Impaired Waterbodies Water Quality Assessment
Monitoring and Implementation Work Plan
BACTERIA
Spirit Creek Augusta, Georgia

EXECUTIVE SUMMARY

Section 303(d) of the Federal Clean Water Act (CWA) requires developing 305(b)/303(d) list of waters. The Georgia Environmental Protection Division (GA EPD) develops this list for the State of Georgia rivers and streams in accordance with 40 CFR Part 130.7(b)(4) and guidance provided by the United States Environmental Protection Agency (U.S. EPA). The 2022 Section 303(d) list identified Spirit Creek in Richmond County as not supporting the designated use due to violation of Surface Water Quality Bacteria Criteria. The lower seven-mile segment of Rocky Creek from SR56 to Savannah River is listed for Fecal Coliform (FC) bacteria impairment identified as due to nonpoint source & urban runoff.

Spirit Creek impaired segment listing is based on Tier 2 data collected by GA EPD in 2018. Only four samples were collected; one each in March, August, October, and November. Out of four collected samples only one sample, collected in August, exceeded single sample threshold value and was used to place a 7mile reach of Spirit Creek on impaired waters list. In our professional opinion, this reach should have been placed in Category 3 (assessment pending) until additional data are collected. Factors such as seasonality of the data with regards to the parameter being assessed and results of other data including historical data at the site. Augusta Ms4 discharges are limited in vicinity of GA EPD sampling location and there is high probably other factors contributed to August 29, 2018 collected sample. Same segment was listed previously and Augusta, Georgia collected sufficient geometric mean data to delist this segment in 2006 through 2010. Historical data summary included as EXHIBIT A (page 9/9).

The purpose of this work plan is to comply with the Augusta, GA Area wide National Pollutant Discharge Elimination System (NPDES), Municipal Separate Storm Sewer System (MS4) permit, and in general implement integrated management control measures to manage the identified pollutant(s) of concern to Maximum Extent Practicable (MEP).

INTRODUCTION

Augusta is located adjacent to the Savannah River in east central Georgia. It is bounded by Columbia County to the north and northwest; McDuffie County and Jefferson County to the southwest; Burke County to the south; and the Savannah River and South Carolina to the east (FIGURE 1). Augusta is approximately 150 miles east of Atlanta, Georgia and approximately 68 miles southwest of Columbia, South Carolina. The County encompasses approximately 324 square miles, almost 75 percent of which is serviced by Augusta. The majority of Augusta is located within the Upper Coastal Plain Physiographic Province. However, a small northern portion, which includes Rock Creek and Rae's Creek, lies in the Piedmont Physiographic Province. The Coastal Plain is underlain by stratified and weakly unconsolidated marine sedimentary rock. Spirit Creek flows in an easterly direction to Savannah River. The creek flows through Fort Eisenhower and the community of Hephzibah.

WATERSHED DESCRIPTION

Spirit Creek watershed is located in the central portion of Richmond County. The creek drains approximately 41,210 acres (64.41 square miles) of the County, including a portion of Fort Gordon and the City of Hephzibah. Land use in the watershed is primarily residential, with significant amount of

forests and natural areas. This results in a relatively low impervious percentage for the overall watershed. Soils are well drained with low runoff potential. The majority of the soil in the watershed is type A, followed by B or C. The following are characteristics of each of the hydrologic soil groups as defined by the Natural Resource Conservation Service (NRCS).

Type A – Sand, loamy sand or sandy loam type; Low runoff potential; mostly sandy soils; high infiltration rate, deep, well to excessively drained sands or gravel and have a high rate of water transmission.
Type B – Silt loam or loam type; moderately low runoff potential; mostly sandy soils; less deep and less aggregated than Type A, but the group as a whole has above average infiltration after thorough wetting.
Type C – Sandy clay loam type; moderately high runoff potential; Comprises shallow soils and soils containing considerable clay and colloids, though less than those of group D. The group has below average infiltration after saturation.

