Total Maximum Daily Load Document
Little Salkehatchie River and Buckhead Creek
Stations: CSTL-115, RS-08076, CSTL-119, and CSTL-117
(Hydrologic Unit Codes: 030502070301 - 302; 030502070401 - 403; 030502070501 - 504; and, 030502070506)
Escherichia coli Bacteria,
Indicator for Pathogens

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Prepared for:

Bureau of Water

D H E C

PROMOTE PROTECT PROSPER

SCDHEC Technical Document Number 0624-14

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Photographs on Title Page

Photograph in the foreground: proximity of the South Carolina Department of Health and Environmental Control's (SCDHEC) Water Quality Monitoring Station CSTL-117 in the Little Salkehatchie River at SC Route 64 in Colleton County, SC. (Date of photography: January 23, 2014.) Photograph in the background: proximity of the SCDHEC's Water Quality Monitoring Station CSTL-119 in Buckhead Creek at SC Route 212 in Colleton County, SC. (Date of photography: January 23, 2014.)

Abstract

§303(d) of the Clean Water Act (CWA) 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 included on the §303(d) list of impaired waters. A TMDL is the maximum amount of pollutant a waterbody can assimilate while meeting water quality standards for the pollutant of concern. All TMDLs include a waste load allocation (WLA) for all National Pollutant Discharge Elimination System (NPDES)-permitted discharges, a load allocation (LA) for all nonpoint sources, and an explicit and/or implicit margin of safety (MOS). Fecal Coliform (FC bacteria) TMDLs were developed for three (3) impaired water quality monitoring (WQM) stations, CSTL-115, CSTL-119, and CSTL-117, in the Little Salkehatchie River and tributaries (including Buckhead Creek) located in Barnwell, Bamberg, and Colleton Counties, SC. Because South Carolina has recently adopted a change from FC bacteria to *Escherichia coli (E. coli)* bacteria as a recreational use standard in all freshwaters, the aforementioned three sites will be included on future §303(d) lists due to exceedances of the current *E. coli* water quality standard (WQS) until such time such that sufficient *E. coli* data are collected and demonstrate the standard is attained, or such time that TMDLs are developed and approved to address the parameter of concern. In addition to addressing FC bacteria impairments, this TMDL document also includes converted *E. coli* TMDLs for the three aforementioned impaired stations for the purposes of implementation of the current recreational use standard. In addition, an E. coli TMDL was developed for impaired WQM Station RS-08076, also in a tributary to the Little Salkehatchie River in Colleton County. Samples were collected several times a month at WQM Station RS-08076 in 2009, and were analyzed for both FC bacteria and E. coli. These four WQM stations along the Little Salkehatchie River and tributaries are included as impaired on the State's final 2012 §303(d) list due to excessive fecal FC bacteria and on the draft 2014 §303(d) list due to excessive *E.coli*. At least ten (10) percent of the samples collected between November 1999 and November 2010 at the impaired WQM stations exceeded the water quality standards.

Probable sources of fecal contamination include direct loading by livestock, failing septic systems, surrounding wildlife, and other agricultural activities. The load-duration curve methodology was used to calculate existing and TMDL loads for each impaired segment. Existing pollutant loadings and proposed TMDL reductions for critical hydrologic conditions are presented in Table Ab-1. Critical hydrologic conditions were defined as either moist, mid-range, or dry depending on which condition demonstrated the highest load reductions necessary to meet water quality standards. In order to achieve the target load for the Little Salkehatchie River and tributaries, the following reductions in the existing loads at the respective stations will be necessary: **a)** up to 18% at CSTL-115; **b)** up to 48% at RS-08076; **c)** up to 49% at CSTL-119; and, **d)** up to 23% at CSTL-117. For the South Carolina Department of Transportation (SCDOT), existing and future NPDES municipal separate storm sewer system (MS4) permittees, compliance with terms and conditions of its NPDES permit is effective implementation of the WLA to the Maximum Extent Practicable (MEP) and demonstrates consistency with the assumptions and requirements of the TMDLs. For existing and future NPDES construction and Industrial stormwater permittees, compliance with terms and conditions of its permit is effective implementation of the WLA. Required load reductions in the LA portion of these TMDLs can be implemented through voluntary measures and are eligible for CWA §319 grants.

The Department recognizes that **adaptive management/implementation** of these TMDLs might be needed to achieve the water quality standard and we are committed towards targeting the load reductions to improve water quality in the Little Salkehatchie River and tributaries watersheds. As additional data and/or information become available, it may become necessary to revise and/or modify these TMDLs targets accordingly.

Table Ab-1. Total Maximum Daily Loads for the Little Salkehatchie River and Tributaries Watersheds
Loads are expressed as FC bacteria or *E. coli* count/day

	Existing Load (count/day)		TMDL (count/day)		Margin of Safety (MOS) (count/day)		Waste Load Allocation (WLA)				Load Allocation (LA)		
							Continuous Source[3] (count/day)		Non-Continuous Sources[4,5] (%Reduction)	Non-Continuous SCDOT[5] (%Reduction)	Load Allocation (count/day)		% Reduction to Meet LA[5]
Station	FC (cfu/day)[1]	*E. coli* (MPN/day)[2]	FC (cfu /day)	*E. coli* (MPN/day)[8]	FC (cfu /day)	*E. coli* (MPN/day)[8]	FC (cfu /day)	*E. coli* (MPN/day)[8]	(Percent)	(Percent)	FC (cfu /day)	*E. coli* (MPN/day)[8]	(Percent)
CSTL-115	4.47E+11	---	3.92E+11	*3.42E+11*	1.96E+10	*1.67E+10*	5.87E+09	*5.13E+09*	18	0[6]	3.66E+11	*3.20E+11*	18
RS-08076	---	*6.35E+11*	---	*3.46E+11*	---	*1.69E+10*	---	*1.98E+08*	48	0[6]	---	*3.27E+11*	48
CSTL-119	1.80E+12	---	9.75E+11	*8.51E+11*	4.88E+10	*4.15E+10*	See Note Below	See Note Below	49	0[6]	9.27E+11	*8.10E+11*	49
CSTL-117	3.10E+12	---	2.50E+12	*2.18E+12*	1.25E+11	*1.06E+11*	See Note Below	See Note Below	23	23[7]	2.38E+12	*2.08E+12*	23

Table Notes:

1. Existing FC bacteria loads were based on observed FC bacteria concentrations and stream flows during critical flow conditions. FC bacteria samples were collected as part of the Department's ambient water quality monitoring program.
2. Existing *E. coli* loads were based on observed *E. coli* concentrations and stream flows during critical flow conditions. *E. coli* samples were collected during the Department's 2009 Pathogen Indicator Study in freshwaters.
3. WLAs are expressed as a daily maximum. Existing and future continuous discharges are required to meet the prescribed loading for the pollutant of concern. For the purposes of NPDES permitting, continuous discharges may be required to meet a loading equivalent of FC bacteria, based upon permitted flow and an allowable permitted maximum FC bacteria concentration of 400 cfu/100ml, until such time that *E. coli* limits are incorporated into individual permits. *E. coli* limits will be developed based upon permitted flow and an allowable permitted maximum *E. coli* concentration of 349 MPN/100ml.
4. Percent reduction applies to all NPDES-permitted stormwater discharges, including current and future municipal separate storm sewer system (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 in accordance with their NPDES Permit.
5. Percent reduction applies to existing instream FC bacteria or *E. coli.*
6. As long as the conditions within the SCDOT MS4 area remain the same the Department deem the current contributions from SCDOT negligible and no reduction of FC bacteria or *E. coli* is necessary. SCDOT must continue to comply with the provisions of its approved NPDES stormwater permit.
7. By implementing the best management practices that are prescribed in either the SCDOT annual SWMP or the SCDOT MS4 Permit to address fecal coliform or *E. coli,* the SCDOT will comply with these TMDLs and its applicable WLA to the maximum extent practicable (MEP) as required by its MS4 permit140.
8. Expressed as *E. coli* (MPN/day). Loadings are developed by applying a conversion factor to values calculated for FC bacteria. This conversion is derived from an established relationship between FC bacteria and *E. coli* water quality standards in freshwaters.

Contents

LIST OF TABLES

LIST OF FIGURES

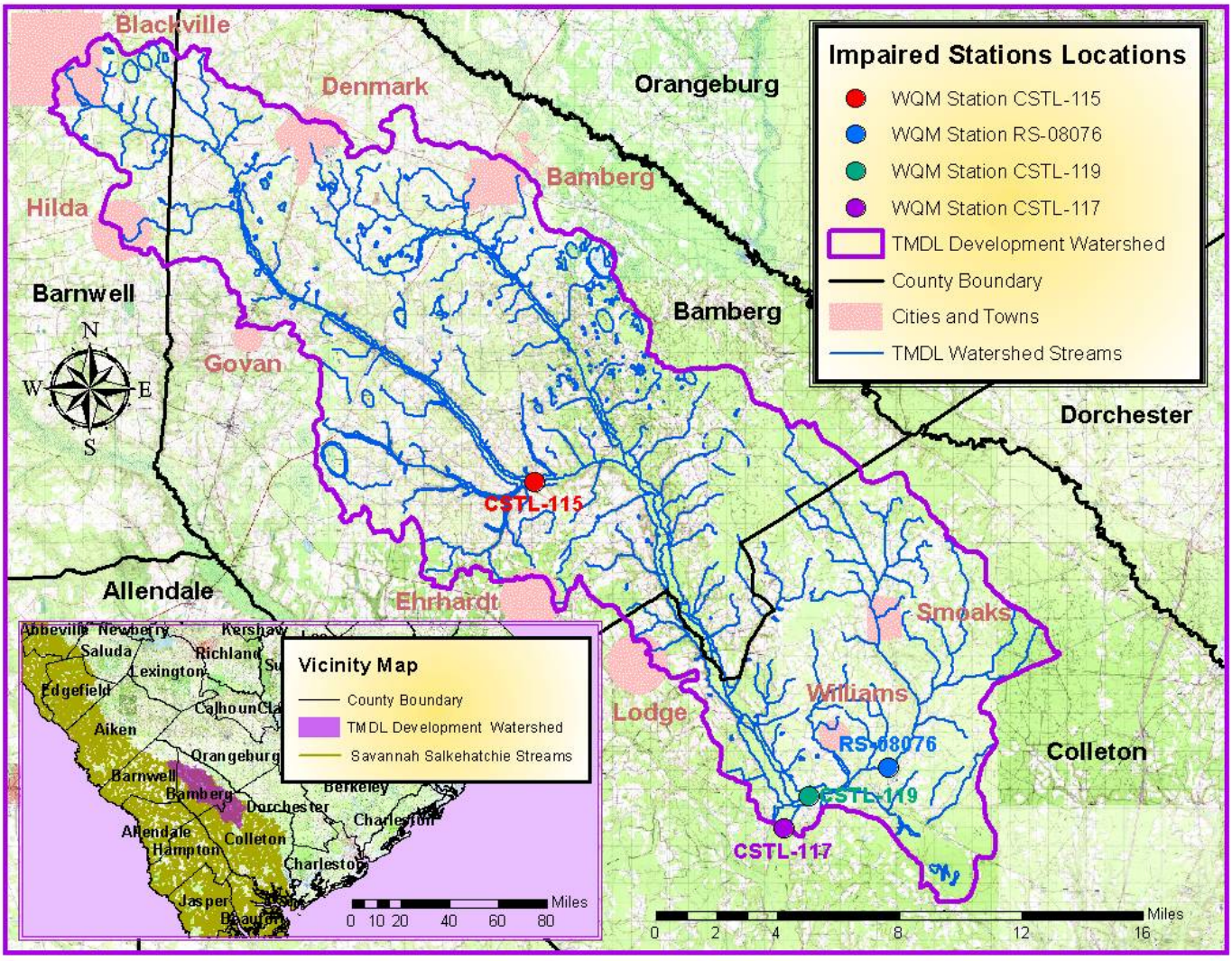
LIST OF APPENDICES

1.0 Introduction

1.1 Background

The Federal Clean Water Act (CWA) directs each state to review the quality of its waters every two years to determine if water quality standards are being met. If it is determined that the water quality is not being met, the states are to list the impaired water bodies under §303(d) of the CWA. The South Carolina Department of Health and Environmental Health (SCDHEC) has included four monitoring stations in the Little Salkehatchie River watershed(s) (including Buckhead Creek watersheds) on South Carolina's 2012 §303(d) list for impairment due to FC bacteria exceedances. These stations are CSTL-115, RS-08076, CSTL-119, and CSTL-119, and are identified in Figure 1 and Table 1.

Figure 1. Location of Water Quality Monitoring Stations CSTL-115, RS-08076, CSTL-119, and CSTL-119 Impaired with Excessive FC and *E. coli* Numbers



A Total Maximum Daily Load (TMDL) is a written plan and analysis to determine the maximum pollutant load a waterbody can receive and still meet applicable water quality standards. The TMDL process includes estimating pollutant loadings from all sources, linking pollutant sources to their impacts on water quality, allocation of pollutant sources to each source and establishment of control mechanisms to achieve water quality standards (US EPA, 1999). All TMDLs include a wasteload allocation (WLA) for all National Pollutant Discharge Elimination System (NPDES) permitted discharges, a load allocation (LA) for all unregulated nonpoint sources, and an explicit and/or implicit margin of safety (MOS). TMDLs are required

to be developed for each waterbody and pollutant combination on the States' §303(d) lists by 40 CFR 130.31(a) (US EPA, 1999).

Table 1. Little Salkehatchie River and Tributaries Watersheds FC and *E. coli* Impaired Waters

Waterbody	Station Number	Description
Little Salkehatchie River	CSTL-115	Little Salkehatchie River at US 601 in Bamberg County
Buckhead Creek	RS-08076	Buckhead Creek at US 21 in Colleton County
Buckhead Creek	CSTL-119	Buckhead Creek at SC 212 in Colleton County
Little Salkehatchie River	CSTL-117	Little Salkehatchie River at SC 64 in Colleton County

Escherichia coli *(E. coli)* bacteria are members of the FC group of bacteria and are part of the normal flora of the gastrointestinal tract of warm-blooded animals including humans. These harmless bacteria play an important role in preventing the growth of harmful bacteria, vitamin K production, and lactose digestion as well as producing compounds necessary for fat metabolism (Starr and Taggart, 1992; Wolfson and Harrigan, 2010). Some verotoxin producing strains of *E. coli*, such as 0157:H7, a major cause of foodborne illnesses, can cause gastrointestinal illnesses, kidney failure and death (Nadakavukaren, 1995; Wolfson and Harrigan, 2010).

E. coli bacteria in surface waters are indicators of recent human or animal waste contamination and originate from failing septic systems, agricultural runoff, leaking sewers among other sources. Section §303(d) of the Clean Water Act (CWA) and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop TMDLs for water bodies that are not meeting designated uses under technology-based pollution controls. The TMDL process establishes the allowable loading 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).

This TMDL document includes TMDLs for the aforementioned four (4) WQM stations in the Little Salkehatchie River and tributaries on South Carolina's 2012 §303(d) list for impairment due to FC bacteria exceedances. FC TMDLs were developed for WQM stations CSTL-115, CSTL-119, and CSTL-117; and, these three FC TMDLs were translated to *E. coli* TMDLs. And, an *E. coli* TMDL was developed for WQM Station RS-08076 based on E. coli samples taken several times a month at the station in 2009 during the SCDHEC's Pathogen Indicator Study (PIS).

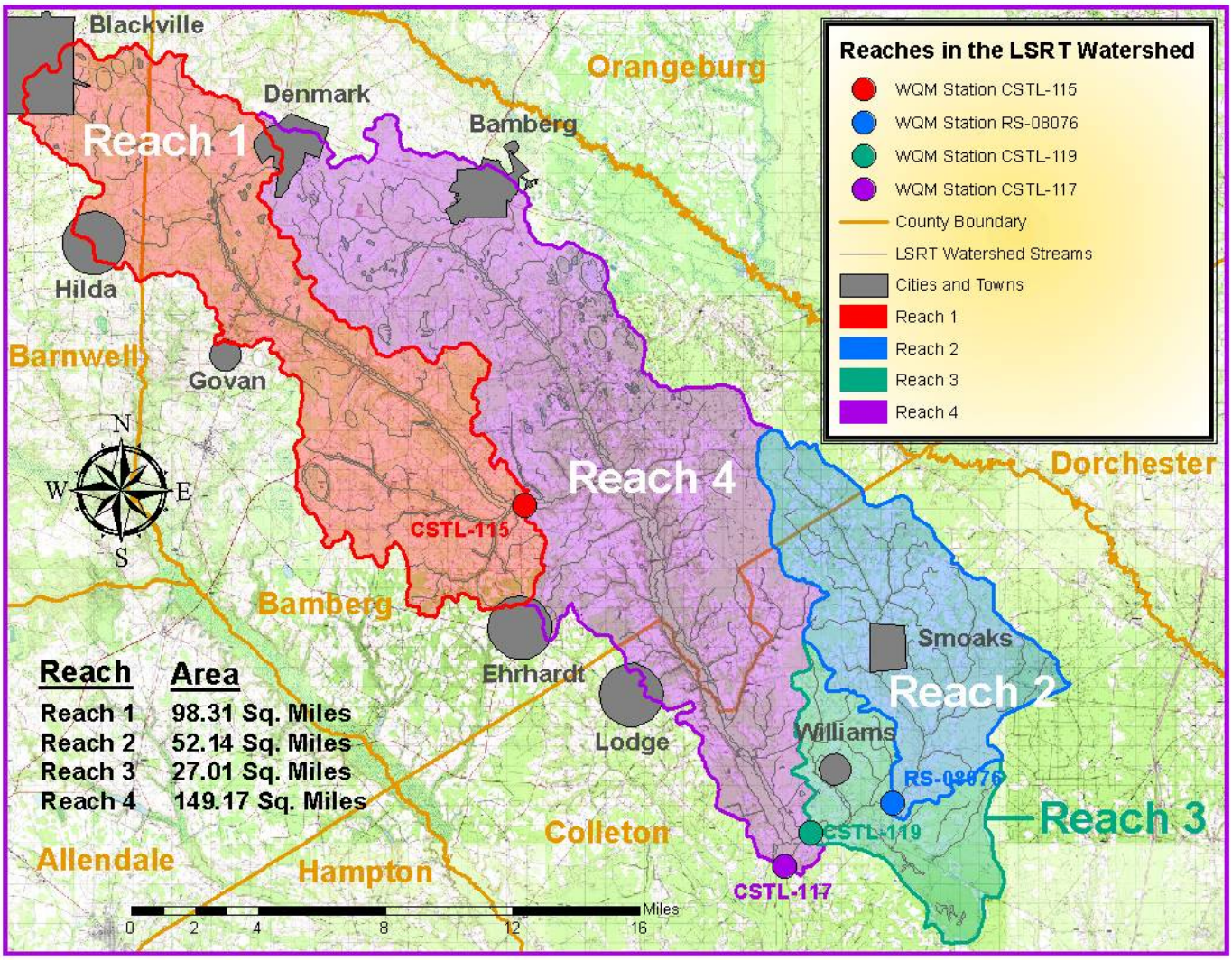
1.2 Watershed Descriptions

The watersheds for the four (4) WQM stations placed on South Carolina's 2012 §303(d) list for impairment due to FC bacteria and addressed in this TMDL document are hydrologically connected. Drainage from all four watersheds ultimately flows through WQM Station CSTL-117. Collectively, the four watersheds will be referred to as the Little Salkehatchie River and Tributaries (LSRT) Watershed in this TMDL document. The LSRT Watershed is 326.63 mi^2 in size, and is located in Barnwell, Bamberg, and Colleton Counties in South Carolina, and lies in both the Southeastern Plains and Middle Atlantic Coastal Plains ecoregions of the State. The general stream flow direction in the LSRT Watershed is in the southeastern direction. The upper northwestern part of the watershed is located at the City of Blackville in Barnwell County, and the lower southeastern part of the LSRT Watershed is located in Colleton County about six miles northwest of the City of Walterboro.

Each of the four (4) separate WQM station watersheds in the LSRT Watershed will be addressed as separate distinct reaches in the LSRT Watershed in this TMDL document. The four reaches are: **a)** Reach 1 - the watershed draining through WQM Station CSTL-115 in the Little Salkehatchie River; **b)** Reach 2 - the watershed draining through WQM Station RS-08076 in Buckhead Creek; **c)** Reach 3 - the watershed draining through WQM Station CSTL-119 in Buckhead Creek; and, **d)** Reach 4 - the watershed draining through WQM Station CSTL-117 in the Little Salkehatchie River. The reaches of the LSRT Watershed are shown in Figure 2.

Land use within the entire LSRT Watershed is predominately Evergreen Forest (29.00%), and Woody Wetlands (26.19%) (Figure 3). Following are detailed descriptions for each reach in the LSRT Watershed.

Figure 2. Location of the Little Salkehatchie River and Tributaries Watershed Station Reaches



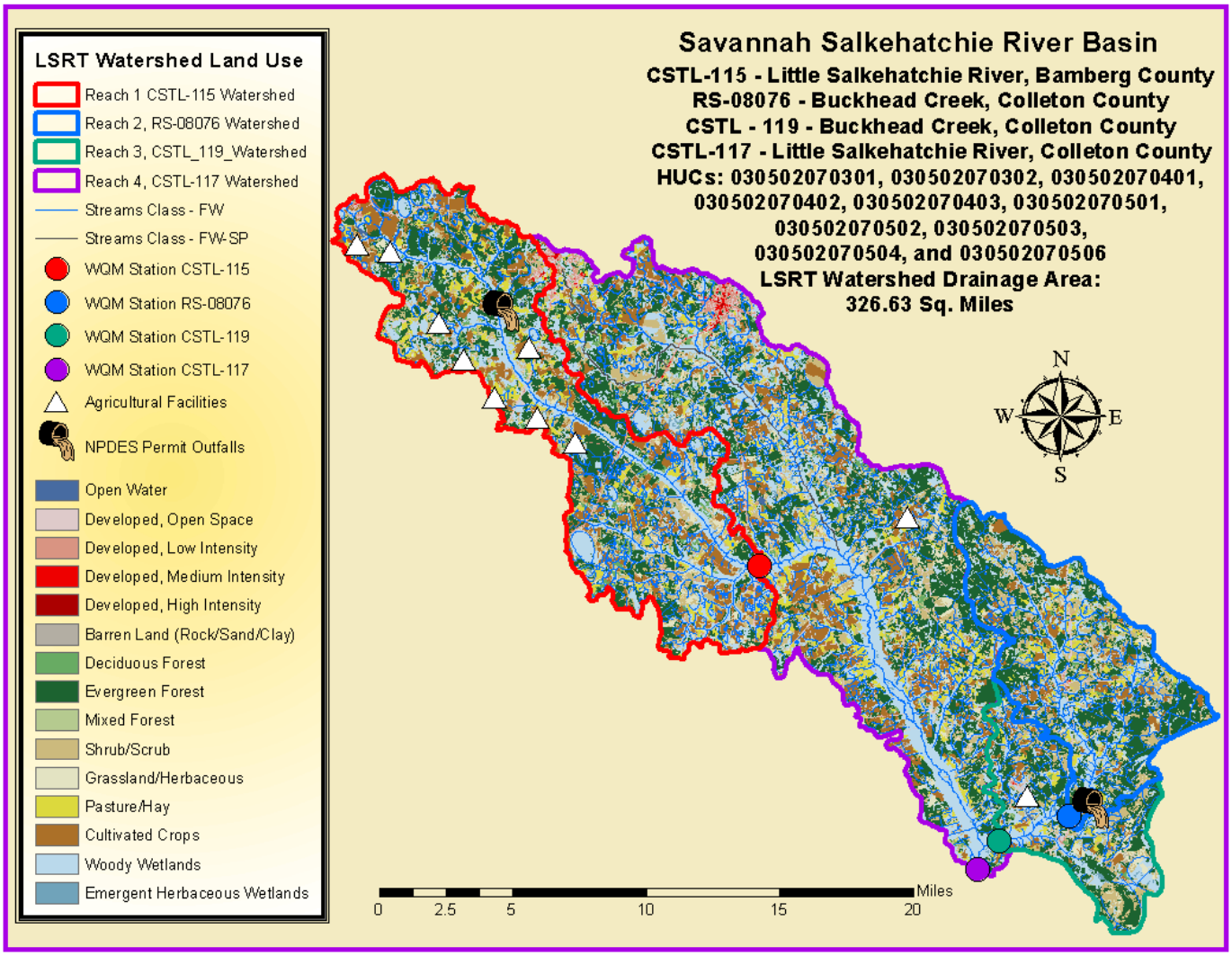
1.2.1 Reach 1 of the LSRT Watershed; Terminal WQM Station CSTL-115

Reach 1 of the LSRT Watershed covers a drainage area of 98.31 mi^2 (62,935.49 acres) in size that drains into the Little Salkehatchie River and its tributaries from the City of Blackville in Barnwell County, in a general southeastern fashion to impaired station CSTL-115 in the Little Salkehatchie River at US 601 in Bamberg County. The reach lies in both the Southeastern Plains and Middle Atlantic Coastal Plains ecoregions of the State.

Land use within Reach 1 of the LSRT Watershed is predominately Evergreen Forest (26.47%), and Woody Wetlands (25.33%) (Figure 3a, Table 2a). Developed lands (residential, commercial, industrial, or open urban space) only comprise approximately 4.62% of the reach (Table 3). At the time of the development of these TMDLs, there were eight (8) active animal feeding operations in the reach.

There are approximately 173 miles of streams within Reach 1 of the LSRT Watershed. The streams are all classified as freshwater (FW). From WQM Station CSTL-115, the Little Salkehatchie River flows for approximately thirty-one (31) stream miles to the Salkehatchie River on the Hampton/Colleton County border approximately five miles north of the City of Yamasee in Hampton/Beaufort County.

Figure 3. Land Use Diagram for the Little Salkehatchie River and Tributaries Watershed



1.2.2 Reach 2 of the LSRT Watershed; Terminal WQM Station RS-08076

Reach 2 of the LSRT Watershed covers a drainage area of 52.14 mi^2 (33,378.66 acres) in size that drains into Buckhead Creek and its tributaries from an area near the intersection of SC 61 and County Route S-5-18 in Bamberg County, in a general southern fashion to impaired station RS-08076 in Buckhead Creek at US 21 in Colleton County. The reach lies in the Middle Atlantic Coastal Plains ecoregion of the State.

Land use within Reach 2 of the LSRT Watershed is predominately Evergreen Forest (39.70%), and Woody Wetlands (20.88%) (Figure 3b, Table 2b). Developed lands (residential, commercial, industrial, or open urban space) only comprise approximately 3.98% of the reach (Table 3). At the time of the development of these TMDLs, there were no animal feeding operations in the reach.

There are approximately 61 miles of streams within Reach 2 of the LSRT Watershed. The streams are all classified as freshwater (FW). From WQM Station RS-08076, Buckhead Creek flows for approximately three (3) stream miles to the Little Salkehatchie River approximately two miles southwest of the City of Williams in Colleton County.

Figure 3a. Land Use Diagram for Reach 1 in the Little Salkehatchie River and Tributaries Watershed

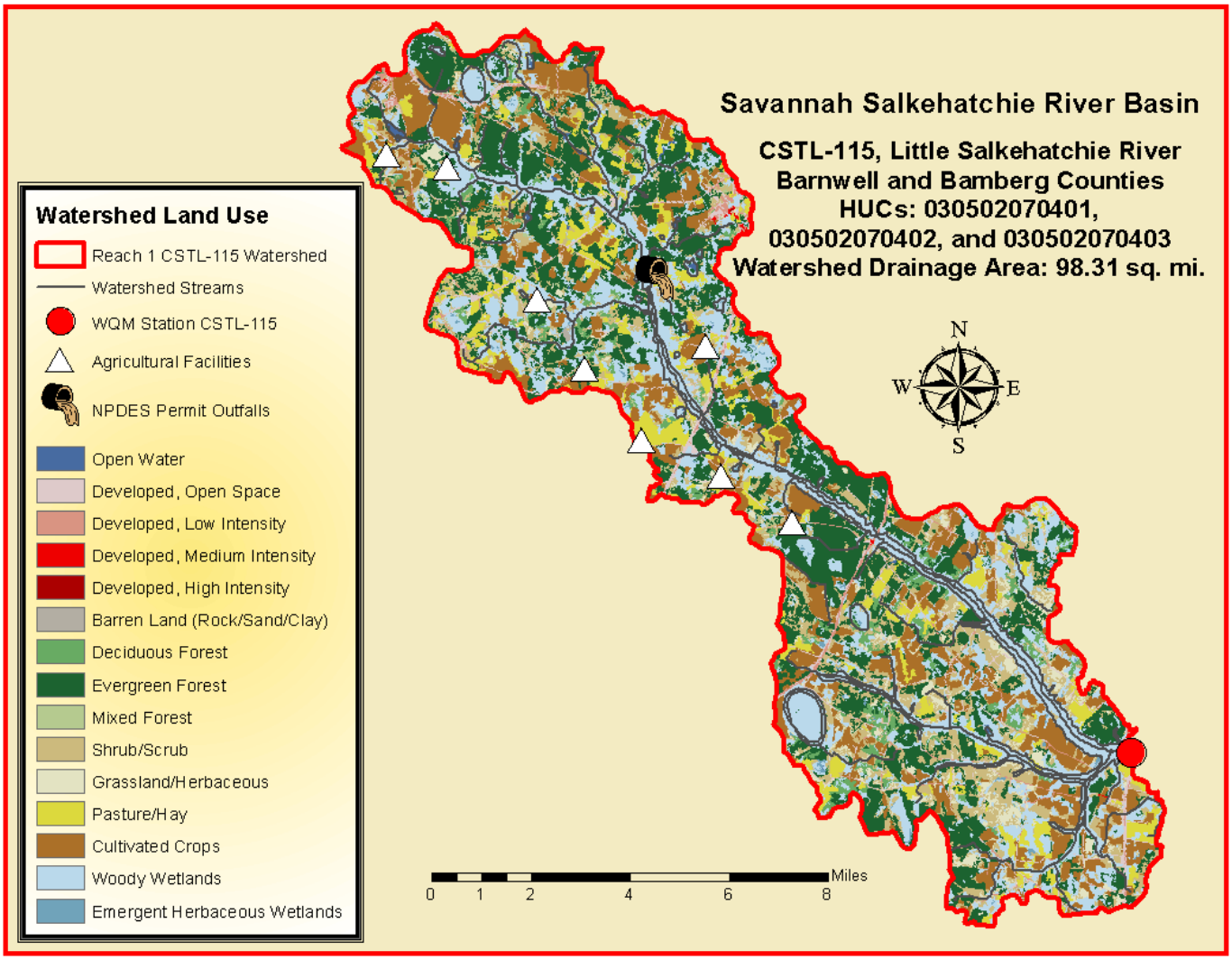


Table 2a. Little Salkehatchie River and Tributaries Watershed: Land Use in Reach 1 (WQM Station CSTL-115) (Derived from National Land Cover Database (NLCD) 2006)

Description	Area (Acres)	Area (Mile^2)	Percent
Evergreen Forest	16659.31	26.02	26.41%
Woody Wetlands	15944.31	24.91	25.33%
Cultivated Crops	10026.63	15.66	15.93%
Shrub/Scrub	8162.97	12.75	12.97%
Pasture/Hay	4625.79	7.23	7.35%
Developed, Open Space	2142.77	3.35	3.40%
Grassland/Herbaceous	1988.20	3.11	3.16%
Deciduous Forest	1666.84	2.60	2.65%
Developed, Low Intensity	717.00	1.12	1.14%
Mixed Forest	448.79	0.70	0.71%
Emergent Herbaceous Wetlands	289.33	0.45	0.46%
Open Water	194.59	0.30	0.31%
Developed, Medium Intensity	44.26	0.07	0.07%
Barren Land (Rock/Sand/Clay)	22.46	0.04	0.04%
Developed, High Intensity	2.22	0.00	0.00%
Totals	**62935.49**	**98.31**	**100.00%**

Table 3. Developed Area from Reach to Reach in the Little Salkehatchie River and Tributaries Watershed

Reach	Reach Description	Total Drainage Area of Station Reach (Sq. Miles)	Total Developed Area (Sq. Miles)	Percent Developed Area (%)
1	From the City of Blackville in Barnwell County to impaired station CSTL-115 in the Little Salkehatchie River at US 601 in Bamberg County.	98.31	4.54	4.62%
2	From an area near the intersection of SC 61 and County Route S-5-18 in Bamberg County, to impaired station RS-08076 in Buckhead Creek at US 21 in Colleton County.	52.14	2.07	3.98%
3	From an area near the intersection of US 21 and SC 217, and from an area near the intersection of Alligator Road and Calabash Creek Lane in Colleton County, to impaired station CSTL-119 in Buckhead Creek at SC 212 in Colleton County.	27.01	1.07	3.96%
4	From the Cities of Denmark and Bamberg in Bamberg County, to impaired station CSTL-117 in the Little Salkehatchie River at SC 64 in Colleton County.	149.17	8.55	5.73%
All	Total for All Reaches	326.63	16.23	4.97%

1.2.3 Reach 3 of the LSRT Watershed; Terminal WQM Station CSTL-119

Reach 3 of the LSRT Watershed covers a drainage area of 27.01 mi^2 (17,287.79 acres) in size that drains into Buckhead Creek and its tributaries from an area near the intersection of US 21 and SC 217, and from an area near the intersection of Alligator Road and Calabash Creek Lane in Colleton County, in a general southwestern fashion to impaired station CSTL-119 in Buckhead Creek at SC 212 in Colleton County. The reach lies in the Middle Atlantic Coastal Plains ecoregion of the State.

