Total Maximum Daily Load Document
PD-072, Sparrow Swamp Watershed
(Hydrologic Unit Codes 030402020401, -03, and 05)
Fecal Coliform Bacteria,
Indicator for Pathogens

July 2011

Prepared for:

Bureau of Water

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Prepared by:

Harvey S. Daniel

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). A fecal coliform (FC) TMDL was developed for impaired station PD-072 within the Sparrow Swamp watershed located in Darlington County and Lee County, SC. One station along Sparrow Swamp and tributaries in Darlington County and Lee County, SC is included as impaired on the State's 2010 §303(d) list due to excessive fecal coliform numbers documented during the 2004-2008 assessment period. In addition, 21 percent of the samples collected between 1999-2008 at the impaired monitoring stations exceeded the water quality standards.

Probable sources of fecal contamination include direct loading of 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 (slightly below water quality standards) for Sparrow Swamp and tributaries, reductions in the existing loads of up to 19% will be necessary at station PD-072. For SCDOT, existing 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). 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 recognizes that **adaptive management/implementation** of this TMDL might be needed to achieve the water quality standard and we are committed towards targeting the load reductions to improve water quality in the Sparrow Swamp Watershed. As additional data and/or information become available, it may become necessary to revise and/or modify the TMDL target accordingly.

Table Ab-1. Total Maximum Daily Loads for the Sparrow Swamp Watershed. Loads are expressed as colony forming units (cfu) per day.

				Waste load Allocation (WLA)		Load Allocation (LA)	
Station	Existing Load (cfu/day)	TMDL (cfu/day)	Margin of Safety (MOS) (cfu/day)	Continuous Source[1] (cfu/day)	Non-Continuous Sources[2,3,4] (% Reduction)	Load Allocation (cfu/day)	% Reduction to Meet LA[3]
PD-072	5.54E+11	4.72E+11	2.36E+10	See Note Below	19	4.49E+11	19

Table Notes:

1. WLAs are expressed as a daily maximum. Existing and future continuous discharges are required to meet the prescribed loading for the pollutant of concern. Loadings were developed based upon permitted flow and an allowable permitted maximum concentration of 400cfu/100ml.
2. Percent reduction applies to all NPDES-permitted stormwater discharges, including current and future MS4, construction and industrial discharges covered under permits numbered SCS & SCR. Stormwater discharges are expressed as a percentage reduction due to the uncertain nature of stormwater discharge volumes and recurrence intervals. Stormwater discharges are required to meet percentage reduction or the existing instream standard for pollutant of concern in accordance with their NPDES Permit.
3. Percent reduction applies to existing instream load.
4. By implementing the best management practices that are prescribed in either the SCDOT annual SWMP or the SCDOT MS4 Permit to address fecal coliform, the SCDOT will comply with this TMDL and its applicable WLA to the maximum extent practicable (MEP) as required by its MS4 permit.

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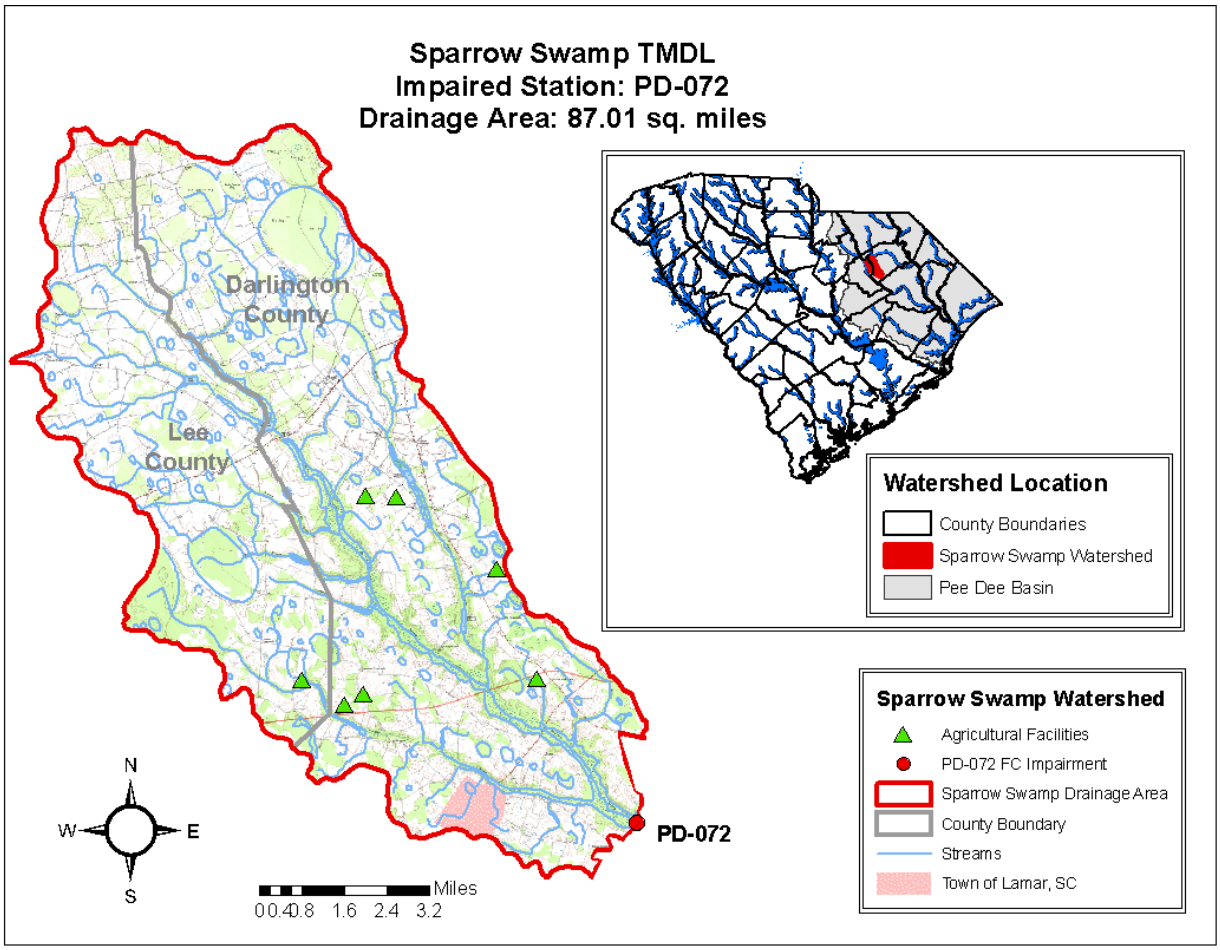
1.0 Introduction

1.1 Background

FC bacteria are widely used as an indicator of pathogens in surface waters and wastewater. Acute gastrointestinal illnesses caused by pathogens affect millions of people in the United States and cause billions of dollars of costs each year (Gaffield et al. 2003). Of these illnesses many are caused by contaminated drinking water. Untreated stormwater runoff has been associated with a number of disease outbreaks, most notably an outbreak in Milwaukee that caused many deaths in 1993.

