of the TMDL or 20 counts/ 100ml of the instantaneous criterion of 400 cfu/100 ml. Values of the MOS for RS-04544 are given in Table 3.

5.6 TMDL

For most pollutants, TMDLs are expressed as a mass load (e.g., kilograms per day). For bacteria, however, TMDLs are expressed in terms of cfu or organism counts (or resulting concentration), in accordance with 40 CFR 130.2(l). The resulting TMDL should be protective of both the instantaneous, per day, and geometric mean, per 30-day, criteria.

The target loading value is the load to the creek that it can receive and meet the water quality standard. It is simply the TMDL minus the MOS. Values for each component of the TMDL for Pretty Run Creek is provided in Table 3.

Table 3. TMDL components for Pretty Run Creek.

Station ID	TMDL (cfu/day)	MOS (cfu/day)	WLA		LA (cfu/day)	Existing Load (cfu/day)	% Reduction to Meet Load Allocation[3]
			Continuous Sources[1] (cfu/day)	Intermittent Sources[2] (% Reduction)			
RS-04544	1.77E+10	8.84 E+08	NA	31 %	1.68 E+10	2.43 E+10	31%

Table Notes:

1 - WLA is expressed as total monthly average.

2 - Percent reduction applies to all NPDES-permitted stormwater discharges, including current and future MS4, construction and industrial discharges covered under permits numbered SCS & SCR. Stormwater discharges are expressed as a percentage reduction due to the uncertain nature of stormwater discharge volumes and recurrence intervals. Stormwater discharges are required to meet percentage reduction or the existing instream standard for pollutant of concern, whichever is less restrictive.

3 - Percent reduction applies to existing load; Where Percentage Reduction = (Existing Load-Load Allocation) / Existing Load

6.0 IMPLEMENTATION

As discussed in the *Implementation Plan for Achieving Total Maximum Daily Load Reductions From Nonpoint Sources for the State of South Carolina* (SCDHEC,1998), South Carolina has several tools available for implementing this nonpoint source TMDL. Specifically, SCDHEC's animal agriculture permitting program addresses animal operations and land application of animal wastes. In addition, SCDHEC will work with the existing agencies in the area to provide nonpoint source education in the Pretty Run Creek watershed. Local sources of nonpoint source education and assistance include the City of North Augusta, Aiken County, the Natural Resource Conservation Service (NRCS), the Aiken County Soil and Water Conservation Services, and the South Carolina Department of Natural Resources.

SCDHEC is empowered under the State Pollution Control Act to perform investigations of and pursue enforcement for activities and conditions, which threaten the quality of waters of the state. In addition, other interested parties (universities, local watershed groups, etc.) may apply for section 319 grants to install BMPs that will reduce fecal coliform loading to Pretty Run Creek. TMDL implementation projects are given highest priority for 319 funding.

The iterative BMP approach as defined in the general storm water NPDES MS4 permit is expected to provide significant implementation of this TMDL. Discovery and removal of illicit storm drain cross connection is one important element of the storm water NPDES permit. Public nonpoint source pollution education is another.

In addition to the resources cited above for the implementation of this TMDL in the Pretty Run Creek watershed, Clemson Extension has developed a Home-A-Syst handbook that can help rural homeowners reduce sources of NPS pollution on their property. This document guides homeowners through a self-assessment, including information on proper maintenance practices for septic tanks. SCDHEC also employs a nonpoint source educator and Watershed Manager who can assist with distribution of these tools as well as provide additional BMP information.

Using existing authorities and mechanisms, these measures will be implemented in these watersheds in order to bring about the required reductions in fecal coliform bacteria loading to Pretty Run Creek and tributaries. DHEC will continue to monitor, according to the basin monitoring schedule, the effectiveness of implementation measures and evaluate stream water quality as the implementation strategy progresses.

7.0 REFERENCES AND BIBLIOGRAPHY

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APPENDIX A Fecal Coliform Data

Table A-1 Fecal coliform data for Pretty Run Creek in North Augusta (2004).

Date	FC (cfu/100 ml)
01/08/2004	140
02/24/2004	500
03/30/2004	600
04/15/2004	500
05/11/2004	380
06/02/2004	260
07/06/2004	600
08/03/2004	600
09/21/2004	600
10/14/2004	300
11/01/2004	540
12/02/2004	600

Table A-2 Statistics for fecal coliform data for Pretty Run Creek in North Augusta (2004).

Mean	468
Geometric Mean	433
Minimum	140
Maximum	600

APPENDIX B Calculation of Existing and TMDL Loads

Table B-1 Calculation of existing loads.

Existing Load Calculation:

Equation: $y = 9E+10e^{-2.6727x}$

% Exceeded	Load (cfu/day)
90%	8.12E+09
85%	9.28E+09
80%	1.06E+10
75%	1.21E+10
70%	1.39E+10
65%	1.58E+10
60%	1.81E+10
55%	2.07E+10
50%	2.37E+10
45%	2.70E+10
40%	3.09E+10
35%	3.53E+10
30%	4.04E+10
25%	4.61E+10
20%	5.27E+10
Mean	2.43E+10

Table B-2. Calculation of TMDL load.

	Load Allocation	
Target FC Conc:		380
% Exceeded	Flow (cfs)	Load (cfu/day)
20%	3.34	3.11E+10
25%	2.92	2.72E+10
30%	2.57	2.39E+10
35%	2.42	2.25E+10
40%	2.22	2.06E+10
45%	2.07	1.93E+10
50%	1.94	1.81E+10
55%	1.80	1.67E+10
60%	1.63	1.52E+10
65%	1.49	1.39E+10
70%	1.31	1.22E+10
75%	1.13	1.05E+10
80%	0.95	8.85E+09
85%	0.75	6.95E+09
90%	0.54	5.02E+09
Average		1.68E+10