Land use within Reach 3 of the LSRT Watershed is predominately Evergreen Forest (34.86%), and Woody Wetlands (24.78%) (Figure 3c, Table 2c). Developed lands (residential, commercial, industrial, or open urban space) only comprise approximately 3.96% of the reach (Table 3). At the time of the development of these TMDLs, there was one animal feeding operation in the reach.

There are approximately 41 miles of streams within Reach 3 of the LSRT Watershed. The streams are all classified as freshwater (FW). From WQM Station CSTL-119, Buckhead Creek flows for approximately one-half (0.5) stream miles to the Little Salkehatchie River approximately two miles southwest of the City of Williams in Colleton County.

1.2.4 Reach 4 of the LSRT Watershed; Terminal WQM Station CSTL-117

Reach 4 of the LSRT Watershed covers a drainage area of 149.17 mi^2 (95,495.74 acres) in size that drains into the Little Salkehatchie River and its tributaries from the Cities of Denmark and Bamberg in Bamberg County, in a general southeastern fashion to impaired station CSTL-117 in the Little Salkehatchie River at SC 64 in Colleton County. The reach lies in both the Southeastern Plains and Middle Atlantic Coastal Plains ecoregions of the State.

Figure 3b. Land Use Diagram for Reach 2 in the Little Salkehatchie River and Tributaries Watershed

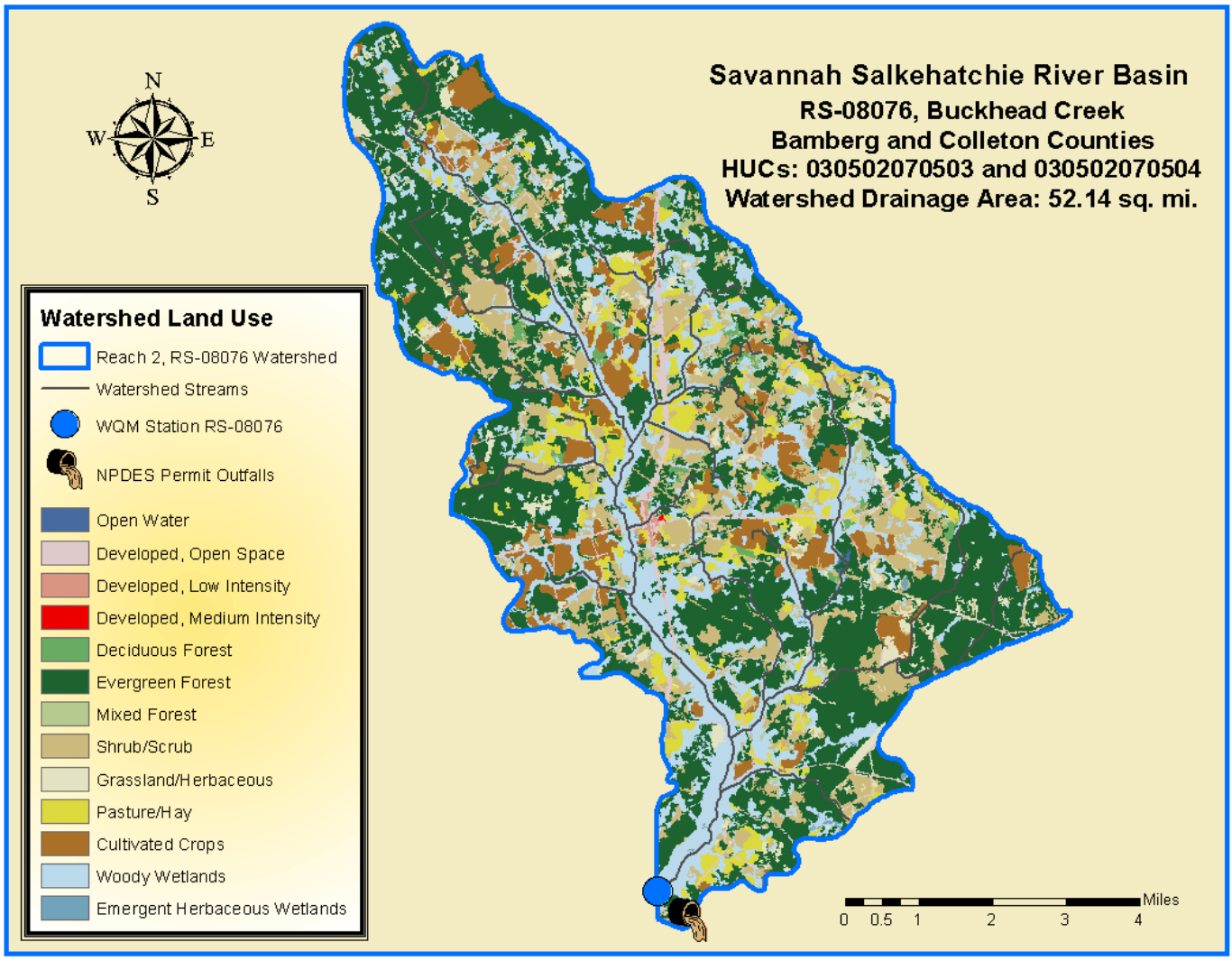


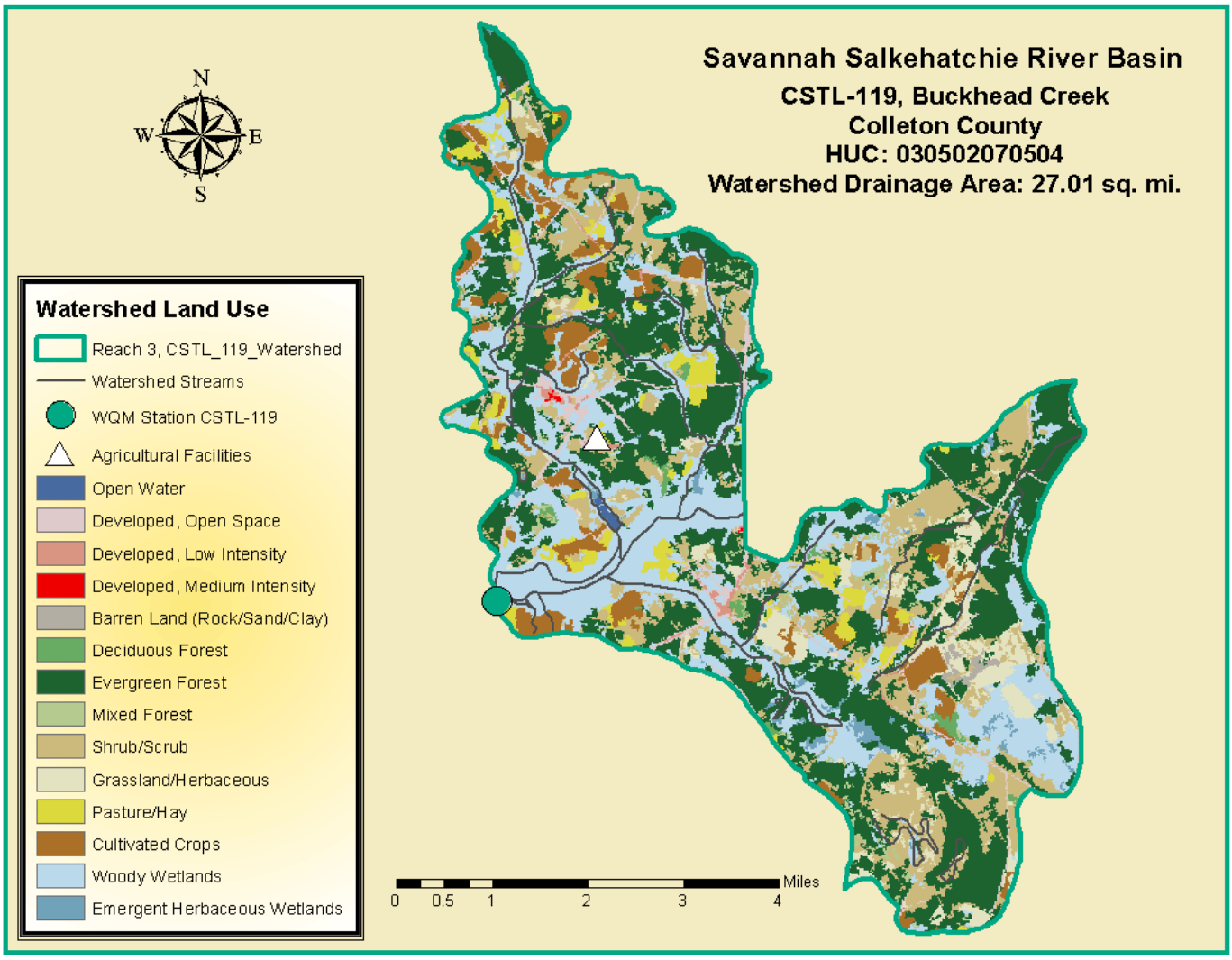
Table 2b. Little Salkehatchie River and Tributaries Watershed: Land Use in Reach 2 (WQM Station RS-08076) (Derived from National Land Cover Database (NLCD) 2006)

Description	Area (Acres)	Area (Mile^2)	Percent
Evergreen Forest	13252.90	20.70	39.80%
Woody Wetlands	6970.05	10.89	20.88%
Shrub/Scrub	4877.32	7.62	14.61%
Cultivated Crops	2789.93	4.36	8.36%
Pasture/Hay	2125.86	3.32	6.37%
Developed, Open Space	1226.73	1.92	3.68%
Grassland/Herbaceous	1218.94	1.90	3.65%
Mixed Forest	452.35	0.71	1.36%
Deciduous Forest	259.31	0.41	0.78%
Developed, Low Intensity	93.85	0.15	0.28%
Emergent Herbaceous Wetlands	84.73	0.13	0.25%
Open Water	19.35	0.03	0.06%
Developed, Medium Intensity	7.34	0.01	0.02%
Totals	**33378.66**	**52.14**	**100.00%**

Land use within Reach 4 of the LSRT Watershed is predominately Woody Wetlands (28.83%), and Evergreen Forest (25.89%) (Figure 3d, Table 2d). Developed lands (residential, commercial, industrial, or open urban space) comprise approximately 5.73% of the reach (Table 3). At the time of the development of these TMDLs, there was one active animal feeding operations in the reach.

There are approximately 284 miles of streams within Reach 4 of the LSRT Watershed. The streams are all classified as freshwater (FW or FW-SP). From WQM Station CSTL-115, the Little Salkehatchie River flows for approximately fourteen (14) stream miles to the Salkehatchie River on the Hampton/Colleton County border approximately five miles north of the City of Yamasee in Hampton/Beaufort County.

Figure 3c. Land Use Diagram for Reach 3 in the Little Salkehatchie River and Tributaries Watershed



1.3 Water Quality Standard

The impaired stream segments of the Little Salkehatchie River and tributary basins are designated as Class Freshwater (FW or FW-SP), which are defined in SC Regulation 61-68 (SCDHEC 2012) as:

> "Freshwaters are 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 aquatic community of fauna and flora. Suitable also for industrial and agricultural uses."

Table 2c. Little Salkehatchie River and Tributaries Watershed: Land Use in Reach 3 (WQM Station CSTL-119) (Derived from National Land Cover Database (NLCD) 2006)

Description	Area (Acres)	Area (Mile^2)	Percent
Evergreen Forest	6027.10	9.41	34.86%
Woody Wetlands	4284.64	6.69	24.78%
Shrub/Scrub	2929.82	4.58	16.95%
Cultivated Crops	1143.10	1.79	6.61%
Grassland/Herbaceous	909.37	1.42	5.26%
Pasture/Hay	685.86	1.07	3.97%
Developed, Open Space	605.13	0.95	3.50%
Mixed Forest	239.52	0.37	1.39%
Emergent Herbaceous Wetlands	189.26	0.30	1.09%
Deciduous Forest	119.43	0.19	0.69%
Developed, Low Intensity	72.50	0.11	0.42%
Barren Land (Rock/Sand/Clay)	52.71	0.08	0.30%
Open Water	23.13	0.04	0.13%
Developed, Medium Intensity	6.23	0.01	0.04%
Totals	**17,287.79**	**27.01**	**100.00%**

Figure 3d. Land Use Diagram for Reach 4 in the Little Salkehatchie River and Tributaries Watershed

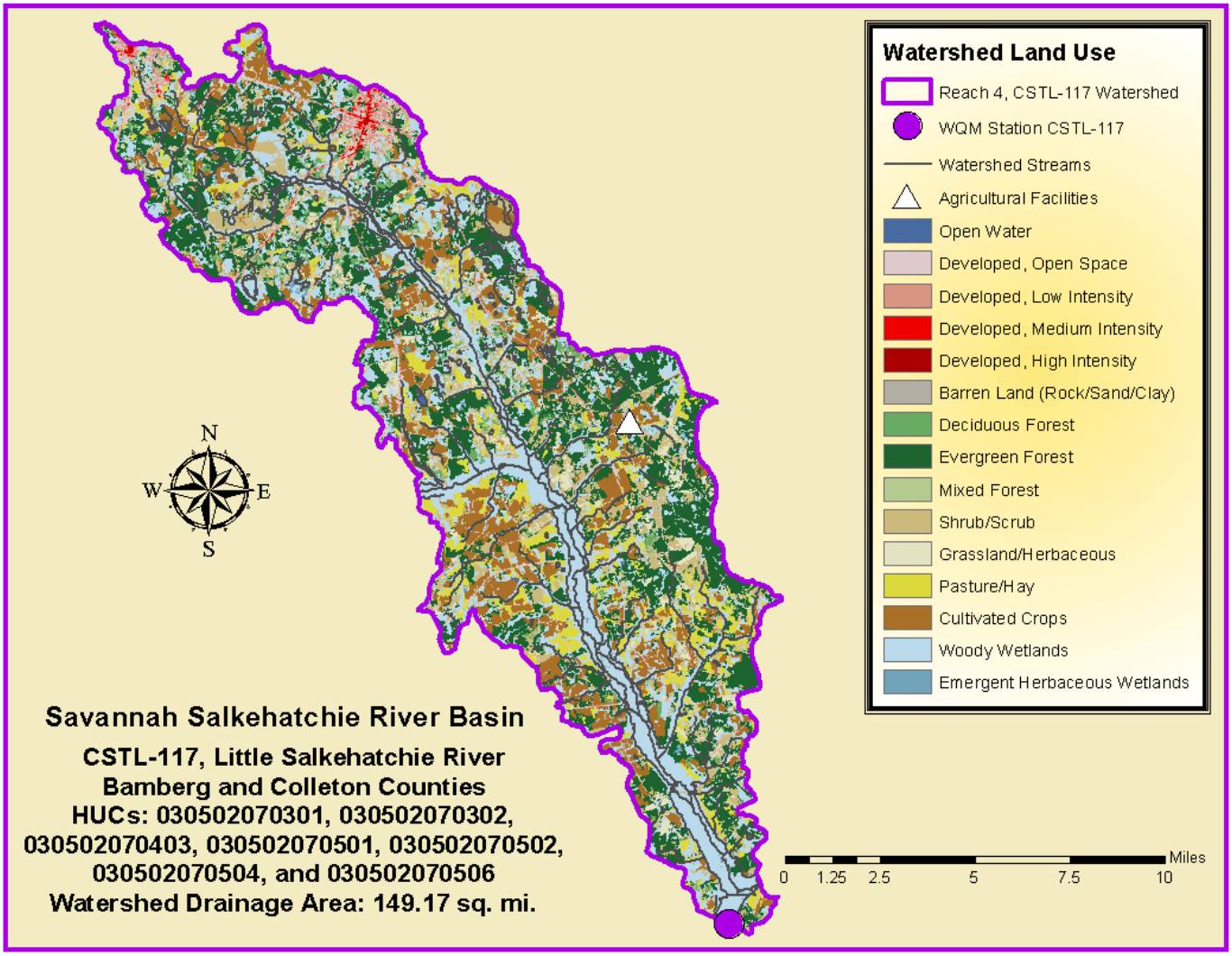


Table 2d. Little Salkehatchie River and Tributaries Watershed: Land Use in Reach 4 (WQM Station CSTL-117) (Derived from National Land Cover Database (NLCD) 2006)

Description	Area (Acres)	Area (Mile^2)	Percent
Woody Wetlands	27,528.59	43.00	28.83%
Evergreen Forest	24,721.09	38.62	25.89%
Cultivated Crops	12,645.54	19.75	13.24%
Shrub/Scrub	11,483.53	17.94	12.03%
Pasture/Hay	6733.42	10.52	7.05%
Developed, Open Space	3565.64	5.57	3.73%
Grassland/Herbaceous	3523.39	5.50	3.69%
Deciduous Forest	2007.55	3.14	2.10%
Developed, Low Intensity	1583.44	2.47	1.66%
Emergent Herbaceous Wetlands	658.51	1.03	0.69%
Mixed Forest	478.37	0.75	0.50%
Developed, Medium Intensity	272.65	0.43	0.29%
Open Water	172.58	0.27	0.18%
Barren Land (Rock/Sand/Clay)	66.72	0.10	0.07%
Developed, High Intensity	54.71	0.09	0.06%
Totals	**95,495.74**	**149.17**	**100.00%**

South Carolina's current water quality standard (WQS) for recreational use in freshwater is *E. coli* (R.61-68):

> "Not to exceed a geometric mean of 126/100 ml based on at least four samples collected from a given sampling site over a 30 day period, nor shall a single sample maximum exceed 349/100 ml (SCDHEC, 2012)."

Prior to February 28, 2013, South Carolina's WQS for recreational use in freshwaters was FC bacteria (R.61-68):

> "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 (SCDHEC 2008)."

Primary contact and secondary 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.

2.0 WATER QUALITY ASSESSMENT

In 1986, the USEPA documented that *E. coli* and *Enterococcus* bacteria are better indicators than FC bacteria group in predicting the presence of human gastroenteritis (upset stomach, nausea, diarrhea, vomiting) causing pathogenic bacteria in fresh waters. The USEPA study was based on data collected when swimmers were directly exposed in freshwater lakes with established public swimming areas. In almost all cases of water-borne illnesses, pathogens come from inadequately treated waste of humans or

other warm-blooded animals. Also, *Enterococcus* and *E. coli* are more specific to sewage and fecal sources than the FC bacteria group. In light of this information, USEPA has recommended the use of either *E. coli* or *Enterococcus* as the pathogen indicator for fresh waters.

In order to determine which pathogen indicator bacteria is better suited in South Carolina as the recreational use water quality standard in fresh waters, the SCDHEC designed a PIS and conducted the study during 2009. Weekly water samples were collected from 73 stations statewide and analyzed for *E. coli, Enterococcus* and for FC bacteria group. PIS results showed *E. coli* (a member of the FC bacteria group) is a better indicator for predicting the presence of pathogens in South Carolina freshwaters.

During 2012 and following the public participation, public comment period and legislative processes, the SDHEC submitted a proposed amendment to EPA to change the pathogen indicator from FC bacteria to *E. coli* in R. 61-68. Details of this process as well as PIS raw data can be found at: http://www.scdhec.gov/environment/water/fwater.htm. The proposed amendment was approved by EPA on February 28, 2013 and *E. coli* has been promulgated in R. 61-68. *E. coli* is the applicable water quality standard for recreational use in fresh waters. WQM Station RS-08076 was among the 73 stations where weekly samples were collected during the PIS in 2009.

Beginning with 2014 §303(d) list of impaired waters, sites included as impaired for recreational use FC bacteria on the 2012 §303(d) lists will be listed as impaired for *E. coli.* Once sufficient *E. coli* data are collected from impaired stations, future TMDLs will be calculated based on *E. coli* data. Until sufficient data are collected, TMDLs for currently FC impaired stations can be calculated using FC data. Then, these FC TMDLs can be converted to *E. coli* TMDLs by multiplying the FC TMDL number by 0.8725. A 0.8725 ratio was derived by dividing the current single sample maximum (SSM) WQS for *E. coli*, 349 MPN/100ml by former SSM WQS for FC bacteria, 400 cfu/100 ml.

The SCDHEC currently has several monitoring locations within the watersheds described earlier in this document. Four of the monitoring sites have been included in the State's 2012 §303(d) list for FC bacteria due to the exceedances of the previous WQS for pathogens in freshwaters (SCDHEC, 2012). Waters in which no more than 10% of the samples collected over a five year period are greater than 400 FC counts or cfu/100 ml are considered to comply with the South Carolina former freshwater FC bacteria recreational use WQS. Waters with more than 10% of samples greater than 400 cfu/100 ml are considered impaired for FC bacteria and were placed on South Carolina's §303(d) list[1]. These stations will be included on future §303(d) lists, beginning in 2014, due to exceedances of the current *E. coli* WQS until such time such time that sufficient *E. coli* data are collected and demonstrate the WQS is attained or such time that TMDLs are developed and approved to address the parameter of concern. As discussed previously, this TMDL documents addresses the development of TMDLs for three of these four impaired WQM stations in the LSRT Watershed based on FC samples (i.e., WQM stations CSTL-115, CSTL-119, and CSTL-117). This TMDL document also addresses the development of a TMDL for the fourth WQM station in the LSRT Watershed (i.e., WQM Station RS-08076) based on *E. coli* samples collected during the SCDHEC's 2009 PIS. Table 4 provides a summary of number of samples collected, number of exceedences and exceedence percentage.

Figure 4 illustrates precipitation and FC by data and date for WQM Station CSTL-117. The graph and Table 4 show that there is little or no correlation between the amount of precipitation and the temporal FC exceedences of water quality standards (r = -0.059). The graphs for precipitation and FC (or *E. coli* in the case of WQM Station RS-08076) by data and date for the other three WQM stations are shown in Appendix A. Table 4 and the graphs (in Appendix A) show that, for WQM stations CSTL-115, RS-08076, and CSTL-119, there is little or no correlation between the amount of precipitation and the temporal FC or *E. coli* exceedences of water quality standards.

[1] The frequency of sampling was fewer than five samples within a 30 day period; therefore the water quality assessment was based on the 10% FC bacteria standard (400/100 mL).

Table 4. FC and *E. coli* WQS Exceedence Summary for Impaired Stations (1999-2010)

Station	Waterbody	Number of Samples	Number of FC Samples >400/100mL	Number of *E. coli* Samples >349/100mL	% Samples Exceed WQS
CSTL-115	Little Salkehatchie River	125	12	---	10%
RS-08076	Buckhead Creek	47	---	8	17%
CSTL-119	Buckhead Creek	105	19	---	18%
CSTL-117	Little Salkkhatchie River	115	16	---	14%

Table 5. Correlations Between Rainfall and FC/E. coli in the Little Salkehatchie River and Tributaries Watersheds

Station	Waterbody	Correlation Coefficient (r)	Coefficient of Determination (r^2)
CSTL-115	Little Salkehatchie River	-0.059	0.003
RS-08076	Buckhead Creek	-0.086	0.007
CSTL-119	Buckhead Creel	-0.091	0.008
CSTL-115	Little Salkehatchie River	-0.104	0.011

3.0 SOURCE ASSESSMENT AND LOAD ALLOCATION

The SCDHEC has adopted a change of its pathogen indicator from FC bacteria to *E. coli* during 2012. The new WQS were approved by EPA on February 28, 2013. Starting with the effective date of February 28, 2013, *E. coli* is the new pathogen indicator for recreational use in freshwaters.

Even though there are tests for specific pathogens, it is difficult to determine beforehand which organism may be present, and test for those specific organisms. Indicators such as FC bacteria, enteroccoci, or *E. coli*, which are indicators for human pollution, are easier to measure, have similar sources as pathogens, and persist in surface waters for a similar or longer length of time (Tchobanoglous & Schroeder, 1987). These bacteria are not in themselves disease causing, but indicate the potential presence of organisms that may result in illness.

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 continuous point sources, such as factories and wastewater treatment facilities, has been greatly reduced. These point sources are required by the (CWA) to obtain a NPDES permit. In South Carolina NPDES permits require that dischargers of sanitary wastewater must meet the state standard for the relevant pathogen indicator at the point of discharge. Municipal and private sanitary wastewater treatment facilities may occasionally be sources of pathogens. However, if these facilities are discharging wastewater that meets their permit limits, they are not causing impairment. If any of these facilities is not meeting its permit limits, enforcement actions/mechanisms are required.

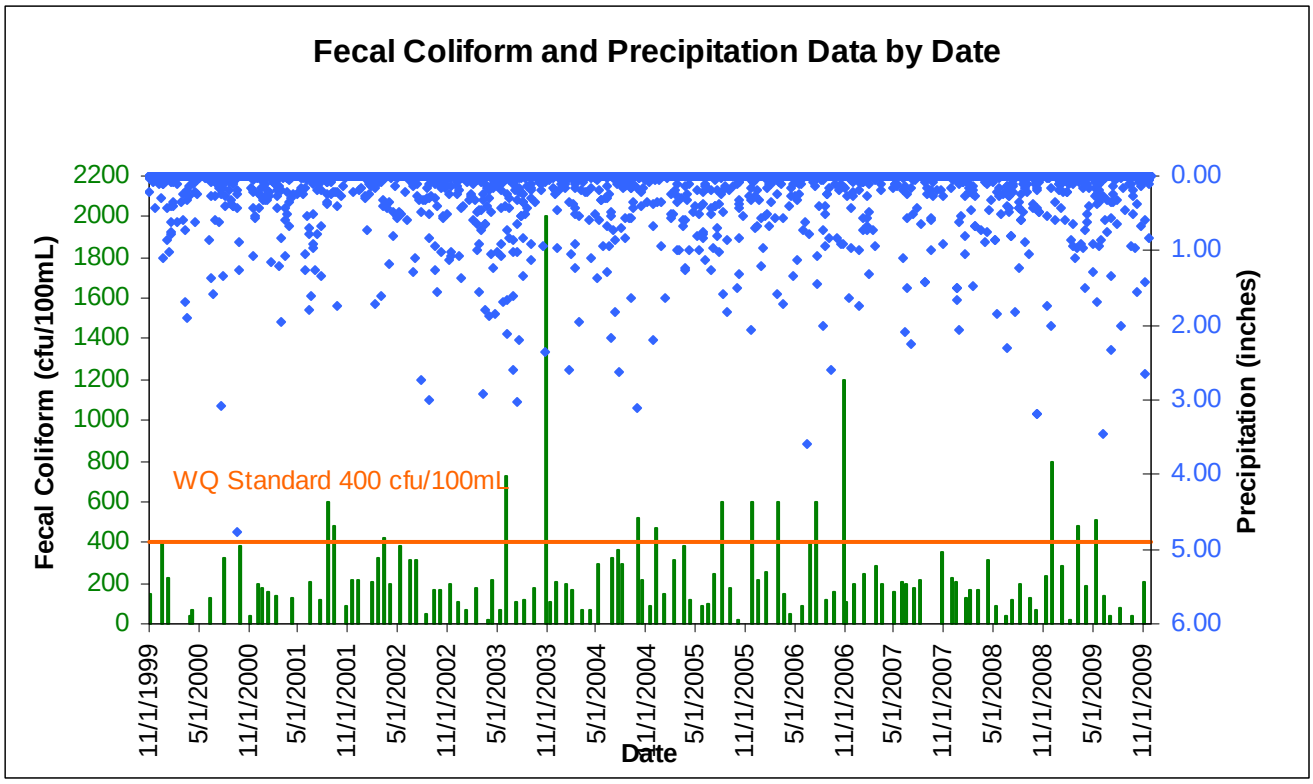
Other non-continuous point sources required to obtain NPDES permits that may be a source of pathogens include MS4s and stormwater discharges from construction or industrial sites. MS4s may require NPDES discharge permits for industrial and construction activities under the NPDES stormwater regulations. These sources are also required to comply with the state standard for the pollutant(s) of concern. If MS4s and discharges from construction sites meet the percentage reduction or the water quality standard as prescribed in Section 5 of this TMDL document and required in their MS4 permits, they should not be causing or contributing to an instream pathogen impairment.

3.1 Point Sources

Point sources are defined as pollutant loads discharged at a specific location from pipes, outfalls, and conveyance channels from either municipal wastewater treatment plants, industrial waste treatment

facilities, or regulated stormwater discharges. Point sources can also include pollutant loads contributed by tributaries to the main receiving water stream or river. Point sources can be further broken down into continuous and non-continuous.

Figure 4. Precipitation and FC Data by Date for Water Quality Monitoring Station CSTL-117



3.1.1 Continuous Point Sources

There are two (2) FC-bacteria related continuous point sources in the LSRT Watershed authorized under NPDES permits, one for FC and the other for *E. coli* (Figure 5 and Table 6). An NPDES permitted continuous point source for FC is located in Reach 1 of the LSRT Watershed (WQM Station CSTL-115); and, an NPDES permitted continuous point source for *E. coli* is located in Reach 2 of the watershed (WQM Station RS-08076). WQM Station CSTL-119 and WQM Station CSTL-117 are also located downstream of the *E. coli* continuous point source; and, WQM-117 is located downstream of the FC continuous point source. There are no NPDES permitted FC-bacteria related continuous point sources in Reach 3 and Reach 4 of the LSRT Watershed..