Though occurring at low levels from natural sources, the concentration of FC bacteria can be elevated in water bodies as the result of pollution. Sources of FC bacteria are usually diffuse or nonpoint in nature and originate from stormwater runoff, failing septic systems, agricultural runoff, leaking sewers among other sources. Occasionally, the source of the pollutant is a point source. Section 303(d) of the 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

Figure 1. PD-072 Station Impaired with Excessive FC Numbers



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).

The State of South Carolina has placed one monitoring station in the Sparrow Swamp Watershed on South Carolina's 2010 §303(d) list for impairment due to FC bacteria. This station is identified in Table 1 and Figure 1.

Table 1. Sparrow Swamp Watershed FC Impaired Waters.

Waterbody	Station Number	Description
Sparrow Swamp	PD-072	Sparrow Swamp at S-16-697, 2.5 miles east of Lamar, South Carolina

1.2 Watershed Description

The Sparrow Swamp Watershed consists of Sparrow Swamp and its tributaries and is located in Darlington and Lee Counties. The watershed occupies 87.0 mi^2 (55,685.5 acres) of the Southeastern Plains ecoregion of South Carolina. Sparrow Swamp drains into the Lynches River approximately 5.6 miles south of the city of Florence, South Carolina. There is approximately a total of 238 stream miles in the watershed and they are all classified as freshwater.

Land use within the Sparrow Swamp Watershed is predominately cultivated crops (47%), and wetlands and open waters (23%) (Table 2). Developed lands (residential, commercial, industrial, or open urban space) only comprise approximately 7% of the watershed.

1.3 Water Quality Standard

The impaired stream segments of the Sparrow Swamp basin are designated as Class Freshwater. Waters of this class are described as:

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

South Carolina's Water Quality Standard (WQS) for FC in freshwater is:

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

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

Figure 2. SCDHEC Impaired Monitoring Station PD-072 Land Use Diagram

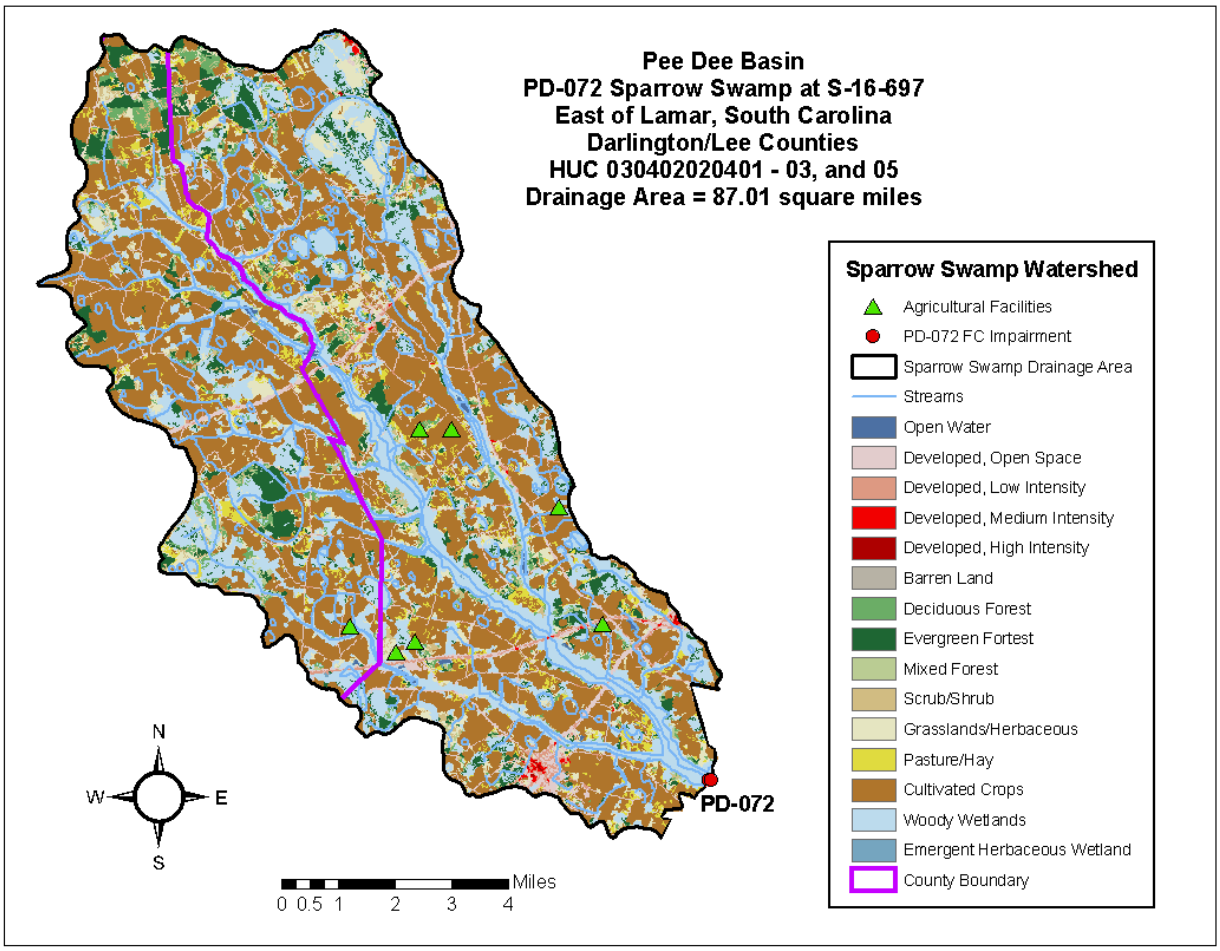


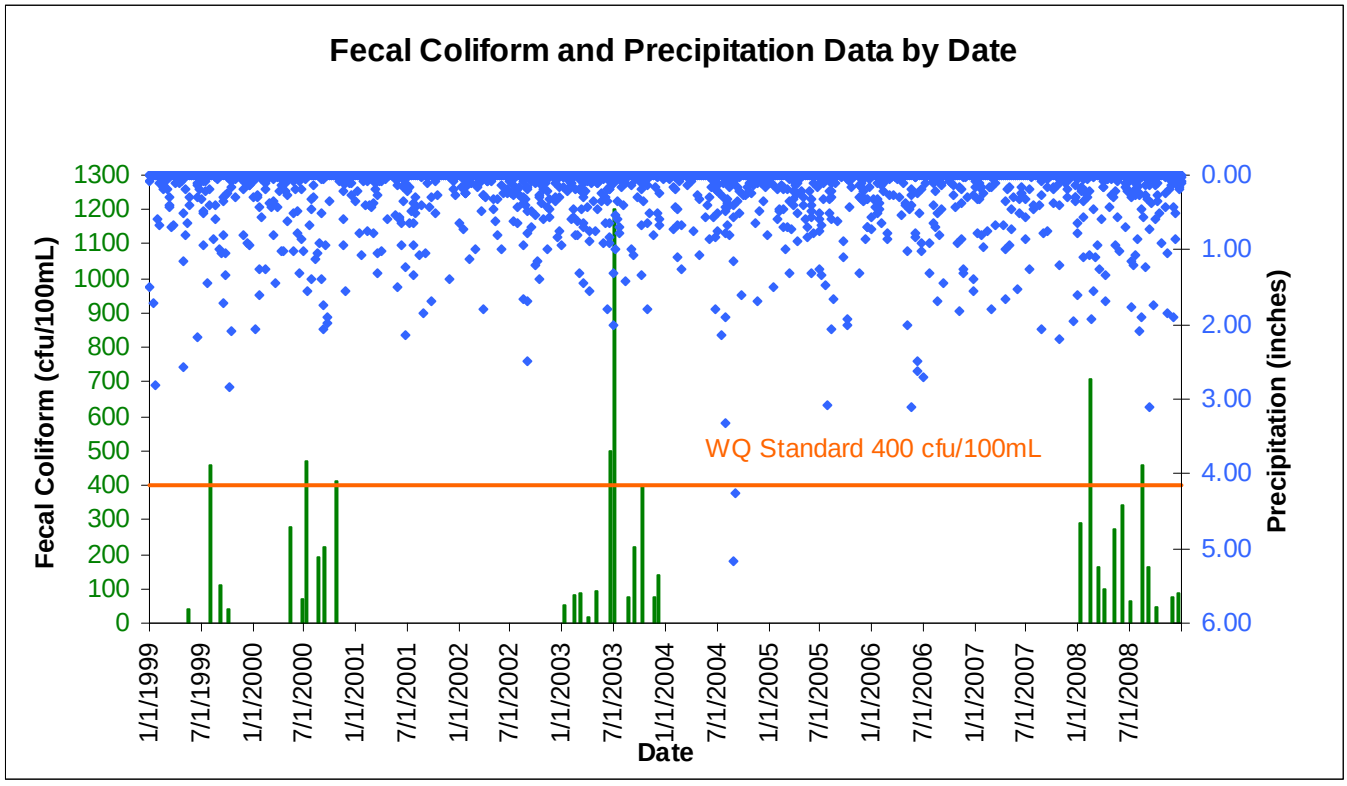
Table 2. Sparrow Swamp Watershed Land Use (derived from National Land Cover Database (NLCD) 2001)

Land use	Darlington County Watershed (Acres)	Lee County Watershed (Acres)	Total Watershed (Acres)	Total Mile^2	%
Pasture/Hay	1256	731	1987	3.10	4
Developed (residential, commercial, industrial)	2826	912	3738	5.84	7
Forest or otherwise vegetated (non-cultivated)	7010	3782	10,792	16.86	19
Wetlands/Open Water	9168	3623	12,791	19.99	23
Cultivated Crops	16,273	10,105	26,378	41.22	47
Total	**36,533**	**19,153**	**55,686**	**87.01**	**100**

2.0 WATER QUALITY ASSESSMENT

The South Carolina Department of Health and Environmental Control (SCDHEC) conducts monitoring at only one station within the Sparrow Swamp Watershed (SCDHEC 2007). Monitoring is conducted at station PD-072. 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 WQS for FC bacteria. Waters with more than 10% of samples greater than 400 cfu/100 ml are considered impaired for FC bacteria and placed on South Carolina's §303(d) list[1]. The PD-072 location is considered impaired due to FC WQS exceedences. Table 3 provides a summary of number of samples collected, number of exceedences and exceedence percentage. Figure 3 illustrates precipitation and FC by data and date. The graph shows that there is little to no correlation between the amount of precipitation and the temporal FC exceedences of water quality standards.

Figure 3. Precipitation and FC Data by Date



[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% standard (400/100 mL).

Table 3. FC WQS Exceedence Summary for Impaired Station (1999-2008)

Station	Waterbody	Number of Samples	Number Samples >400/100mL	% Samples Exceed WQS
PD-072	Sparrow Swamp	34	7	21%

3.0 SOURCE ASSESSMENT AND LOAD ALLOCATION

FC bacteria are used by the State of South Carolina as the indicator for pathogens in surface waters. Pathogens, which are usually difficult to detect, cause disease and make full body contact recreation in lakes and streams a risk to public health. Indicators such as FC bacteria, enteroccoci, or *E. coli* are easier to measure, have similar sources as pathogens, and persist in surface waters for a similar or longer length of time. These bacteria are not in themselves disease causing, but indicate the potential presence of organisms that may result in sickness.