Table B-3 Calculation of Percent Reduction

Percent Reduction
= (Existing Load - Load Allocation) / Existing Load
31.0%

APPENDIX C Flow-Duration Curve

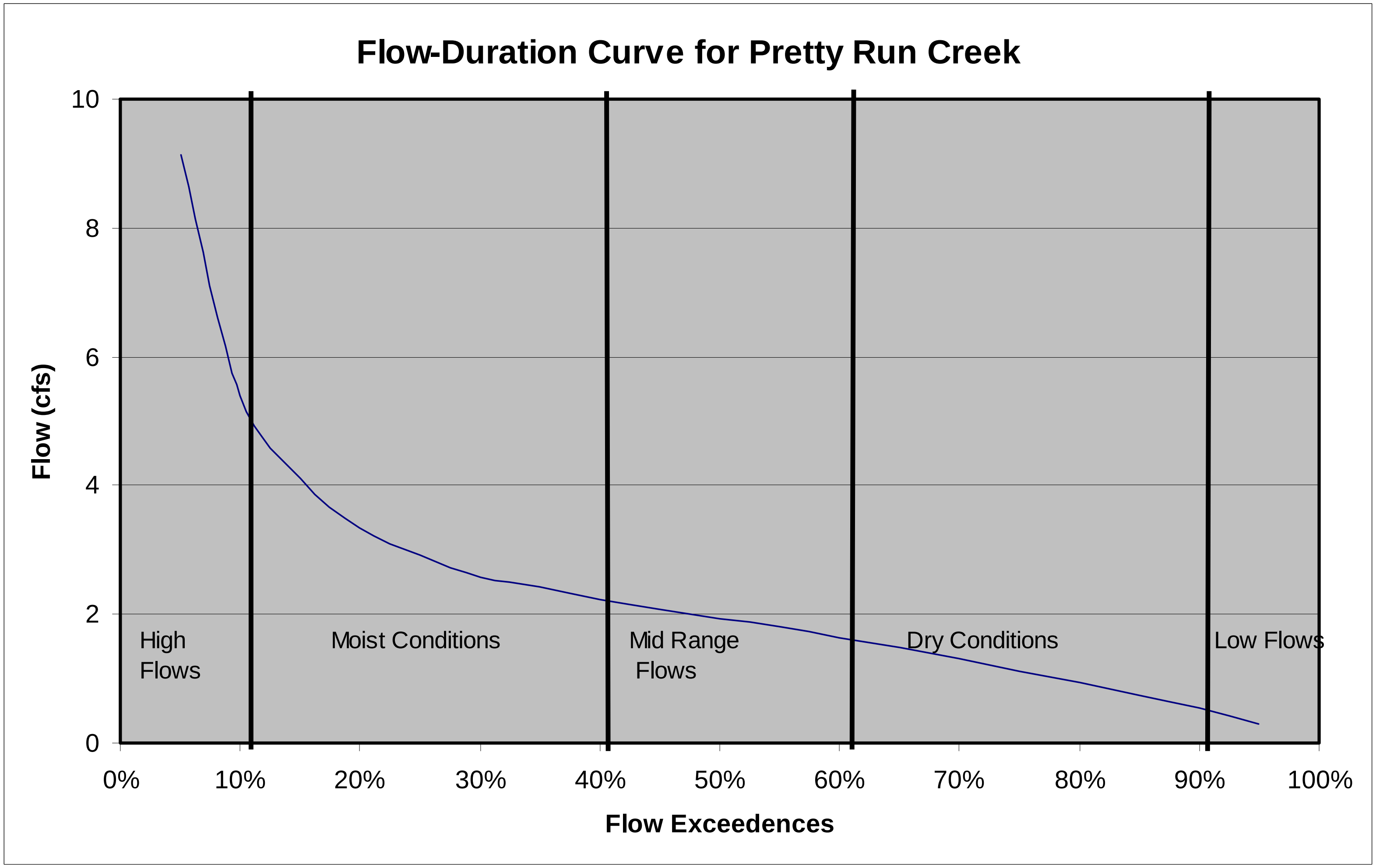


Figure C-1 Flow-Duration curve for Pretty Run Creek

Appendix C-*Fecal coliform* and *E. coli* Analysis & SOP

North Augusta Lab Certification

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL
ENVIRONMENTAL LABORATORY CERTIFICATION PROGRAM

NORTH AUGUSTA WATER LABORATORY (Laboratory ID 02005)
Laboratory Director: CHRIS B LIND
Certifying Authority: SC
Certificate Number: 02005001

Date of Issue: April 02, 2012
Expiration Date: January 16, 2015

SAFE DRINKING WATER ACT

DISINFECTION BY-PRODUCTS	
CHLORITE	SM 4500CLO2E (19TH)
INORGANIC - MINERAL	
ALKALINITY	SM 2320B (18TH)
CALCIUM - HARDNESS (CACO3)	SM 3500CAD (18TH)
FLUORIDE	SM 4500F-C (18TH)
HYDROGEN-ION CONC. (PH)	SM 4500HB (18TH)
SPECIFIC CONDUCTANCE	SM 2510B (18TH)
INORGANIC - MISCELLANEOUS	
CHLORINE DIOXIDE	SM 4500CLO2E (19TH)
RESIDUAL CHLORINE	SM 4500CLG (18TH)
TEMPERATURE	SM 2550B (18TH)
TURBIDITY	SM 2130B (18TH)
INORGANIC - NUTRIENT	
ORTHOPHOSPHATE	SM 4500PE (18TH)
MICROBIOLOGY	
TOTAL COLIFORM/E.COLI	SM 9223B (18TH)
TOTAL COLIFORM/E.COLI(MPN)	SM 9223B (18TH)

Bacteria - Stream Monitoring- Surface Water Analytical Methods Accepted

Variable	Method	Sample Collection Method
Escherichia coli (E.coli)	SM 9223B	Grab
Fecal coliform	SM 9223B	Grab
Hold time - 6 hours		

Total Coliform with E. coli

Colilert Presence / Absence Method

Total Coliform - SM9223B – 1992

City of North Augusta Drinking Water Laboratory

Approved By:

Water Production Supervisor Date 11-01-2014

Reviewed By:

Initials:					
Date:					

Initials:					
Date:					

I. **Description:**

A. Colilert simultaneously detects total coliforms and E. coli in water. When total coliforms metabolize Colilert's nutrient-indicator, ONPG, the sample turns yellow. When E. coli metabolize Colilert's nutrient-indicator, MUG, the sample also fluoresces. Colilert can simultaneously detect these bacteria at 1 cfu/100 mL within 24 hours.

II. **Equipment and Glassware:**

A. Incubator (Maintains a Temperature of 35±0.5 °C).
B. 120 mL Sterile, Non-Fluorescent Vessels (IDEXX Catalog #: WV120SBST-200)
C. 6 watt 365 nm UV Light (Spectroline Catalog #: EA160)
D. Colilert Presence / Absence Color Comparator (IDEXX Catalog #: WP104)
E. Quanti-Tray / 2000 (IDEXX Catalog #: WQT2K)
F. Quanti-Tray Color Comparator (IDEXX Catalog #: WP102Q)
G. Quanti-Tray Sealer (Model 89-10894-00)

III. **Chemicals and Reagents:**

A. Colilert Presence / Absence Snap Pack for 100 mL Samples (IDEXX Catalog #: WP200)
B. Quanti-Cult QC Kit (IDEXX Catalog #: WKIT-1001)
C. BacDown Hand Soap (Hach Catalog #: 2617700)

IV. **Procedure:**

A. Finished Water & Distribution System Samples:

1. Wash hands thoroughly with disinfectant soap before starting this procedure.
2. Collect 100 mL of water sample in a sterile 120 mL sample vessel.
3. Carefully separate one pack from the strip taking care not to accidentally open the adjacent pack.
4. Tap the pack to ensure that all of the Colilert nutrient-indicator is in the bottom of the pack.
5. Open the pack by snapping back the top at the score line and do not touch the opening of the pack.
6. Add the contents of one pack to the 100 mL water sample.
7. Aseptically cap the vessel and shake until the powder is dissolved.
8. Incubate for 24 hours at 35±0.5° C.
9. Following the 24 hour incubation period, read the results using the Presence/ Absence Comparator and the table below.

Appearance	Result
Less yellow than the comparator	Negative for total coliforms and E. coli
Yellow equal to or greater than the comparator	Positive for total coliforms
Yellow and fluorescence equal to or greater than the comparator	Positive for E. coli

10. Look for fluorescence with a 6-watt, 365-nm UV light within 5 inches of the sample in a dark environment. Face light away from your eyes and towards the sample.

11. Colilert results are definitive at 24-28 hours. In addition, positive for both total coliforms and E. coli observed before 24 hours and negatives observed after 28 hours are also valid.

B. Raw Water Samples:

1. Wash hands thoroughly with disinfectant soap before starting this procedure.
2. Collect 100 mL of water sample in a sterile 120 mL sample vessel.
3. Carefully separate one pack from the strip taking care not to accidentally open the adjacent pack.
4. Tap the pack to ensure that all of the Colilert nutrient-indicator is in the bottom of the pack.
5. Open the pack by snapping back the top at the score line and do not touch the opening of the pack.
6. Add the contents of one pack to the 100 mL water sample.
7. Aseptically cap the vessel and shake until the powder is dissolved.
8. Use one hand to hold a Quanti-Tray upright with the well side facing the palm.
9. Squeeze the upper part of the Quanti-Tray so that the Quanti-Tray bends toward the palm.
10. Gently pull the foil tab to separate the foil from the tray. Avoid touching the inside of the foil or the tray.
11. Pour the reagent / sample mixture directly into the Quanti-Tray avoiding contact with the foil tab. Tap the small wells 2-3 times to release any air bubbles and allow any foam to settle.
12. Place the sample-filled Quanti-Tray onto the rubber insert of the Quanti-Tray Sealer with the well side (plastic) of the Quanti-Tray facing down. Make sure that the tray is properly seated in the Rubber Insert on the Input Shelf with each well of the tray in its corresponding Rubber insert hole.
13. Slide the Rubber Insert into the Sealer until the motor grabs the Rubber Insert and begins to draw it into the Sealer.
14. After approximately 15 seconds, the Quanti-Tray will be sealed and partially ejected from the rear of the Sealer. Remove the Rubber Insert and Quanti-Tray from the rear of the Sealer.
15. Place the sealed Quanti-Tray in the incubator and incubate for 24 hours at 35±0.5° C. Following the incubation period, remove the tray and count the number of wells that have changed color when compared to the Quanti-tray Comparator. Use the table above to assist with result determinations.
16. Refer to the IDEXX Quanti-Tray/2000 MPN Table to determine the MPN value for total coliform count. Any wells that have tested positive for total coliforms must then be viewed with the UV light as described above determine the E. coli count.
17. Wells which fluoresce under UV light are counted as E. coli positive. Use the IDEXX Quanti-Tray/2000 MPN Table to determine the MPN for E. coli.

V. **Special Conditions and Interferences:**

A. Colilert reagent Snap Packs must be stored at 2 to 30 °C away from light.

B. Presence/ Absence Comparator and Quanti-Tray/2000 Comparator must be stored at 15-30 °C away from light.
C. If a water sample has some background color, compare inoculated Colilert sample to a control blank of the sample water sample.
D. If sample dilutions are made, multiply the MPN value by the dilution factor to obtain the proper quantitative result. Use only sterile, non-buffered, oxidant-free water for dilutions.
E. In samples with excessive chlorine, a blue flash may be seen when adding Colilert. If this is seen consider sample invalid and discontinue testing.
F. Do not use any Colilert packs if they are discolored in any way.