Spirit Creek watershed is located in the central portion of Richmond County. Land use in the watershed is primarily residential with significant amounts of forests and natural areas. There is some industrial activity in the lower two miles of the watershed along Highway SR56.

Commercial/Industrial	10.3
Residential	14
Lakes/Reservoir/water	0.2
Forests / Open Land	58.9
Agriculture	12.3
Other	4.3

PROJECT OBJECTIVE

The purpose of this work plan is to comply with Augusta, GA Area wide National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit. The objective of this plan is to monitor and reduce listed bacteria concentrations in designated section of the creek using integrated management control measures to Maximum Extent Practicable (MEP).

PROJECT MEASURE OF SUCCESS

Data gathered so far by the Phinizy Center for Water Sciences and Augusta, GA indicate that sediments are highly likely the primary driver for noted bacteria contamination and that sediment-borne bacteria could have contributed to the noted occasionally increased concentrations that lead to the listing of the creek's lower segment "not supporting" its designated use (fishing). In addition, it is documented that dryfall and rainfall are another significant sources of such bacteria. As a result, it is nearly impossible to determine sources of listed bacteria from watersheds as well as be able to implement cost-effective Best Management Practices that would reduce listed bacteria loads from urban watersheds. The Measure of success for noted bacteria is managing the listed bacteria in the listed impaired segment at concentrations that will not result in further degradation of its water quality.

PROJECT CONTACT

Primary contacts for this Implementation Plan for Augusta GA is Augusta Engineering Department, Director Engineering or Associate Director. Current contact information is provided below:

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SCOPE OF WORK

Scope of work consists of conducting periodic water quality monitoring within the impaired segment of Spirit Creek. Georgia 2022 Section 303(d) list identified Spirit Creek in Richmond County as not supporting the designated use of "Fishing" due to violation of Surface Water Quality Bacteria Criteria. The lower seven-mile segment of Rocky Creek from SR56 to Savannah River is listed for Fecal Coliform (FC) bacteria impairment identified as due to nonpoint source & urban runoff.

a) Sampling Location

Sampling will be conducted at one location (at bridge located where Spirit Creek crosses Mike Padgett Hwy/ GA EPD Sample location) for E. Coli within Spirit Creek reach as shown on Figure 2. This location is selected based on the ability to assess the reach safely. Listed reach is not safely accessible and sampling poses significant human safety risk to staff conducting sampling.

b) Sampling Methods

Manual grab surface water samples will be collected for E. Coli analysis. Samples will be taken in vicinity of stream center area and at a point that is safely accessible. Where possible, the sample will be collected directly into the sample container. If direct access to the stream is not possible or wadable, then supplemental sampling equipment (i.e., sampling rod with clean collection bucket) will be utilized.

Water quality sampling methods will conform to the EPA present approved Microbiological Methods for Ambient Water (40 CFR 136.3-Table IH). Augusta prefers to use IDEXX Colilert 18 methodology.

c) Sampling Frequency

Samples for E. Coli will be collected at one location (at bridge located where Spirit Creek crosses Mike Padgett Hwy/GA EPD Sample location EPD sampling location/Fig2). One sample will be collected each month. Augusta will initiate data trend evaluation during the third year. If trend assessment reveals minor or no variation in data trend, then Augusta will reduce sampling frequently to semiannually sampling.

Due to changes in the in-stream water quality standards for bacteria, sampling variance will be documented in case monthly representative sample collection within specified period is not feasible due to safety hazard conditions for the creek. Such variance will be reported in the Annual Report.

d) Sampling Parameters

Sampling collected during each event will be analyzed for the following parameters and methods:

i) E. Coli: EPA approved method for Ambient Water – IDEXX Colilert 18 method or alternate EPA approved method.