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 continuous point sources are required by the CWA to obtain an NPDES permit to discharge treated process or sanitary effluent. In South Carolina NPDES permits require that dischargers of sanitary wastewater must meet the state standard for FC at the point of discharge. Municipal and private sanitary wastewater treatment facilities may occasionally be sources of pathogen or FC bacteria pollution. 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.

Non-continuous point sources required to obtain NPDES permits that may be a source of pathogens include Municipal Separate Storm Sewer Systems (MS4s) and stormwater discharges from construction or industrial sites. And, the operator of an MS4 will require an NPDES permit for storm water discharges from industrial and construction activities under the NPDES Stormwater regulations, if that operator engages in industrial and construction activities under the 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 FC bacteria impairment.

3.1 Point Sources

3.1.1 Continuous Point Sources

There are no continuous point sources within the Sparrow Swamp Watershed at the current time. Future NPDES discharges in the referenced watershed are required to implement the WLA and demonstrate consistency with the assumptions and requirements of the TMDL. While the City of Lamar may contain the sanitary sewer collection system in the watershed, there are there are no continuous point sources within the Sparrow Swamp Watershed at the current time. The City of Lamar currently has an NPDES permit to discharge treated wastewater from the treatment plant into the Lynches River (permit number: SC0043702). However, the discharge point is outside of the TMDL watershed. For the purposes of this TMDL, no WLA was provided for Lamar.

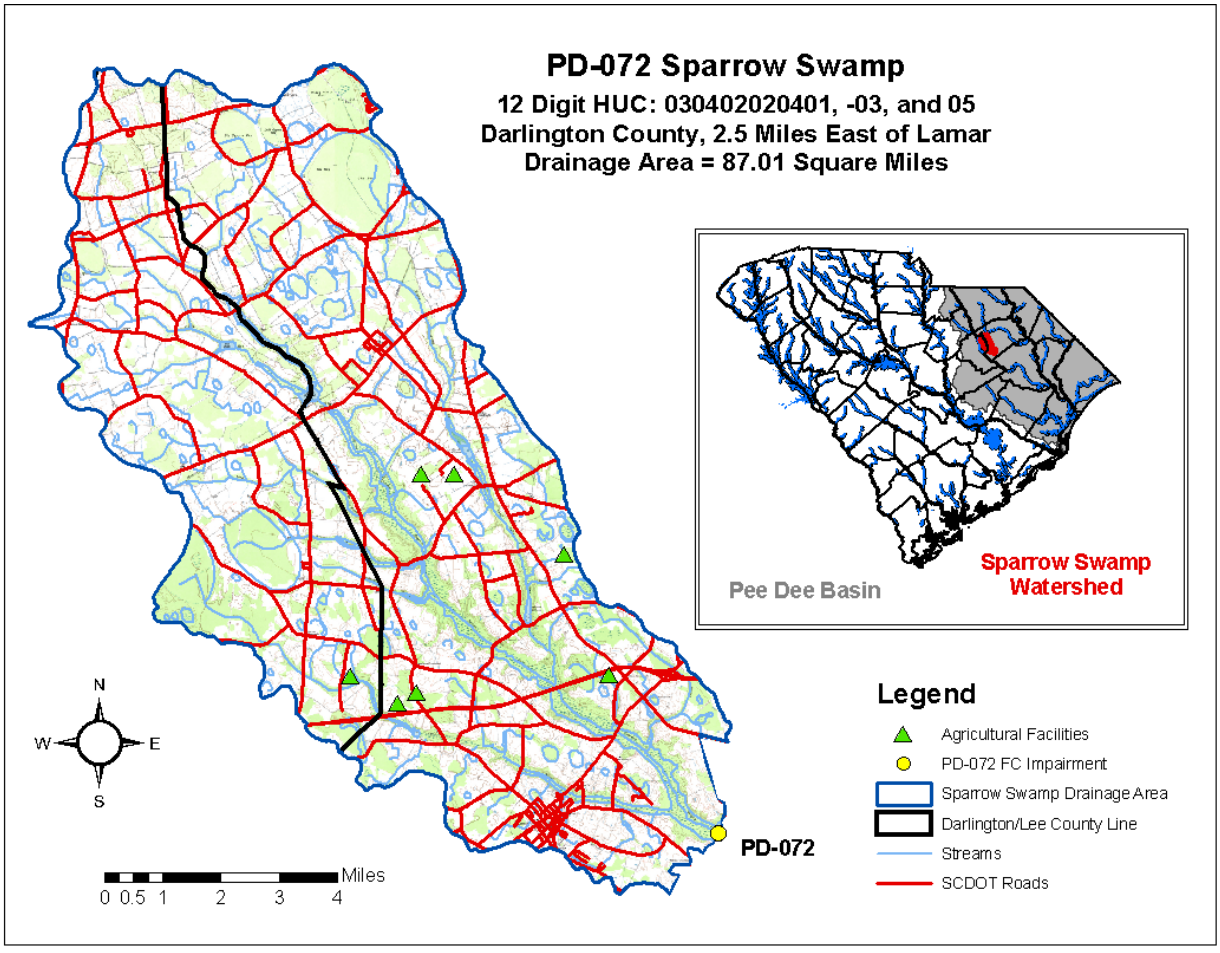
3.1.2 Non-Continuous Point Sources

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 regulated under South Carolina *Water Pollution Control Permits* Regulation 122.26(b)(14)&(15). All regulated MS4 entities have the potential to contribute FC pollutant loadings in the delineated drainage area used in the development of this TMDL.

The South Carolina Department of Transportation (SCDOT) is currently the only designated Municipal Separate Storm Sewer System (MS4) within the Sparrow Swamp Watershed. The SCDOT operates under NPDES MS4 Permit SCS040001 and owns and operates approximately 210 miles of roads within the watershed (Figure 4). However, the Department recognizes that 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.

Current Developed land use for the Sparrow Swamp Watershed is 7%. Based on current Geographic Information System (GIS) information (available at time of TMDL development) there are currently no SCDOT facilities located in the referenced watershed area. And, based on the SCDOT website, there are no highway rest areas in the watershed area.