VI. **Records and Reporting[1]:**

A. All total coliform and E. coli results are recorded in the **Bacteriological Analysis Record**. Daily routine monitoring, distribution system, and raw water samples are also recorded in the **DHEC Monthly Operating Report**.

VII. **Quality Control and Quality Assurance:**

A. Personnel Qualifications and Responsibilities:
   1. Bacteriological analysis is a certified parameter at the North Augusta Drinking Water Laboratory, because of that any bacteriological analysis data that is to be reported for regulatory purposes must be analyzed by a South Carolina certified Environmental Systems Operator level "C" or higher. Any bacteriological analysis performed by anyone not holding at least a current "C" level ESO certification must be directly supervised by an approved analyst.
   2. To become an approved analyst in the North Augusta Drinking Water Laboratory the certified ESO will be required to perform an Initial Demonstration of Capability (IDOC). The IDOC will consist of a blind sample prepared in the laboratory by the laboratory supervisor.
   3. Each approved analyst in the North Augusta Drinking Water Laboratory will be required to perform a Demonstration of Capability (DOC) annually. The DOC will consist of a blind sample prepared in the laboratory by the laboratory supervisor. Analysis results of the DOC must fall within the specified range in order to be considered acceptable. Acceptable results must be documented for each analyst by the end of each calendar year or the analyst will lose their approval to perform bacteriological analysis in the North Augusta Drinking Water Laboratory.

B. In order for the North Augusta Drinking Water Laboratory to remain certified for bacteriological analysis a blind audit or PT sample must be performed annually. The PT sample is purchased from a secondary source that has been approved by SCDHEC Laboratory Certification and analyzed within the laboratory. Analysis results are submitted to the secondary source to determine a Pass or Fail of the analysis. That determination is then sent to SCDHEC Laboratory Certification.

C. The air incubator temperature is checked and recorded twice daily. The incubator temperature is also recorded when samples are put into the incubator and taken out of the incubator, those readings are recorded on the **Bacteriological Analysis Record.**

[1] Copies of all forms listed in this procedure are located in Appendix B for reference.

D. A maintenance contract is maintained on the Quanti-Tray Sealer to ensure reliable service. Records of this contract are maintained at all times. The Quanti-Tray Sealer is also checked monthly to make sure it is making a proper seal on the sample trays. To perform the monthly sealer check, use the following steps:
    1. Turn on the Quanti-Tray Sealer and allow it to warm-up. The indicator light will turn green when the unit is ready to accept a sample.
    2. Fill a sample vessel with 200-mL of distilled or deionized water.
    3. Add two to three drops of red food coloring or $KMnO_4$ Stock Solution (used for Free Residual Chlorine quality control) to the filled sample vessel and shake to mix.
    4. Pour the solution into a new Quanti-Tray and place the tray into the rubber holder.
    5. Place the tray on the sealer and push it forward until the sealer begins to automatically pull the tray through.
    6. Once the tray exits the rear of the sealer, examine it closely to make sure there is a proper seal and that there is dyed solution leaking from any place on the sealed tray.
    7. Record the results on the **Monthly Quality Control Record**.

E. Each new lot of Colilert reagent and sample vessels are tested and documented in the **Colilert Quality Control Record** using three known bacterial cultures and a sterility control to confirm acceptable performance is obtained:

Bacterial Culture	Expected Result
Escherichia coli (EC +)	Yellow, Fluorescent
Klebsiella pneumoniae (KP +)	Yellow, No Fluorescence
Pseudomonas aeruginosa (PA -)	Clear, No Fluorescence
Distilled Water (Sterility Control)	Clear, No fluorescence

F. Quanti-Cult is the procedure used for quality control testing and performance evaluations of the Colilert media and 120 mL sample vessels. Each Quanti-Cult kit includes:
    1. (3) Escherichia coli – capped vials labeled "EC" in foil packs and (2) reusable labels.
    2. (3) Klebsiella pneumonia – capped vials labeled "KP" in foil packs and (2) reusable labels.
    3. (3) Pseudomonas aeruginosa – capped vials labeled "PA" in foil packs and (2) reusable labels.
    4. (12) Rehydration fluid vials.
    5. (1) Autoclavable foam vial holder.
    6. Both rehydration fluid and bacteria vials must be stored at 2-8 °C until time of use. The reagents are stable through the expiration date on the label when stored properly.

G. Use the following steps to perform the Colilert quality control test using the Quanti-Cult kit:
    1. Place 4 rehydration fluid vials in the foam vial holder and place in the incubator for 10 minutes at 35-37 °C. After 10 minutes proceed to the next step.

2. Discard the blue cap from the rehydration fluid vial. Remove each organism vial from its foil pouch.
3. Transfer the colorless cap onto the prewarmed rehydration fluid vial. Discard the vial containing desiccant.
4. Insert the rehydration fluid vial in the foam rack.
5. Invert the foam rack and incubate for 10 minutes at 35-37 °C. After 10 minutes proceed to the next step.
6. Remove each vial from the rack and tap gently to mix.
7. Remove the cap from each vial and look at the inside surface to be certain that no undissolved black particles are present. If black particles are present, incubate for another 10 minutes.
8. Add the entire contents of the Quanti-Cult vial to 100 mL of prewarmed distilled water. Place the reusable label from each foil pack on the sample vessel containing that organism.
9. Add the Colilert reagent to the sample, cap, and mix. Incubate according to the Colilert procedure.
10. After 24 hours of incubation each sample needs to be checked with the fluorescent light and the results logged into the **Colilert Quality Control Record.** If any sample checks bad, the bad sample needs to be run again and checked in 24 hours. If the repeat sample checks badly, then the bottles and reagents that are currently being used for daily analysis need to be used to check the organisms individually. For example, use sample vessels that have passed QC with new Colilert or Colilert that has passed QC with new sample vessels to determine whether the new Colilert is bad or the new sample vessels are bad.

H. On a daily basis, a known positive sample (raw water) is run; and on a weekly basis a sterility control sample (distilled water) is run. Both samples are documented in the **Bacteriological Analysis Record.**

I. The Colilert reagents are stable through the expiration date on the label when stored properly.

J. The P/A Comparator and the Quanti-Tray Comparator are stable through the expiration date on the label when stored properly and must be replaced 30 days prior to the listed expiration date.

K. The following information must be recorded on each individual chemical's **Laboratory Chemical / Reagent Receipt Record:**
1. Chemical/Reagent Name
2. Manufacturer
3. Catalog Number
4. Date Received
5. Receiver's Name
6. Quantity Received
7. Lot Number
8. Package Sequence # (if multiple units are received)
9. Date Opened
10. Opened By
11. Expiration Date

L. The following information must be written on the container:
    1. Date Received
    2. Receiver's Initials
    3. Package Sequence # (if multiple units are received)
    4. Date Opened
    5. Opened By
    6. Expiration Date

VIII. **Revision History:**

A. Only the date of previous revisions is documented. There are no other details on record.

B. 11/03/2014_GRS
    1. Updated the SOP format to include a signature page and to have consistency for all SOPs throughout the entire Laboratory Procedure Manual.
    2. Updated the equipment and supplies list along with the corresponding manufacturer and product catalog number.
    3. Added the Quanti-Tray sealer check procedure to the Quality Control and Quality Assurance section of this procedure.

IDEXX **Quanti-Tray/2000**

Insert and Most Probable Number (MPN) Table

Quanti-Tray Certificate of Sterility

This certifies that the enclosed Quanti-Trays have been sterilized with ethylene oxide.

For further information or documentation, contact IDEXX Laboratories, Inc.

North/South America: 1-207-556-4496/1-800-321-0207

Europe: 00800 4339 9111

UK: +44 (0) 1638 676800

China: +86-21-61279528

Japan: +81 422 71 5921

Australia: 1800 655 978

IDEXX Laboratories, Inc.
One IDEXX Drive
Westbrook, Maine 04092 USA

06-02320-10

IDEXX **Quanti-Tray/2000**

English Version

Introduction

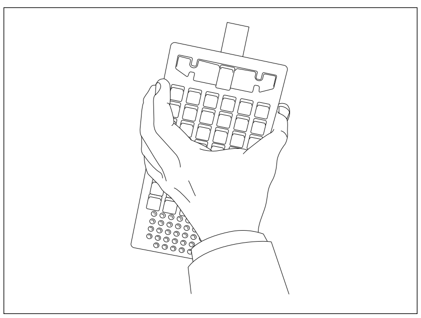
IDEXX Quanti-Tray/2000 is designed to give quantitated bacterial counts of 100 mL samples using IDEXX Defined Substrate Technology reagent products. Add the reagent/sample mixture to a Quanti-Tray/2000, seal it in a Quanti-Tray Sealer and incubate per the reagent instructions. Then count the number of positive large and small wells and use the Most Probable Number (MPN) Table attached to determine the MPN.