The City of Denmark has a domestic WWTP (wastewater treatment plant) located at the end of an unpaved approach road located about 0.8 miles south of the junction of E. Voorhees Road (S-5-15) and S. Honeyford Street (S-5-53) in Bamberg County. The facility is authorized under the SCDHEC's NPDES Permit No. SC0040215 to discharge to the Little Salkehatchie River (Figure 5 and Table 6). Under the terms and conditions of the permit, the facility has limitations on the discharge of FC, and is authorized to discharge a monthly average of up to 0.388 MGD. The permit had an expiration date of September 30, 2012; however, the permit continues in force since the SCDHEC received an application to renew the permit prior to the expiration date.

Ruffin High School has a domestic WWTP (wastewater treatment plant) located at off the junction of Smyly Road (S-15-67) and Patriot Lane (S-15-187), approximately three-fourth miles northeast of Ruffin in Colleton County. The facility is authorized under the SCDHEC's NPDES Permit No. SC0033766 to discharge to Buckhead Creek (Figure 5 and Table 6). Under the terms and conditions of the permit, the facility has

limitations on the discharge of *E. coli,* and is authorized to discharge a monthly average of up to 0.015 MGD. The permit will expire on September 30, 2018.

The NPDES-permitted continuous point source containing FC bacteria (i.e., Permit No. SC0040215) is also expected to contain *E. coli* bacteria. When the NPDES permit is reissued in the future, it may include *E. coli* limitations in lieu of FC bacteria limitations. For the purposes of developing these TMDLs, the source is considered a potential source for both pathogen indicators.

Figure 5. NPDES Permitted FC and *E. coli* Discharges in the Little Salkehatchie River and Tributaries Watershed

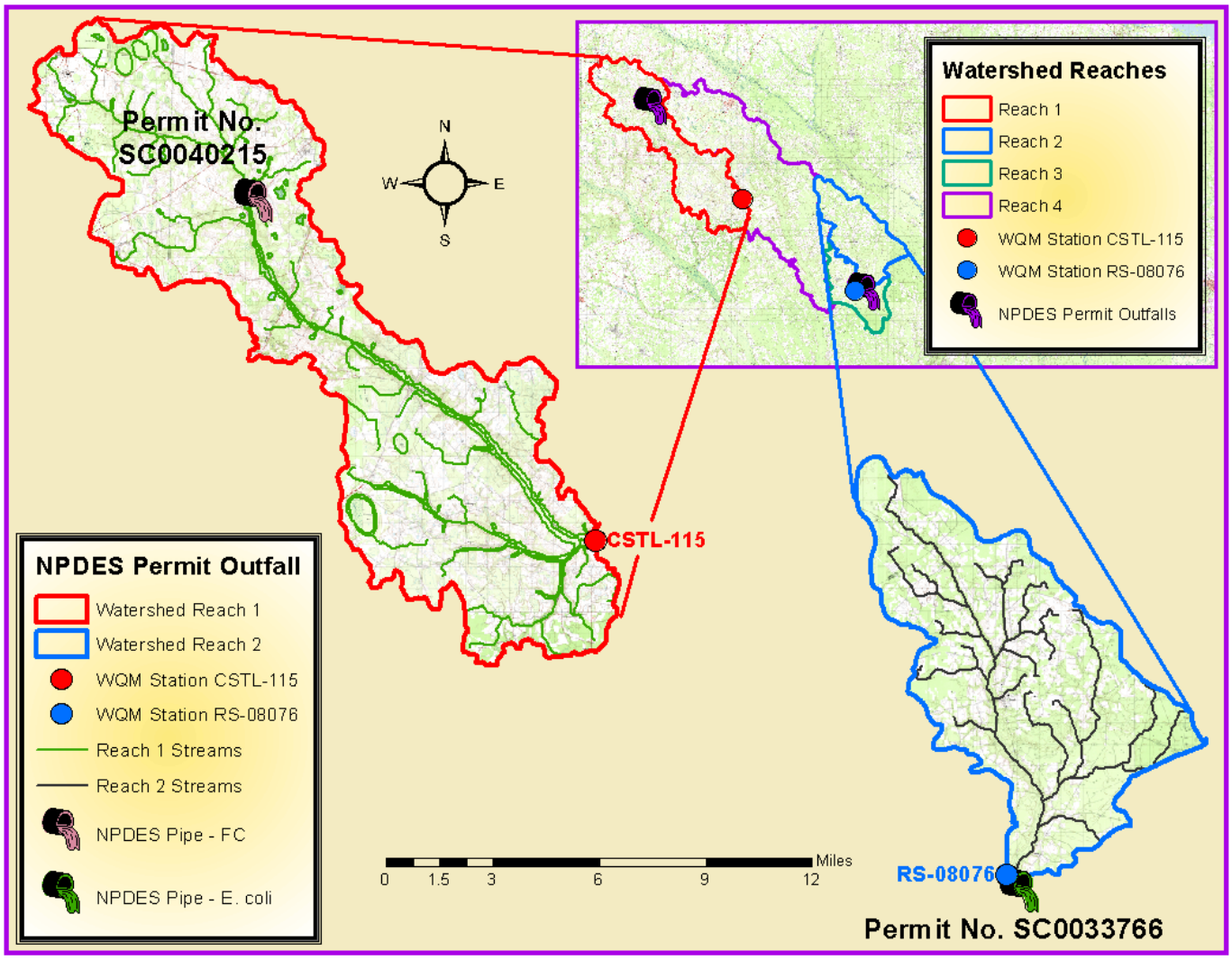


Table 6. NPDES Permitted FC and E. coli Discharges in the Little Salkehatchie River Watershed

Impaired Station Watershed	Permitted Facility	Permit Number	Permit Type	Permit Limitation (Constituent * Unit/Time)	Permitted Flow (MGD)	Outfall Stream
CSTL-115	City of Denmark	SC0040215	Minor	FC * 400 cfu/day	0.388	Little Salkehatchie River
RS-08076	Ruffin High School	SC0033766	Minor	*E. coli* * 349 MPN/day	0.015	Bulkhead Creek

Future NPDES-permitted discharges of *E.coli* and other FC bacteria in the LSRT Watershed are required to implement the WLAs and demonstrate consistency with the assumptions and requirements of the TMDLs in this document.

3.1.2 Non-Continuous Point Sources

Non-continuous point sources include all NPDES-permitted stormwater discharges, including current and future MS4s, construction and industrial discharges covered under permits numbered SCS and SCR and/or regulated under South Carolina Water Pollution Control Permits: R61-9, §122.26(b)(4),(7),(14) - (21) (SCDHEC, 2011). All regulated MS4 entities have the potential to contribute *E. coli* and other FC bacteria pollutant loadings in the delineated drainage area used in the development of this TMDL.

The SCDOT operates the only regulated MS4 in the LSRT Watershed. The SCDOT is a large MS4 operator, and operates under the SCDHEC's NPDES MS4 Permit SCS040001. The SCDOT owns and operates roads within all of the LSRT Watershed reaches (Figure 6 and Table 7). However, the SCDHEC recognizes that the SCDOT is not a traditional MS4 in that it does not possess statutory taxing or has enforcement powers. SCDOT does not regulate land use or zoning, issue building or development permits.

Figure 6. SCDOT Owned and Maintained Roads in the Little Salkehatchie River and Tributaries Watershed

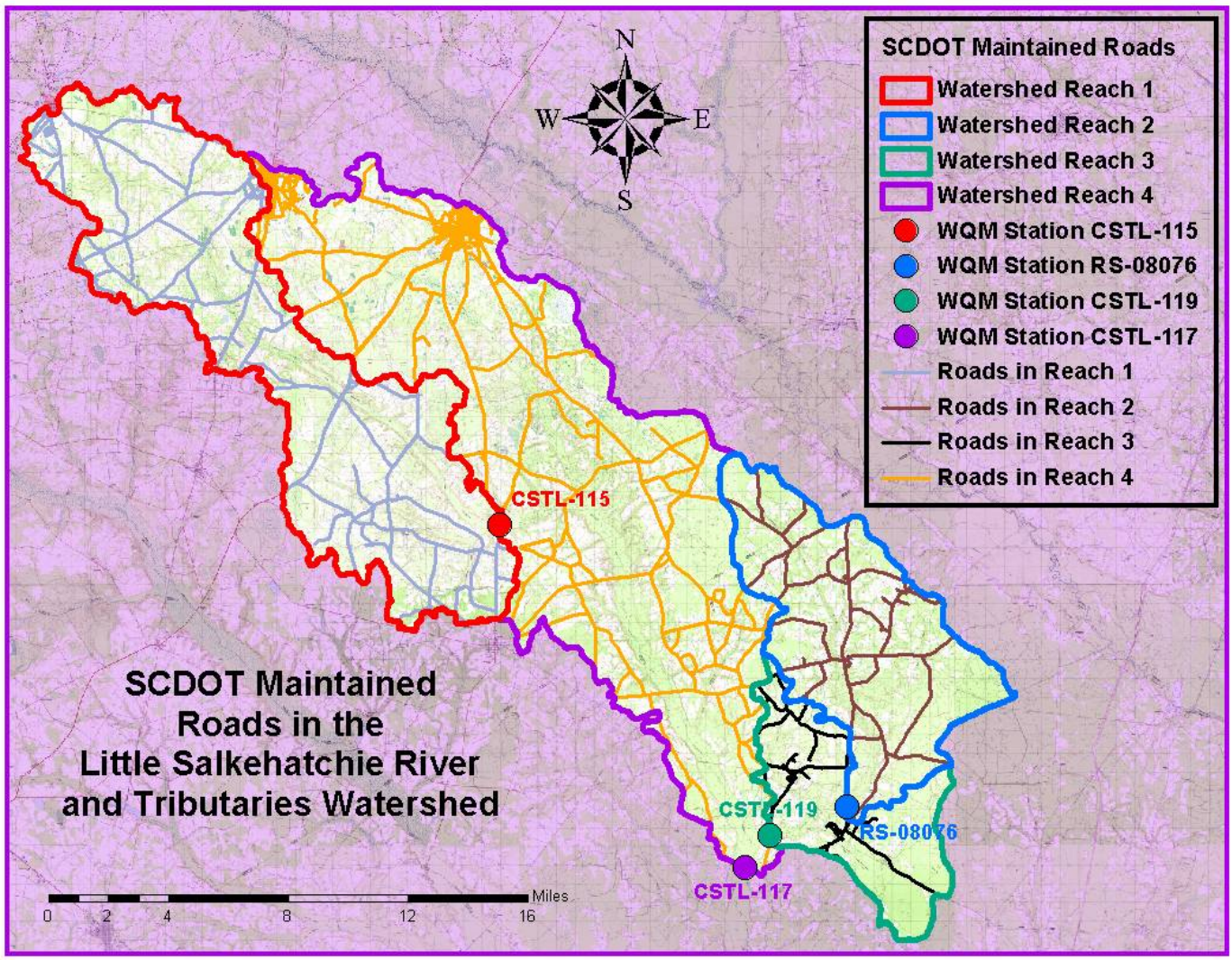


Table 7. SCDOT Maintained Road Miles in the Little Salkehatchie River and Tributaries Watershed

Watershed Reach	Station	Road Miles
Watershed Reach 1	CSTL-115	138.1
Watershed Reach 2	RS-08076	61.8
Watershed Reach 3	CSTL-119	33.6
Watershed Reach 4	CSTL-117	240.1
Total Miles in the LSRT Watershed:		473.6

Current developed land use for reaches in the LSRT Watershed range from 3.96% to 5.73% (Table 3). Based on current Geographic Information System (GIS) information (available at time of TMDL development) there is one SCDOT facility located in the LSRT Watershed. The SCDOT facility is located in Reach 4 of the watershed at 462 South Main Street in the City of Bamberg, in Bamberg County. And, based on information provided on the SCDOT website, there are no highway rest areas in the watershed areas.

Small MS4s that discharge stormwater in urbanized areas, as designated by the U.S. Bureau of Census, are regulated under South Carolina *Water Pollution Control Permits* Regulation 122.26(b)(16) and 122.32. At the time of the development of these TMDLs, there were no regulated small MS4 discharges in the LSRT Watershed.

Other than the above-mentioned MS4 owned and/or operated storm sewer system, there are currently no permitted stormwater systems that discharge in these watersheds. Future permitted sanitary sewer or stormwater systems in the referenced watersheds will be required to comply with the load reductions prescribed in the WLA and demonstrate consistency with the assumptions and requirements of these TMDLs.

Industrial facilities that have the potential to cause or contribute to a violation of a water quality standard are covered by the NPDES Storm Water Industrial General Permit (SCR000000). Construction activities are usually covered by the NPDES Stormwater Construction General Permit from the SCDHEC (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 waste load allocations in the TMDLs. Note that there may be other stormwater discharges not covered under permits numbered SCS and SCR that occur in the referenced watersheds. These activities are not subject to the WLA portion of the TMDLs.

Similar to regulated MS4s, potentially designated MS4 entities (as listed in 64 FR, 235, P.68837) or other unregulated MS4 communities located in the aforementioned watershed and surrounding watersheds may have the potential to contribute *E. coli* and other FC bacteria in stormwater runoff. These unregulated entities are subject to the LA for the purposes of these TMDLs.

Sanitary sewer overflows (SSOs) to surface waters have the potential to severely impact water quality. These untreated sanitary discharges result in violations of the WQS. It is the responsibility of the NPDES wastewater discharger, or collection system operator for non-permitted 'collection only' systems, to ensure that releases do not occur. Unfortunately releases to surface waters from SSOs are not always preventable or reported. Currently, a small area of the northwestern portion of Reach 1 (WQM Station CSTL-115) of the LSRT Watershed is serviced the City of Blackville sewer lines; and, a small area of the northeastern portion of the reach is serviced by the City of Denmark sewer lines. However, the vast majority of Reach 1 is not serviced by a community collection system. A small area of the northwestern portion of Reach 4 (WQM Station CSTL-117) is serviced the City of Demark sewer lines; and, a small area of the northeastern portion of the reach is serviced by the City of Bamberg sewer lines. However, the vast majority of Reach 4 is not

serviced by a community collection system. No portions of Reach 2 (WQM Station RS-08076) or Reach 3 (WQM Station CSTL-119) are serviced by a community collection system.

The Department acknowledges that progress with the assumptions and requirements of the TMDLs by MS4s is expected to take one or more permit iteration. Progress towards achieving the WLA reduction for the TMDLs may constitute MS4 compliance with its SWMP, provided the MEP definition is met, even where the numeric percent reduction may not be achieved in the interim.

3.2 Nonpoint Sources

Nonpoint source pollution is defined as pollution that is not released through pipes but rather originates from multiple sources over a relatively large area. Nonpoint sources can be divided into source activities related either to land or water use including failing septic tanks, improper animal-keeping practices, agriculture, forestry practices, wildlife and urban and rural runoff.

The Department recognizes that there may be wildlife, agricultural activities, grazing animals, septic tanks, and/or other nonpoint source contributors located within unregulated areas (outside of NPDES permitted area) of the Little Salkehatchie River and tributaries watersheds. Nonpoint sources located in unregulated areas are subject to the load allocation (LA) and not the WLA of the TMDL document.

Pathogenic forms of *E. coli,* found in the guts of ruminant animals such as cattle, goats, sheep, deer and elk, produce toxins and are called "Shiga toxin-producing" *E. coli* or STEC. Of these ruminant animals, cattle are the major source for human illnesses. STEC infections start with ingestion of human or animal feces, contact with cattle, unpasteurized apple cider, soft cheeses made from raw milk, consumption of contaminated unpasteurized raw milk and water (CDC, n.d.).

3.2.1 Wildlife

Resident and migrant wildlife (mammals and birds) can be a significant contributor of *E. coli* and other FC 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. The upper 19% of Reach 1 (i.e., the drainage area draining through WQM Station CSTL-115) of the LSRT Watershed lie in Barnwell County, and the bottom 81% of the reach lie in Bamberg County (Figure 2). According to a study conducted by the SCDNR in 2008, there are an estimated 30 deer per square mile in the Barnwell County portion of Reach 1; and, there are more than 45 deer per square mile in the Bamberg County portion of the reach (SCDNR 2008).

The upper 12% of Reach 2 (i.e., the drainage area draining through WQM Station RS-08076) of the LSRT Watershed lie in Bamberg County, and the bottom 88% of the reach lie in Colleton County (Figure 2). According to the SCDNR 2008 study, there are an estimated 30-45 deer per square mile in both portions of the reach in Bamberg and Colleton Counties (SCDNR 2008).

Reach 3 of the LSRT Watershed (i.e., the drainage area draining through WQM Station CSTL-119) lie in Colleton County (Figure 2). According to the SCDNR 2008 study, there are more than 45 deer per square mile in the western one-fourth of the reach; and, there are 30-45 deer per square mile in the eastern three-fourths of the reach (SCDNR 2008).

The upper 83% of Reach 4 (i.e., the drainage area draining through WQM Station CSTL-117) of the LSRT Watershed lie in Bamberg County, and the bottom 17% of the reach lie in Colleton County (Figure 2). According to the SCDNR 2008 study, there are an estimated 30-45 deer per square mile in the top two-thirds of the reach in Bamberg County; and, there are more than 45 deer per square mile in the bottom third of the reach in Bamberg County. Also, according to the SCDNR 2008 study, there are more than 45 deer per square mile in the Colleton County portion of Reach 4 (SCDNR 2008).

The SCDNR's 2008 study estimated deer density based on suitable habitat (forests, croplands, and pastures). The FC production rate for deer has been shown to be 347 x 10^6 cfu/head-day in a study conducted by Yagow (1999), of which only a portion will enter the Little Salkehatchie River and tributaries watersheds. Wildlife may contribute a significant portion of the overall *E. coli* and other FC bacteria load within the watersheds.

3.2.2 Agricultural Activities

Agricultural activities that involve livestock or animal wastes are potential sources of pathogen contamination of surface waters. Fecal matter can enter the waterway via runoff from the land or by direct deposition into the stream. Unstabilized soil directly adjacent to surface waters can contribute to pollutant loading during periods of runoff after rain events. During these events, fertilizer and wildlife wastes can be transported into the creek and carried downstream. Agricultural activities may represent a contributing source in the LSRT Watershed where agricultural activities constitute a greater portion of the land use.

3.2.2.1 Agricultural Animal Facilities

Owners/operators of most commercial animal growing operations are required by South Carolina Regulation 61-43, *Standards for the Permitting of Agricultural Animal Facilities*, to obtain permits for the handling, storage, treatment (if necessary) and disposal of the manure, litter and dead animals generated at their facilities (SCDHEC, 2002). The requirements of R. 61-43 are designed to protect water quality; therefore, we have a reasonable assurance that facilities operating in compliance with this regulation should not contribute to downstream water quality impairments. South Carolina currently does not have any confined animal feeding operations (CAFOs) under NPDES coverage; however, the State does have permitted animal feeding operations (AFOs) covered under R. 61-43. These permitted operations are not allowed to discharge to waters of the State and are covered under 'no discharge' (ND) permits. Discharges from these operations to waters of the State are illegal and are subject to enforcement actions by the SCDHEC.

At the time of the development of these TMDLs, there were ten (10) active AFOs with regulated structures or activities in the LSRT Watershed (Figure 3, and Table 8). These facilities consist of five (5) dairy facilities, three (3) poultry facilities, one swine facility, and a composting facility. Eight (8) of the AFOs are located in Reach 1 of the LSRT Watershed (terminal WQM station CSTL-115) (Figures 3 and 3a); one of the AFOs is located in Reach 3 of the watershed (terminal WQM station CSTL-119) (Figures 3 and 3c); and, one of the AFO's is located in Reach 4 of the watershed (terminal WQM Station CSTL-117) (Figures 3 and 3d). The three poultry operations are considered according to Section 122.23 of SC Regulation 61-9, *Water Pollution Control Permits*. There may also be land application sites associated with these facilities.

Table 8. Active Animal Feeding Operations with Regulated Structures or Activities Within the Little Salkehatchie River and Tributaries Watershed

Downstream Impaired Station	AFO Permit	Facility	Type of Livestock	Number of Permitted Animals
CSTL-115	ND0007153	Aden Diem Dairy Farm	Dairy	200
CSTL-115	ND0015571	Heatwole Farms, Inc.	Dairy	350
CSTL-115	ND0081418	Humble Acres Breeder Farm	Poultry (Breeders)	40,700
CSTL-115	ND0087238	Humble Acres Farm	Quality Compost	---
CSTL-115	ND0083101	Meadow View Cattle, Inc.	Dairy	300
CSTL-115	ND0006696	Platt Dairy	Dairy	100
CSTL-115	ND0082406	Sassafras Dairy Farm	Dairy	150
CSTL-115	ND0085227	Vintage Acres, LLC	Poultry (Breeders)	75,000
CSTL-119	ND0070556	Bill Farish Broiler Facility	Poultry (Breeders)	28,600
CSTL-117	ND0066214	Rentz Swine Facility #1 and #2	Swine	250

These facilities are routinely inspected for compliance. Permitted agricultural facilities that operate in compliance with their permit are not considered to be sources of impairment.

3.2.2.2 Grazing Animals

Livestock, especially cattle, are frequently major contributors of FC bacteria or *E. coli* to streams. Cattle on average produce some 1.0E+11 cfu/day per animal of FC bacteria (ASAE 1998). Grazing cattle and other livestock may contaminate streams with FC bacteria or *E. coli* indirectly by runoff from pastures or directly by defecating into streams and ponds. Direct loading by cattle or other livestock to surface waters within the LSRT Watershed is likely to be a contributing source of *E. coli* and other FC bacteria. However, the grazing of unconfined livestock (in pastures) is not regulated by the SCDHEC.

The United States Department of Agriculture's (USDA) National Agricultural Statistics Service reported 4587, 7486 and 4546 cattle and calves in Barnwell, Bamberg, and Colleton Counties, respectively, in 2007 (USDA 2009). According to the NLCD 2006, there are 17,759.49, 16,912.17, and 32,289.16 acres of pastureland in Barnwell, Bamberg, and Colleton Counties, respectively. This relates to 0.26, 0.44 and 0.14 cattle per acre of pastureland in Barnwell, Bamberg, and Colleton Counties, respectively, assuming an even distribution of cattle across pastureland in the counties. Table 9 shows the number of acres of pastureland and, based on this acreage, an estimate of the number of cattle in the LSRT Watershed. And, based on the number of cattle, the table shows an average of cfu/day of FC bacteria produced by cattle in the watershed. Based on the table, an estimated 1897 cattle and calves within Reach 1 of the LRST Watershed (terminal WQM Station CSTL-115) combine to produce an average of 1.90E+14 cfu/day of FC bacteria; an estimated 316 cattle and calves within Reach 2 of the watershed (terminal WQM Station RS-08076) combine to produce an average of 3.16E+13 cfu/day of FC bacteria; an estimated 96 cattle and calves within Reach 3 of the watershed (terminal WQM Station CSTL-119) combine to produce an average of 9.60E+12 cfu/day of FC bacteria; and, an estimated 2502 cattle and calves within Reach 4 of the watershed (terminal WQM Station CSTL-117) combine to produce an average of 2.50E+14 cfu/day of FC bacteria.

Table 9. Cattle FC per Day in the Little Salkehatchie River and Tributaries Watershed

Downstream Impaired Station	County	Pasture Area (Acre) per Watershed	Cattle per Watershed	Cattle Fecal Coliform, cfu/day
CSTL-115	Barnwell	769.97	200	2.00E+13
	Bamberg	3855.86	1697	1.70E+14
RS-08076	Bamberg	65.38	28	2.80E+12
	Colleton	2058.93	288	2.88E+13
CSTL-119	Colleton	685.86	96	9.60E+12
CSTL-117	Bamberg	5198.62	228	2.29E+14
	Colleton	1529.83	214	2.14E+13

3.2.3 Land Application of Industrial, Domestic Sludge or Treated Wastewater

NPDES-permitted industrial and domestic wastewater treatment processes may generate solid waste bi-products, also know as sludge. In some cases, facilities may be permitted to land apply sludge at designated locations and under specific conditions. There are also some NPDES-permitted facilities authorized to land apply treated effluent at designated locations and under specific conditions. Land application permits for industrial and domestic wastewater facilities may be covered under SC Regulation 61-9, Sections 503, 504, or 505. It is recognized that there may be operating, regulated land application sites located in the LSRT Watershed. If properly managed, waste is applied at a rate that ensures pollutants will be incorporated into the soil or plants and pollutants will not enter streams. Land applications sites can be a source of pathogen loadings and stream impairment if not properly managed. Similar to AFO land application sites, the permitted land application sites described in this section are not allowed to directly

discharge to LSRT Watershed. Direct discharges from land applications sites to surface waters of the State are illegal and are subject to enforcement actions by SCDHEC.

3.2.4 Leaking Sanitary Sewers and Illicit Discharges

Leaking sewer pipes and illicit sewer connections represent a direct threat to public health since they result in discharge of partially treated or untreated human wastes to the surrounding environment. Quantifying these sources is extremely speculative without direct monitoring of the source because the magnitude is directly proportional to the volume and its proximity to the surface water.

Illicit sewer connections into storm drains result in direct discharges of sewage via the storm drainage system outfalls. Monitoring of storm drain outfalls during dry weather is needed to document the presence or absence of sewage in the drainage systems. Besides the SCDOT, there are currently no entities subject to an NPDES MS4 permit within or with impact to the LSRT Watershed.

3.2.5 Failing Septic Systems

Failing, leaking or non-conforming septic systems, however, can be a major contributor of *E. coli* and other FC bacteria to the LSRT Watershed. Wastes from failing septic systems enter surface waters either as direct overland flow or via groundwater. Although loading to streams from failing septic systems is likely to be a continual source, wet weather events can increase the rate of transport of pollutants from failing septic systems because of the wash-off effect from runoff and the increased rate of groundwater recharge.

3.2.5.1. Septic Systems in Reach 1 of the Little Salkehatchie River and Tributaries Watershed (WQM Station CSTL-115)

According to GIS information, sewer lines for the City of Blackville extend into the northwestern portion of the 62,935.49-acre Reach 1 of the LSRT Watershed; and, sewer lines for the City of Denmark extend into the northeastern portion of the reach. Based on current GIS information, 2013 USDA aerial photography of the watershed, and based on the 2010 U.S. population census, there are 970 households within the reach not served by the City of Blackville sewer system, the City of Denmark sewer system, or any other community sewer system. Therefore, assuming one septic tank per household, it is estimated that there are approximately 970 septic tanks within the reach. This translates into 0.015 septic tanks per watershed acre. At the time of the development of these TMDLs, their status in relation to function was unknown.

3.2.5.2. Septic Systems in Reach 2 of the Little Salkehatchie River and Tributaries Watershed (WQM Station RS-08076)

According to GIS information, there are no community sewer systems serving Reach 2 of the LSRT Watershed. Based on current GIS information, 2013 USDA aerial photography of the watershed, and based on the 2010 U.S. population census, there are 600 households within the 33,378.66-acre reach. Therefore, assuming one septic tank per household, it is estimated that there are approximately 600 septic tanks within the reach. This translates into 0.018 septic tanks per watershed acre. At the time of the development of these TMDLs, their status in relation to function was unknown.

3.2.5.3. Septic Systems in Reach 3 of the Little Salkehatchie River and Tributaries Watershed (WQM Station CSTL-119)

According to GIS information, there are no community sewer systems serving Reach 3 of the LSRT Watershed. Based on current GIS information, 2013 USDA aerial photography of the watershed, and based on the 2010 U.S. population census, there are 292 households within the 17,287.79-acre reach. Therefore, assuming one septic tank per household, it is estimated that there are approximately 292 septic tanks within the reach. This translates into 0.017 septic tanks per watershed acre. At the time of the development of these TMDLs, their status in relation to function was unknown.

3.2.5.4. Septic Systems in Reach 4 of the Little Salkehatchie River and Tributaries Watershed (WQM Station CSTL-117)

According to GIS information, sewer lines for the City of Denmark extend into the northwestern portion of the 95,495.74-acre Reach 4 of the LSRT Watershed; and, sewer lines for the City of Bamberg extend into the northeastern portion of the reach. Based on current GIS information, 2013 USDA aerial photography of the watershed, and based on the 2010 U.S. population census, there are 1693 households within the reach not served by the City of Denmark sewer system, the City of Bamberg sewer system, or any other community sewer system. Therefore, assuming one septic tank per household, it is estimated that there are approximately 1693 septic tanks within the reach. This translates into 0.018 septic tanks per watershed acre. At the time of the development of these TMDLs, their status in relation to function was unknown.

3.2.6 Urban and Suburban Runoff

Dogs, cats, and other domesticated pets are the primary source of *E. coli* and other FC bacteria deposited on the urban landscape. There are also 'urban' wildlife, squirrels, raccoons, pigeons, and other birds, all of which contribute to the FC bacteria or *E. coli* load. Based on current GIS information, nine (9) incorporated areas lie with the LSRT Watershed (Figure 2). However, urban runoff is considered to be negligible within the watershed.

Incorporated areas of the cities and towns of Blackville, Hilda, Denmark, Govan, and Ehrhardt lie within the 62,935.49-acre Reach 1 of the LSRT Watershed (Figure 2). According to GIS information, approximately 26.28% of the incorporated area of Blackville (approximately 1555.89 acres) lies in the northwestern portion of the reach. Approximately 19.83% of the incorporated area of Denmark (approximately 386.23 acres) lies in the northeastern portion of the reach. Approximately 58.92% of the incorporated area of Hilda (approximately 1161.19 acres) lies in the western portion of the reach. Approximately 3.78% of the incorporated area of Govan (approximately 17.91 acres) lies in the western portion of the reach. And, approximately 7.14% of the incorporated area of Ehrhardt (approximately 147.73 acres) lies in the western portion of the reach. Therefore, total incorporated area in the reach (approximately 3264.95 acres) only compromises 5.19% of the reach.

The Town of Smoaks is the only incorporated area in the 33,378.66-acre Reach 2 of the LSRT Watershed (Figure 2). According to GIS information, the entire area of the town (approximately 1034.86 acres) lies in the central portion of the reach. Therefore, total incorporated area in the reach only compromises 3.10% of the reach.

The Town of Williams is the only incorporated area in the 17,287.79-acre Reach 3 of the LSRT Watershed (Figure 2). According to GIS information, the entire area of the town (approximately 494.15 acres) lies in the northwestern portion of the reach. Therefore, total incorporated area in the reach only compromises 2.86% of the reach.

Incorporated areas of the cities and towns of Denmark, Bamberg, Ehrhardt, and Lodge lie within the 95,495.74-acre Reach 4 of the LSRT Watershed (Figure 2). According to GIS information, approximately 60.69% of the incorporated area of Denmark (approximately 1181.91 acres) lies in the northwestern portion of the reach. Approximately 80.49% of the incorporated area of Bamberg (approximately 1798.69 acres) lies in the northeastern portion of the reach. Approximately 10.19% of the incorporated area of Ehrhardt (approximately 205.33 acres) lies in the southwestern portion of the reach. And, approximately 19.22% of the incorporated area of Lodge (approximately 383.65 acres) lies in the southwestern portion of the reach. Therefore, total incorporated area in the reach (approximately 3569.98 acres) only compromises 3.74% of the reach.