Figure 4. SCDOT Owned and Maintained Roads in Sparrow Swamp Watershed



Other than SCDOT owned and/or operated storm sewer systems, there are currently no permitted sanitary sewer or stormwater systems that discharge in this watershed. Future permitted sanitary sewer or

stormwater systems in the referenced watershed are required to comply with the load reductions prescribed in the WLA and demonstrate consistency with the assumptions and requirements of the TMDL.

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 Storm Water 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 TMDL. Note that there may be other stormwater discharges not covered under permits numbered SCS and SCR that occur in the referenced watershed. These activities are not subject to the WLA portion of the TMDL.

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 no part of the Sparrow Swamp Watershed is serviced by a community collection system.

The Department acknowledges that progress with the assumptions and requirements of the TMDL by MS4s is expected to take one or more permit iteration. Progress towards achieving the WLA reduction for the TMDL 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

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 the permitted area) of the Sparrow Swamp Watershed. Nonpoint sources located in unregulated areas are subject to the load allocation and not the waste load allocation of the TMDL document.

3.2.1 Wildlife

Wildlife (mammals and birds) can be a significant contributor of 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. According to a study conducted by the SCDNR in 2008, there are an estimated 30 deer per square mile within Darlington County and Lee County (SCDNR 2008). The study estimated deer density based on suitable habitat (forests, croplands, and pastures). The FC production rate for deer has been shown to be 347×10^6 cfu/head-day in a study conducted by Yagow (1999), of which only a portion will enter the Sparrow Swamp Watershed. Wildlife may contribute a significant portion of the overall FC load within the watershed.

3.2.2 Agricultural Activities

Agricultural activities that involve livestock or animal wastes are potential sources of FC contamination of surface waters. Fecal matter can enter the waterway via runoff from the land or by direct deposition into the stream. Agricultural activities may represent a significant source in the Sparrow Swamp 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.

There are currently seven active (AFOs) with regulated structures or activities in the Sparrow Swamp Watershed (Table 4). These facilities consist of three turkey operations and four poultry operations and are located within the Sparrow Swamp watershed. The three turkey operations are considered AFOs and the four poultry operations are considered according to Section 122.23 of South Carolina Regulation 61-9, *Water Pollution Control Permits*. There may also be land application sites associated with these facilities. 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.

Table 4. Active Animal Feeding Operations with Regulated Structures or Activities within the Sparrow Swamp Watershed.

Downstream Impaired	AFO Permit	Facility	Type of Livestock	Number of Permitted Animals	Total Permitted Acres
PD-072	ND0072974	Collins Broiler Facility	Poultry (Broilers)	180,000	NA
PD-072	ND0075736	Howell Brooder Facility #1	Turkey	25,000	NA
PD-072	ND0075736	Howell Grow-Out Facility #1	Turkey (Grow-Out)	45,000	NA
PD-072	ND0079715	Jimmy Freeman Broiler Facility	Poultry (Broilers)	118,000	NA
PD-072	ND0084697	Mark White Farms	Poultry (Broilers)	120,000	NA
PD-072	ND0064653	Watford Turkey farm	Turkey	45,000	NA
PD-072	ND0079880	Yarborough Poultry Facility	Poultry (Broilers)	236,000	NA

NA = not available

3.2.2.2 Grazing Animals

Livestock, especially cattle, are frequently major contributors of FC bacteria 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 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 Sparrow Swamp Watershed is likely to be a significant source of FC. However, the grazing of unconfined livestock (in pastures) is not regulated by the SCDHEC.

The United States Department of Agriculture's National Agricultural Statistics Service reported 3414 and 2925 cattle and calves in Darlington County and Lee County respectively in 2007 (USDA 2009). According to the NLCD 2001, there are 13,034 and 12,580 acres of pasture land in Darlington County and Lee County, respectively. This relates to 0.26 and 0.23 cattle per acre of pasture land in Darlington County and Lee County, respectively, assuming an even distribution of cattle across pasture land in the counties. There are 1256 acres of pasture land in the Darlington County portion of the Sparrow Swamp Watershed; and, there are 731 acres of pasture land in the Lee County portion of the watershed. This relates to 327 and 168 cattle in the Darlington County and Lee County portions, respectively, again assuming an even distribution of cattle across pasture land in the counties. This relates to an estimated 495 cattle and calves within the watershed, which combined produces an average of 4.95E+13 cfu/day of FC bacteria.

3.2.3 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. Typical values of FC in untreated domestic wastewater range from 10^4 to 10^6 MPN (Most Probable Number)/100mL (Metcalf and Eddy 1991).

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 SCDOT, there are currently no entities subject to NPDES MS4 permit within or with impact to the Sparrow Swamp Watershed.

3.2.4 Failing Septic Systems

Studies demonstrate that wastewater located four feet below properly functioning septic systems contain on average less than one FC bacteria organism per 100 mL (Ayres Associates 1993). Failed or non-conforming septic systems, however, can be a major contributor of FC to Sparrow Swamp and tributaries. 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.

Based on the 2000 U.S. population census, there are an estimated 28,942 households with 67,394 people within Darlington County; and, 7670 households with 20,119 people within Lee County. Therefore, based on the census, it is estimated that there are 2901 households with a total population of 6744 people within the Sparrow Swamp Watershed. Based on GIS information, 810 households within the watershed are serviced by the City of Lamar sewer system. Assuming that households not serviced by a sewer system rely on septic tanks, and assuming one septic tank per household, it is estimated that there are 2091 septic tanks with the watershed. At the time of TMDL development, their status in relation to function is unknown.

3.2.5 Urban Runoff

Dogs, cats, and other domesticated pets are the primary source of FC deposited on the urban landscape. There are also 'urban' wildlife, squirrels, raccoons, pigeons, and other birds, all of which contribute to the FC load. The Town of Lamar is located in the downstream portion of the Sparrow Swamp Watershed. The incorporated area of Lamar occupies 1.14 square miles, and represents only 1% of the watershed. However, given the impervious areas and well-defined storm water conveyances in urban areas, the town could be a contributing source of FC to the watershed. The Town of Lamar is not a designated MS4.