Contents

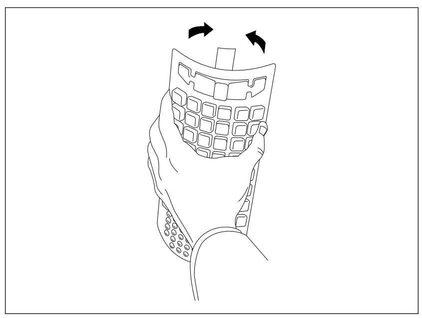
This package contains sterile Quanti-Tray/2000s.

User Instructions

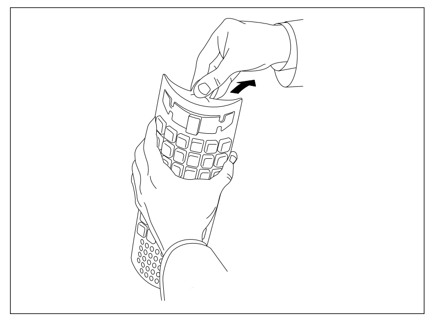
1. Use one hand to hold a Quanti-Tray upright with the well side facing the palm.



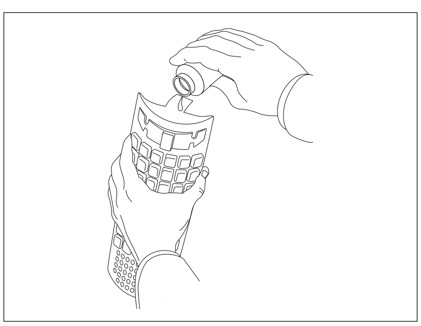
2. Squeeze the upper part of the Quanti-Tray so that the Quanti-Tray bends toward the palm.



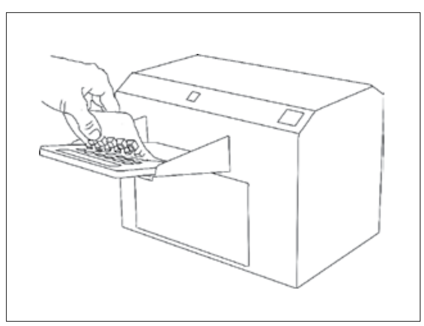
3. Gently pull foil tab to separate the foil from the tray. Avoid touching the inside of the foil or tray.



4. Pour the reagent/sample mixture directly into the Quanti-Tray, avoiding contact with the foil tab. Tap the small wells 2–3 times to release any air bubbles. Allow foam to settle.



5. Place the sample-filled Quanti-Tray onto the Quanti-Tray/2000 rubber insert of the Quanti-Tray Sealer with the well side (plastic) of the Quanti-Tray facing down.



6. Seal according to the Quanti-Tray Sealer instructions.
7. Incubate according to reagent instructions.
8. Count large and small positive wells and refer to the Quanti-Tray/2000 MPN table to find the MPN.
9. Dispose of media in accordance with good laboratory practices.

For Technical Support
U.S./Canada 1-800-321-0207 or 1-207-556-4496
www.idexx.com/water