Similar to regulated MS4s, potentially designated MS4 entities (as listed in FR 64, 235, p.68837) or other unregulated MS4 communities located in the LSRT Watershed may have the potential to contribute pollutant loadings in stormwater runoff. Only approximately 5% of the watershed is developed, therefore there is potential for growth.

4.0 LOAD-DURATION CURVE METHOD

The load-duration curve method was developed as a means of incorporating natural variability, uncertainty, and risk assessment into TMDL development (Bonta and Cleland 2003). The analysis is based on the range of hydrologic conditions for which there are appropriate water quality data. The load-duration curve method uses the cumulative frequency distribution of stream flow and pollutant concentration data to estimate existing and 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. Two (2) United States Geological Survey (USGS) gages were used for estimating "real-time" flow data for the Little Salkehatchie River and tributaries TMDLs, based primarily on the size of the drainage area to the downstream gage, and secondarily on the general land use in the drainage area. The USGS gage used for estimating flow data for Reach 1, Reach 2, and Reach 3 of the LSRT Watershed (WQM Stations CSTL-115, RS-08076, and CSTL-119) was the Black Creek gage near McBee, SC (Gage Number: 02130900). This gage has a drainage area of 108 square miles, and began recording daily flows in 1959 and provides the flow data required to establish flow duration curves for these three impaired stations. The USGS gage used for estimating flow data for Reach 4 of the watershed (WQM Station CSTL-117) was the Salkehatchie River gage near Miley, SC (Gage Number: 02175500). This gage has a drainage area of 341 square miles, and began recording daily flows in 1951 and provides the flow data required to establish the flow duration curve for this impaired station.

For example, flow data for an 12-year period (January 1, 1999 to December 31, 2010) from the USGS Miley, SC gage was used to establish flow duration curve for Reach 4 of the LSRT Watershed (WQM Station CSTL-117). The records for this period were complete (i.e., no missing dates). The drainage area of the sampling station was delineated using USGS topographic maps using ArcMap software. The cumulative area drained was calculated and used to estimate flow based on the ratio of the monitoring station drainage area to the downstream USGS gage. For example, the Miley, SC gage records flow from 341 square miles (sq mi). The cumulative drainage area for the Reach 4 of the LSRT Watershed at WQM Station CSTL-117 (in the Little Salkehatchie River at SC 64 in Colleton County) is approximately 326.63 sq mi, or 95.8% of the area drained at the Miley, SC gage. Mean daily flow for the CSTL-117 monitoring location was assumed to be 95.8% of the daily flow at the Miley, SC gage. Figure 2 provides an illustration of monitoring and gage locations along with a summary of drainage area statistics used to establish flows at un-gaged monitoring stations.

Flow duration curves were developed by ranking flows from highest to lowest and calculating the probability of occurrence (presented as a percentage or duration interval), where zero corresponds to the highest flow. The duration interval can be used to determine the percentage of time a given flow is achieved or exceeded, based on the period of record. The flow duration curves were divided into five hydrologic condition categories (High Flows, Moist Conditions, Mid-Range, Dry Conditions and Low Flows). Categorizing flow conditions can assist in determining which hydrologic conditions result in the greatest number of exceedences. A high number of exceedences under dry conditions might indicate a point source or illicit connection issue, whereas moist conditions may indicate nonpoint sources. Data within the High Flow and Low Flow categories are generally not used in the development of a TMDL due to their infrequency.

For those WQM stations impaired due to FC (i.e., stations CSTL-115, CSTL-119, and CSTL-117), target load-duration curves were created by calculating the allowable load using daily flow, former FC WQS concentration and a unit conversion factor. The water quality target was set at 380 cfu/100ml for the instantaneous criterion, which is five percent lower than the former water quality criterion of 400 cfu/100ml. A five percent explicit Margin of Safety (MOS) was reserved from the water quality criteria in developing target load-duration curves. The load-duration curve for station CSTL-117 is presented in Figure 7 as an example. The load-duration curves for stations CSTL-115 and CSTL-119 are presented in Appendix B.

Because SC has recently adopted a change from FC bacteria to *Escherichia coli (E. coli)* bacteria as a recreational use standard in all freshwaters, this TMDL document also includes converted *E. coli* TMDLs for stations CSTL-115, CSTL-119, and CSTL-117, for purposes of implementation of the current recreational use standard. For these calculations, the daily flow and a unit conversion factor were used and the water quality target was set at 332 MPN/100ml for the instantaneous criterion, which is five percent lower than the water quality criteria of 349 MPN/100ml. A five percent explicit Margin of Safety (MOS) was reserved from the water quality criteria in developing target load-duration curves.

Target loads in freshwaters impaired for *E. coli* may alternatively be calculated as the ratio of *E.coli* MPN/100 ml to FC bacteria cfu/100 ml or (349/400=0.8725). This conversion is derived from an established relationship between FC bacteria and *E. coli* WQS in freshwaters determined during the SCDHEC's 2009 PIS.

At the time of TMDL development, there were no *E. coli* data available to consider for determining percent reductions necessary to meet the calculated TMDLs for WQM Stations CSTL-115, CSTL-119, and CSTL-117. Therefore, all percent reductions recommended in this document for these three impaired stations are based on existing FC bacteria data. For the purposes of establishing these three TMDLs, FC bacteria percent reductions should also be representative of reductions necessary to meet the *E. coli* WQS.

However, due to the SCDHEC's 2009 PIS, *E. coli* data was available to consider for determining percent reductions necessary to meet the calculated TMDL for WQM Station RS-08076. Therefore, a target load-duration curve was created by calculating the allowable load using daily flow, *E. coli* WQS concentration and a unit conversion factor. The water quality target was set at 332 cfu/100ml for the instantaneous criterion, which is five percent lower than the water quality criterion of 349 cfu/100ml. A five percent explicit Margin of Safety (MOS) was reserved from the water quality criteria in developing the target load-duration curve. The load-duration curve for WQM Station RS-08076 is also presented in Appendix B.

For the curves for WQM Stations CSTL-115, CSTL-119, and CSTL-117, including Figure 7, the independent variable (X-Axis) represents the percentage of estimated flows greater than value x. The dependent variable (Y-Axis) represents the FC loading at each estimated flow expressed in terms of colony forming units per day (cfu/day). In each of the defined flow intervals for these three stations, existing and target loadings were calculated by the following equations:

Existing Load = Mid-Point Flow in Each Hydrologic Category x 90th Percentile FC Concentration x 10000

Target Load = Mid-Point Flow in Each Hydrologic Category x 380 (WQ criterion minus a 5% MOS) x 10000

Percent Reduction = (Existing Load – Target Load) / Existing Load

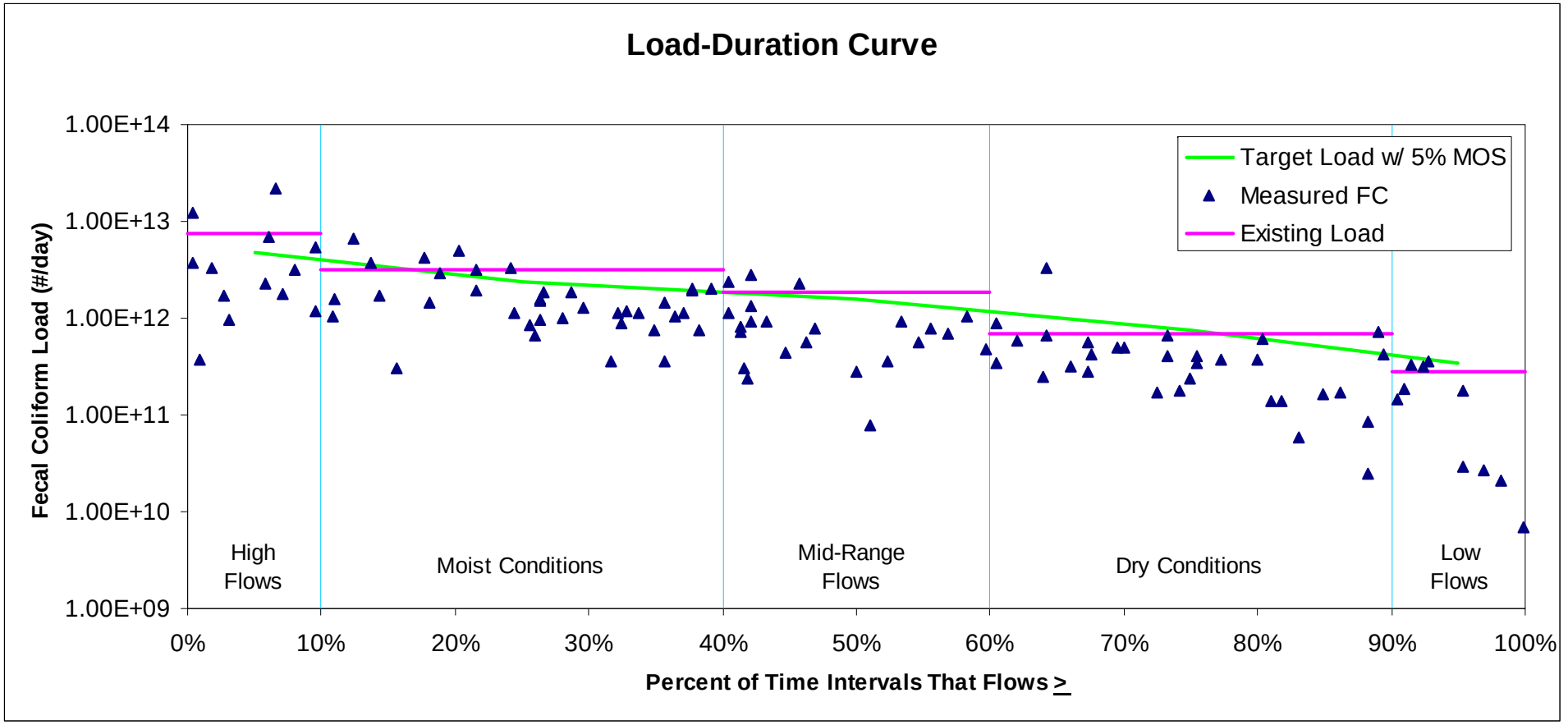
For the curve for WQM Station RS-08076, the independent variable (X-Axis) represents the percentage of estimated flows greater than value x. The dependent variable (Y-Axis) represents the *E. coli* loading at each estimated flow expressed in terms of most probable number per day (MPN/day). In each of the defined flow intervals for this station, existing and target loadings were calculated by the following equations:

Existing Load = Mid-Point Flow in Each Hydrologic Category x 90th Percentile E. coli Concentration x 10000

Target Load = Mid-Point Flow in Each Hydrologic Category x 332 (WQ criterion minus a 5% MOS) x 10000

Percent Reduction = (Existing Load – Target Load) / Existing Load

Figure 7. Load Duration Curve for Reach 4 of the Little Salkehatchie River and Tributaries Watershed, Water Quality Monitoring Station CSTL-117



Instantaneous loads for each of the impaired stations were calculated. Available measured FC concentrations from 1999 through 2010 (for WQM Stations CSTL-115, CSTL-119, and CSTL-117), and measured *E. coli* concentrations from 2009 (for WQM Station RS-08076 during the SCDHEC's PIS) were multiplied by measured (or estimated flow based on drainage area) flow on the day of sampling and a unit conversion factor. These data were plotted on the load-duration graph based on the flow duration interval for the day of sampling. Samples above the target line are violations of the WQS while samples below the line are in compliance (Figure 7 and Appendix B).

An existing load was determined for each hydrologic category for the TMDL calculations. The 90th percentile of measured FC or *E. coli* concentrations within each hydrologic category were multiplied by the flow at each category midpoint (i.e., flow at the 25% duration interval for the Moist Conditions, 50% interval for Mid-Range, and 75% for Dry Condition). Existing loads are plotted on the load-duration curves presented in Figure 7 and Appendix B. TMDL targets in this document are based on the SSM criterion because the value is more representative of a daily maximum as compared to a geometric mean calculated over a 30-day period. In addition, this load duration approach is not an appropriate methodology for calculating load reductions required to meet the geometric mean criterion. The effectiveness of implementing the load reductions prescribed in this TMDL document will be based on achieving both components of the WQS over time.

Existing loads are plotted on the load-duration curves presented in Appendix B as well as the example for station CSTL-117 in Figure 7. These values were compared to the target load (which includes an explicit 5% MOS) at each hydrologic category midpoint to determine the percent load reduction necessary to achieve compliance with the WQS. This TMDL assumes that if the highest percent reduction is achieved than the WQS will be attained under all flow conditions.

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 waste load 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:

$$TMDL = \sum WLAs + \sum LAs + MOS$$

The TMDL is the total amount of pollutant that can be assimilated by the receiving water body while still achieving compliance with WQS. 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 (#), colony forming units (cfu), organism counts (or resulting concentration), or MPN, in accordance with 40 CFR 130.2(l).

5.1 Critical Conditions

These TMDLs are based on the flow recurrence interval between 10% and 90% and excludes extreme high and low flow conditions; flows that are characterized as 'Low' or 'High' in Figure 7 were not included in the analysis. The critical condition for each monitoring station is identified as the flow condition requiring the largest percent reduction, within the 10-90% duration intervals. Critical conditions for the Little Salkehatchie River and tributaries watersheds pathogen impaired segments are listed in Table 10. This data indicates that for WQM Station CSTL-115, dry conditions result in larger bacteria loads and is therefore the critical condition for that station. The following flow conditions result in larger bacteria loads, and is therefore the critical conditions, for

the other three WQM stations in the LSRT Watershed: **a)** mid-range conditions for RS-08076; **b)** moist conditions for CSTL-119; and, **c)** moist conditions for CSTL-117.

Table 10. Percent Reduction Necessary to Achieve Target Load by Hydrologic Category

Station	Waterbody	Moist Conditions	Mid-Range Flow	Dry Conditions
CSTL-115	Little Salkehatchie River	3	NRN	18
RS-08076	Buckhead Creek	22	48	NRN
CSTL-119	Buckhead Creek	49	32	16
CSTL-117	Little Salkehatchie River	23	15	NRN

Highlighted cells indicate critical condition
NRN = no reduction needed. Existing load below target load

5.2 Existing Load

An existing load was determined for each hydrologic category for the TMDL calculations as described in Section 4.0 of this TMDL document. The existing load under the critical condition, described in Section 5.1 above was used in the TMDL calculations. Loadings from all sources are included in this value: cattle-in-streams, failing septic systems as well as wildlife. The existing load for WQM Stations CSTL-115, RS-08076, CSTL-119, and CSTL-117 are provided in Appendix D.

5.3 Waste load Allocation

The waste load allocation (WLA) is the portion of the TMDL allocated to NPDES-permitted point sources (USEPA 1991). Note that all illicit dischargers, including SSOs, are illegal and not covered under the WLA of these TMDLs.

5.3.1 Continuous Point Sources

There are two (2) active permitted domestic dischargers discharging pathogen indicator bacteria in the LSRT Watershed (Figure 5). The first permitted domestic discharger is City of Denmark, which is discharging in Reach 1 of the watershed. The city is permitted under the SCDHEC's NPDES Permit No. SC0040215 to discharge FC from a domestic WWTP into the Little Salkehatchie River. To determine the WLA for the city, the average monthly design flow for the city's WWTP was multiplied by an allowable permitted maximum concentration of 400 cfu/100mL and a unit conversion factor. The WLA for the city, based on a permitted daily maximum of 400 cfu/100 ml, is presented in Table 11. The WLA for the city is 5.87 billion colony forming units per day (7.19+E09 cfu/day) based on an average design flow of 0.388 MGD, until such time that *E. coli* limits are incorporated into Permit No. SC0040215. *E. coli* limits will be developed based upon permitted flow and an allowable permitted maximum *E. coli* concentration of 349 MPN/100ml.

Table 11. Average Monthly Permitted Flow, FC Bacteria and *E. coli* WLAs for the NPDES Wastewater Discharges in the Little Salkehatchie River and Tributaries Watersheds

Impaired Station Watershed	Permitted Facility	Permit Number	Permitted Flow (MGD)	WLA FC (cfu/day)	WLA *E. coli* (MPN/day)
CSTl-115, CSTL-117	City of Denmark	SC0040215	0.388[1]	5.87E+09	---
RS-08076, CSTL-119, CSTL-117	Ruffin High School	SC0033766	0.015[2]	---	1.98E+08

1. Based on facility average design flow.
2. Based on facility average design flow.

Ruffin High School in the Community of Ruffin is the other permitted domestic discharger discharging pathogen indicator bacteria in the LSRT Watershed. The school is permitted under the SCDHEC's NPDES Permit No. SC0033766 to discharge *E. coli* from its WWTP into Buckhead Creek in Reach 2 of the LSRT Watershed. To determine the WLA for the school, the average monthly design flow for the school's WWTP was multiplied by an allowable permitted maximum concentration of 349 MPN/100mL and a unit conversion factor. The WLA for the school is 1.98 million counts per day (1.98+E07 MPN/day) based on an average design flow of 0.015 MGD (Table 11).

Because South Carolina has recently adopted a change from FC bacteria to *E. coli* bacteria as a recreational use standard in all freshwaters, future continuous discharges are required to meet the prescribed loading for *E. coli* based on permitted flow and assuming an allowable permitted maximum concentration of 349MPN/100mL.

5.3.2 Non Continuous Point Sources

Non-continuous point sources include all NPDES-permitted stormwater discharges, including current and future MS4s, construction and industrial stormwater discharges covered under permits numbered SCS & SCR and regulated under SC *Water Pollution Control Permits* R61-9, §122.26(b)(4),(7),(14)-(21) (SCDHEC, 2011) Illicit discharges, including SSOs, are not covered under any NPDES permit and are subject to enforcement mechanisms. All areas defined as "Urbanized Area" by the US Census are required under the NPDES Phase II Stormwater Regulations to obtain a permit for the discharge of stormwater. At the time of the development of these TMDLs, there were no urbanized areas in the LSRT Watershed. Other non-urbanized areas may be required under the NPDES Phase II Stormwater Regulations to obtain a permit for the discharge of stormwater.

Waste load allocations for 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. All current and future stormwater discharges are required to meet the percentage reduction or the existing instream standard for the pollutant of concern. The percent reduction is based on the maximum percent reduction (critical condition) within any hydrologic category necessary to achieve target conditions. Table 12 presents the reduction needed for each impaired segment. The reduction percentages in these TMDLs also apply to the FC or *E. coli* waste load attributable to those areas of the watershed that are covered or will be covered under NPDES MS4 permits.

Table 12. Percent Reduction Necessary to Achieve Target Load

Station	Waterbody	% Reduction
CSTL-115	Little Salkehatchie River	18
RS-08076	Buckhead Creek	48
CSTL-119	Buckhead Creek	49
CSTL-117	Little Salkehatchie River	23

Compliance by an entity with responsibility for the MS4, with the terms of its individual MS4 permit may fulfill any obligations it has towards implementing these TMDLs. As appropriate information is made available to further define the pollutant contributions for the permitted MS4, an effort can be made to revise these TMDLs. This effort will be initiated as resources permit and if deemed appropriate by the Department. For the Department to revise these TMDLs the following information should be provided, but not limited to:

1. An inventory of service boundaries of the MS4 covered in the MS4 permit, provided as ARCGIS compatible shape files.
2. An inventory of all existing and planned stormwater discharge points, conveyances, and drainage areas for the discharge points, provided as ARCGIS compatible shape files. If drainage areas are not

known, any information that would help estimate the drainage areas should be provided. The percentage of impervious surface within the MS4 area should also be provided.

3. Appropriate and relevant data should be provided to calculate individual pollutant contributions for the MS4 permitted entities. At a minimum, this information should include precipitation, water quality, and flow data for stormwater discharge points.

Compliance with terms and conditions of existing and future NPDES sanitary and stormwater permits (including all construction, industrial and MS4) will effectively implement the WLA and demonstrate consistency with the assumptions and requirements of the TMDLs. However, the Department recognizes that the SCDOT is not a traditional MS4 in that it does not possess statutory taxing or enforcement powers. The SCDOT does not regulate land use of zoning, issue building or development permits.

5.4 Load Allocation

The Load Allocation applies to the nonpoint sources of FC and *E. coli* bacteria and is expressed both as a load and as a percent reduction. The load allocation is calculated as the difference between the target load under the critical condition and the point source WLA. The load allocation is listed in Table 13. There may be other unregulated MS4s located in the Little Salkehatchie River and tributaries watersheds that are subject to the LA components of these TMDLs. At such time that the referenced entities, or other future unregulated entities become regulated NPDES MS4 entities and are subject to applicable provisions of SC Regulation 61-68D, they will be required to meet load reductions prescribed in the WLA component of the TMDLs. This also applies to future discharges associated with industrial and construction activities that will be subject to R61-9 §122.26(b)(4),(7),(14) - (21) (SCDHEC, 2011).

5.5 Seasonal Variability

Federal regulations require that TMDLs take into account the seasonal variability in watershed loading. The variability in these TMDLs is accounted for by using a 10-year hydrological and water quality sampling data set.

5.6 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, in the case of FC TMDLs, 20 counts/100mL of the instantaneous criterion of 400 cfu/100 mL (380 cfu/100mL); and, in the case of *E. coli* TMDLs, 17 counts/100mL of the instantaneous criterion of 349 MPN/100 mL (332 MPN/100mL).. Target loads are therefore 95% of the assimilative capacity (TMDL) of the waterbody. The MOS is expressed as the value calculated from the critical condition defined in Section 5.1 and is the difference between the TMDL and the sum of the WLA and LA.

A 5% MOS in freshwaters impaired for *E. coli* may be calculated as the ratio of *E.coli* MPN/100 ml to FC bacteria cfu/100 ml or 20*0.8725 = 17 MPN/100 ml of the instantaneous *E. coli* criterion of 349 MPN/100 ml (332 MPn/100 ml). This conversion is deemed appropriate by the Department and derived from an established relationship between FC bacteria and *E. coli* WQS in freshwaters determined during the 2009 PIS.

5.7 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). Only the instantaneous water quality criterion was targeted for the Little Salkehatchie River and tributaries watersheds because there is insufficient data to evaluate against the 30-day geometric mean. The target load is defined as the load (from point and nonpoint sources) minus the MOS that a stream segment can receive while meeting the WQS. The TMDL value is the median target load within the critical condition (i.e., the middle value within the hydrologic category that requires the greatest load reduction) plus WLA and MOS.

While TMDL development was primarily based on instantaneous water quality criterion, terms and conditions of NPDES permits for continuous discharges require facilities to demonstrate compliance with both geometric

Table 13. Total Maximum Daily Loads for the Little Salkehatchie River and Tributaries Watersheds
Loads are expressed as FC bacteria or *E. coli* count/day

	Existing Load (count/day)		TMDL (count/day)		Margin of Safety (MOS) (count/day)		Waste Load Allocation (WLA)				Load Allocation (LA)		
							Continuous Source[3] (count/day)		Non-Continuous Sources[4,5] (%Reduction)	Non-Continuous SCDOT[5] (%Reduction)	Load Allocation (count/day)		% Reduction to Meet LA[5]
Station	FC (cfu /day)[1]	*E. coli* (MPN/day)[2]	FC (cfu /day)	*E. coli* (MPN/day)[8]	FC (cfu /day)	*E. coli* (MPN/day)[8]	FC (cfu/day)	*E. coli* (MPN/day)[8]	(Percent)	(Percent)	FC (cfu/day)	*E. coli* (MPN/day)[8]	(Percent)
CSTL-115	4.47E+11	---	3.92E+11	*3.42E+11*	1.96E+10	*1.67E+10*	5.87E+09	*5.13E+09*	18	0[6]	3.66E+11	*3.20E+11*	18
RS-08076	---	*6.35E+11*	---	*3.46E+11*	---	*1.69E+10*	---	*1.98E+08*	48	0[6]	---	*3.27E+11*	48
CSTL-119	1.80E+12	---	9.75E+11	*8.51E+11*	4.88E+10	*4.15E+10*	See Note Below	See Note Below	49	0[6]	9.27E+11	*8.10E+11*	49
CSTL-117	3.10E+12	---	2.50E+12	*2.18E+12*	1.25E+11	*1.06E+11*	See Note Below	See Note Below	23	23[7]	2.38E+12	*2.08E+12*	23

Table Notes:

1. Existing FC bacteria loads were based on observed FC bacteria concentrations and stream flows during critical flow conditions. FC bacteria samples were collected as part of the Department's ambient water quality monitoring program.
2. Existing *E. coli* loads were based on observed *E. coli* concentrations and stream flows during critical flow conditions. *E. coli* samples were collected during the Department's 2009 Pathogen Indicator Study in freshwaters.
3. WLAs are expressed as a daily maximum. Existing and future continuous discharges are required to meet the prescribed loading for the pollutant of concern. For the purposes of NPDES permitting, continuous discharges may be required to meet a loading equivalent of FC bacteria, based upon permitted flow and an allowable permitted maximum FC bacteria concentration of 400 cfu/100ml, until such time that *E. coli* limits are incorporated into individual permits. *E. coli* limits will be developed based upon permitted flow and an allowable permitted maximum *E. coli* concentration of 349 MPN/100ml.
4. Percent reduction applies to all NPDES-permitted stormwater discharges, including current and future municipal separate storm sewer system (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 in accordance with their NPDES Permit.
5. Percent reduction applies to existing instream FC bacteria or *E. coli.*
6. As long as the conditions within the SCDOT MS4 area remain the same the Department deem the current contributions from SCDOT negligible and no reduction of FC bacteria or *E. coli* is necessary. SCDOT must continue to comply with the provisions of its approved NPDES stormwater permit.
7. By implementing the best management practices that are prescribed in either the SCDOT annual SWMP or the SCDOT MS4 Permit to address fecal coliform or *E. coli,* the SCDOT will comply with these TMDLs and its applicable WLA to the maximum extent practicable (MEP) as required by its MS4 permit.
8. Expressed as *E. coli* (MPN/day). Loadings are developed by applying a conversion factor to values calculated for FC bacteria. This conversion is derived from an established relationship between FC bacteria and *E. coli* water quality standards in freshwaters.

mean and instantaneous water quality criteria for FC bacteria in treated effluent. NPDES permits for continuous dischargers require data collection sufficient to monitor for compliance of both criteria at the point of outfall.

Table 13 indicates the percentage reduction or water quality standard required for each subwatershed in the Little Salkehatchie River and tributaries watersheds (WQM Station). Note that all future regulated NPDES-permitted stormwater discharges will also be required to meet the prescribed percentage reductions, or the water quality standard. It should be noted that in order to meet the WQS for FC bacteria or *E. coli* prescribed load reductions must be targeted from all sources, including NPDES permitted and nonpoint sources.

Based on the available information at this time, the portions of the Little Salkehatchie River and tributaries watersheds that drain directly to a regulated MS4 and that drain through the unregulated MS4 has not been clearly defined within the MS4 jurisdictional area. Loading from both types of sources (regulated and unregulated) typically occurs in response to rainfall events, and discharge volumes as well as recurrence intervals are largely unknown. Therefore, the regulated MS4 is assigned the same percent reduction as the non-regulated sources in the watershed. Compliance with the MS4 permit in regards to this TMDL document is determined at the point of discharge to waters of the state. The regulated MS4 entity is only responsible for implementing the TMDL WLA in accordance with their MS4 permit requirements and is not responsible for reducing loads prescribed as LA in this TMDL document.

6.0 IMPLEMENTATION

The implementation of both point (WLA) and non-point (LA) source components of the TMDLs are necessary to bring about the required reductions in FC bacteria or *E. coli* loading to the Little Salkehatchie River and tributaries in order to achieve water quality standards. Using existing authorities and mechanisms, an implementation plan providing information on how point and non point sources of pollution are being abated or may be abated in order to meet water quality standards is provided. Sections 6.1.1-6.1.7 presented below correspond with sections 3.1.1-3.2.5 of the source assessment presented in the TMDL document. As the implementation strategy progresses, the SCDHEC will continue to monitor the effectiveness of implementation measures and evaluate water quality where deemed appropriate.

Point sources are discernible, confined, and discrete conveyances of pollutants to a water body including but not limited to pipes, outfalls, channels, tunnels, conduits, man-made ditches, etc. The Clean Water Act's primary point source control program is the National Pollutant Discharge Elimination System (NPDES). Point sources can be broken down into continuous and non-continuous point sources. Some examples of a continuous point source are wastewater treatment facilities (WWTF) and industrial facilities. Non-continuous point sources are related to stormwater and include MS4, construction activities, etc. Current and future NPDES discharges in the referenced watersheds are required to comply with the load reductions prescribed in the waste load allocation (WLA).

Nonpoint source pollution originates from multiple sources over a relatively large area. It is diffuse in nature and indistinct from other sources of pollution. It is generally caused by the pickup and transport of pollutants from rainfall moving over and through the ground. Nonpoint sources of pollution may include, but are not limited to: wildlife, agricultural activities, illicit discharges, failing septic systems, and urban runoff. Nonpoint sources located in unregulated portions of the LSRT Watershed are subject to the load allocation (LA) and not the WLA of the TMDL document.

South Carolina has several tools available for implementing the non-point source components of these TMDLs. The *Implementation Plan for Achieving Total Maximum Daily Load Reductions From Nonpoint Sources for the State of South Carolina* (SCDHEC 1998) document is one example. Another key component for interested parties to control pollution and prevent water quality degradation in the LSRT Watershed would be the establishment and administration of a program of BMPs. BMPs may be defined as a practice or a combination

of practices that have been determined to be the most effective, practical means used in the prevention and/or reduction of pollution.

Interested parties (local stakeholder groups, universities, local governments, etc.) may be eligible to apply for CWA §319 grants to install BMPs that will implement the LA portions of these TMDLs and reduce nonpoint source FC bacteria or *E. coli* loading to Little Salkehatchie River and tributaries. Congress amended the Clean Water Act (CWA) in 1987 to establish the Section 319 Nonpoint Source Management Program. Under Section 319, States receive grant money to support a wide variety of activities including the restoration of impaired waters. TMDL implementation projects are given highest priority for 319 funding. CWA §319 grants are not available for implementation of the WLA component of this TMDL but may be available for the LA component within permitted MS4 jurisdictional boundaries.. Additional resources are provided in Section 7.0 of this TMDL document.

The SCDHEC will also work with the existing agencies in the area to provide nonpoint source education in the Little Salkehatchie River and tributaries watersheds. Local sources of nonpoint source education and assistance include the Natural Resource Conservation Service (NRCS), the Barnwell, Bamberg, and Colleton County Soil and Water Conservation Services, the Clemson University Cooperative Extension Service, and the South Carolina Department of Natural Resources..

The Department recognizes that **adaptive management/implementation** of these TMDLs might be needed to achieve the water quality standard and we are committed towards targeting the load reductions to improve water quality in the LSRT Watershed As additional data and/or information become available, it may become necessary to revise and/or modify the TMDL targets accordingly.