Similar to regulated MS4s, potentially designated MS4 entities (as listed in FR 64, 235, p.68837) or other unregulated MS4 communities located in the Sparrow Swamp Watershed may have the potential to contribute FC bacteria in stormwater runoff.

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. The United States Geological Survey (USGS) gage used for collecting "real-time" flow data was the Black Creek gage near

Hartsville, South Carolina (Gage Number: 02130910). This gage began recording daily flows in 1960 and provides the flow data required to establish flow duration curves for the impaired station.

Flow data for a ten-year period (1999-2008) from the USGS Hartsville gage was used to establish flow duration curves. 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 Hartsville gage records flow from 173 square miles (sq mi). The cumulative drainage area at monitoring station PD-073 (Sparrow Swamp at S-16-697, 2.5 miles east of Lamar, South Carolina) is approximately 87 sq mi, or 50% of the area drained at the Hartsville gage. Mean daily flow for the PD-072 monitoring location was assumed to be 50% of the daily flow at the Hartsville gage. Figure 3 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.

A flow duration curve was 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 curve was 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.

A target load-duration curve was created by calculating the allowable load using daily flow, the 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 water quality criteria 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 PD-072 is presented in Figure 5 as an example.

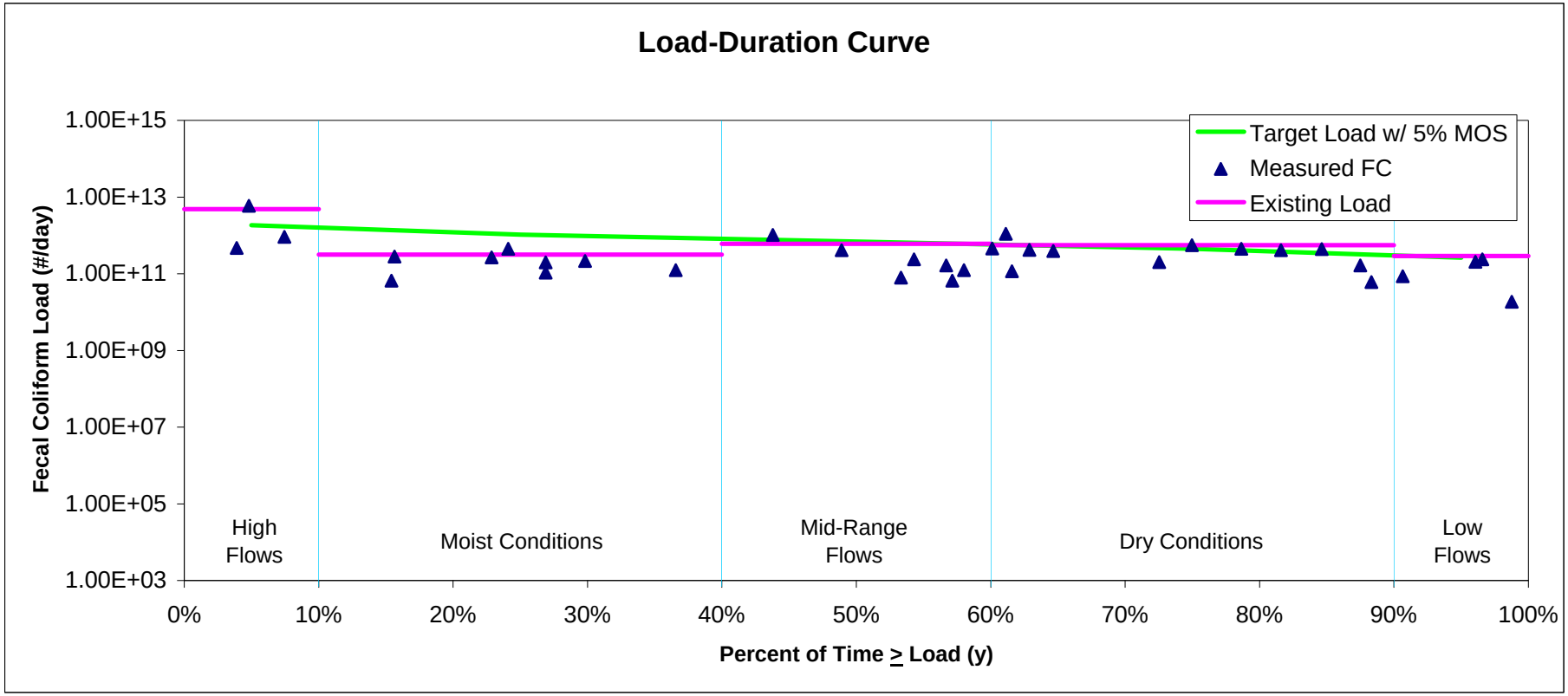
For the load duration curve, the independent variable (X-Axis) represents the percentage of estimated flows greater than value x. The dependent variable (Y-Axis) represent the FC loading at each estimated flow expressed in terms of colony forming units per day (cfu/day). In each defined flow interval, existing and target loadings were calculated by the following equations:

Existing Load = Mid-Point Flow in Each Hydrologic Category *x* 90^{th} Percentile FC Concentration *x* Conversion Factor (24465758.4)

Target Load = Mid-Point Flow in Each Hydrologic Category *x* 380 (WQ criterion minus a 5% MOS) x Conversion Factor (24465758.4)

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

Figure 5. Load Duration Curve for Sparrow Swamp Station PD-072



Instantaneous loads for each of the impaired stations were calculated. Measured FC concentrations from 1999 through 2008 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 4). Only the instantaneous water quality criterion was targeted because there is insufficient data to evaluate against the 30-day geometric mean.

An existing load was determined for each hydrologic category for the TMDL calculations. The 90th percentile of measured FC concentration within each hydrologic category was 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 for station PD-072 in Figure 4. 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

This TMDL is 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 5 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 Sparrow Swamp Watershed pathogen impaired segments are listed in Table 5. This data indicates that for station PD-072, dry conditions result in larger bacteria loads and is therefore the critical condition for this station.

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. 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 station PD-072 is provided in Appendix A.

Table 5. Percent Reduction Necessary to Achieve Target Load by Hydrologic Category.