IDEXX Laboratories, Inc.
One IDEXX Drive
Westbrook, Maine 04092 USA

IDEXX Quanti-Tray/2000 MPN Table

# Large Wells Positive	# Small Wells Positive																								
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
0	<1	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.1	15.1	16.1	17.1	18.1	19.1	20.2	21.2	22.2	23.3	24.3
1	1.0	2.0	3.0	4.0	5.0	6.0	7.1	8.1	9.1	10.1	11.1	12.1	13.2	14.2	15.2	16.2	17.3	18.3	19.3	20.4	21.4	22.4	23.5	24.5	25.6
2	2.0	3.0	4.1	5.1	6.1	7.1	8.1	9.2	10.2	11.2	12.2	13.3	14.3	15.4	16.4	17.4	18.5	19.5	20.6	21.6	22.7	23.7	24.8	25.8	26.9
3	3.1	4.1	5.1	6.1	7.2	8.2	9.2	10.3	11.3	12.4	13.4	14.5	15.5	16.5	17.6	18.6	19.7	20.8	21.8	22.9	23.9	25.0	26.1	27.1	28.2
4	4.1	5.2	6.2	7.2	8.3	9.3	10.4	11.4	12.5	13.5	14.6	15.6	16.7	17.8	18.8	19.9	21.0	22.0	23.1	24.2	25.3	26.3	27.4	28.5	29.6
5	5.2	6.3	7.3	8.4	9.4	10.5	11.5	12.6	13.7	14.7	15.8	16.9	17.9	19.0	20.1	21.2	22.2	23.3	24.4	25.5	26.6	27.7	28.8	29.9	31.0
6	6.3	7.4	8.4	9.5	10.6	11.6	12.7	13.8	14.9	16.0	17.0	18.1	19.2	20.3	21.4	22.5	23.6	24.7	25.8	26.9	28.0	29.1	30.2	31.3	32.4
7	7.5	8.5	9.6	10.7	11.8	12.8	13.9	15.0	16.1	17.2	18.3	19.4	20.5	21.6	22.7	23.8	24.9	26.0	27.1	28.3	29.4	30.5	31.6	32.8	33.9
8	8.6	9.7	10.8	11.9	13.0	14.1	15.2	16.3	17.4	18.5	19.6	20.7	21.8	22.9	24.1	25.2	26.3	27.4	28.6	29.7	30.8	32.0	33.1	34.3	35.4
9	9.8	10.9	12.0	13.1	14.2	15.3	16.4	17.6	18.7	19.8	20.9	22.0	23.2	24.3	25.4	26.6	27.7	28.9	30.0	31.2	32.3	33.5	34.6	35.8	37.0
10	11.0	12.1	13.2	14.4	15.5	16.6	17.7	18.9	20.0	21.1	22.3	23.4	24.6	25.7	26.9	28.0	29.2	30.3	31.5	32.7	33.8	35.0	36.2	37.4	38.6
11	12.2	13.4	14.5	15.6	16.8	17.9	19.1	20.2	21.4	22.5	23.7	24.8	26.0	27.2	28.3	29.5	30.7	31.9	33.0	34.2	35.4	36.6	37.8	39.0	40.2
12	13.5	14.6	15.8	16.9	18.1	19.3	20.4	21.6	22.8	23.9	25.1	26.3	27.5	28.6	29.8	31.0	32.2	33.4	34.6	35.8	37.0	38.2	39.5	40.7	41.9
13	14.8	16.0	17.1	18.3	19.5	20.6	21.8	23.0	24.2	25.4	26.6	27.8	29.0	30.2	31.4	32.6	33.8	35.0	36.2	37.5	38.7	39.9	41.2	42.4	43.6
14	16.1	17.3	18.5	19.7	20.9	22.1	23.3	24.5	25.7	26.9	28.1	29.3	30.5	31.7	33.0	34.2	35.4	36.7	37.9	39.1	40.4	41.6	42.9	44.2	45.4
15	17.5	18.7	19.9	21.1	22.3	23.5	24.7	25.9	27.2	28.4	29.6	30.9	32.1	33.3	34.6	35.8	37.1	38.4	39.6	40.9	42.2	43.4	44.7	46.0	47.3
16	18.9	20.1	21.3	22.6	23.8	25.0	26.2	27.5	28.7	30.0	31.2	32.5	33.7	35.0	36.3	37.5	38.8	40.1	41.4	42.7	44.0	45.3	46.6	47.9	49.2
17	20.3	21.6	22.8	24.1	25.3	26.6	27.8	29.1	30.3	31.6	32.9	34.1	35.4	36.7	38.0	39.3	40.6	41.9	43.2	44.5	45.9	47.2	48.5	49.8	51.2
18	21.8	23.1	24.3	25.6	26.9	28.1	29.4	30.7	32.0	33.3	34.6	35.9	37.2	38.5	39.8	41.1	42.4	43.8	45.1	46.5	47.8	49.2	50.5	51.9	53.2
19	23.3	24.6	25.9	27.2	28.5	29.8	31.1	32.4	33.7	35.0	36.3	37.6	39.0	40.3	41.6	43.0	44.3	45.7	47.1	48.4	49.8	51.2	52.6	54.0	55.4
20	24.9	26.2	27.5	28.8	30.1	31.5	32.8	34.1	35.4	36.8	38.1	39.5	40.8	42.2	43.6	44.9	46.3	47.7	49.1	50.5	51.9	53.3	54.7	56.1	57.6
21	26.5	27.9	29.2	30.5	31.8	33.2	34.5	35.9	37.3	38.6	40.0	41.4	42.8	44.1	45.5	46.9	48.4	49.8	51.2	52.6	54.1	55.5	56.9	58.4	59.9
22	28.2	29.5	30.9	32.3	33.6	35.0	36.4	37.7	39.1	40.5	41.9	43.3	44.8	46.2	47.6	49.0	50.5	51.9	53.4	54.8	56.3	57.8	59.3	60.8	62.3
23	29.9	31.3	32.7	34.1	35.5	36.8	38.3	39.7	41.1	42.5	43.9	45.4	46.8	48.3	49.7	51.2	52.7	54.2	55.6	57.1	58.6	60.2	61.7	63.2	64.7
24	31.7	33.1	34.5	35.9	37.3	38.8	40.2	41.7	43.1	44.6	46.0	47.5	49.0	50.5	52.0	53.5	55.0	56.5	58.0	59.5	61.1	62.6	64.2	65.8	67.3
25	33.6	35.0	36.4	37.9	39.3	40.8	42.2	43.7	45.2	46.7	48.2	49.7	51.2	52.7	54.3	55.8	57.3	58.9	60.5	62.0	63.6	65.2	66.8	68.4	70.0
26	35.5	36.9	38.4	39.9	41.4	42.8	44.3	45.9	47.4	48.9	50.4	52.0	53.5	55.1	56.7	58.2	59.8	61.4	63.0	64.7	66.3	67.9	69.6	71.2	72.9
27	37.4	38.9	40.4	42.0	43.5	45.0	46.5	48.1	49.6	51.2	52.8	54.4	56.0	57.6	59.2	60.8	62.4	64.1	65.7	67.4	69.1	70.8	72.5	74.2	75.9
28	39.5	41.0	42.6	44.1	45.7	47.3	48.8	50.4	52.0	53.6	55.2	56.9	58.5	60.2	61.8	63.5	65.2	66.9	68.6	70.3	72.0	73.7	75.5	77.3	79.0
29	41.7	43.2	44.8	46.4	48.0	49.6	51.2	52.8	54.5	56.1	57.8	59.5	61.2	62.9	64.6	66.3	68.0	69.8	71.5	73.3	75.1	76.9	78.7	80.5	82.4
30	43.9	45.5	47.1	48.7	50.4	52.0	53.7	55.4	57.1	58.8	60.5	62.2	64.0	65.7	67.5	69.3	71.0	72.9	74.7	76.5	78.3	80.2	82.1	84.0	85.9
31	46.2	47.9	49.5	51.2	52.9	54.6	56.3	58.1	59.8	61.6	63.3	65.1	66.9	68.7	70.5	72.4	74.2	76.1	78.0	79.9	81.8	83.7	85.7	87.6	89.6
32	48.7	50.4	52.1	53.8	55.6	57.3	59.1	60.9	62.7	64.5	66.3	68.2	70.0	71.9	73.8	75.7	77.6	79.5	81.5	83.5	85.4	87.5	89.5	91.5	93.6
33	51.2	53.0	54.8	56.5	58.3	60.2	62.0	63.8	65.7	67.6	69.5	71.4	73.3	75.2	77.2	79.2	81.2	83.2	85.2	87.3	89.3	91.4	93.6	95.7	97.8
34	53.9	55.7	57.6	59.4	61.3	63.1	65.0	67.0	68.9	70.8	72.8	74.8	76.8	78.8	80.8	82.9	85.0	87.1	89.2	91.4	93.5	95.7	97.9	100.2	102.4
35	56.8	58.6	60.5	62.4	64.4	66.3	68.3	70.3	72.3	74.3	76.3	78.4	80.5	82.6	84.7	86.9	89.1	91.3	93.5	95.7	98.0	100.3	102.6	105.0	107.3
36	59.8	61.7	63.7	65.7	67.7	69.7	71.7	73.8	75.9	78.0	80.1	82.3	84.5	86.7	88.9	91.2	93.5	95.8	98.1	100.5	102.9	105.3	107.7	110.2	112.7
37	62.9	65.0	67.0	69.1	71.2	73.3	75.4	77.6	79.8	82.0	84.2	86.5	88.8	91.1	93.4	95.8	98.2	100.6	103.1	105.6	108.1	110.7	113.3	115.9	118.6
38	66.3	68.4	70.6	72.7	74.9	77.1	79.4	81.6	83.9	86.2	88.6	91.0	93.4	95.8	98.3	100.8	103.4	105.9	108.6	111.2	113.9	116.6	119.4	122.2	125.0
39	70.0	72.2	74.4	76.7	78.9	81.3	83.6	86.0	88.4	90.9	93.4	95.9	98.4	101.0	103.6	106.3	109.0	111.8	114.6	117.4	120.3	123.2	126.1	129.2	132.2
40	73.8	76.2	78.5	80.9	83.3	85.7	88.2	90.8	93.3	95.9	98.5	101.2	103.9	106.7	109.5	112.4	115.3	118.2	121.2	124.3	127.4	130.5	133.7	137.0	140.3
41	78.0	80.5	83.0	85.5	88.0	90.6	93.3	95.9	98.7	101.4	104.3	107.1	110.0	113.0	116.0	119.1	122.2	125.4	128.7	132.0	135.4	138.8	142.3	145.9	149.5
42	82.6	85.2	87.8	90.5	93.2	96.0	98.8	101.7	104.6	107.6	110.6	113.7	116.9	120.1	123.4	126.7	130.1	133.6	137.2	140.8	144.5	148.3	152.2	156.1	160.2
43	87.6	90.4	93.2	96.0	99.0	101.9	105.0	108.1	111.2	114.5	117.8	121.1	124.6	128.1	131.7	135.4	139.1	143.0	147.0	151.0	155.2	159.4	163.8	168.2	172.8
44	93.1	96.1	99.1	102.2	105.4	108.6	111.9	115.3	118.7	122.3	125.9	129.6	133.4	137.4	141.4	145.5	149.7	154.1	158.5	163.1	167.9	172.7	177.7	182.9	188.2
45	99.3	102.5	105.8	109.2	112.6	116.2	119.8	123.6	127.4	131.4	135.4	139.6	143.9	148.3	152.9	157.6	162.4	167.4	172.6	178.0	183.5	189.2	195.1	201.2	207.5
46	106.3	109.8	113.4	117.2	121.0	125.0	129.1	133.3	137.6	142.1	146.7	151.5	156.5	161.6	167.0	172.5	178.2	184.2	190.4	196.8	203.5	210.5	217.8	225.4	233.3
47	114.3	118.3	122.4	126.6	130.9	135.4	140.1	145.0	150.0	155.3	160.7	166.4	172.3	178.5	185.0	191.8	198.9	206.4	214.2	222.4	231.0	240.0	249.5	259.5	270.0
48	123.9	128.4	133.1	137.9	143.0	148.3	153.9	159.7	165.8	172.2	178.9	186.0	193.5	201.4	209.8	218.7	228.2	238.2	248.9	260.3	272.3	285.1	298.7	313.0	328.2
49	135.5	140.8	146.4	152.3	158.5	165.0	172.0	179.3	187.2	195.6	204.6	214.3	224.7	235.9	248.1	261.3	275.5	290.9	307.6	325.5	344.8	365.4	387.3	410.6	435.2