6.1 Implementation Strategies

The strategies presented in this document for implementation of the referenced TMDLs are not inclusive and are to be used only as guidance. The strategies are informational suggestions that may lead to the required load reductions being met for the referenced watersheds while demonstrating consistency with the assumptions and requirements of the TMDLs. Application of certain strategies provided within may be voluntary and are not a substitute for actual NPDES permit conditions.

6.1.1 Continuous Point Sources

Continuous point source WLA reductions will be implemented through NPDES permits. Existing and future continuous discharges are required to meet the prescribed loading for the pollutant of concern and demonstrate consistency with the assumptions and requirements of the TMDLs. FC Loadings are developed based upon permitted flow and assume an allowable permitted maximum concentration of 400 cfu/100ml. *E. coli* loadings are developed based upon permitted flow and an allowable permitted maximum *E. coli* concentration of 349 MPN/100ml.

6.1.2 Non-Continuous Point Sources

An iterative BMP approach as defined in the general stormwater NPDES MS4 permit is expected to provide significant implementation of the WLA. Permit requirements for implementing WLAs in approved TMDLs will vary across waterbodies, discharges, and pollutant(s) of concern. The allocations within a TMDL can take many different forms – narrative, numeric, specific BMPs – and may be complimented by other special requirements such as monitoring.

The level of monitoring necessary, deployment of structural and non-structural BMPs, evaluation of BMP performance, and optimization or revisions to the existing pollutant reduction goals of the SWMP or any other plan is TMDL and watershed specific. Hence, it is expected that NPDES permit holders evaluate their existing SWMP or other plans in a manner that would effectively address implementation of these TMDLs with an acceptable schedule and activities for their permit compliance. The Department staff (permit writers, TMDL project managers, and compliance staff) is willing to assist in developing or updating the referenced plan as deemed necessary. Please see Appendix C which provides additional information as it relates to evaluating

the effectiveness of an MS4 Permit as it related to compliance with approved TMDLs. For the SCDOT and future NPDES MS4 permittees, compliance with terms and conditions of its NPDES permit is effective implementation of the WLA to the Maximum Extent Practicable (MEP) and demonstrates consistency with the assumptions and requirements of the TMDLs. For existing and future NPDES construction and Industrial stormwater permittees, compliance with terms and conditions of its permit is effective implementation of the WLA. Required load reductions in the LA portion of this TMDL can be implemented through voluntary measures and are eligible for CWA §319 grants.

The Department acknowledges that progress with the assumptions and requirements of the TMDLs by MS4s is expected to take one or more permit iteration. Achieving the WLA reduction for the TMDLs may constitute MS4 compliance with its SWMP, provided the MEP definition is met, even where the numeric percent reduction may not be achieved in the interim.

Regulated MS4 entities are required to develop a SWMP that includes the following: public education, public involvement, illicit discharge detection & elimination, construction site runoff control, post construction runoff control, and pollution prevention/good housekeeping. These measures are not exhaustive and may include additional criterion depending on the type of NPDES MS4 permit that applies. The following examples are recognized as acceptable stormwater practices and may be applied to unregulated MS4 entities or other interested parties in the development of a stormwater management plan.

An informed and knowledgeable community is crucial to the success of a stormwater management plan (USEPA, 2005). MS4 entities may implement a public education program to distribute educational materials to the community, or conduct equivalent outreach activities about the impacts of stormwater discharges on local waterbodies and the steps that can be taken to reduce stormwater pollution. Some appropriate BMPs may be brochures, educational programs, storm drain stenciling, stormwater hotlines, tributary signage, and alternative information sources such as web sites, bumper stickers, etc (USEPA, 2005).

The public can provide valuable input and assistance to a stormwater management program and they may have the potential to play an active role in both the development and implementation of the stormwater program where deemed appropriate by the entity. There are a variety of practices that can involve public participation such as public meetings/citizens panels, volunteer water quality monitoring, volunteer educators, community clean-ups, citizen watch groups, and “Adopt a Storm Drain” programs which encourage individuals or groups to keep storm drains free of debris and monitor what is entering local waterways through storm drains (USEPA, 2005).

Illicit discharge detection and elimination efforts are also necessary. Discharges from MS4s often include wastes and wastewater from non-stormwater sources. These discharges enter the system through either direct connections or indirect connections. The result is untreated discharges that contribute high levels of pollutants, including heavy metals, toxics, oil and grease, solvents, nutrients, viruses, and bacteria to receiving waterbodies (USEPA, 2005). Pollutant levels from these illicit discharges have been shown in EPA studies to be high enough to significantly degrade receiving water quality and threaten aquatic, wildlife, and human health. MS4 entities may have a storm sewer system map which shows the location of all outfalls and to which waters of the US they discharge for instance. If not already in place, an ordinance prohibiting non-stormwater discharges into a MS4 with appropriate enforcement procedures may also be developed. Entities may also have a plan for detecting and addressing non-stormwater discharges. The plan may include locating problem areas through infrared photography, finding the sources through dye testing, removal/correction of illicit connections, and documenting the actions taken to illustrate that progress is being made to eliminate illicit connections and discharges.

A program might also be developed to reduce pollutants in stormwater runoff to the MS4 area from construction activities. An ordinance or other regulatory mechanism may exist requiring the implementation of proper erosion and sediment controls on applicable construction sites. Site plans should be reviewed for projects that consider potential water quality impacts. It is recommended that site inspections should be conducted and control measures enforced where applicable. A procedure might also exist for considering information submitted by the public (USEPA, 2005). For information on specific BMPs please refer to the SCDHEC

Stormwater Management BMP Handbook online at: http://www.scdhec.com/environment/ocrm/pubs/docs/SW/BMP_Handbook/Erosion_prevention.pdf

Post-construction stormwater management in areas undergoing new development or redevelopment is recommended because runoff from these areas has been shown to significantly affect receiving waterbodies. Many studies indicate that prior planning and design for the minimization of pollutants in post-construction stormwater discharges is the most cost-effective approach to stormwater quality management (USEPA, 2005). Strategies might be developed to include a combination of structural and/or non-structural BMPs. An ordinance or other regulatory mechanism may also exist requiring the implementation of post-construction runoff controls and ensuring their long term-operation and maintenance. Examples of non-structural BMPs are planning procedures and site-based BMPs (minimization of imperviousness and maximization of open space). Structural BMPs may include but are not limited to stormwater retention/detention BMPs, infiltration BMPs (dry wells, porous pavement, etc.), and vegetative BMPs (grassy swales, filter strips, rain gardens, artificial wetlands, etc.).

Pollution prevention/good housekeeping is also a key element of stormwater management programs. Generally this requires the MS4 entity to examine and alter their programs or activities to ensure reductions in pollution are occurring. It is recommended that a plan be developed to prevent or reduce pollutant runoff from municipal operations into the storm sewer system and it is encouraged to include employee training on how to incorporate and document pollution prevention/good housekeeping techniques. To minimize duplication of effort and conserve resources, the MS4 operator can use training materials that are available from EPA or relevant organizations (USEPA, 2005).

MS4 communities are encouraged to utilize partnerships when developing and implementing a stormwater management program. Watershed associations, educational organizations, and state, county, and city governments are all examples of possible partners with resources that can be shared. For additional information on partnerships contact the SCDHEC Watershed Manager for the waterbody of concern online at: http://www.scdhec.gov/environment/water/shed/contact.htm For additional information on stormwater discharges associated with MS4 entities please see the SCDHEC's NPDES web page online at http://www.scdhec.gov/environment/water/swnpdes.htm as well as the USEPA NPDES website online at http://cfpub.epa.gov/npdes/home.cfm?program_id=6 for information pertaining to the National Menu of BMPs, Urban BMP Performance Tool, Outreach Documents, etc.

6.1.3 Wildlife

Suggested forms of implementation for wildlife will vary widely due to geographic location and species. There are many forms of acceptable wildlife BMPs in practice and development at the present time. For example, contiguous forested areas could be set up and managed to keep wildlife from bedding down and defecating near surface waters. This management practice relies on concentrating wildlife away from water bodies to minimize their impact to pollutant loading. Additionally, contributions from wildlife could be reduced in protected areas by developing a management plan which would allow hunting access during certain seasons. Although this strategy might not work in all situations, it would decrease FC bacteria or *E. coli* loading from wildlife in areas where wildlife may be a significant contributor to the overall watershed. The LSRT Watershed is 75.26 percent forest or otherwise vegetated (non-cultivated). On January 16, 17, and 23, 2014, the SCDHEC conducted site visits in the LSRT Watershed to assess pollutant sources potentially contributing to water quality impairment in the watershed. All potential pollutant sources in the watershed found during the January 2014 site visits are identified in tables Ap-1, Ap-2, Ap-3, and Ap-4 (see Appendix E). During the potential pollutant source assessment visit, the department found evidence of hunting, ergo the existence of game, throughout the LSRT Watershed. Hunting clubs and a shooting preserve were found in Reach 2 and Reach 4 of the watershed (e.g., Figures F-1, F-2, and F-3 in Appendix F). During the visit, the department found wild turkeys in the woods in Reach 3 of the watershed (Figure F-4).

According to the SCDNR 2008 study, some of the higher concentrations of deer (i.e., 30-45 deer per square mile, and more than 45 deer per square mile) occur in the LSRT Watershed (see Section 3.2.1 of this TMDL document) (SCDNR 2008). While the SCDHEC did not find any deer in the watershed during the January 2014

potential pollutant source assessment visit, the evidence of their presence was ample throughout the watershed in the form of deer stands (e.g., Figures F-5, F-6, and F7).

Deterrents may also be used to keep wildlife away from docks and lawns in close proximity to surface waters. Non-toxic spray deterrents, decoys, eagles, kites, noisemakers, scarecrows, and plastic owls are a sample of what is currently available. During the SCDHEC's potential pollutant source assessment visit in January 2014, the department found Canadian geese in a stream-fed pond within the incorporated limits of Smoaks in Reach 2 of the LSRT Watershed (Figure F-8). The department also found an egret in a wetlands area in Reach 4 of the watershed (Figure F-9). Many waterfowl species are deterred by foreign objects on lawns and the planting of a shrub buffer along greenways adjacent to impoundments may also be effective.

In addition, homeowners and the hunting community should be educated on the impacts of feeding wildlife or planting wildlife food plots in close proximity to surface waters. Please check local and federal laws before applying deterrents or harassing wildlife. Additional information may be obtained from the "Managing Pet and Wildlife Waste to Prevent Contamination of Drinking Water" bulletin provided by USEPA (2001).

6.1.4 Agricultural Activities

Suggested forms of implementation for agricultural activities will vary based on the activity of concern. Agricultural BMPs can be vegetative, structural or management oriented. When selecting BMPs, it is important to keep in mind that nonpoint source pollution occurs when a pollutant becomes available, is detached and then transported to nearby receiving waters. Therefore, for BMPs to be effective, the transport mechanism of the pollutant, FC bacteria or *E. coli,* needs to be identified. For livestock in the referenced watersheds, installing fencing along the streams within the watershed and providing an alternative water source where livestock are present would eliminate direct contact with the streams. During the potential pollutant source assessment visit in January 2014, the SCDHEC found several cattle pastures throughout the LSRT Watershed (e.g., Figures F-10, F-11, F-12, and F-13).

During the potential pollutant source assessment visit in January 2014, the SCDHEC also found numerous hobby farms within the LSRT Watershed. Horses were found in all four reaches of the watershed (e.g., Figures F-14, F-15, F-16, and F-17). A hog pen was found within the incorporated limits of Hilda in Reach 1 of the watershed (Figure F-18). Goats were also found in all reaches of the watershed (e.g., Figures F-19, F-20, and F-21).

If fencing is not feasible, it has been shown that installing water troughs within a pasture area reduced the amount of time livestock spent drinking directly from streams by 92% (ASABE 1997). An indirect result of this was a 77% reduction in stream bank erosion by providing an alternative to accessing the stream directly for water supply.

For row crop farms in the referenced watersheds, many common practices exist to reduce FC bacteria or *E. coli* contributions. Unstabilized soil directly adjacent to surface waters can contribute to FC bacteria or *E. coli* loading during periods of runoff after rain events. Agricultural field borders and filter strips (vegetative buffers) can provide erosion control around the border of planted crop fields. These borders can provide food for wildlife, may possibly be harvested (grass and legume), and also provide an area where farmers can turn around their equipment (SCDNR, 1997). A study conducted in 1998 by the American Society of Agricultural and Biological Engineers (ASABE 1998) has shown that a vegetative buffer measuring 6.1 meters in width can reduce fecal runoff concentrations from 2.0E+7 to an immeasurable amount once filtered through the buffer. A buffer of this width was also shown to reduce phosphorous and nitrogen concentrations by 75%.

The agricultural BMPs listed above are a sample of the many accepted practices that are currently available. Many other techniques such as conservation tillage, responsible pest management, and precision agriculture also exist and may contribute to an improvement in overall water quality in the LSRT Watershed. Education should be provided to local farmers on these methods as well as acceptable manure spreading and holding (stacking sheds) practices. In fact, during the SCDHEC's potential pollutant source assessment visit in January

2014, the department found a large manure pile in an agricultural field in Reach 1 of the watershed (Figure F-22).

For additional information on accepted agricultural BMPs you can obtain a copy of the "Farming for Clean Water in South Carolina" handbook by contacting Clemson University Cooperative Extension Service at (864) 656-1550. In addition, Clemson Extension Service offers a 'Farm-A-Syst' package to farmers. Farm-A-Syst allows the farmer to evaluate practices on their property and determine the nonpoint source impact they may be having. It recommends best management practices (BMPs) to correct nonpoint source problems on the farm. You can access Farm-A-Syst by going onto the Clemson Extension Service website: http://www.clemson.edu/waterquality/FARM.HTM.

NRCS provides financial and technical assistance to help South Carolina landowners address natural resource concerns, promote environmental quality, and protect wildlife habitat on property they own or control. The cost-share funds are available through the Environmental Quality Incentives Program (EQIP). EQIP helps farmers improve production while protecting environmental quality by addressing such concerns as soil erosion and productivity, grazing management, water quality, animal waste, and forestry concerns. EQIP also assists eligible small-scale farmers who have historically not participated in or ranked high enough to be funded in previous sign ups. Please visit www.sc.nrcs.usda.gov/programs/ for more information, including eligibility requirements.

Also available through NRCS, the Grassland Reserve Program (GRP) is a voluntary program offering landowners the opportunity to protect, restore and enhance grasslands on their property. NRCS and the Farm Service Agency (FSA) coordinate implementation of the GRP, which helps landowners restore and protect grassland, rangeland, pastureland, shrubland and certain other lands and provides assistance for rehabilitating grasslands. The program will conserve vulnerable grasslands from conversion to cropland or other uses and conserve valuable grasslands by helping maintain viable grazing operations. A grazing management plan is required for participants. NRCS has further information on their website for the GRP as well as additional programs such as the Conservation Reserve Program, Conservation Security Program, Farm and Ranch Lands Protection Program, etc. You can visit the NRCS website by going to: www.sc.nrcs.usda.gov/programs/.

6.1.5 Leaking Sanitary Sewers and Illicit Discharges

Leaking sanitary sewers and illicit discharges, although illegal and subject to enforcement, may be occurring in regulated or unregulated portions of the LSRT Watershed at any time. Due to the high concentration of pollutant loading that is generally associated with these discharges, their detection may provide a substantial improvement in overall water quality in the watershed. Detection methods may include, but are not limited to: dye testing, air pressure testing, static pressure testing, and infrared photography.

The SCDHEC recognizes illicit discharge detection and elimination activities are conducted by regulated MS4 entities as pursuant to compliance with existing MS4 permits. Note that these activities are designed to detect and eliminate illicit discharges that may contain FC bacteria or *E. coli.* It is the intent of the SCDHEC to work with the MS4 entities to recognize FC bacteria or *E. coli* load reductions as they are achieved. The SCDHEC acknowledges that these efforts to reduce illicit discharges and SSOs are ongoing and some reduction may already be accountable (i.e., load reductions occurring during TMDL development process). Thus, the implementation process is an iterative and adaptive process. Regular communication between all implementation stakeholders will result in successful remediation of controllable sources over time. As designated uses are restored, the SCDHEC will recognize efforts of implementers where their efforts can be directly linked to restoration.

6.1.6 Failing Septic Systems

A septic system, also known as an onsite wastewater system, is defined as failing when it is not treating or disposing of sewage in an effective manner. The most common reason for failure is improper maintenance by homeowners. Untreated sewage water contains disease-causing bacteria and viruses, as well as unhealthy amounts of nitrate and other chemicals. Failed septic systems can allow untreated sewage to seep into wells,

groundwater, and surface water bodies, where people get their drinking water and recreate. Pumping a septic tank is probably the single most important thing that can be done to protect the system. If the buildup of solids in the tanks becomes too high and solids move to the drainfield, this could clog and strain the system to the point where a new drainfield will be needed.

The SCDHEC's Office of Coastal Resource Management (OCRM) has created a toolkit for homeowners and local governments which includes tips for maintaining septic systems. These septic system Do's and Don't's are as follows:

Do's:

- Conserve water to reduce the amount of wastewater that must be treated and disposed of by your system. Doing laundry over several days will put less stress on your system.
- Repair any leaking faucets or toilets. To detect toilet leaks, add several drops of food dye to the toilet tank and see if dye ends up in the bowl.
- Divert down spouts and other surface water away from your drainfield. Excessive water keeps the soil from adequately cleansing the wastewater.
- Have your septic tank inspected yearly and pumped regularly by a licensed septic tank contractor.

Don'ts:

- Don't drive over your drainfield or compact the soil in any way.
- Don't dig in your drainfield or build anything over it, and don't cover it with a hard surface such as concrete or asphalt.
- Don't plant anything over or near the drainfield except grass. Roots from nearby trees an shrubs may clog and damage the drain lines.
- Don't use your toilet as a trash can or poison your system and the groundwater by pouring harmful chemicals and cleansers down the drain. Harsh chemicals can kill the bacteria that help purify your wastewater.

For additional information on how septic systems work, how to properly plan and maintain a septic system, or to link to the OCRM toolkit mentioned above, please visit the SCDHEC Environmental Health Onsite Wastewater page at the following link: http://www.scdhec.gov/health/envhlth/onsite_wastewater/septic_tank.htm

6.1.7 Urban Runoff

Urban runoff is surface runoff of rainwater created by urbanization outside of regulated areas which may pick up and carry pollutants to receiving waters. Pavement, compacted areas, roofs, reduced tree canopy and open space increase runoff volumes that rapidly flow into receiving waters. This increase in volume and velocity of runoff often causes stream bank erosion, channel incision and sediment deposition in stream channels. In addition, runoff from these developed areas can increase stream temperatures that along with the increase in flow rate and pollutant loads negatively affect water quality and aquatic life (USEPA 2005). This runoff can pick up FC bacteria or *E. coli* along the way. Many strategies currently exist to reduce FC loading from urban runoff and the USEPA nonpoint source pollution website provides extensive resources on this subject, which can be accessed online at: http://www.epa.gov/nps/urban.html.

Some examples of urban nonpoint source BMPs are street sweeping, stormwater wetlands, pet waste receptacles (equipped with waste bags), and educational signs which can be installed adjacent to receiving waters in the watershed such as parks, common areas, apartment complexes, trails, etc. Low impact development (LID) may also be effective. LID is an approach to land development (or re-development) that works with nature to manage stormwater as close to its source as possible. LID employs principles such as preserving and recreating natural landscape features, minimizing effective imperviousness to create functional and appealing site drainage that treats stormwater as a resource rather than a waste product. There are many

practices that have been used to adhere to these principles such as bioretention facilities, rain gardens, vegetated rooftops, rain barrels, and permeable pavements (USEPA, 2009).

Some additional urban BMPs that can be adopted in public parks are doggy dooleys and pooch patches. Doggy dooleys are disposal units, which act like septic systems for pet waste, and are installed in the ground where decomposition can occur (USEPA, 2001). This requires that pet owners place the waste into the disposal units. During the SCDHEC potential pollutant source assessment visit in January 2014, domesticated animals were evident in urban areas in the LSRT Watershed. Unattended chickens were found in a yard with the incorporated limits of Williams in Reach 3 of the watershed (Figure F-23). An unattended cat was found in the street within the incorporated limits of Bamberg in Reach 4 of the watershed (Figure F-24). In addition to finding unattended dogs within incorporated areas in the LSRT Watershed, unattended dogs were found in all reaches of the watershed (e.g., Figures F-25, F-26, and F-27).

Although the LSRT Watershed is primarily rural in nature, many of the urban runoff practices discussed in this section can be applied to individual households in the watersheds. Education should be provided to individual homeowners in the referenced watersheds on the contributions to FC bacteria or *E. coli* loading from pet waste. Education to homeowners in the watershed on the fate of substances poured into storm drain inlets should also be provided. For additional information on urban runoff please see the SCDHEC Nonpoint Source Runoff Pollution homepage at http://www.scdhec.gov/environment/water/npspage.htm.

Clemson Extension's Home-A-Syst handbook can also help homeowners reduce sources of NPS pollution on their property. This document guides homeowners through a self-assessment of their property and can be accessed online at: http://www.clemson.edu/waterquality/HOMASYS.HTM

7.0 RESOURCES FOR POLLUTION MANAGEMENT

This section provides a listing of available resources to aid in the mitigation and control of pollutants. There are examples from across the nation, most of which are easily accessible on the world wide web.

7.1 General for Urban and Suburban Stormwater Mitigation

- National Management Measures to Control Nonpoint Source Pollution from Urban Areas – Draft. 2002. EPA842-B-02-003. Available at: http://www.epa.gov/owow/nps/urbanmm/index.html
- Stormwater Management Volume Two: Stormwater Technical Manual. Massachusetts Department of Environmental Management. 1997. Available at: http://www.mass.gov/dep/brp/stormwtr/stormpub.htm
- Fact Sheets for the six minimum control measures for storm sewers regulated under Phase I or Phase II. Available at: http://cfpub1.epa.gov/npdes/stormwater/swfinal.cfm?program_id=6
- A Current Assessment of Urban Best Management Practices. 1992. Metropolitan Washington Council of Governments. Washington, DC
- Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. 1987. Metropolitan Washington Council of Governments. Washington, DC
- 2004 Stormwater Quality Manual. Connecticut Department of Environmental Protection 2004. Available at: http://dep.state.ct.us/wtr/stormwater/strmwtrman.htm

- Stormwater Treatment BMP New Technology Report. California Department of Transportation. 2004. SW-04-069-.04.02 Available at: http://www.dot.ca.gov/hq/env/stormwater/special/newsetup/_pdfs/new_technology/CTSW-RT-04-069.pdf
- Moonlight Beach Urban Runoff Treatment facility: Using Ultraviolet Disinfection to Reduce Bacteria Counts. Rasmus, J. and K. Weldon. 2003. StormWater, May/June 2003. Available at http://www.forester.net/sw_0305_moonlight.html
- Operation, Maintenance, and Management of Stormwater Management Systems. Livingston, Shaver, Skupien, and Horner. August 1997. Watershed Management Institute. Call: (850) 926-5310.
- Model Ordinances to Protect Local Resources – Stormwater Control Operation and Maintenance. USEPA Webpage: http://www.epa.gov/owow/nps/ordinance/stormwater.htm
- Stormwater O & M Fact Sheet Preventive Maintenance. USEPA 1999. 832-F-99-004. Available at: http://www.epa.gov/owm/mtb/prevmain.pdf
- The MassHighway Stormwater Handbook. Massachusetts Highway Department. 2004. Available at: http://166.90.180.162/mhd/downloads/projDev/swbook.pdf
- University of New Hampshire Stormwater Center: Dedicated to the protection of water resources through effective stormwater management. Available at: http://www.unh.edu/erg/cstev/index.htm#
- EPA's Stormwater website: http://www.epa.gov/region1/topics/water/stormwater.html

7.2 Illicit Discharges

- Illicit Discharge Detection and Elimination Manual - A Handbook for Municipalities. 2003. New England Interstate Water Pollution Control Commission. Available at: http://www.neiwpcc.org/PDF_Docs/iddmanual.pdf
- Model Ordinances to Protect Local Resources – Illicit Discharges. USEPA webpage: http://www.epa.gov/owow/nps/ordinance/discharges.htm

7.3 Pet Waste

- National Management Measure to Control Non Point Source Pollution from Urban Areas – Draft. USEPA 2002. EPA 842-B-02-2003. Available from: http://www.epa.gov/owow/nps/urbanmm/index.html
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- Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. U.S. EPA, Office of Water 1993. Washington, DC.
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7.4 Wildlife

- An example of a bylaw prohibiting the feeding of wildlife: Prohibiting Feeding of Wildlife. Town of Bourne Bylaws Section 3.4.3. Available at: http://www.townofbourne.com/Town%20Offices/Bylaws/chapter__3.htm
- Integrated Management of Urban Canadian Geese. M Underhill. 1999. Conference Proceedings, Waterfowl Information Network.
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7.5 Septic Systems

- National Management Measures to Control Nonpoint Source Pollution from Urban Areas – Draft. Chapter 6. New and Existing Onsite Wastewater Treatment Systems. USEPA 2002. EPA842-B-02-003. Available at: http://www.epa.gov/owow/nps/urbanmm/index.html
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7.6 Field Application of Manure

- Conservation Standard Practice-Irrigation Water Management. Number 449. United States Department of Agriculture (USDA) Natural Resources Conservation Service. 2003. Available at: http://www.nrcs.usda.gov/technical/Standards/nhcp.html
- Conservation Standard Practice-Filter Strip. Number 393. USDA Natural Resources Conservation Service (NRCS). 2003. Available at: http://www.nrcs.usda.gov/technical/Standards/nhcp.html
- Buffer Strips: Common Sense Conservation. USDA Natural Resource Conservations Service. No Date. Website. Available at: http://www.nrcs.usda.gov/feature/buffers/
- Conservation Standard Practice-Riparian Forest Buffer. Number 391. USDA Natural Resource Conservation Service. 2003. Available at:

http://www.nrcs.usda.gov/technical/Standards/nhcp.html

- Conservation Standard Practice-Riparian Herbaceous Cover. Number 390 USDA Natural Resource Conservation Service. 2003. Available at: http://www.nrcs.usda.gov/technical/Standards/nhcp.html

7.7 Grazing Management

- Conservation Standard Practice-Stream Crossing. Number 578. USDA Natural Resource Conservation Service. 2003. Available at: http://www.nrcs.usda.gov/technical/Standards/nhcp.html
- Guidance Specifying Management Measures for Nonpoint Source Pollution in Coastal Waters. Chapter 2. Management Measures for Agricultural Sources. Grazing Management. USEPA. Available at: http://www.epa.gov/owow/nps/MMGI/Chapter2/ch2-2e.html

7.8 Animal Feeding Operations and Barnyards

- National Management Measures to Control Nonpoint Source Pollution from Agriculture. USEPA 2003. Report: EPA 841-B-03-004. Available at: http://www.epa.gov/owow/nps/agmm/index.html
- Livestock Manure Storage. Software designed to asses the threat to ground and surface water from manure storage facilities. USEPA. Available at: http://www.epa.gov/seahome/manure.html
- National Engineering Handbook Part 651. Agricultural Waste Management Field Handbook. NRCS. Available At: http://www.wcc.nrcs.usda.gov/awm/awmfh.html
- Animal Waste Management. NRCS website: http://www.wcc.nrcs.usda.gov/awm/
- Animal Waste Management Software. A tool for estimating waste production and storage requirements. Available at: http://www.wcc.nrcs.usda.gov/awm/awm.html
- Manure Management Planner. Software for creating manure management plans. Available at: http://www.agry.purdue.edu/mmp/
- Animal Feeding Operations Virtual Information Center. USEPA website: http://cfpub.epa.gov/npdes/afo/virtualcenter.cfm

7.9 Federal Agriculture Resources: Program Overviews, Technical Assistance, and Funding

- USDA-NRCS assists landowners with planning for the conservation of soil, water, and natural resources. Local, state, and federal agencies and policymakers also rely on NRCS expertise. Cost shares and financial incentives are available in some cases. Most work is done with local partners. The NRCS is the largest funding source for agricultural improvements. To find out about potential funding, see: http://www.ma.nrcs.usda.gov/programs/. To pursue obtaining funding, contact a local NRCS coordinator. Contact information is available at:: http://www.ma.nrcs.usda.gov/contact/employee_directory.html

- NRCS provides a wealth of information and BMP fact sheets tailored to agricultural and conservation practices through the NRCS Electronic Field Office Technical Guide at: http://efotg.nrcs.usda.gov/efotg_locator.aspx?map=SC

- The 2002 USDA Farm Bill (http://www.nrcs.usda.gov/programs/farmbill/2002/) provides a variety of programs related to conservation. Information can be found at: http://www.nrcs.usda.gov/programs/farmbill/2002/products.html. The following programs can be linked to from the USDA Farm Bill website:

  - Conservation Security Program (CSP): http://www.nrcs.usda.gov/programs/csp/
  - Conservation Reserve Program (CRP): http://www.nrcs.usda.gov/programs/crp/
  - Wetlands Reserve Program (WRP): http://www.nrcs.usda.gov/programs/wrp/
  - Environmental Quality Incentives Program (EQIP): http://www.nrcs.usda.gov/programs/eqip/
  - Grassland Reserve Program (GRP): http://www.nrcs.usda.gov/programs/GRP/
  - Conservation of Private Grazing Land Program (CPGL): http://www.nrcs.usda.gov/programs/cpgl/
  - Wildlife Habitat Incentives Program (WHIP): http://www.nrcs.usda.gov/programs/whip/
  - Farm and Ranch Land Protection Program (FRPP): http://www.nrcs.usda.gov/programs/frpp/
  - Resource Conservation and Development Program (RC&D): http://www.nrcs.usda.gov/programs/rcd/

- CORE4 Conservation Practices. The common sense approach to natural resource conservation. USDA-NRCS (1999). This manual is intended to help USDA-NRCS personnel and other conservation and nonpoint source management professionals implement effective programs using four core conservation practices: conservation tillage, nutrient management, pest management, and conservation buffers, available at: http://www.nrcs.usda.gov/technical/ECS/agronomy/core4.pdf

- County soil survey maps are available from NRCS at: http://soils.usda.gov

- Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. U.S. EPA, Office of Water (1993). Developed for use by State Coastal Nonpoint Pollution Control Programs, Chapter 2 of this document covers erosion control, animal feeding operation management, grazing practices, and management of nutrients, pesticides, and irrigation water, available at:: http://www.epa.gov/owow/nps/MMGI/Chapter2/index.html.