Station	Waterbody	Moist Conditions	Mid-Range Flow	Dry Conditions
PD-072	Sparrow Swamp	NRN	NRN	19

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

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 this TMDL.

5.3.1 Continuous Point Sources

There are currently no permitted domestic dischargers in the Sparrow Swamp Watershed. Future continuous discharges are required to meet the prescribed loading for the pollutant of concern based on permitted flow and an allowable permitted maximum concentration of 400cfu/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 South Carolina *Water Pollution Control Permits* Regulation 122.26(b)(14) & (15) (SCDHEC 2003). 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. Other non-urbanized areas may be required under the NPDES Phase II Stormwater Regulations to obtain a permit for the discharge of stormwater. At the time of the TMDL development, no part of the Sparrow Swamp Watershed is classified as urbanized area.

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 6 presents the reduction needed for the impaired segment. The reduction percentages in this TMDL also apply to the FC waste load attributable to those areas of the watershed that are covered or will be covered under NPDES MS4 permits. 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 this TMDL.

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.

Table 6. Percent Reduction Necessary to Achieve Target Load.

Station	Waterbody	% Reduction
PD-072	Sparrow Swamp	19

Compliance with terms and conditions of existing and future NPDES sanitary and stormwater permits (including all construction, industrial and MS4) may effectively implement the WLA and demonstrate consistency with the assumptions and requirements of the TMDL. 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 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 7. There may be other unregulated MS4s located in the Sparrow Swamp Watershed that are subject to the LA component of this TMDL. At such time that the referenced entities, or other future unregulated entities become regulated NPDES MS4 entities and are subject to applicable provisions of South Carolina Regulation 61-68D, they will be required to meet load reductions prescribed in the WLA component of the TMDL. This also applies to future discharges associated with industrial and construction activities that will be subject to South Carolina R. 122.26(b)(14) & (15)(SCDHEC 2003).

5.5 Seasonal Variability

Federal regulations require that TMDLs take into account the seasonal variability in watershed loading. The variability in this TMDL 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 20 counts/100mL of the instantaneous criterion of 400 cfu/100 mL (380 cfu/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. The MOS is defined in Table 7.

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 Sparrow Swamp Watershed 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 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 7 indicates the percentage reduction or water quality standard required for Sparrow Swamp Watershed. 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 prescribed load reductions must be targeted from all sources, including NPDES permitted and nonpoint sources.

Based on the available information at this time, the portion of the Sparrow Swamp Watershed that drains directly to a regulated MS4 and that which drains 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.

Table 7. Total Maximum Daily Loads for the Sparrow Swamp Watershed. Loads are expressed as colony forming units (cfu) per day.

				Waste load Allocation (WLA)		Load Allocation (LA)	
Station	Existing Load (cfu/day)	TMDL (cfu/day)	Margin of Safety (MOS) (cfu/day)	Continuous Source[1] (cfu/day)	Non-Continuous Sources[2,3,4] (% Reduction)	Load Allocation (cfu/day)	% Reduction to Meet LA[3]
PD-072	5.54E+11	4.72E+11	2.36E+10	See Note Below	19	4.49E+11	19

Table Notes:

1. WLAs are expressed as a daily maximum. Existing and future continuous discharges are required to meet the prescribed loading for the pollutant of concern. Loadings were developed based upon permitted flow and an allowable permitted maximum concentration of 400cfu/100ml.
2. Percent reduction applies to all NPDES-permitted stormwater discharges, including current and future MS4, construction and industrial discharges covered under permits numbered SCS & SCR. Stormwater discharges are expressed as a percentage reduction due to the uncertain nature of stormwater discharge volumes and recurrence intervals. Stormwater discharges are required to meet percentage reduction or the existing instream standard for pollutant of concern in accordance with their NPDES Permit.
3. Percent reduction applies to existing instream load.
4. By implementing the best management practices that are prescribed in either the SCDOT annual SWMP or the SCDOT MS4 Permit to address fecal coliform, the SCDOT will comply with this TMDL and its applicable WLA to the maximum extent practicable (MEP) as required by its MS4 permit.

6.0 IMPLEMENTATION

The implementation of both point (WLA) and non-point (LA) source components of the TMDL are necessary to bring about the required reductions in FC bacteria loading to Sparrow Swamp and its 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 municipal separate storm sewer systems (MS4), construction activities, etc. Current and future NPDES discharges in the referenced watershed 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 Sparrow Swamp 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 component of this TMDL. 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 Sparrow Swamp Watershed would be the establishment and administration of a program of Best Management Practices (BMPs). Best management practices 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 portion of this TMDL and reduce nonpoint source FC loading to Sparrow Swamp and its tributaries. Congress amended the 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 or within any permitted jurisdictional MS4 area. 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 Sparrow Swamp Watershed. Local sources of nonpoint source education and assistance include the Natural Resource Conservation Service (NRCS), the Clarendon 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 this TMDL might be needed to achieve the water quality standard and we are committed towards targeting the load reductions to improve water quality in the Sparrow Swamp Watershed. As additional data and/or information become available, it may become necessary to revise and/or modify the TMDL target accordingly.

6.1 Implementation Strategies

The strategies presented in this document for implementation of the referenced TMDL 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 watershed while demonstrating consistency with the assumptions and requirements of the TMDL. 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 TMDL. Loadings are developed based upon permitted flow and assume an allowable permitted maximum concentration of 400 cfu/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 this TMDL 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 D, which provides additional information as it relates to evaluating the effectiveness of an MS4 Permit as it related to compliance with approved TMDLs. For SCDOT, existing and future NPDES MS4 permittees, compliance with terms and conditions of its NPDES permit is effective implementation of the WLA to the MEP. For existing and future NPDES construction and Industrial stormwater permittees, compliance with terms and conditions of its permit is effective implementation of the WLA.

The Department acknowledges that progress with the assumptions and requirements of the TMDL by MS4s is expected to take one or more permit iteration. Achieving the WLA reduction for the TMDL 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 loading from wildlife in areas where wildlife may be a significant contributor to the overall watershed.