IDEXX Quanti-Tray/2000 MPN Table

# Large Wells Positive	# Small Wells Positive																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
0	25.3	26.4	27.4	28.4	29.5	30.5	31.5	32.6	33.6	34.7	35.7	36.8	37.8	38.9	40.0	41.0	42.1	43.1	44.2	45.3	46.3	47.4	48.5	49.5
1	26.6	27.7	28.7	29.8	30.8	31.9	32.9	34.0	35.0	36.1	37.2	38.2	39.3	40.4	41.4	42.5	43.6	44.7	45.7	46.8	47.9	49.0	50.1	51.2
2	27.9	29.0	30.0	31.1	32.2	33.2	34.3	35.4	36.5	37.5	38.6	39.7	40.8	41.9	43.0	44.0	45.1	46.2	47.3	48.4	49.5	50.6	51.7	52.8
3	29.3	30.4	31.4	32.5	33.6	34.7	35.8	36.8	37.9	39.0	40.1	41.2	42.3	43.4	44.5	45.6	46.7	47.8	48.9	50.0	51.2	52.3	53.4	54.5
4	30.7	31.8	32.8	33.9	35.0	36.1	37.2	38.3	39.4	40.5	41.6	42.8	43.9	45.0	46.1	47.2	48.3	49.5	50.6	51.7	52.9	54.0	55.1	56.3
5	32.1	33.2	34.3	35.4	36.5	37.6	38.7	39.9	41.0	42.1	43.2	44.4	45.5	46.6	47.7	48.9	50.0	51.2	52.3	53.5	54.6	55.8	56.9	58.1
6	33.5	34.7	35.8	36.9	38.0	39.2	40.3	41.4	42.6	43.7	44.8	46.0	47.1	48.3	49.4	50.6	51.7	52.9	54.1	55.2	56.4	57.6	58.7	59.9
7	35.0	36.2	37.3	38.4	39.6	40.7	41.9	43.0	44.2	45.3	46.5	47.7	48.8	50.0	51.2	52.3	53.5	54.7	55.9	57.1	58.3	59.4	60.6	61.8
8	36.6	37.7	38.9	40.0	41.2	42.3	43.5	44.7	45.9	47.0	48.2	49.4	50.6	51.8	53.0	54.1	55.3	56.5	57.7	59.0	60.2	61.4	62.6	63.8
9	38.1	39.3	40.5	41.6	42.8	44.0	45.2	46.4	47.6	48.8	50.0	51.2	52.4	53.6	54.8	56.0	57.2	58.4	59.7	60.9	62.1	63.4	64.6	65.8
10	39.7	40.9	42.1	43.3	44.5	45.7	46.9	48.1	49.3	50.6	51.8	53.0	54.2	55.5	56.7	57.9	59.2	60.4	61.7	62.9	64.2	65.4	66.7	67.9
11	41.4	42.6	43.8	45.0	46.3	47.5	48.7	49.9	51.2	52.4	53.7	54.9	56.1	57.4	58.6	59.9	61.2	62.4	63.7	65.0	66.3	67.5	68.8	70.1
12	43.1	44.3	45.6	46.8	48.1	49.3	50.6	51.8	53.1	54.3	55.6	56.8	58.1	59.4	60.7	62.0	63.2	64.5	65.8	67.1	68.4	69.7	71.0	72.4
13	44.9	46.1	47.4	48.6	49.9	51.2	52.5	53.7	55.0	56.3	57.6	58.9	60.2	61.5	62.8	64.1	65.4	66.7	68.0	69.3	70.7	72.0	73.3	74.7
14	46.7	48.0	49.3	50.5	51.8	53.1	54.4	55.7	57.0	58.3	59.6	60.9	62.3	63.6	64.9	66.3	67.6	68.9	70.3	71.6	73.0	74.4	75.7	77.1
15	48.6	49.9	51.2	52.5	53.8	55.1	56.4	57.8	59.1	60.4	61.8	63.1	64.5	65.8	67.2	68.5	69.9	71.3	72.6	74.0	75.4	76.8	78.2	79.6
16	50.5	51.8	53.2	54.5	55.8	57.2	58.5	59.9	61.2	62.6	64.0	65.3	66.7	68.1	69.5	70.9	72.3	73.7	75.1	76.5	77.9	79.3	80.8	82.2
17	52.5	53.9	55.2	56.6	58.0	59.3	60.7	62.1	63.5	64.9	66.3	67.7	69.1	70.5	71.9	73.3	74.8	76.2	77.6	79.1	80.5	82.0	83.5	84.9
18	54.6	56.0	57.4	58.8	60.2	61.6	63.0	64.4	65.8	67.2	68.6	70.1	71.5	73.0	74.4	75.9	77.3	78.8	80.3	81.8	83.3	84.8	86.3	87.8
19	56.8	58.2	59.6	61.0	62.4	63.9	65.3	66.8	68.2	69.7	71.1	72.6	74.1	75.5	77.0	78.5	80.0	81.5	83.1	84.6	86.1	87.6	89.2	90.7
20	59.0	60.4	61.9	63.3	64.8	66.3	67.7	69.2	70.7	72.2	73.7	75.2	76.7	78.2	79.8	81.3	82.8	84.4	85.9	87.5	89.1	90.7	92.2	93.8
21	61.3	62.8	64.3	65.8	67.3	68.8	70.3	71.8	73.3	74.9	76.4	77.9	79.5	81.1	82.6	84.2	85.8	87.4	89.0	90.6	92.2	93.8	95.4	97.1
22	63.8	65.3	66.8	68.3	69.8	71.4	72.9	74.5	76.1	77.6	79.2	80.8	82.4	84.0	85.6	87.2	88.9	90.5	92.1	93.8	95.5	97.1	98.8	100.5
23	66.3	67.8	69.4	71.0	72.5	74.1	75.7	77.3	78.9	80.5	82.2	83.8	85.4	87.1	88.7	90.4	92.1	93.8	95.5	97.2	98.9	100.6	102.4	104.1
24	68.9	70.5	72.1	73.7	75.3	77.0	78.6	80.3	81.9	83.6	85.2	86.9	88.6	90.3	92.0	93.8	95.5	97.2	99.0	100.7	102.5	104.3	106.1	107.9
25	71.7	73.3	75.0	76.6	78.3	80.0	81.7	83.3	85.1	86.8	88.5	90.2	92.0	93.7	95.5	97.3	99.1	100.9	102.7	104.5	106.3	108.2	110.0	111.9
26	74.6	76.3	78.0	79.7	81.4	83.1	84.8	86.6	88.4	90.1	91.9	93.7	95.5	97.3	99.2	101.0	102.9	104.7	106.6	108.5	110.4	112.3	114.2	116.2
27	77.6	79.4	81.1	82.9	84.6	86.4	88.2	90.0	91.9	93.7	95.5	97.4	99.3	101.2	103.1	105.0	106.9	108.8	110.8	112.7	114.7	116.7	118.7	120.7
28	80.8	82.6	84.4	86.3	88.1	89.9	91.8	93.7	95.6	97.5	99.4	101.3	103.3	105.2	107.2	109.2	111.2	113.2	115.2	117.3	119.3	121.4	123.5	125.6
29	84.2	86.1	87.9	89.8	91.7	93.7	95.6	97.5	99.5	101.5	103.5	105.5	107.5	109.5	111.6	113.7	115.7	117.8	120.0	122.1	124.2	126.4	128.6	130.8
30	87.8	89.7	91.7	93.6	95.6	97.6	99.6	101.6	103.7	105.7	107.8	109.9	112.0	114.2	116.3	118.5	120.6	122.8	125.1	127.3	129.5	131.8	134.1	136.4
31	91.6	93.6	95.6	97.7	99.7	101.8	103.9	106.0	108.2	110.3	112.5	114.7	116.9	119.1	121.4	123.6	125.9	128.2	130.5	132.9	135.3	137.7	140.1	142.5
32	95.7	97.8	99.9	102.0	104.2	106.3	108.5	110.7	113.0	115.2	117.5	119.8	122.1	124.5	126.8	129.2	131.6	134.0	136.5	139.0	141.5	144.0	146.6	149.1
33	100.0	102.2	104.4	106.6	108.9	111.2	113.5	115.8	118.2	120.5	122.9	125.4	127.8	130.3	132.8	135.3	137.8	140.4	143.0	145.6	148.3	150.9	153.7	156.4
34	104.7	107.0	109.3	111.7	114.0	116.4	118.9	121.3	123.8	126.3	128.8	131.4	134.0	136.6	139.2	141.9	144.6	147.4	150.1	152.9	155.7	158.6	161.5	164.4
35	109.7	112.2	114.6	117.1	119.6	122.2	124.7	127.3	129.9	132.6	135.3	138.0	140.8	143.6	146.4	149.2	152.1	155.0	158.0	161.0	164.0	167.1	170.2	173.3
36	115.2	117.8	120.4	123.0	125.7	128.4	131.1	133.9	136.7	139.5	142.4	145.3	148.3	151.3	154.3	157.3	160.5	163.6	166.8	170.0	173.3	176.6	179.9	183.3
37	121.3	124.0	126.8	129.6	132.4	135.3	138.2	141.2	144.2	147.3	150.3	153.5	156.7	159.9	163.1	166.5	169.8	173.2	176.7	180.2	183.7	187.3	191.0	194.7
38	127.9	130.8	133.8	136.8	139.9	143.0	146.2	149.4	152.6	155.9	159.2	162.6	166.1	169.6	173.2	176.8	180.4	184.2	188.0	191.8	195.7	199.7	203.7	207.7
39	135.3	138.5	141.7	145.0	148.3	151.7	155.1	158.6	162.1	165.7	169.4	173.1	176.9	180.7	184.7	188.7	192.7	196.8	201.0	205.3	209.6	214.0	218.5	223.0
40	143.7	147.1	150.6	154.2	157.8	161.5	165.3	169.1	173.0	177.0	181.1	185.2	189.4	193.7	198.1	202.5	207.1	211.7	216.4	221.1	226.0	231.0	236.0	241.1
41	153.2	157.0	160.9	164.8	168.9	173.0	177.2	181.5	185.8	190.3	194.8	199.5	204.2	209.1	214.0	219.1	224.2	229.4	234.8	240.2	245.8	251.5	257.2	263.1
42	164.3	168.6	172.9	177.3	181.9	186.5	191.3	196.1	201.1	206.2	211.4	216.7	222.2	227.7	233.4	239.2	245.2	251.3	257.5	263.8	270.3	276.9	283.6	290.5
43	177.5	182.3	187.3	192.4	197.6	202.9	208.4	214.0	219.8	225.8	231.8	238.1	244.5	251.0	257.7	264.6	271.7	278.9	286.3	293.8	301.5	309.4	317.4	325.7
44	193.6	199.3	205.1	211.0	217.2	223.5	230.0	236.7	243.6	250.8	258.1	265.6	273.3	281.2	289.4	297.8	306.3	315.1	324.1	333.3	342.8	352.4	362.3	372.4
45	214.1	220.9	227.9	235.2	242.7	250.4	258.4	266.7	275.3	284.1	293.3	302.6	312.3	322.3	332.5	343.0	353.8	364.9	376.2	387.9	399.8	412.0	424.5	437.4
46	241.5	250.0	258.9	268.2	277.8	287.8	298.1	308.8	319.9	331.4	343.3	355.5	368.1	381.1	394.5	408.3	422.5	437.1	452.0	467.4	483.3	499.6	516.3	533.5
47	280.9	292.4	304.4	316.9	330.0	343.6	357.8	372.5	387.7	403.4	419.8	436.6	454.1	472.1	490.7	509.9	529.8	550.4	571.7	593.8	616.7	640.5	665.3	691.0
48	344.1	360.9	378.4	396.8	416.0	436.0	456.9	478.6	501.2	524.7	549.3	574.8	601.5	629.4	658.6	689.3	721.5	755.6	791.5	829.7	870.4	913.9	960.6	1011.2
49	461.1	488.4	517.2	547.5	579.4	613.1	648.8	686.7	727.0	770.1	816.4	866.4	920.8	980.4	1046.2	1119.9	1203.3	1299.7	1413.6	1553.1	1732.9	1986.3	2419.6	>2419.6