- Farm-A-Syst is a partnership between government agencies and private business that enables landowners to prevent pollution on farms, ranches, and in homes using confidential environmental assessments, available at: http://www.uwex.edu/farmasyst/

- State Environmental Laws Affecting South Carolina Agriculture: A comprehensive assessment of regulatory issues related to South Carolina agriculture has been compiled by the National Association of State Departments, available at: http://www.nasda-hq.org/nasda/nasda/Foundation/state/states.htm

- Waterborne Pathogens in Agricultural Wastewater. Rosen, B. H., 2000. USDA, NRCS, Watershed Science Institute. Available at: ftp://ftp-fc.sc.egov.usda.gov/WSI/pdffiles/Pathogens_in_Agricultural_Watersheds.pdf

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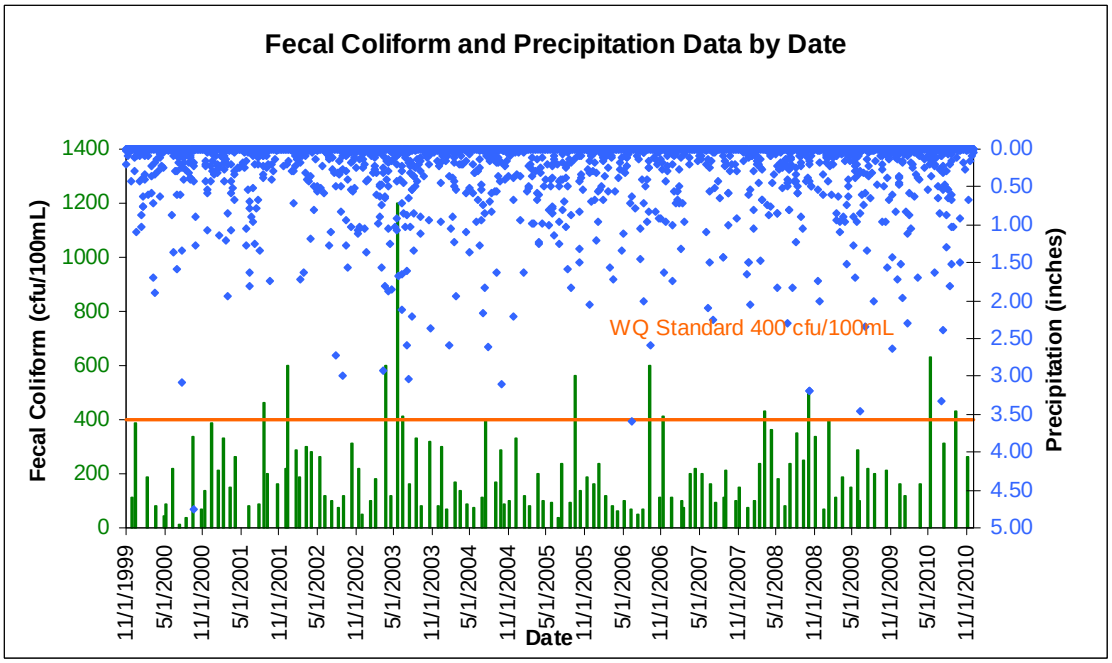
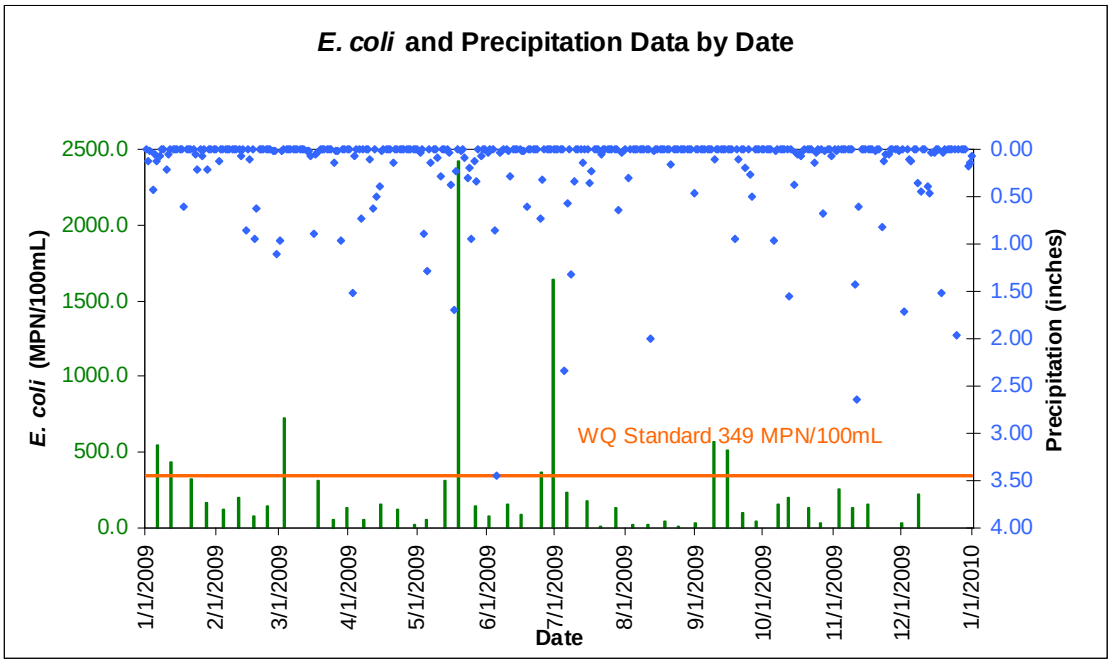
APPENDIX A
ADDITIONAL RAIN CHARTS BY STATION

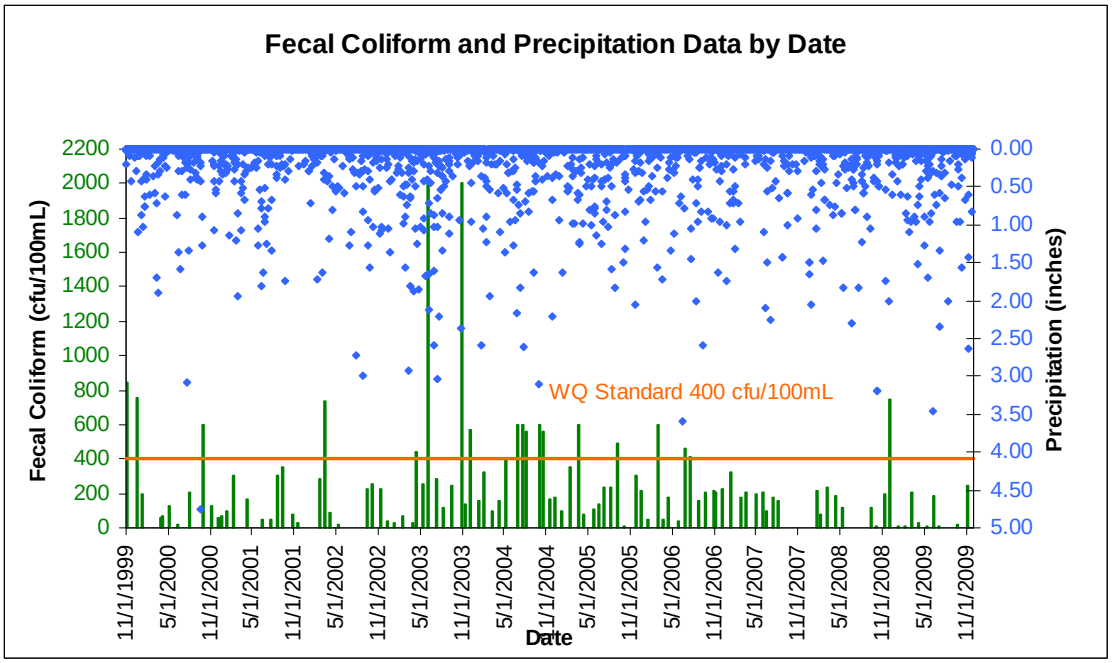
Precipitation and FC Data by Date for Monitoring Station CSTL-115



Precipitation and *E. coli* Data by Date for Monitoring Station RS-08076

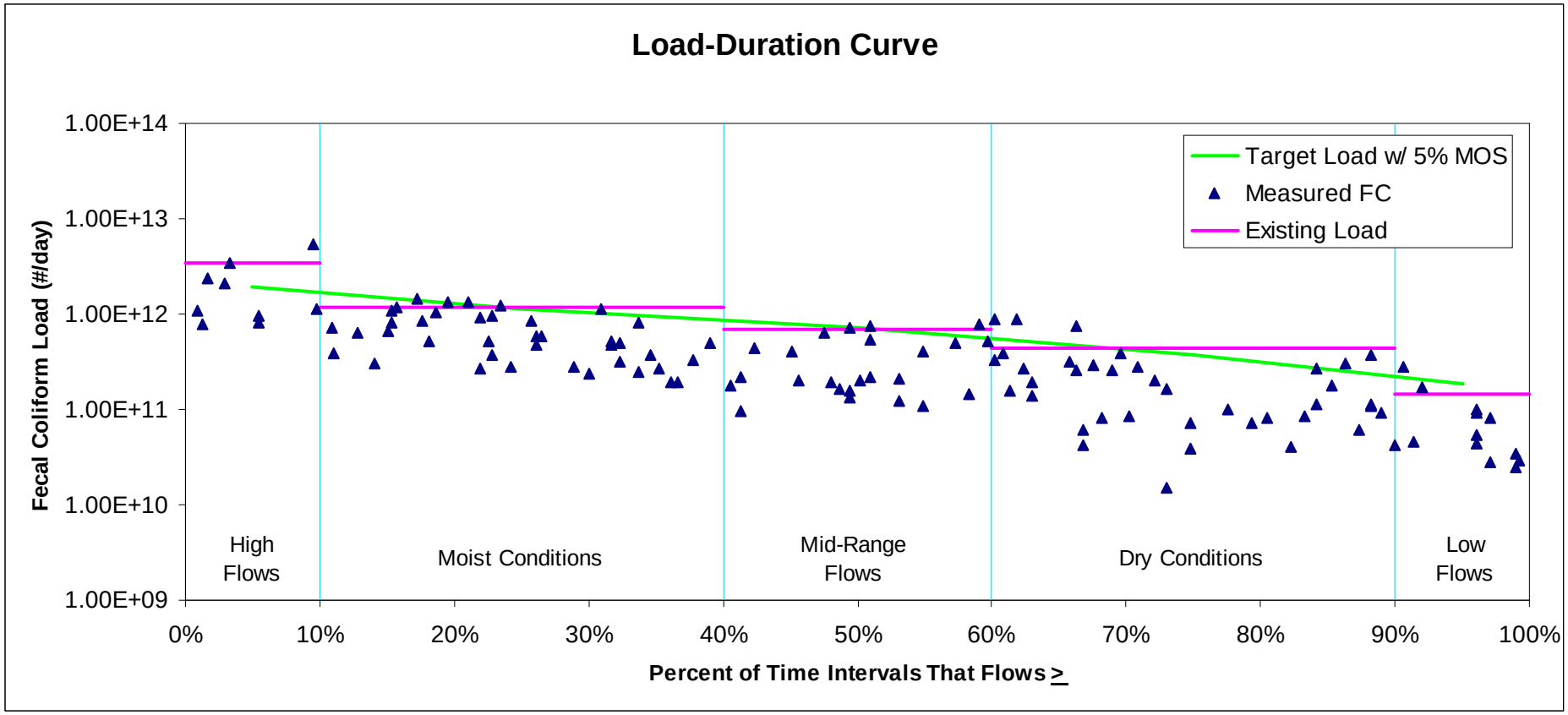


Precipitation and FC Data by Date for Monitoring Station CSTL-119

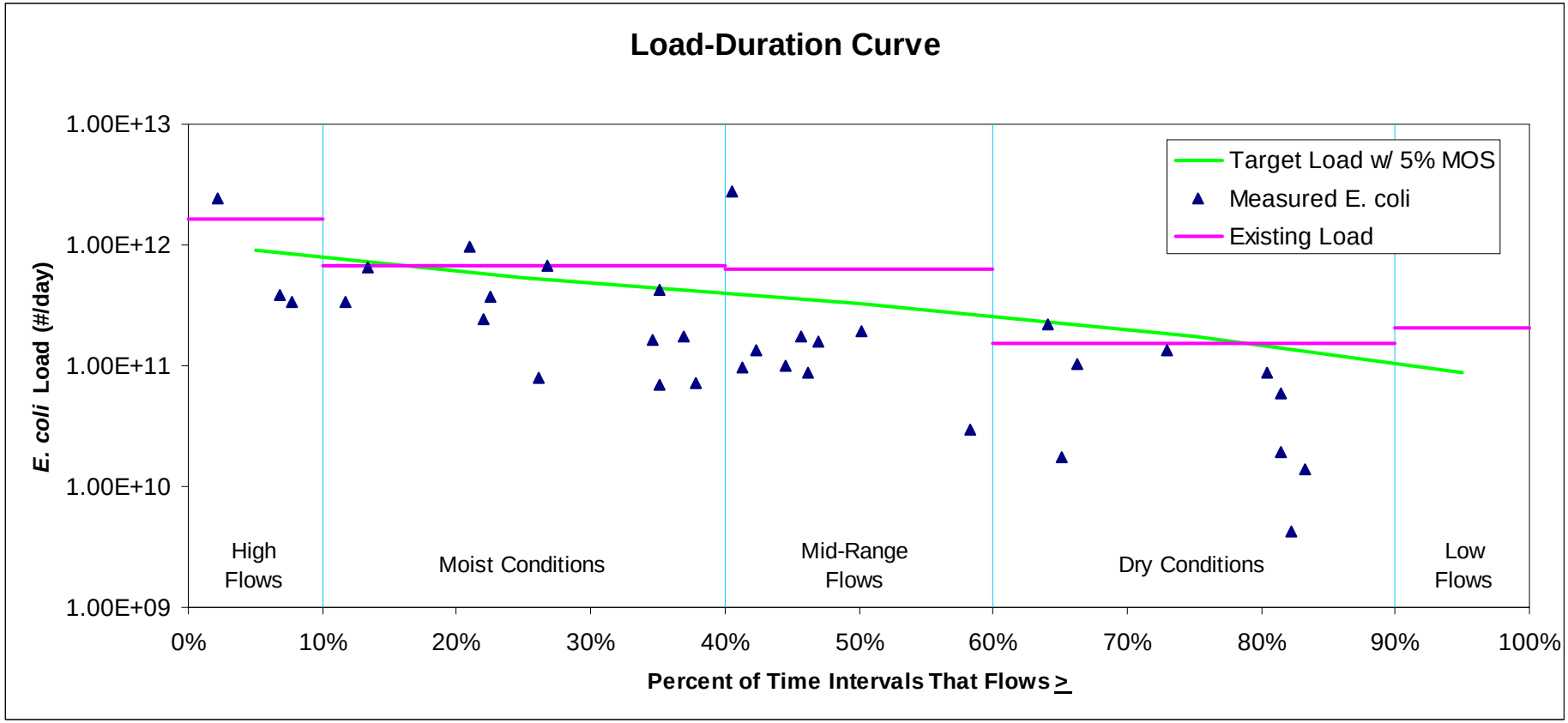


APPENDIX B
ADDITIONAL LOAD-DURATION CURVES BY STATION

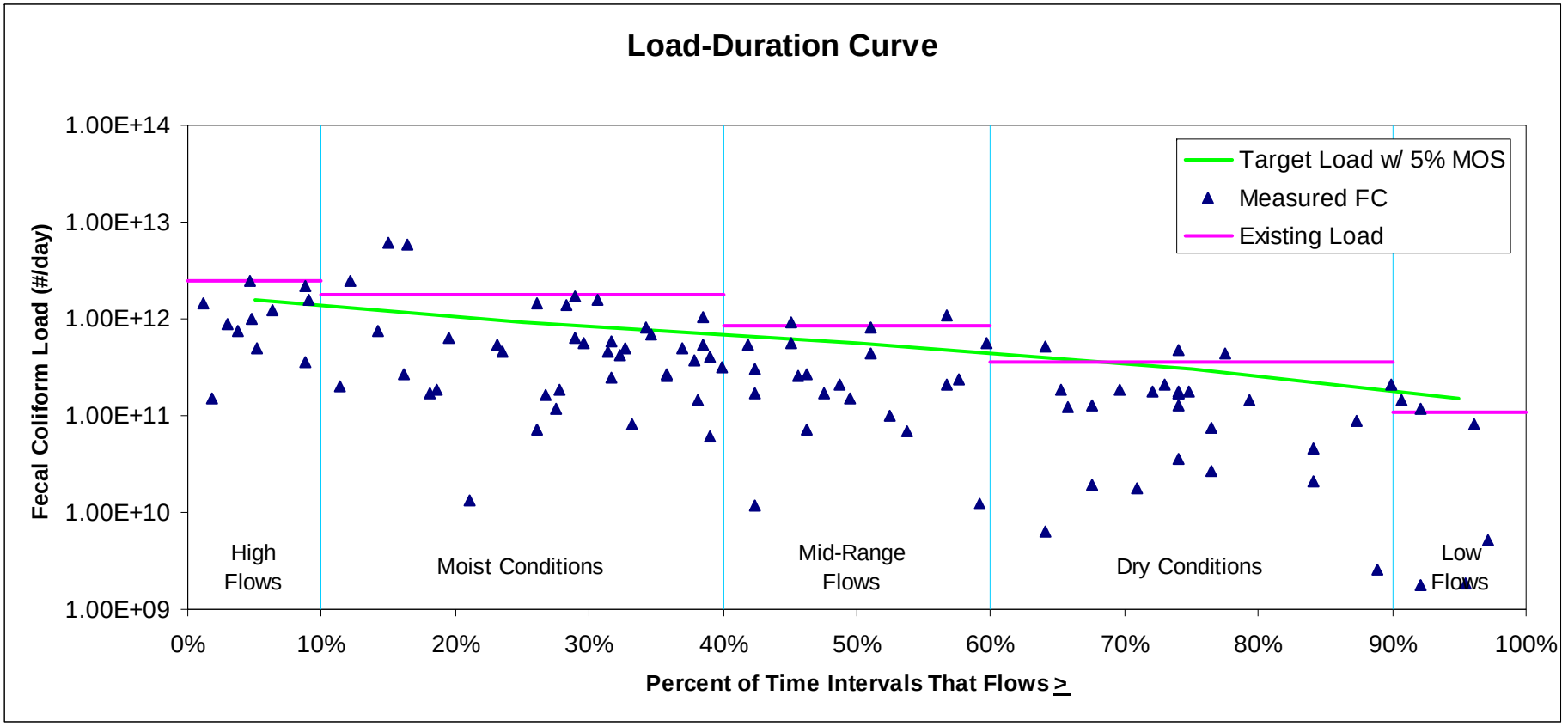
Load Duration Curve for Reach 1 of the Little Salkehatchie River and Tributaries Watershed, WQM Station CSTL-115



Load Duration Curve for Reach 2 of the Little Salkehatchie River and Tributaries Watershed, WQM Station RS-08076



Load Duration Curve for Reach 3 of the Little Salkehatchie River and Tributaries Watershed, WQM Station CSTL-119



Appendix C

EVALUATING THE PROGRESS OF MS4 PROGRAMS

Evaluating the Progress of MS4 Programs:
Meeting the Goals of TMDLs and Attaining Water Quality Standards

Bureau of Water

August 2008

Described below are potential approaches that may be used by MS4 permit holders. These are recommendations and examples only, as the SCDHEC-BOW recognizes that other approaches may be utilized or employed to meet compliance goals.

1. Calculate pollutant load reduction for each best management practice (BMP) deployed:
    - Retrofitting stormwater outlets
    - Creation of green space
    - LID activities (e.g., creation of porous pavements)
    - Creations of riparian buffers
    - Stream bank restoration
    - Scoop the poop program (how many pounds of poop were scooped/collected)
    - Street sweeping program (amount of materials collected etc.)
    - Construction & post-construction site runoff controls
2. Description & documentation of programs directed towards reducing pollutant loading
    - Document tangible efforts made to reduce impacts to urban runoff
    - Track type and number of structural BMPs installed
    - Parking lot maintenance program for pollutant load reduction
    - Identification and elimination of illicit discharges
    - Zoning changes and ordinances designed to reduce pollutant loading
    - Modeling of activities & programs for reducing pollutant reductions
3. Description & documentation of social indicators, outreach, and education programs
    - Number/Type of training & education activities conducted and survey results
    - Activities conducted to increase awareness and knowledge – residents, business owners. What changes have been made based on these efforts? Any measured behavior or knowledge changes?
    - Participation in stream and/or lake clean-up events or activities
    - Number of environmental action pledges
4. Water quality monitoring: A direct and effective way to evaluate the effectiveness of stormwater management plan activities.
    - Use of data collected from existing monitoring activities (e.g., SCDHEC data for ambient monitoring program available through STORET; water supply intake testing; voluntary watershed group's monitoring, etc)
    - Establish a monitoring program for permitted outfalls and/or waterbodies within MS4 areas as deemed

necessary– use a certified lab

- Monitoring should focus on water quality parameters and locations that would both link pollutant sources and BMPs being implemented

5. Links:

- Evaluating the Effectiveness of Municipal Stormwater Programs. September 2007. EPA 833-F-07-010
- The BMP database - http://www.bmpdatabase.org/BMPPerformance.htm (this link is specifically to the BMP performance page, and lot more)
- EPA's STORET data warehouse - http://www.epa.gov/storet/dw_home.html
- EPARegion 5: STEPL – Spreadsheet tool for estimating pollutant loads http://it.tetratech-ffx.com/stepl/
- Measurable goals guidance for Phase II Small MS4 - http://cfpub.epa.gov/npdes/stormwater/measurablegoals/index.cfm
- Environmental indicators for sotrmwater program- http://cfpub.epa.gov/npdes/stormwater/measurablegoals/part5.cfm
- National menu of stormwater best management practices (BMPs) - http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm
- SCDHEC – BOW: 319 grant program has attempted to calculate the load reductions for the following BMPs:

    - Septic tank repair or replacement
    - Removing livestock from streams (cattle, horses, mules)
    - Livestock fencing
    - Waste Storage Facilities (aka stacking sheds)
    - Strip cropping
    - Prescribed grazing
    - Critical Area Planting
    - Runoff Management System
    - Waste Management System
    - Solids Separation Basin
    - Riparian Buffers

Appendix D
DATA TABLES

Fecal Coliform WQS Exceedence Summary for Impaired Station CSTL-115 by Date

Date	FC (cfu/day)
11/23/1999	110
12/151999	390
1/11/2000	0
2/8/2000	190
3/14/2000	82
4/24/2000	45
5/4/2000	88
6/7/2000	220
7/12/2000	15
8/8/2000	35
9/11/2000	340
10/24/2000	70
11/8/2000	140
12/11/2000	390
1/9/2001	210
2/5/2001	330
3/7/2001	150
4/4/2001	260
6/5/2001	82
7/23/2001	90
8/20/2001	**460**
9/5/2001	200

Date	FC (cfu/day)
10/23/2001	160
11/27/2001	220
12/15/2001	**600**
1/15/2002	290
2/5/2002	190
3/6/2002	300
4/1/2002	280
5/7/2002	260
6/3/2002	120
7/2/2002	100
8/5/2002	78
9/3/2002	120
10/10/2002	310
11/13/2002	220
12/2/2002	50
1/6/2003	100
2/4/2003	180
3/18/2003	**600**
4/15/2003	120
5/21/2003	**1200**
6/10/2003	**410**
7/16/2003	160

Date	FC (cfu/day)
8/12/2003	330
9/4/2003	80
10/14/2003	320
11/25/2003	80
12/11/2003	300
1/8/2004	70
2/18/2004	170
3/10/2004	140
4/14/2004	85
5/17/2004	76
6/21/2004	110
7/8/2004	400
8/26/2004	170
9/22/2004	290
10/7/2004	90
11/3/2004	100
12/1/2004	330
1/13/2005	120
2/9/2005	80
3/14/2005	200
4/12/2005	97
5/25/2005	94

____ **WQS Exceeded**

Fecal Coliform WQS Exceedence Summary for Impaired Station CSTL-115 by Date (Continued)

Date	FC (cfu/day)
6/20/2005	40
7/12/2005	240
8/18/2005	93
9/13/2005	**560**
10/5/2005	140
11/9/2005	190
12/12/2005	160
1/5/2006	240
2/6/2006	120
3/6/2006	83
4/4/2006	65
5/1/2006	100
6/7/2006	67
7/5/2006	50
8/3/2006	70
9/6/2006	**600**
10/17/2006	110
11/7/2006	**410**
12/13/2006	110
1/30/2007	100

Date	FC (cfu/day)
2/14/2007	78
3/15/2007	200
4/11/2007	220
5/8/2007	200
6/19/2007	160
7/17/2007	96
8/21/2007	110
9/5/2007	210
10/23/2007	98
11/7/2007	150
12/13/2007	73
1/16/2008	100
2/13/2008	240
3/15/2008	**430**
4/9/2008	360
5/7/2008	180
6/10/2008	79
7/8/2008	240
8/5/2008	350
9/9/2008	250

Date	FC (cfu/day)
10/1/2008	**500**
11/5/2008	340
12/9/2008	70
1/6/2009	400
2/11/2009	110
3/11/2009	190
4/22/2009	150
5/27/2009	290
6/2/2009	100
7/7/2009	220
8/11/2009	200
10/7/2009	210
12/8/2009	160
1/6/2010	120
3/17/2010	160
5/5/2010	**630**
7/8/2010	310
9/7/2010	**430**
11/3/2010	260

____ WQS Exceeded

90th Percentile FC Concentrations (#/100 mL)

Hydro Category Range	High Flow 0-10	Moist Cond. 10-40	Mid Range 40-60	Dry Flow 60-90	Low Flow 90-100	Samples
CSTL-115	660	391	375	456	301	125

Mid Point Hydrologic Category Flow (cfs)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
CSTL-115	208.45	123.80	76.46	40.05	20.03

Existing Load (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
CSTL-115	3.37E+12	1.18E+12	7.02E+11	4.47E+11	1.47E+11

Target Load (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
CSTL-115	1.93E+12	1.15E+12	7.05E+11	3.65E+11	1.80E+11

Load Reduction Necessary (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
CSTL-115	N/A	3.92E+10	NRN	8.03E+10	N/A

NRN = no reduction needed. Existing load below target load.

% Load Reduction Necessary

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
CSTL-115	N/A	3	NRN	18	N/A

NRN = no reduction needed. Existing load below target load.

E. coli WQS Exceedence Summary for Impaired Station RS-08076 by Date

Date	***E. coli*** **(MPN/day)**
1/6/2009	**547.50**
1/12/2009	**435.20**
1/21/2009	325.50
1/28/2009	166.40
2/4/2009	118.70
2/11/2009	195.60
2/18/2009	83.30
2/24/2009	140.10
3/3/2009	**727.00**
3/18/2009	313.00
3/25/2009	58.10
3/31/2009	135.50
4/7/2009	50.65
4/15/2009	152.65
4/22/2009	124.75
4/30/2009	25.60

Date	*E. coli* (MPN/day)
5/5/2009	53.35
5/13/2009	308.55
5/19/2009	**2419.17**
5/27/2009	140.10
6/2/2009	83.30
6/10/2009	150.70
6/16/2009	92.00
6/25/2009	**373.20**
6/30/2009	**1642.40**
7/6/2009	234.40
7/15/2009	182.80
7/21/2009	10.25
7/28/2009	136.40
8/4/2009	21.00
8/11/2009	17.50
8/18/2009	43.80

Date	*E. coli* (MPN/day)
8/24/2009	10.00
9/1/2009	29.60
9/9/2009	**570.60**
9/15/2009	**513.00**
9/22/2009	97.20
9/28/2009	48.60
10/7/2009	156.20
10/12/2009	198.20
10/21/2009	137.20
10/26/2009	34.00
11/3/2009	251.20
11/9/2009	135.60
11/16/2009	152.20
12/1/2009	36.20
12/8/2009	221.20

___ WQS Exceeded

90th Percentile *E. coli* Concentrations (#/100 mL)

Hydro Category Range	High Flow 0-10	Moist Cond. 10-40	Mid Range 40-60	Dry Flow 60-90	Low Flow 90-100	Samples
RS-08076	612	424	640	291	785	47

Mid Point Hydrologic Category Flow (cfs)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
RS-08076	110.56	65.66	40.55	21.24	10.62

Existing Load (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
RS-08076	1.66E+12	6.81E+11	6.35E+11	1.51E+11	2.04E+11

Target Load (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
RS-08076	8.98E+11	5.33E+11	3.27E+11	1.72E+11	8.62E+10

Load Reduction Necessary (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
RS-08076	N/A	1.48E+11	3.08E+11	NRN	N/A

NRN = no reduction needed. Existing load below target load.

% Load Reduction Necessary

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
RS-08076	N/A	22	48	NRN	N/A

NRN = no reduction needed. Existing load below target load.