Samples analysis will be performed by Augusta Publicly Owned Treatment Works (POTW) Laboratory or Phinizy Center for Water Science Laboratory or other external certified laboratory. After collection, E. Coli samples will be delivered immediately to the laboratory by the field staff to maintain 8 hour holding time.

e) Documentation

Each sample will be labeled and sealed immediately after collection. Sample identification documents will be prepared so that identification and chain-of-custody records can be maintained. The following sample identification will be utilized.

i)Sample Label ii) Field Form iii) Chain-of-custody forms

f) Sampling Schedule

Sampling will commence in the summer period of 2024. The sampling schedule is established on a repeating annual basis. The MS4 reporting period ends in March of each year.

g) Sampling Duration and Data Reporting

Samples will be collected per schedule for a three-year period (over duration of Augusta MS4 Permit reissued in 2022). Monitoring data will be included in MS4 yearly report starting 2024-2025 Annual Report Submittal. Augusta will initiate data trend evaluation during the third year using first year data as baseline data for trend assessment. At a minimum data will be included in tabulated format.

STORMWATER QUALITY INTEGRATED CONTROL MEASURES

Augusta, Georgia has in-progress sediment management integrated control measures and is proposing to continue these practices. These measures are listed below. Spirit Creek basin is the least developed suburban watershed within Augusta, GA legal boundary. Chosen control measures are based on assessment of current land use within the listed impaired drainage area. Augusta, GA will review following listed control measures and make adjustments / improvement on as needed basis or location specific basis.

I) Natural Resources Management – Natural Resources Conservation , Erosion & Sedimentation outreach Events (Workshop / Training)

In association with Brier Creek Soil and Water Conservation District and the Georgia Soil and Water Conservation Commission, an Erosion &Sediment (E&S) Control Workshop will be conducted to provide information on latest changes for E&S Control in Georgia and the checklists. Various best management practices including skimmers will also be discussed. Augusta, GA will continue such educational activities.

II) Natural Resource Management – Protection of local natural resources by enforcement of land development ordinances such as Erosion, Sedimentation and Pollution Control Plan compliance, encourage incorporation of low impact development / green infrastructure measures in overall land development practices, and watershed protection through management of various intensity storms. Augusta, GA will continue all in-progress control measures.

PROJECT DATA EVALUTION AND REPORTING

Described under above listed section “Scope of Work (g)”.

STORMWATER INTEGRATED MANAMEGEMENT PLAN PERFORMANCE MEASURE

Measure of success for listed bacteria is managing E. coli bacteria in listed impaired segment at concentrations that will not result in further degradation of its water quality. Targeted threshold is not to exceed geometric mean of 126 count/100ml for months of May through October and 265 count/100ml for months of November through April, and 406 counts/100ml for single sample for months of May through October and 861 count/100ml for months of November through April. In case of significant upward trend in noted values, Augusta will re-evaluate adopted control measures or stream natural conditions and propose modifications accordingly.

Natural Water Quality of listed segment may not be within the specific requirements contained herein (such as Bacteria criteria for non-human sources). Such circumstances do not constitute violation of water quality standards. The Best Management Practices will be the primary mechanism for ensuring that MS4 discharges will not create a harmful situation.

Augusta has done extensive research on fecal and E. coli bacteria in Augusta-Richmond County watersheds. In addition to proving E. coli survives and thrives in stream sediments, we also sampled water running off road, bridge, and other paved surfaces as well as ponded water in parking lots, tree holes, downdrains, and many other sites; we found that E. coli concentrations, more times than not, exceeded the USEPA standard and often exceeded the Colilert-18 maximum concentration. These results are typical and there is much research to support these findings (See a list of example papers below). If high loads of E. coli occur in runoff from watershed surfaces, then differentiation of this source from actual problem areas is itself problematic. The EPA determined that loads of coliform bacteria in urban runoff generally exceed the listed criteria and suggested that fecal coliform bacteria may not be a suitable indicator for identifying potential health risks in stormwater runoff.