Appendix D- Sampling Forms City of North Augusta and Laboratory

Client Name CITY OF NORTH AUGUSTA **CHAIN - OF - CUSTODY RECORD** Page ______ of ______

Address ______

Attention ______

Telephone 803-441-4246 **Fax** 803-441-4208

Purchase Order Number

Lab Fraction	Sample Identification	Collection Date	Time	Grab	Comp	Container Vol.	#of	Type	Preservative	Sample Type*	Analyses Required / Remarks
								Ending Flow (MGD)			
								Starting Flow (MGD)			
								Total Flow (MGD)			

Analyses List 1: ______

Analyses List 2: ______

Hazards Associated with Samples: NA	Comments:	*Sample Types: DW=Drinking Water WW=Wastewater SW=Stormwater SW=Surface Water GW=Ground Water SO=Sediment
Collected date/time	Received By: Date/Time	End Use of Data (circle one): Regulatory Non-regulatory Preserved sample pH values verified upon log-in: ______
Relinquished By: Date/time	Received By: Date/Time	Sampled By (*Print name*) ______
Method of shipment/Cooler Temp C: Date/Time	Received For Laboratory: Date/Time	Compositor Day 1 setup (dates, init): ______ Start /Stop Times: ______
Sampling Charges Applied: Labor ______ Milage ______ Compositor ______ Sample Pick-Up ______ Other		Compositor Day 2 Setup (dates, init): ______ Start /Stop Times: ______

SHEALY **Chain of Custody Record**

SHEALY ENVIRONMENTAL SERVICES, INC.
106 Vantage Point Drive
West Columbia, South Carolina 29172
Telephone No. (803) 791-9700 Fax No. (803) 791-9111

Number

Client	Report to Contact	Telephone No. / Fax No. / E-mail	Quote No.
Address	Sampler's Signature	Waybill No.	Page ____ of ____
City / State / Zip Code	X ____	Analysis (Attach list if more space is needed.)	
Project Name	Printed Name		
Project No. / P.O. No.			Lot No.

Sample ID / Description (Containers for each sample may be combined on one line.)	Date	Time	G=Grab C=Composite	Matrix: Aqueous	Solid	Non-Aqueous	*No. of Containers by Preservative Type: Unpres.	H2SO4	HNO3	HCl	NaOH	5035 Kit											Remarks / Cooler I.D.

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison ☐ Unknown

Sample Disposal
☐ Return to Client ☐ Disposal by Lab

Note: All samples are retained for six weeks from receipt unless other arrangements are made.

Turn Around Time Required (Prior lab approval required for expedited TAT.)
☐ Standard ☐ Rush (Specify)

QC Requirements (Specify)

1. Relinquished by	Date	Time	1. Received by	Date	Time
2. Relinquished by	Date	Time	2. Received by	Date	Time
3. Relinquished by	Date	Time	3. Laboratory received by	Date	Time

Comments

LAB USE ONLY
Received on ice (Circle) Yes No Ice Pack
Receipt Temp. ________ °C

DISTRIBUTION: WHITE & YELLOW-Return to laboratory with Sample(s); PINK-Field/Client Copy

Document Number: F-AD-012 Effective Date: 08-04-02

City of North Augusta
Watershed Basin Sampling
Filed Data Collection Worksheet

BASIN	Sample ID	Date	Time	pH	DO	Temp	Cl2	Turb	Other	Other	Other

Calibration information											
pH Meter	**Hach Sension1**			√	DO Meter: **YSI DO200**					Sat	Composite Setup/Notes/Comments
Date:	Time:	Time:	Time:		Date/time calib:			1st	2nd		
Std. 4.00 su					bp mm/hg		Reading from chart				
Std. 7.00 su					bp mm/hg		Reading				
Std. 10.00 su					bp ppm		Within +/-10%				
Temp °C					**Temp °C**						
Slope					**Time:**						
pH Meter Sat? (Y or N)					New mem?						

Weather (today): ____________ Weather (past week): ____________ Date Data logged: ____________

Samplers (print): ____________ Date: Samples sent to lab: ____________ Results in? ____________

NOTES: ____

Signature of primary sampler: ____________ *Date signed:* ____________ *COC Attached?:* ____________

Appendix E: Historical Sampling Locations and Results within Pretty Run Creek Sub Basin

AE Table 1: City of North Augusta Watershed Basin Sampling Stations
(NA-PR-01 is city identification for RS-04544)

BASIN	ID	(Location)	Coordinates
Pretty Run Basin (formerly Rapids)	NA-PR-01	Pretty Run Creek, Riverbluff Drive, service Rd on left by creek	Lat 33°31'01.7116'N Long 81°59'22.9954'W
Pretty Run Basin	NA-PR-02	By Overlook IV, ck behind house on Blue Heron Lane	Lat 33°31'20.78"N Long 81°59'49.13"W
Pretty Run Basin	NA-PR-04	Downstream of Halloweens (Bolin Rd, 1st house by Martintown)	Lat 33°31'05.27"N Long 81°58'45.80"W
Pretty Run Basin	NA-PR-15	Pretty Run Creek behind home at 1800 Flamingo Road (Williamson)	Lat 33°31'05.92"N Long 81°58'27.80"W
Pretty Run	NAPRKW	Sewer access road from Knollwood at Cascade Drive, where stream crosses access rd., rocks (57 stone) (2011)	On map
Pretty Run	NAPRHSP (NA-PR-06)	Storm Pipe at Halloween's House (end of driveway) Bolin Road 1st house on right (2011)	Lat 33°31'05.62"N Long 81°58'43.16"W
Pretty Run	NAPRHC (NA-PR-03)	Channel upstream of NAPRHSP (Bolin Rd) (2011)	Lat 33°31'05.09"N Long 81°58'42.84"W

AE Table 2: City of North Augusta Historical Sampling Data (next page)
(RS-040544 is identified as NA-PR-01 by city in the spreadsheet below)

Appendix E: Table 2 City of North Augusta Historical Sampling Data (RS-040544 is identified as NA-PR-01)