Fecal Coliform WQS Exceedence Summary for Impaired Station CSTL-119 by Date

Date	FC (cfu/day)
11/4/1999	**840**
12/14/1999	**760**
1/5/2000	200
3/28/2000	60
4/6/2000	70
5/2/2000	130
6/8/2000	20
8/1/2000	210
9/27/2000	**600**
10/31/2000	130
11/29/2000	60
12/14/2000	70
1/9/2001	100
2/7/2001	300
3/5/2001	0
4/3/2001	170
6/12/2001	45
7/17/2001	50
8/20/2001	300
9/5/2001	350
10/18/2001	75
11/14/2001	34

Date	FC (cfu/day)
2/13/2002	280
3/7/2002	**740**
4/3/2002	90
5/8/2002	20
9/9/2002	230
10/2/2002	260
11/5/2002	230
12/9/2002	40
1/7/2003	34
2/11/2003	68
3/25/2003	28
4/8/2003	**440**
5/14/2003	260
6/4/2003	**2000**
7/8/2003	280
8/6/2003	120
9/11/2003	250
10/29/2003	**2000**
11/13/2003	140
12/2/2003	**570**
1/6/2004	160
2/3/2004	320

Date	FC (cfu/day)
3/4/2004	100
4/8/2004	160
5/52004	400
6/22/2004	**600**
7/20/2004	**600**
8/4/2004	**560**
9/29/2004	**600**
10/12/2004	**560**
11/9/2004	170
12/2/2004	180
1/5/2005	100
2/10/2005	350
3/16/2005	**600**
4/6/2005	80
5/24/2005	110
6/14/2005	140
7/6/2005	240
8/4/2005	240
9/11/2005	**490**
10/5/2005	5
11/22/2005	300
12/15/2005	220

____ WQS Exceeded

Fecal Coliform WQS Exceedence Summary for Impaired Station CSTL-119 by Date (Continued)

Date	FC (cfu/day)
1/12/2006	45
2/28/2006	**600**
3/23/2006	50
4/13/2006	180
5/24/2006	35
6/21/2006	**460**
7/12/2006	**410**
8/21/2006	160
9/21/2006	210
10/24/2006	220
11/6/2006	210
12/6/2006	230
1/9/2007	320

Date	FC (cfu/day)
2/21/2007	180
3/13/2007	210
4/25/2007	200
5/29/2007	210
6/14/2007	100
7/10/2007	180
8/2/2007	160
1/15/2008	220
2/5/2008	80
3/4/2008	240
4/9/2008	190
5/7/2008	120
9/9/2008	120

Date	FC (cfu/day)
10/1/2008	10
11/5/2008	200
12/2/2008	**750**
1/6/2009	5
2/4/2009	7
3/4/2009	210
4/7/2009	30
5/13/2009	6
6/9/2009	190
7/1/2009	5
8/5/2009	4
9/16/2009	16
11/3/2009	250

___ WQS Exceeded

90th Percentile FC Concentrations (#/100 mL)

Hydro Category Range	High Flow 0-10	Moist Cond. 10-40	Mid Range 40-60	Dry Flow 60-90	Low Flow 90-100	Samples
CSTL-119	600	740	560	450	280	105

Mid Point Hydrologic Category Flow (cfs)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
CSTL-119	167.83	99.67	61.56	32.25	16.12

Existing Load (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
CSTL-119	2.46E+12	1.80E+12	8.43E+11	3.55E+11	1.10E+11

Target Load (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
CSTL-119	1.56E+12	9.27E+11	5.72E+11	3.00E+11	1.50E+11

Load Reduction Necessary (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
CSTL-119	N/A	8.78E+11	2.71E+11	5.52E+10	N/A

% Load Reduction Necessary

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
CSTL-119	N/A	49	32	16	N/A

Fecal Coliform WQS Exceedence Summary for Impaired Station CSTL-117 by Date

Date	FC (cfu/day)
11/4/1999	150
12/14/1999	400
1/5/2000	230
3/28/2000	40
4/6/2000	70
6/8/2000	130
8/1/2000	320
9/27/2000	380
10/31/2000	40
11/29/2000	200
12/14/2000	180
1/9/2001	160
2/7/2001	140
3/5/2001	0
4/3/2001	130
6/12/2001	210
7/17/2001	120
8/20/2001	**600**
9/5/2001	**480**
10/18/2001	90
11/14/2001	220
12/3/2001	220

Date	FC (cfu/day)
1/23/2002	210
2/13/2002	320
3/7/2002	**420**
4/3/2002	200
5/8/2002	380
6/11/2002	310
7/9/2002	310
8/14/2002	45
9/9/2002	170
10/2/2002	170
11/5/2002	200
12/9/2002	110
1/7/2003	65
2/11/2003	180
3/25/2003	15
4/8/2003	220
5/14/2003	65
6/4/2003	**730**
7/8/2003	110
8/6/2003	120
9/11/2003	180
10/29/2003	**2000**

Date	FC (cfu/day)
11/13/2003	110
12/2/2003	210
1/6/2004	200
2/3/2004	170
3/4/2004	65
4/8/2004	68
5/5/2004	290
6/22/2004	320
7/20/2004	360
8/4/2004	290
9/29/2004	**520**
10/12/2004	220
11/9/2004	90
12/2/2004	**470**
1/5/2005	150
2/10/2005	310
3/16/2005	380
4/6/2005	120
5/24/2005	93
6/14/2005	100
7/26/2005	250
8/4/2005	**600**

___ WQS Exceeded

Fecal Coliform WQS Exceedence Summary for Impaired Station CSTL-117 by Date (Continued)

Date	FC (cfu/day)
9/1/2005	180
10/5/2005	20
11/22/2005	**600**
12/15/2005	220
1/12/2006	260
2/28/2006	**600**
3/23/2006	150
4/13/2006	50
5/24/2006	90
6/21/2006	390
7/12/2006	**600**
8/21/2006	120
9/21/2006	160
10/24/2006	**1200**
11/6/2006	110
12/6/2006	200
1/9/2007	250

Date	FC (cfu/day)
2/21/2007	280
3/13/2007	200
4/25/2007	160
5/29/2007	210
6/14/2007	200
7/10/2007	180
8/2/2007	220
10/25/2007	350
11/27/2007	230
12/10/2007	210
1/15/2008	130
2/5/2008	170
3/4/2008	170
4/9/2008	310
5/7/2008	91
6/10/2008	35
7/8/2008	120

Date	FC (cfu/day)
8/5/2008	200
9/9/2008	130
10/1/2008	71
11/5/2008	240
12/2/2008	**800**
1/6/2009	280
2/4/2009	20
3/4/2009	**480**
4/7/2009	190
5/13/2009	**510**
6/9/2009	140
7/1/2009	35
8/5/2009	80
9/16/2009	37
11/3/2009	210

___ WQS Exceeded

90th Percentile FC Concentrations (#/100 mL)

Hydro Category Range	High Flow 0-10	Moist Cond. 10-40	Mid Range 40-60	Dry Flow 60-90	Low Flow 90-100	Samples
CSTL-117	600	496	448	360	314	115

Mid Point Hydrologic Category Flow (cfs)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
CSTL-117	513.41	255.75	165.71	79.50	36.40

Existing Load (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
CSTL-117	7.54E+12	3.10E+12	1.82E+12	7.00E+11	2.80E+11

Target Load (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
CSTL-117	4.77E+12	2.38E+12	1.54E+12	7.39E+11	3.38E+11

Load Reduction Necessary (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
CSTL-117	N/A	7.26E+11	2.76E+11	NRN	N/A

NRN = no reduction needed. Existing load below target load.

% Load Reduction Necessary

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
CSTL-117	N/A	23	15	NRN	N/A

NRN = no reduction needed. Existing load below target load.

Appendix E

POTENTIAL POLLUTANT SOURCE IDENTIFICATION

Table Ap-1. Potential FC and *E. coli* Pollutant Sources in Reach 1 of the Little Salkehatchie River and Tributaries Watershed (WQM Station CSTL-115)

Reach Statiion	Source	Vicinity of Road/Street	County	Location in Watershed	Latitude	Longitude	Date Observed	Sourcce Notes
CSTL-115	Cattle	Hilda Road	Barnwell	Northwest	33.32845	-81.26389	1/16/2014	Pastured cattle
CSTL-115	Cattle	Honey Ford Road	Bamberg	Central	33.26404	-81.20248	1/16/2014	Cattle in pasture with pond
CSTL-115	Cattle	US 321	Bamberg	Central	33.26423	-81.15640	1/16/2014	Pastured cattle
CSTL-115	Cattle	Lodge Road	Bamberg	Southeast	33.14282	-81.00544	1/17/2014	Pastured cattle
CSTL-115	Cattle	US 601	Bamberg	Southeast	33.14771	-81.01166	1/17/2014	Pastured cattle
CSTL-115	Cattle	US 601	Bamberg	Southeast	33.14545	-81.01252	1/17/2014	Cattle in pasture near stream
CSTL-115	Deer	County Route S-5-23	Bamberg	Central	33.20255	-81.10214	1/16/2014	Deer stand in woods
CSTL-115	Deer	Macedonia Church Road	Bamberg	South	33.14474	-81.04570	1/17/2014	Deer stand in woods
CSTL-115	Dogs	SC 70	Bamberg	Northwest	33.29048	-81.23013	1/16/2014	Unattended dogs in pasture
CSTL-115	Dogs	SC 70	Bamberg	Northwest	33.29001	-81.23140	1/16/2014	Unattended dog in yard
CSTL-115	Donkeys	US 601	Bamberg	Southeast	33.14401	-81.01307	1/17/2014	Donkey in pasture with pond
CSTL-115	Goats	Ghents Branch Road	Bamberg	Northeast	33.31641	-81.19111	1/16/2014	Goats in pen near Ghents Branch
CSTL-115	Goats	Hilda Road	Barnwell	Northwest	33.32845	-81.26389	1/16/2014	Pastured goats feeding
CSTL-115	Goats	Mac Road	Bamberg	Central	33.22371	-81.04395	1/16/2014	Pastured goats
CSTL-115	Hogs	Hilda Road	Barnwell	Northwest	33.28485	-81.25397	1/16/2014	Hog in a pen in Hilda
CSTL-115	Horses	Hilda Road	Barnwell	Northwest	33.32845	-81.26389	1/16/2014	Pastured horses
CSTL-115	Horses	SC 70	Bamberg	Northwest	33.29048	-81.23024	1/16/2014	Pastured horses
CSTL-115	Horses	Macedonia Church Road	Bamberg	Southeast	33.14187	-81.02136	1/17/2014	Pastured horses with stable
CSTL-115	Horses	Colston Road	Bamberg	South	33.16526	-81.07989	1/17/2014	Horses in pasture near Colston Branch
CSTL-115	Horses	Homeplace Trail	Bamberg	South	33.11598	-81.05161	1/17/2014	Pastured horses with stable
CSTL-115	Manure	County Route S-5-23	Bamberg	Central	33.20255	-81.10214	1/16/2014	Manure pile in an agricultural field
CSTL-115	Ponies	US 601	Bamberg	Southeast	33.14401	-81.01307	1/17/2014	Pony in pasture with pond

Table Ap-2. Potential FC and *E. coli* Pollutant Sources in Reach 2 of the Little Salkehatchie River and Tributaries Watershed (WQM Station RS-08076)

Reach Statiion	Source	Vicinity of Road/Street	County	Location in Watershed	Latitude	Longitude	Date Observed	Source Notes
RS-08076	Cattle	U.S. Route 21	Colleton	Central	33.11846	-80.81013	1/23/2014	Pastured cattle near Steedly Branch
RS-08076	Cattle	Sizemore Road	Colleton	East	33.12020	-80.76974	1/23/2014	Pastured cattle near stream
RS-08076	Chickens	Mount Carmel Road	Colleton	South	33.05777	-80.79395	1/23/2014	Chickens in coop
RS-08076	Deer	Barr's Road	Bamberg	Northwest	33.15400	-80.84058	1/23/2014	Deer stand in woods
RS-08076	Deer	Buckhead Road	Bamberg	Northwest	33.17085	-80.86242	1/17/2014	Deer stand in woods
RS-08076	Deer	Buckhead Road	Colleton	West	33.12505	-80.84672	1/23/2014	Deer stand in woods
RS-08076	Deer	Orvis Road	Colleton	West	33.13588	-80.83280	1/23/2014	Deer stand in woods
RS-08076	Deer	Mill Pond Road	Colleton	South	33.05155	-80.79283	1/23/2014	Deer stand in woods
RS-08076	Deer	Uncle Bobs Lane	Colleton	South	33.02557	-80.79456	1/23/2014	Deer stand in woods
RS-08076	Dogs	Beulah Road	Colleton	Southwest	33.09003	-80.82087	1/23/2014	Unattended dogs in yard in Smoaks
RS-08076	Dogs	Smyly Road	Colleton	South	33.03449	-80.79289	1/23/2014	Unattended dogs in yard
RS-08076	Game	Gaskins Road	Bamberg	Northwest	33.16162	-80.87042	1/17/2014	Sign for a hunt club
RS-08076	Game	Beulah Road	Colleton	Southwest	33.09767	-80.82439	1/23/2014	A hunt club
RS-08076	Game	Lodge Highway	Colleton	Southwest	33.08863	-80.82452	1/23/2014	A hunt club
RS-08076	Game	Low Country Highway	Colleton	Southwest	33.07561	-80.81006	1/23/2014	A hunt club
RS-08076	Geese	Lodge Highway	Colleton	Southwest	33.08933	-80.81709	1/23/2014	Canadian geese in stream-fed pond
RS-08076	Goats	Buckhead Road	Bamberg	Northwest	33.16528	-80.86331	1/17/2014	Pastured goats near stream
RS-08076	Horses	Chreokee Drive	Colleton	West	33.12600	-80.83750	1/23/2014	Pastured horses
RS-08076	Horses	Chreokee Drive	Colleton	West	33.13032	-80.82361	1/23/2014	Horses in pasture with pond
RS-08076	Horses	Low Country Highway	Colleton	Southwest	33.08269	-80.81239	1/23/2014	Horse in pasture in Smoaks
RS-08076	Horses	Mount Carmel Road	Colleton	South	33.05599	-80.79263	1/23/2014	Pastured horses with stable

Table Ap-3. Potential FC and *E. coli* Pollutant Sources in Reach 3 of the Little Salkehatchie River and Tributaries Watershed (WQM Station CSTL-119)

Reach Station	Source	Vicinity of Road/Street	County	Location in Watershed	Latitude	Longitude	Date Observed	Source Notes
CSTL-119	Chickens	George Warren Drive	Colleton	West	33.03401	-80.84359	1/23/2014	Unattended chickens in yard in Williams
CSTL-119	Deer	Mill Pond rRoad	Colleton	Northwest	33.07630	-80.86224	1/23/2014	Deer stand in woods
CSTL-119	Deer	County Route S-15-543	Colleton	Southwest	32.99881	-80.83617	1/23/2014	Deer stand in woods
CSTL-119	Dogs	Duncan Drive	Colleton	West	33.03109	-80.84419	1/23/2014	Unattended dog in yard in Williams
CSTL-119	Dogs	George Warren Drive	Colleton	West	33.03401	-80.84359	1/23/2014	Unattended dog in yard in Williams
CSTL-119	Goats	Double Churches Road	Colleton	Central	33.00882	-80.82074	1/23/2014	Goats in pen in Ruffin
CSTL-119	Horses	Mill Pond rRoad	Colleton	Northwest	33.06643	-80.85225	1/23/2014	Horses in pasture near stream
CSTL-119	Horses	Pool Street	Colleton	Central	33.00290	-80.81483	1/23/2014	Horse and foals in pen in Ruffin
CSTL-119	Horses	Ruffin Road	Colleton	Central	33.00052	-80.80133	1/23/2014	Horses in pen with stable in Ruffin
CSTL-119	Turkeys	Sunflower Drive	Colleton	Northwest	33.07764	-80.84937	1/23/2014	Wild turkey in woods

Table Ap-4. Potential FC and *E. coli* Pollutant Sources in Reach 4 of the Little Salkehatchie River and Tributaries Watershed (WQM Station CSTL-117)

Reach Station	Source	Vicinity of Road/Street	County	Location in Watershed	Latitude	Longitude	Date Observed	Source Notes
CSTL-117	Cattle	County Route S-5-541	Bamberg	North	33.21784	-80.98366	1/17/2014	Cattle manure in pasture
CSTL-117	Cattle	Crider Road	Bamberg	North	33.24429	-80.99523	1/16/2014	Pastured cattle
CSTL-117	Cattle	George Allen Drive	Bamberg	North	33.20129	-81.01509	1/17/2014	Pastured cattle
CSTL-117	Cats	Brickle Street	Bamberg	Northeast	33.29094	-81.03375	1/16/2014	Unattended cat in street in Bamberg
CSTL-117	Cattle	Vorhees Road	Bamberg	Northwest	33.26748	-81.10512	1/16/2014	Pastured cattle
CSTL-117	Cattle	Lodge Road	Bamberg	West	33.13247	-80.97041	1/17/2014	Pastured cattle
CSTL-117	Cattle	Lodge Road	Bamberg	West	33.13940	-80.98822	1/17/2014	Pastured cattle near stream
CSTL-117	Cattle	Lodge Road	Bamberg	West	33.11621	-80.96350	1/17/2014	Pastured cattle
CSTL-117	Cattle	Morning Star Road	Colleton	Southwest	33.09752	-80.94557	1/17/2014	Pastured cattle
CSTL-117	Deer	Bethel Road	Bamberg	North	33.22259	-80.96763	1/17/2014	Deer stand in woods
CSTL-117	Deer	Boyd Road	Bamberg	East	33.16296	-80.92038	1/17/2014	Deer stand on edge of field
CSTL-117	Deer	Mays Road	Bamberg	East	33.19881	-80.94029	1/17/2014	Deer stand in power line right-of-way
CSTL-117	Deer	War Eagle Road	Bamberg	Southwest	33.07401	-80.91183	1/23/2014	Deer stand in woods
CSTL-117	Deer	War Eagle Road	Bamberg	Southwest	33.07401	-80.91183	1/23/2014	Deer stand in power line right-of-way
CSTL-117	Deer	Carters Ford Road	Colleton	South	32.99594	-80.88294	1/23/2014	Deer stand in woods
CSTL-117	Deer	County Route S-15-543	Colleton	South	32.99918	-80.85124	1/23/2014	Deer stand in field
CSTL-117	Dogs	Broxton Bridge Road	Bamberg	North	33.23897	-81.03203	1/16/2014	Unattended dogs in yard
CSTL-117	Dogs	Carlise Street	Bamberg	North	33.24797	-81.04052	1/16/2014	Unattended dog in yard
CSTL-117	Dogs	Deacon Road	Bamberg	North	33.24931	-80.99619	1/16/2014	Unattended dog in yard
CSTL-117	Dogs	Lake Drive	Bamberg	North	33.19204	-81.00846	1/17/2014	Unattended dog in yard near Clear Pond
CSTL-117	Dogs	Brickle Street	Bamberg	Northeast	33.29346	-81.03425	1/16/2014	Unattended dog in yard in Bamberg
CSTL-117	Dogs	Brickle Street	Bamberg	Northeast	33.29178	-81.03393	1/16/2014	Unattended dog in yard in Bamberg
CSTL-117	Dogs	Hunters Chapel Road	Bamberg	East	33.14734	-80.91501	1/17/2014	Unattended dog in yard
CSTL-117	Egret	Lodge Road	Bamberg	West	33.13901	-80.98583	1/17/2014	Egret in wetlands
CSTL-117	Game	Bethel Road	Bamberg	North	33.19723	-80.99745	1/17/2014	Sign for shooting preserve
CSTL-117	Game	County Route S-5-124	Bamberg	East	33.16760	-80.90782	1/17/2014	A hunt club
CSTL-117	Goats	Broxton Bridge Road	Bamberg	North	33.23897	-81.03203	1/16/2014	Goats in yard
CSTL-117	Goats	Harley Road	Bamberg	North	33.23885	-81.03124	1/16/2014	Goats in pen
CSTL-117	Goats	Hunters Chapel Road	Bamberg	East	33.14743	-80.91507	1/17/2014	Tethered goat in yard
CSTL-117	Goats	Lodge Road	Bamberg	West	33.11749	-80.96391	1/17/2014	Goats in pen near stream

Table Ap-4 (Continued). Potential FC and *E. coli* Pollutant Sources in Reach 4 of the Little Salkehatchie River and Tributaries Watershed (WQM Station CSTL-117)

Reach Station	Source	Vicinity of Road/Street	County	Location in Watershed	Latitude	Longitude	Date Observed	Source Notes
CSTL-117	Horses	Charleston-Augusta Road	Bamberg	Northeast	33.27228	-80.98490	1/16/2014	Horses in pen
CSTL-117	Horses	County Route S-5-124	Bamberg	East	33.16716	-80.90866	1/17/2014	Horse in pen near stream
CSTL-117	Horses	County Route S-5-124	Bamberg	East	33.16618	-80.90984	1/17/2014	Pastured horses near stream
CSTL-117	Horses	Ehrhardt Road	Bamberg	East	33.13083	-80.92679	1/17/2014	Pastured horses near stream
CSTL-117	Horses	Howell Mills Road	Bamberg	East	33.18796	-80.91893	1/17/2014	Pastured horses near stream
CSTL-117	Horses	Hunters Chapel Road	Bamberg	East	33.16760	-80.92509	1/17/2014	Pastured horses near Hurricane Branch
CSTL-117	Horses	Ehrhardt Road	Bamberg	West	33.12463	-80.97082	1/17/2014	Horse in pasture
CSTL-117	Horses	Ehrhardt Road	Bamberg	West	33.12116	-80.97958	1/17/2014	Pastured horses
CSTL-117	Horses	Howells Mill Road	Bamberg	West	33.13494	-80.96916	1/17/2014	Horse in pasture
CSTL-117	Horses	Carters Ford Road	Colleton	Southwest	33.05196	-80.91566	1/23/2014	Psstured horsed near stream
CSTL-117	Horses	Morning Star Road	Colleton	Southwest	33.08809	-80.93858	1/17/2014	Horses in pen near stream
CSTL-117	Horses	War Eagle Road	Bamberg	Southwest	33.07466	-80.90261	1/17/2014	Psstured horsed near stream
CSTL-117	Horses	War Eagle Road	Bamberg	Southwest	33.07401	-80.91183	1/23/2014	Pastured horses near stream

Appendix F

SOURCE ASSESSMENT PICTURES

Figure F-1

Sign for a hunt club (location: 33.16162 N, -80.87042 W) on Gaskins Road near Buckhead Creek in Bamberg County. Found in Reach 2 of the Little Salke-hatchie River and Tributaries (LSRT) Watershed (Date of photography: January 17, 2014). **Note:** Photography dates may differ from the date stamps on the photographs.

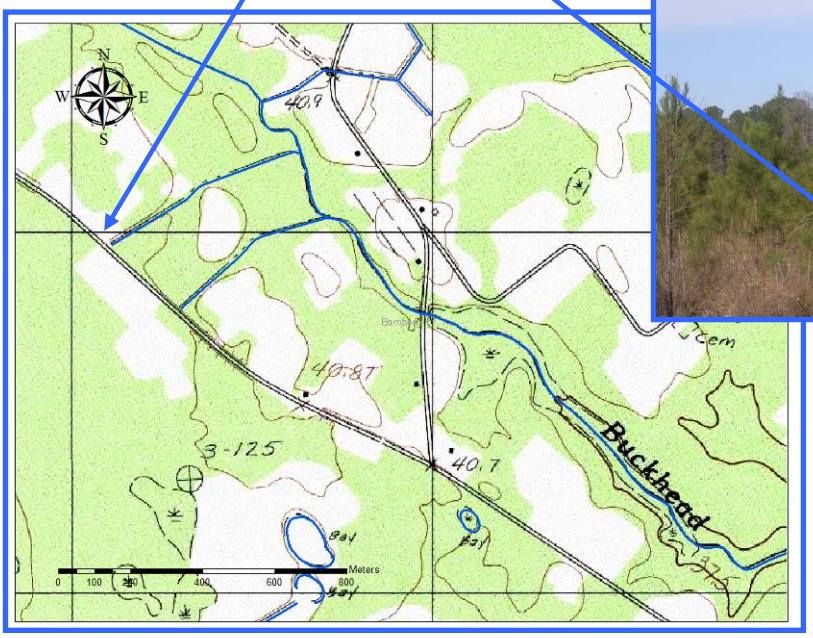
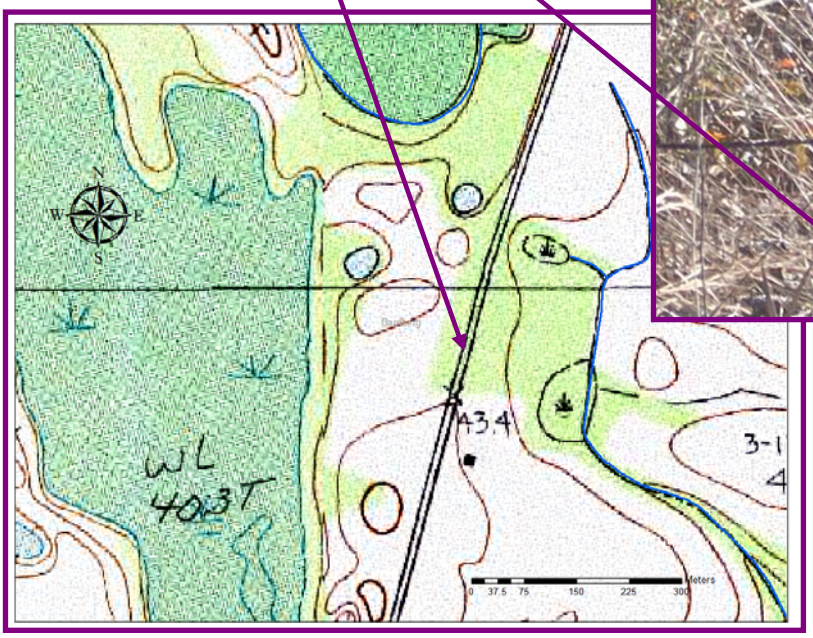


Figure F-2

A hunt club (location: 33.07561 N, -80.81006 W) on Lounty Country Highway in Colleton County. Found in Reach 2 of the LSRT Watershed (Date of photography: January 23, 2014).

Figure F-3

Sign for shooting preserve (location: 33.19723 N, -80.99745 W) on Bethel Road near wetlands in Bamberg County. Found in Reach 4 of the LSRT Watershed (Date of photography: January 17, 2014).



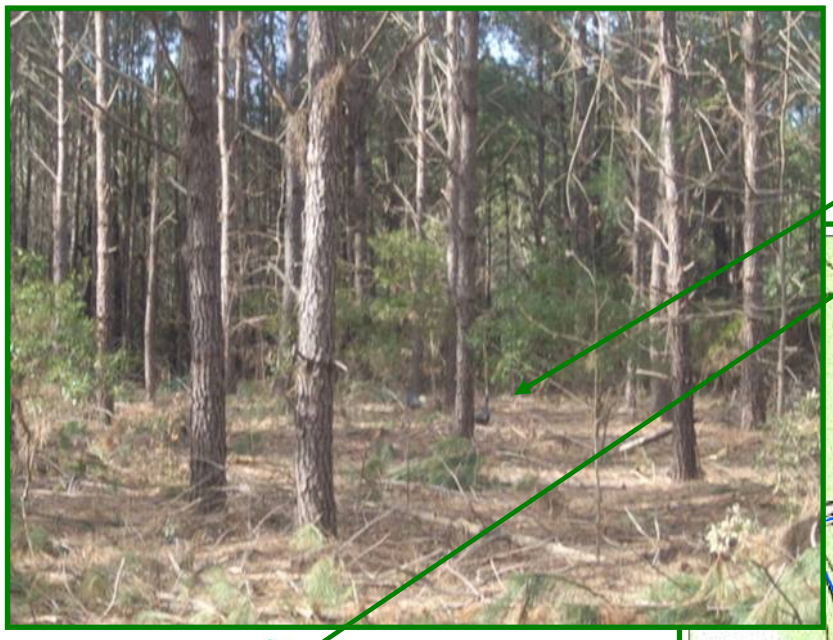


Figure F-4

Two wild turkeys in the woods (location: 33.07764 N, -80.84937 W) on Sunflower Drive in Colleton County. Found in Reach 3 of the LSRT Watershed (Date of photography: January 23, 2014).

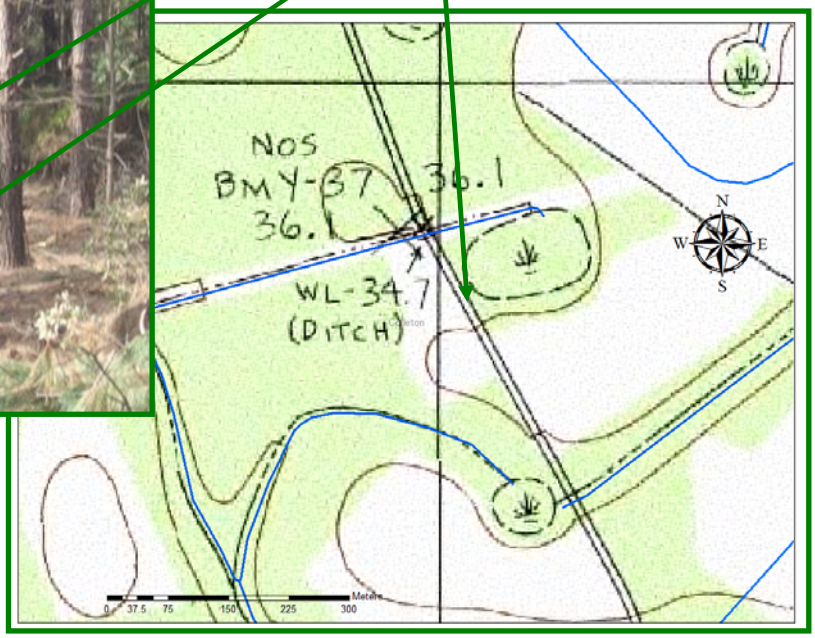


Figure F-5

Deer stand in woods (location: 33.20255 N, -80.10214 W) on County Route S-5-23 in Bamberg County. Found in Reach 1 of the LSRT Watershed (Date of photography: January 16, 2014).

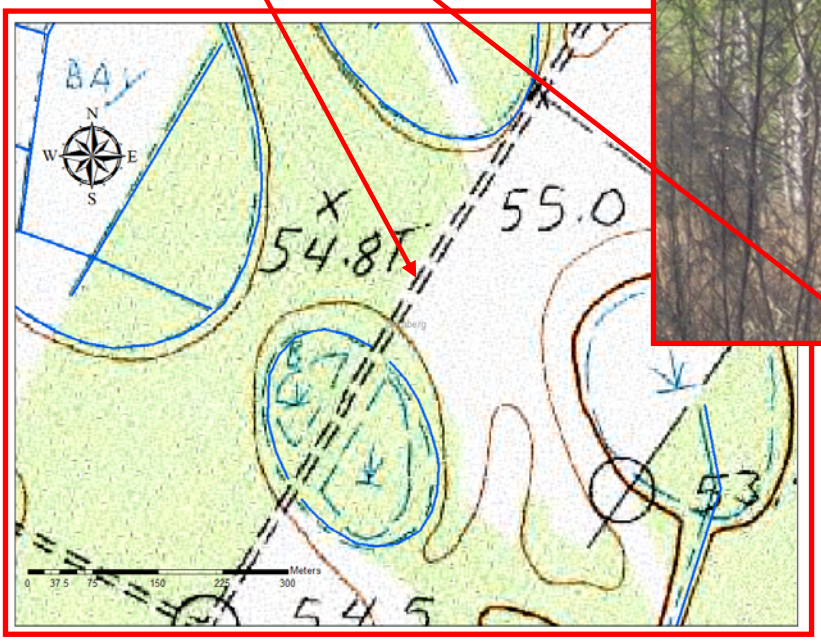


Figure F-6

Deer stand in woods (location: 33.02557 N, -80.79456 W) on Uncle Bobs Lane in Colleton County. Found in Reach 2 of the LSRT Watershed (Date of photography: January 23, 2014).

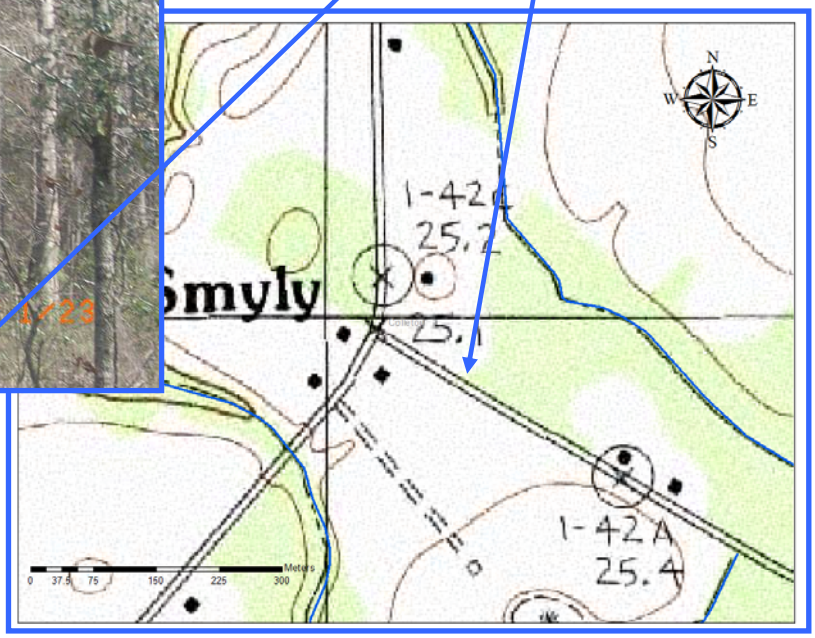


Figure F-7

Deer stand in power line right-of-way (location: 33.19881 N, -80.94029 W) on Mays Road in Bamberg County. Found in Reach 4 of the LSRT Watershed (Date of photography: January 17, 2014).

Figure F-8

Canadian geese in a stream-fed pond (location: 33.08933 N, -80.81709 W) on Lodge Highway in Colleton County. Found in Reach 2 of the LSRT Watershed (Date of photography: January 23, 2014).