Finally, the viability of E. coli outside the gut has been questioned for years and within both freshwater and saltwater. For example, Stephenson and Rychert (G. R. *Stephenson* and R. C. *Rychert*, "Bottom Sediment A Reservoir of Escherichia coli in Rangeland Streams," Journal of Range Manage, Vol. 35, No. 1, *1982*) found E. coli concentrations 2 to 760 times higher in the sediment than the overlying water in a rangeland stream and that survivability was high. Gerba and McLeod (*Gerba*, C.P. and *McLeod*, J.S. (*1976*) Effect of sediments on the survival of Escherichia coli in marine waters. Appl Environ Microbiol. 32, 114-120) found that E. coli could survive for longer periods in unsterilized sea water with sediment than in unsterilized seawater without sediment; they attributed longer survivability to organic matter content of the sediment. While these are somewhat "dated" examples, they were seminal articles in making the case that fecal bacteria survive just fine in sediments; there are hundreds if not thousands of similar articles that discuss survivability of these bacteria in the environment.

This leads to the final question of regulation of these bacteria in creeks. How can these bacteria effectively be used as indicators if they exist on road surfaces, creek sediments and even clouds (DeLeon-Rodriguez, Natasha, et al. "Microbiome of the upper troposphere: Species composition and prevalence, effects of tropical storms, and atmospheric implications." *Proceedings of the National Academy of Sciences*110.7 (2013): 2575-2580)?

Selected list of papers that support dryfall and rainfall as significant source of E. Coli.

1) DeLeon-Rodriguez, Natasha, et al. "Microbiome of the upper troposphere: species composition and prevalence, effects of tropical storms, and atmospheric implications." *Proceedings of the National Academy of Sciences* 110.7 (2013): 2575-2580.
2) Chubaka, Chirhakarhula Emmanuel, et al. "Microbiological values of rainwater harvested in Adelaide." *Pathogens* 7.1 (2018): 21.
3) Denissen, Julia K., et al. "Human pathogenic bacteria detected in rainwater: risk assessment and correlation to microbial source tracking markers and traditional indicators." *Frontiers in microbiology* 12 (2021): 659784.
4) Ahmed, Warish, Jatinder PS Sidhu, and Simon Toze. "An attempt to identify the likely sources of Escherichia coli harboring toxin genes in rainwater tanks." *Environmental Science & Technology* 46.9 (2012): 5193-5197.
5) Sánchez, A. S., E. Cohim, and R. A. Kalid. "A review on physicochemical and microbiological contamination of roof-harvested rainwater in urban areas." *Sustainability of Water Quality and Ecology* 6 (2015): 119-137.