	STANDARDS or Average for SC→													<1.17 avg < 1.3 HH	<0.20 avg	<0.61 EPA/SC	<0.62 avg < 10.0 HH	<0.013 HH < 0.014 AQ	<0.58 avg	<0.14 avg < 1.3 HH	<0.01 avg < 1.3 HH <0.0038 AQCMC	<1.17 avg < 0.3 EPA/SC	<0.084 avg < 0.05 HH < 1.0 Aq	<0.04 avg < 7.4 HH <0.03 AQ
Code Code Key: 1=Clear no rain, 2=Rainfall, 3=First Flush, 4=24 Hour, 5=Field data only, 6=fecal only, 7=Nuts only, 8=Pond	BASIN	ID	Field Notes from Log Books: Two active log books (1) Hard bound Rite in Rain pages 16 to end. Book (2) Small pocket sized Rite in Rain spiral and one large bound Data Logbook in SW office. Composite samplers chained and locked at each use location. (3) Data LB: logbook of all anlaytical results	Log Bk # & Pg #	Date (order)	Grab Time	pH	DO	Temp	Cl2 or Notes	Fecal Coliform col/100 ml	Hardness	Turb/tss	Cadmium	Ammonia	Nickel	Nitrite/Nitrate	Lead	TKN	Phosphorus	Copper	Iron	Manganese	Zinc
5	Pretty Run	NA-PR-01	Stream sampling Field Param only, weather cloudy and overcast all day, water that was clear had no turb. test run, All Calibrations successful BP=29.97 in/hg Sampler Tstrick	1-19	10/11/2005	14:36	7.41	8.4	21.9	<0.1			12.8											
1	Pretty Run	NA-PR-01	Primary streams. Weather clear. Calibrations successful BP=30.48 in/hg Sampler Tstrick	1-31	12/7/2005	12:30	7.62	9.91	13.1	<0.1	107		6.3	nd 0.005	1.4	nd 0.005	0.7	nd 0.002	1	0.7	nd 0.002	0.462	nd 0.1	nd 0.002
6, 1	Pretty Run	NA-PR-01	Fecal coliform samples only, no field parameters. Creek pt same as SCDHEC RS04545. Sampler Tstrick	1-35	2/16/2006	11:15					242													
5	Pretty Run	NA-PR-01	Streams, cal successful, BP=30.13 in/hg. Sampler: Ejones & Jacob	1-39	3/22/2006	14:50	7.58	9.79	17.5				6.64											
1	Pretty Run	NA-PR-01	Streams All Calibrations successful BP=30.10 in/hg, Heavy rains 2 wks ago, light rain 1 wk ago, dry this week. Air temp 69 deg F. at 9:45 a.m. Samplers: Tstrick/EJones	1-43	6/30/2006	12:10	7.13	7.81	24.2				24	nd 0.01	nd 0.1	nd 0.05	0.57	nd 0.002	0.5	0.21	nd 0.01	0.553	0.038	0.051
6, 1	Pretty Run	NA-PR-01	Cold, rained last week (COC). *Fecal coliform* only	Data LB	1/10/2007	13:15					160													
1	Pretty Run	NA-PR-01	Minnows, trsrick	2-2	5/14/2007	12:00	7.05	9	19.8		426		5		nd 0.10		0.67	nd 0.003	nd 0.05	0.029	nd 0.005	0.75	0.15	nd 0.02
2	Pretty Run	NA-PR-01	All calibr. Successful, Rain yesterday, light rain during today. BP=30.05 in/hg	2-5	9/13/2007	15:27	7.29	7.79	25					nd 0.002	0.14	nd 0.04	0.47	nd 0.003	nd 0.05	0.018	nd 0.005	0.76	0.24	0.05
1	Pretty Run	NA-PR-01	Weather clear, windy. Bp=30.07 in/hg. All calibr. Successful., Tstrick/Hmentrup.	1-55	5/15/2008	11:10					490				nd 0.10		0.32	0.003	0.51	0.03	nd 0.005	0.72	0.015	nd 0.02
1	Pretty Run	NA-PR-01	All calibrations successful, BP=29.8 in/hg. Sampler: Tstrick/Mmurphy	1-91	8/11/2011	12:30	7.52	7.85	26.7	0	416	39			nd 0.10		0.55	nd 0.01	4.1	0.033	nd 0.005	0.37	0.018	nd 0.02
2	Pretty Run	NA-PR-01	Noted in logbook 1 pg 95 - data corrections. All streams sampled today. 1st Solid rain in months. The weather remained cloudy all day with scattered showers. All calibr. Successful. Sampler: Tstrick	1- 95 to 98	9/22/2011	13:13	6.6	8.53	22.4						0.12		0.34		0.28	0.03				
2	Pretty Run	NA-PR-01	Stream sampling. Raining started at 11:30 a.m. scattered thunder storms (lightning). 0.6" at Municipal Bldg Gage for 5/9/12. Heavy flow, deeper than normal. Took photos. Extreme downpour at 3:50 p.m.. Sampler Tstrick	2-35	5/9/2012	13:20	7.09	8.14	23.6			31	99		0.72		0.052	nd 0.01	1.4	0.14	0.0078	2.5	0.1	0.041
1	Pretty Run	NA-PR-01	Stream sampling. Clear weather, past 24 hours there was 0.44" of rainfall. Recorded at MRF rain gauge. Sampler Tstrick, Ctran, Mnakama. All calib. Recorded.	2-39	12/18/2012	15:52	7.08	7.57	14.9			46			0.33		0.64	nd 0.01	0.69	nd 0.01	nd 0.005	0.58	0.024	nd 0.02
6, 1	Pretty Run	NA-~~PR~~ RiB-02 (behind house Blue Heron Ln)	Cold, rained last week (COC). *Fecal coliform* only	Data LB	1/10/2007	13:25					6													
6, 1	Pretty Run	NA-PR-04 (dnstr hallow)	Cold, rained last week (COC). *Fecal coliform* only	Data LB	1/10/2007	13:45					80													
1	Pretty Run	NA-PR-04 (logbook NA-PR-HC)	All calibrations successful, BP=29.8 in/hg. At Halloweens house on Bolin, in the stream channel. Sampler: Tstrick/Mmurphy	1-91	8/11/2011	12:19					264													
3	Pretty Run	NAPR-15	On 8/8/08 we returned and sampler was empty. Left in place and reset probe securely to 1" above water (1st inch of rainfall). No rainfall. 8/12/08 Mharmon and I checked sampler, reset at 12:10 p.m. to pull since rainfall expected tonight. Water clear and tea colored. We collected minnows at this location for id at USCA. ID results Duskey Shiners *Notropis cummingsae*. 8/13/2008 overnight 1" of rainfall. Checked sampler at 13:45 p.m., both bottles full. Water level touching probe. Water was grey/dark grey. No field parameters taken. First flush samples collected. Tstrick	1-61	8/13/2008	13:45 flush				1" rain pest/herb alpha bhc=0.041 ug/l, beta BHC(*1*)=0.086 ug/l					0.29		0.56	0.014	4.4	0.34	0.0098	4.7	0.41	0.076
4	Pretty Run	NAPR-15	On 8/8/08 we returned and sampler was empty. Left in place and reset probe securely to 1" above water (1st inch of rainfall). No rainfall. 8/12/08 Mharmon and I checked sampler, reset at 12:10 p.m. to pull since rainfall expected tonight. Water clear and tea colored. We collected minnows at this location for id at USCA. ID results Duskey Shiners *Notropis cummingsae*. 8/13/2008 overnight 1" of rainfall. Checked sampler at 13:45 p.m., both bottles full. Water level touching probe. Water was grey/dark grey. No field parameters taken. 24hr composit samples collected. Tstrick	1-61	8/13/2008	13:45 composite				1" rain pest/herb ND					0.11		0.42	0.0062	1.9	0.16	nd 0.005	1.8	0.12	0.041
1	Pretty Run	NA-PR-15	Grab samples. Set up composit sampler at this location. Minnows observed. All calibrations successful. Samplers Tstrick/Dadkins	1-61	8/7/2008	10:43	6.48	8.71	26.5	Pest/herb ND				nd 0.002	nd 0.10	nd 0.04	0.99	nd 0.01	nd 0.50	0.025	nd 0.005	0.28	0.019	0.034
6, 1	Pretty Run	NA-PR-15	All calibrations successful, BP=29.8 in/hg. Sampler: Tstrick/Mmurphy	1-91	8/11/2011	13:00					252													
6, 1	Pretty Run	NA-PR-16	Robin Road Location	Data LB	5/14/2007						697													
6, 1	Pretty Run	NA-PR-**HSP** (NA-PR-06)	All calibrations successful, BP=29.8 in/hg. At Halloweens house on Bolin Rd where storm pipe discharges to stream. Sampler: Tstrick/Mmurphy	1-91	8/11/2011	12:17					140													
6, 1	Pretty Run	NA-PR-KW (NA-PR-14)	All calibrations successful, BP=29.8 in/hg. From access road where it crosses stream. Above Halloweens house. Sampler: Tstrick/Mmurphy	1-91	8/11/2011	13:12					119													

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