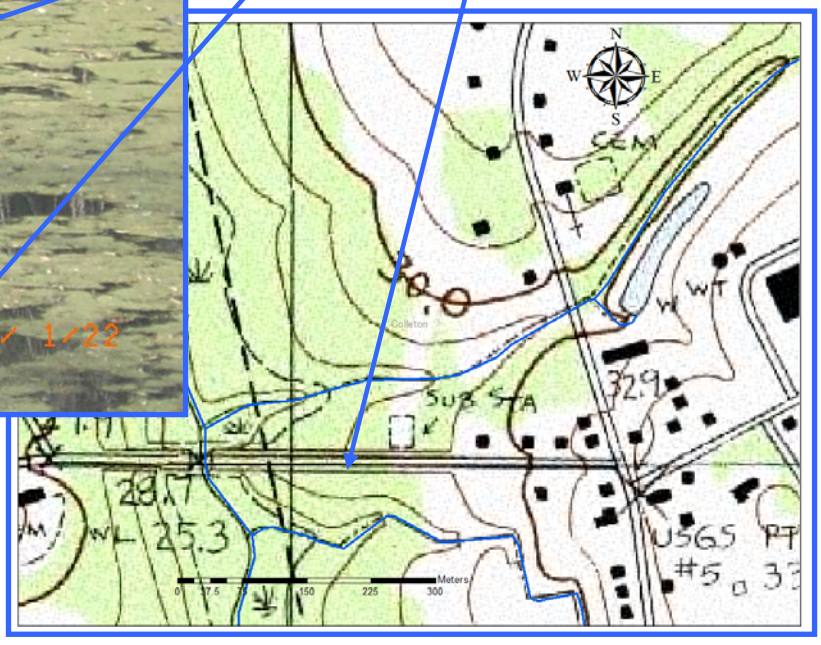


Figure F-9

An egret in a wetlands area (location: 33.99606 N, -80.41336 W) on Lodge Road in Bamberg County. Found in Reach 4 of the LSRT Watershed (Date of photography: January 17, 2014).

Figure F-10

Cattle in pasture with a pond (location: 33.26404 N, -80.20248 W) on Honey Ford Road in Bamberg County. Found in Reach 1 of the LSRT Watershed (Date of photography: January 16, 2014).

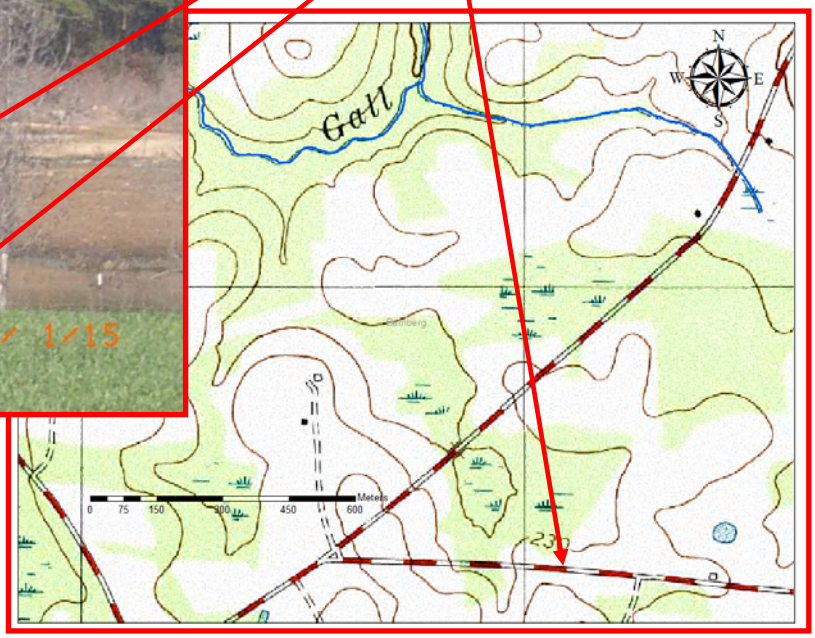


Figure F-11

Cattle in pasture near stream (location: 33.14545 N, -81.01252 W) on U.S. Route 601 in Bamberg County. Found in Reach 1 of the LSRT Watershed (Date of photography: January 17, 2014).

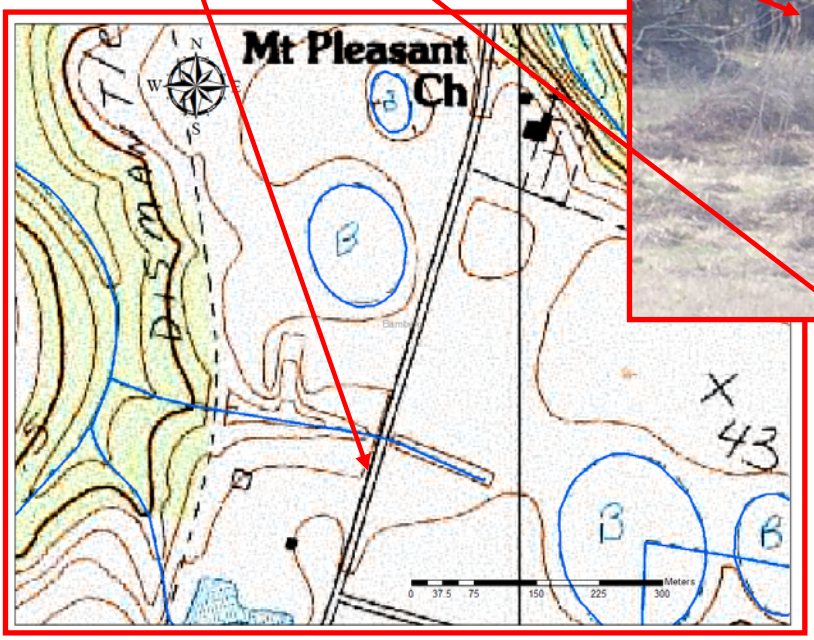


Figure F-12

Pastured cattle (location: 33.13247 N, -80.97041 W) on Lodge Road in Bamberg County. Found in Reach 4 of the LSRT Watershed (Date of photography: January 17, 2014).

Figure F-13

Pastured cattle near Steedly Branch (location: 33.11846 N, -80.81013 W) on U.S. Route 21 in Colleton County. Found in Reach 2 of the LSRT Watershed (Date of photography: January 23, 2014).

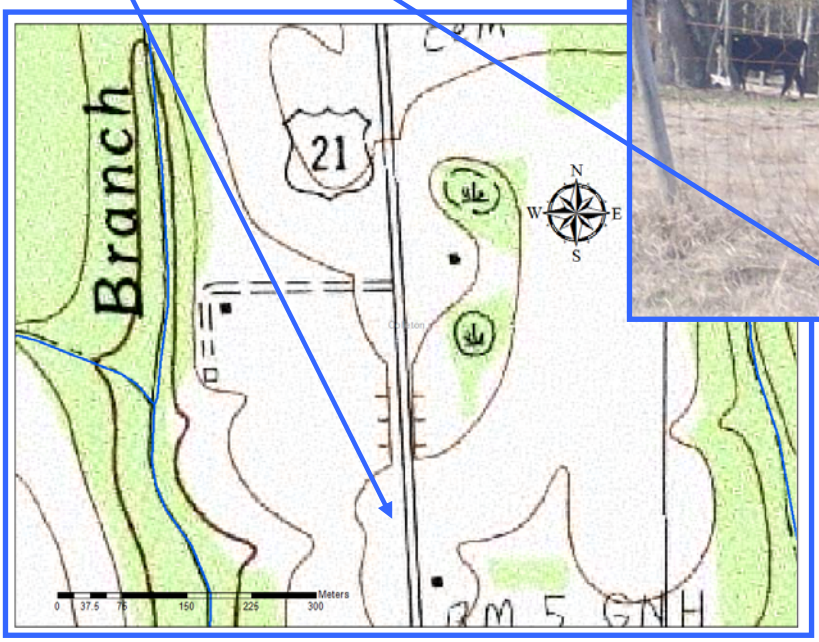


Figure F-14

Horses in pasture near Colston Branch (location: 33.16526 N, -81.07989 W) on Colston Road in Bamberg County. Found in Reach 1 of the LSRT Watershed (Date of photography: January 17, 2014).

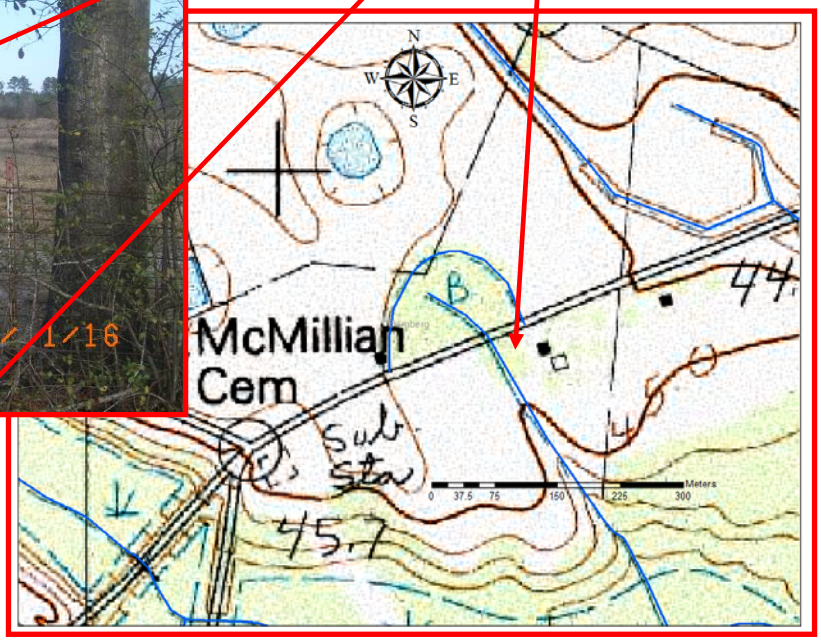


Figure F-15

Horses in pasture with pond (location: 33.82361 N, -80.13032 W) on Cherokee Drive in Colleton County. Found in Reach 2 of the LSRT Watershed (Date of photography: January 23, 2014).

Figure F-16

Horse and foals (location: 33.00290 N, -80.81483 W) on Pool Street in Ruffin in Colleton County. Found in Reach 3 of the LSRT Watershed (Date of photography: January 23, 2014).

Figure F-17

Pastured horses near Hurricane Branch (location: 33.16760 N, -80.92509 W) on Hunters Chapel Road in Bamberg County. Found in Reach 4 of the LSRT Watershed (Date of photography: January 17, 2014).

Figure F-18

Hog in a pen (location: 33.28485 N, -81.25397 W) on Hilda Road in Hilda, in Barnwell County. Found in Reach 1 of the LSRT Watershed (Date of photography: January 16, 2014).

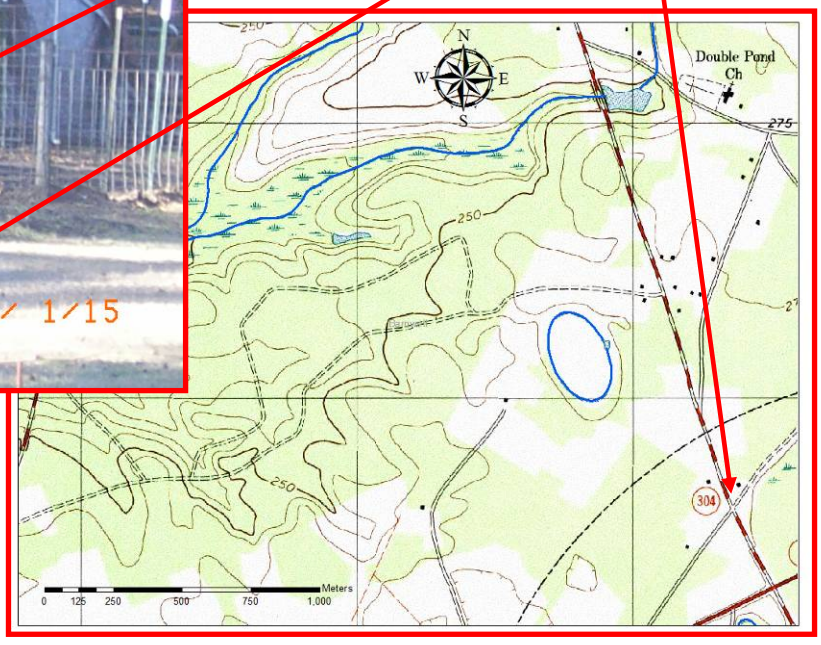


Figure F-19

Goats in pen near Ghents Branch (location: 33.31641 N, -81.19111 W) on Ghents Branch Road in Bamberg County. Found in Reach 1 of the LSRT Watershed (Date of photography: January 16, 2014).

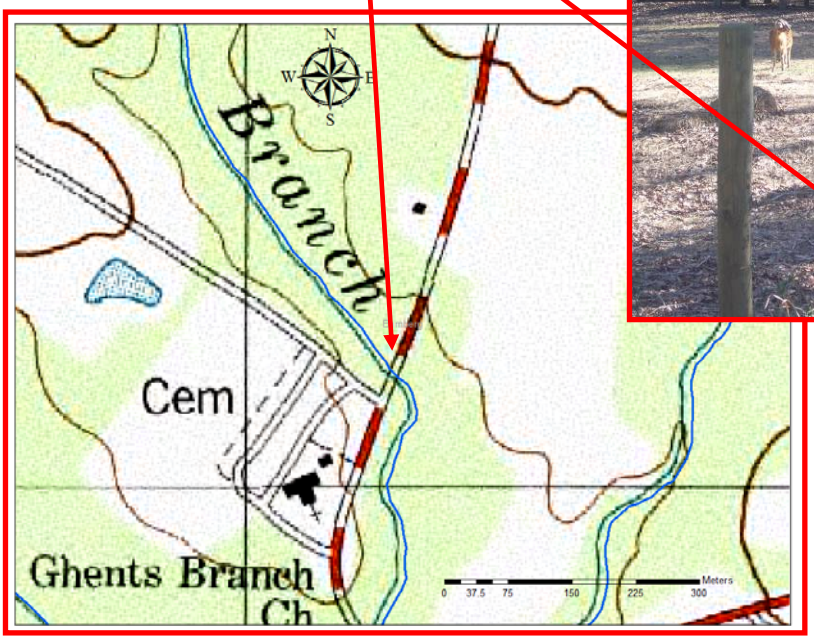


Figure F-20

Pastured goats near stream (location: 33.16528 N, -80.86331 W) on Buckhead Road in Bamberg County. Found in Reach 2 of the LSRT Watershed (Date of photography: January 17, 2014).

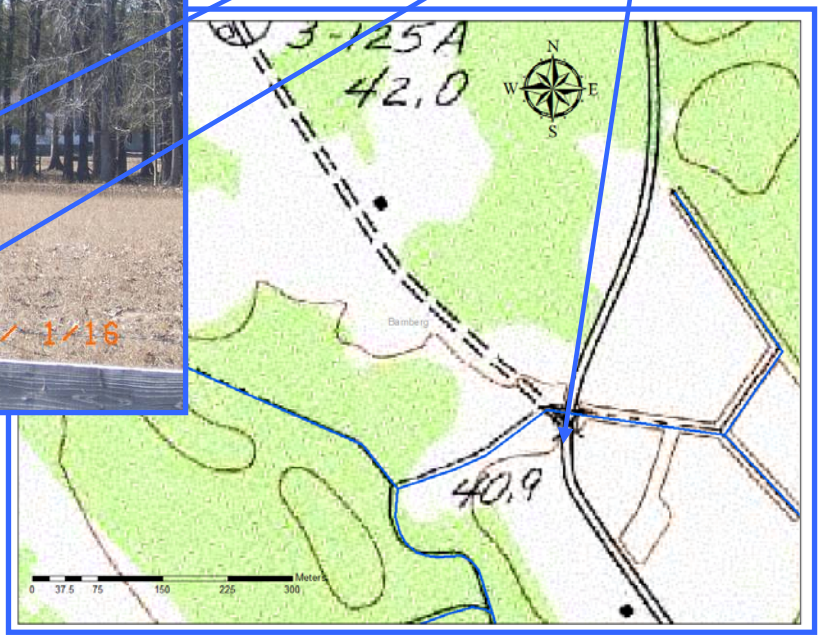


Figure F-21

Goats in pen near stream (location: 33.11749 N, -80.96391 W) on Lodge Road in Bamberg County. Found in Reach 4 of the LSRT Watershed (Date of photography: January 17, 2014).

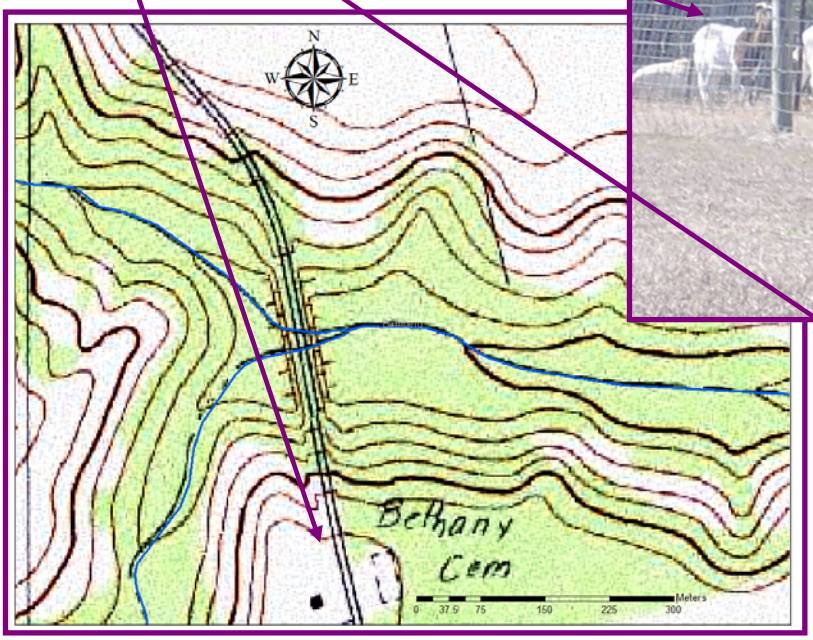


Figure F-22

Manure pile in an agricultural field (location: 33.20255 N, -81.10214 W) on County Route S-5_23 in Bamberg County. Found in Reach 1 of the LSRT Watershed (Date of photography: January 16, 2014).

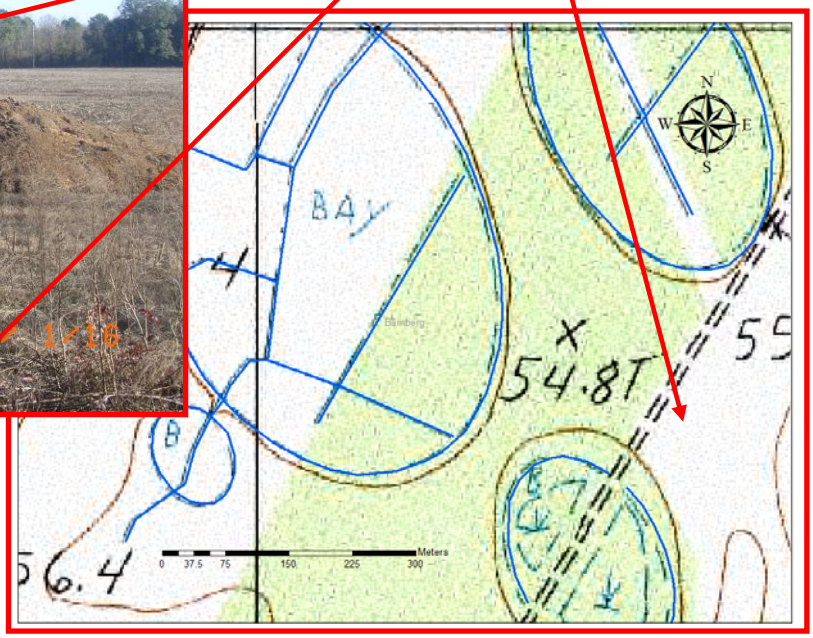
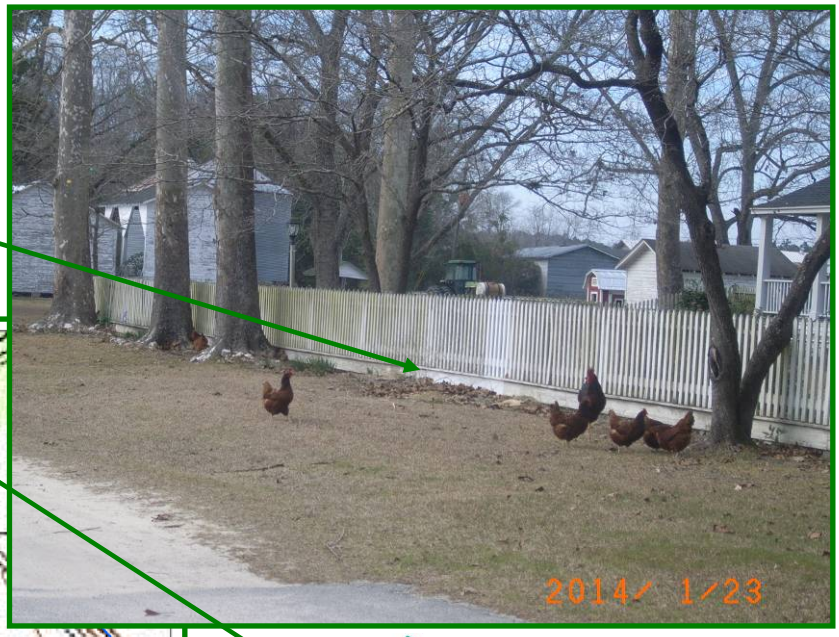


Figure F-23

Unattended chickens in yard (location: 33.03401 N, -80.84359 W) on George Warren Drive in Williams in Colleton County. Found in Reach 3 of the LSRT Watershed (Date of photography: January 23, 2014).



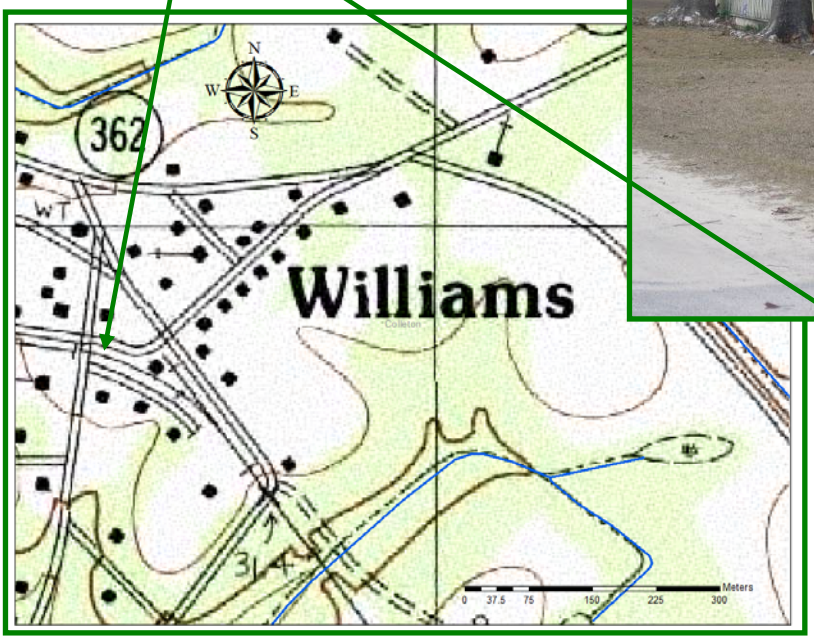


Figure F-24

Unattended cat in street (location: 33.29094 N, -81.03375 W) on Brickle Street in Bamberg in Bamberg County. Found in Reach 4 of the LSRT Watershed (Date of photography: January 16, 2014).

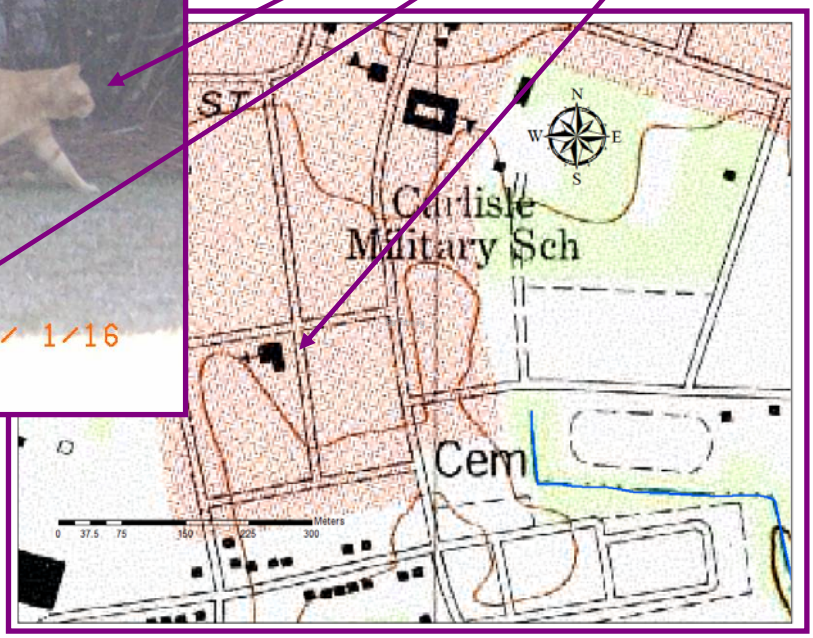


Figure F-25

Unattended dogs in yard (location: 33.09003 N, -80.82087 W) on Beulah Road in Smoaks in Colleton County. Found in Reach 2 of the LSRT Watershed (Date of photography: January 23, 2014).

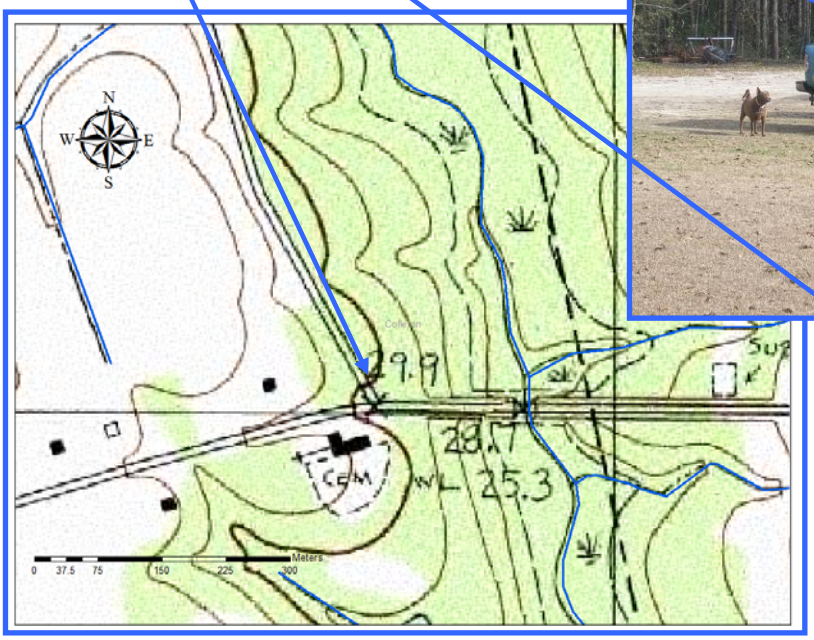
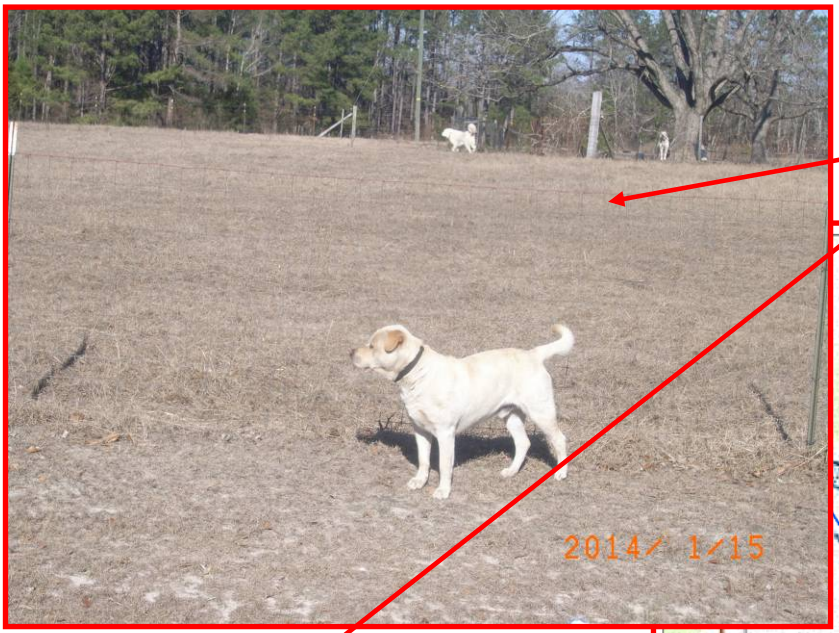


Figure F-26

Unattended dogs in pasture (location: 33.29048 N, -81.23013 W) on SC Route 70 in Bamberg County. Found in Reach 1 of the LSRT Watershed (Date of photography: January 16, 2014).



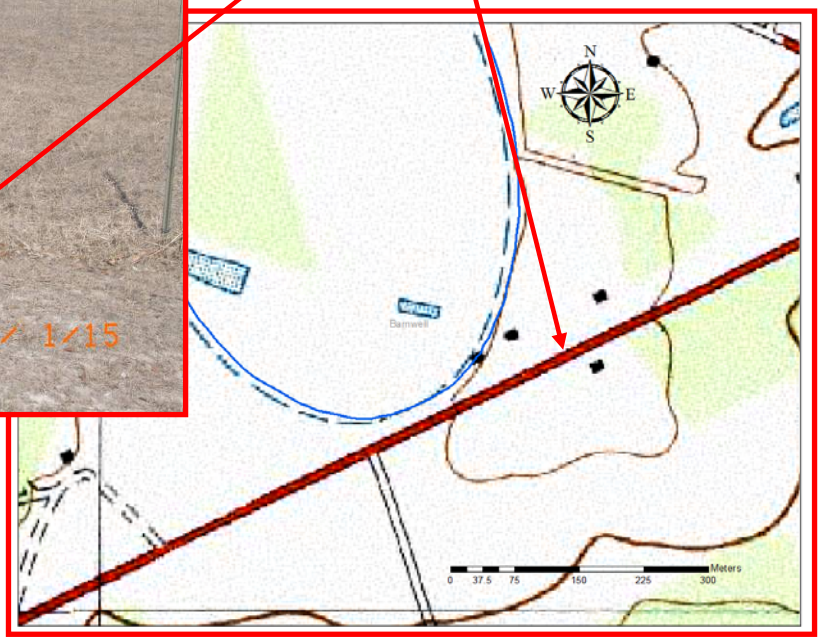


Figure F-27

Unattended dog in yard near Clear Pond (location: 33.19204 N, -81.00846 W) on Lake Drive in Bamberg County. Found in Reach 4 of the LSRT Watershed (Date of photography: January 17, 2014).