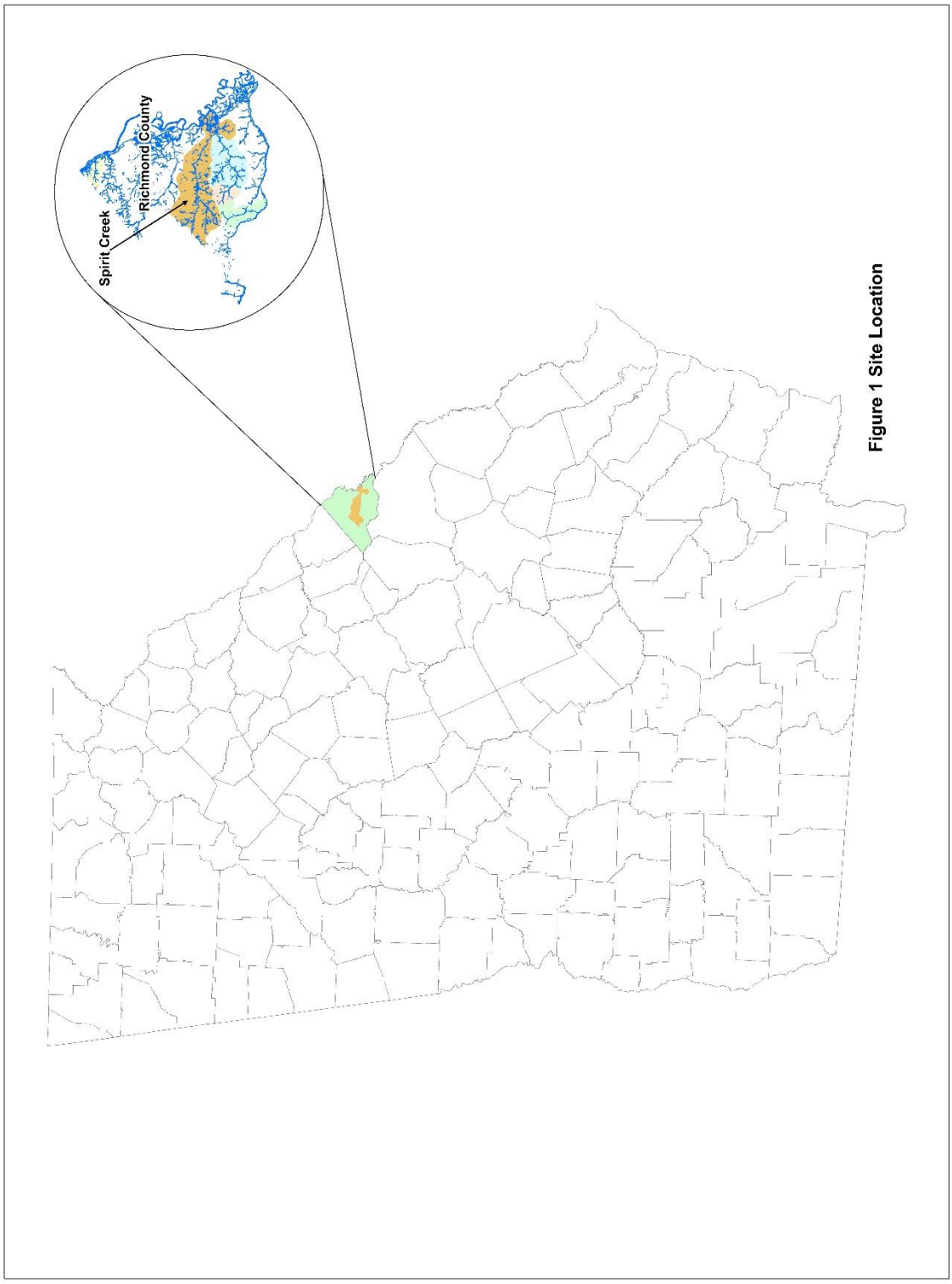

Figure1 – Spirit Creek Watershed Location

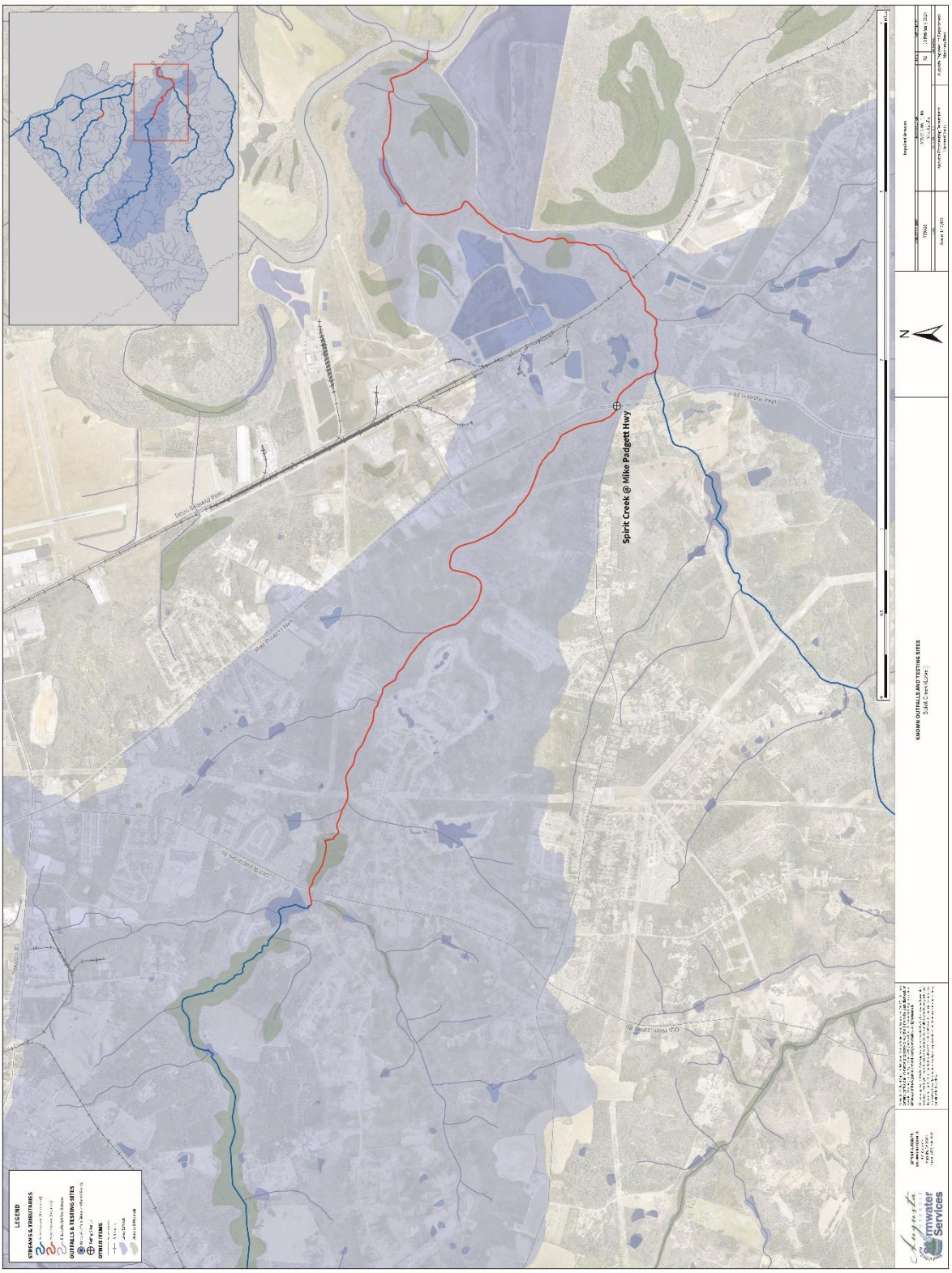

Figure2 – Sampling Location
(No MS4 outfall at Rocky Creek listed segment)

EXHIBIT A
Summary of Historical Coliform Data

All concentrations in Cfu/100 ml

Sample	Recreational	Sample Location		
Date	**Standard**	**Up**	**Mid**	**Down**
9/25/06	200	117	50	160
10/24/06	200	110	63	130
11/21/06	1,000	51	14	28
12/12/06	1,000	31	8	46
1/22/07	1,000	139	11	124
2/6/07	1,000	42	7	67
3/26/07	1,000	42	25	83
4/23/07	1,000	64	11	63
5/21/07	200	40	11	70
6/27/07	200	177	30	270
7/30/07	200	60	23	120
8/20/07	200	105	43	270
9/11/07	200	88	17	104
10/29/07	200	46	8	120
11/19/07	1,000	170	8	150
12/17/07	1,000	170	320	360
1/23/08	1,000	48	24	33
2/20/08	1,000	40	10	70
3/27/08	1,000	52	12	68
4/29/08	1,000	400	64	275
5/27/08	200	< 9	9	9
6/24/08	200	180	140	80

Geometric Means Data (Spirit @ Mike Padgett (Ga Hwy 56)

Nov 2010	1000	166
Feb 2011	1000	38
May 2011	200	98
Aug 2011	200	188

GA EPD Monthly Data (Spirit @ Mike Padgett (Ga Hwy 56) used for listing impaired segment

3/18/2018	1000	130
8/29/2018	200	800
10/18/2018	1000	120
11/28/2018	200	170