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 a source assessment it was noticed that waterfowl were present near an impoundment in the Sparrow Swamp Watershed as shown in figure C-1. 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, fecal coliform, needs to be identified. For livestock in the referenced watershed, 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. Numerous livestock and hobby farms were present in the Sparrow Swamp Watershed at the time a source assessment was conducted (Figures C-2 to C-7). 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 watershed, many common practices exist to reduce FC contributions. Unstabilized soil directly adjacent to surface waters can contribute to FC 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 Sparrow Swamp Watershed.

Education should be provided to local farmers on these methods as well as acceptable manure spreading and holding (stacking sheds) practices.

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 Sparrow Swamp 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. It is the intent of the SCDHEC to work with the MS4 entities to recognize FC 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 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 a source assessment, dogs were noticed unrestrained in the referenced watershed (Figure C-8). Although the Sparrow Swamp Watershed is predominantly rural in nature, many of the urban runoff practices discussed in this section can be applied to individual households in the watershed. Education should be provided to individual homeowners in the referenced watershed on the contributions to FC 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
- Septic Systems for Dogs? Nonpoint Source News-Notes 63. Pet Waste: Dealing with a Real Problem in Suburbia. Kemper, J. 2000. New Jersey Department of Environmental Protection. Available from: http://www.state.nj.us/dep/watershedmgt/pet_waste_fredk.htm
- Stormwater Manager's Resource Center. Schueler, T., Center for Watershed Protection, Inc. http://www.stormwatercenter.net
- Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. U.S. EPA, Office of Water 1993. Washington, DC.
- National Menu of Best Management Practices for Stormwater Phase II. USEPA. 2002. Available at: http://www.epa.gov/npdes/menuofbmps/menu.htm
- Welcome to NVRC'S Four Mile Run Program. NVRC 2001. Available at: http://www.novaregion.org/fourmilerun.htm
- Boston's ordinance on dog waste. City of Boston Municipal Codes, Chapter XVI. 16-1.10A Dog Fouling. Available at: http://www.amlegal.com/boston_ma/
- Pet Waste and Water Quality. Hill, J.A., and D. Johnson. 1994. University of Wisconsin Extension Service. http://cecommerce.uwex.edu/pdfs/GWQ006.PDF
- Long Island Sound Study. Pet Waste Poster. EPA. Available at: http://www.longislandsoundstudy.net/pubs/misc/pet.html
- Source Water Protection Practices Bulletin: Managing Pet and Wildlife Waste to Prevent Contamination of Drinking Water. USEPA. 2001. EPA 916-F-01-027. Available at: http://www.epa.gov/safewater/protect/pdfs/petwaste.pdf

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.

- Urban Canadian Geese in Missouri. Missouri Conservationist Online. Available at: http://www.conservation.state.mo.us/conmag/2004/02/20.htm

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

- Septic Systems. USEPA Webpage: http://cfpub.epa.gov/owm/septic/home.cfm

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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United States Environmental Protection Agency (USEPA). 2005. National Pollutant Discharge Elimination System (NPDES). Available at http://cfpub.epa.gov/npdes/home.cfm?program_id=6

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Water Quality Planning and Management, Title 40 Code of Federal Regulations, Pt. 130.2(i). 2006 ed.

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Appendix A

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 B

DATA TABLES

Fecal Coliform WQS Exceedence Summary for Impaired Station PD-072 by Date

Date	FC (cfu/day)
05/19/99	40
08/02/99	**460**
09/08/99	110
10/04/99	40
05/10/00	280
06/22/00	72
07/05/00	**470**
08/16/00	190
09/05/00	220
10/17/00	**410**
01/07/03	54
02/11/03	84

Date	FC (cfu/day)
03/06/03	87
04/02/03	20
05/01/03	94
06/17/03	**500**
07/02/03	**1200**
08/21/03	74
09/11/03	220
10/08/03	400
11/17/03	76
12/01/03	140
01/09/08	290
02/13/08	**710**

Date	FC (cfu/day)
03/13/08	160
04/01/08	100
05/05/08	270
06/02/08	340
07/02/08	66
08/13/08	**460**
09/02/08	160
10/01/08	46
11/25/08	76
12/16/08	86

___ 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
PD-072	1004	114	332	469	424	34

Mid Point Hydrologic Category Flow (cfs)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
PD-072	197.13	112.65	74.43	48.28	28.16

Existing Load (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
PD-072	4.84E+12	3.14E+11	6.05E+11	5.54E+11	2.92E+11

Target Load (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
PD-072	1.83E+12	1.05E+12	6.92E+11	4.49E+11	2.62E+11

Load Reduction Necessary (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
PD-072	N/A	NRN	NRN	1.05E+11	N/A

% Load Reduction Necessary

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
PD-072	N/A	NRN	NRN	19	N/A

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

Appendix C

SOURCE ASSESSMENT PICTURES

Figure C-1

Waterfowl near impoundment (location: 34.301322 N, -80.151476 W) near the intersection of County Routes S-16-65 and S-16-936 in Darlington County (Date of Photograph: March 17, 2011).

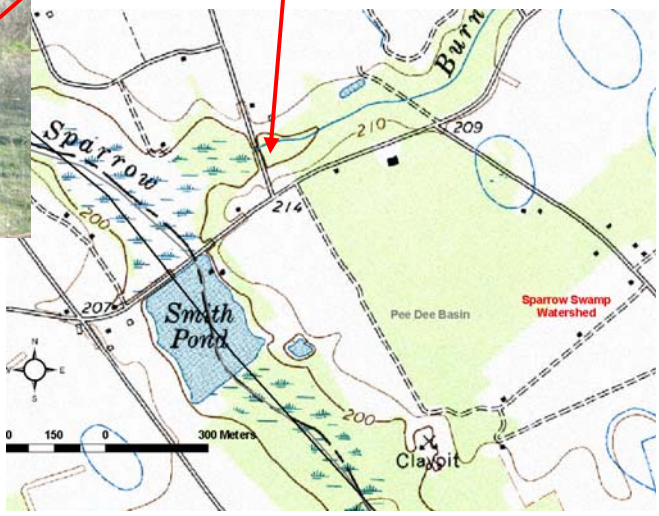


Figure C-2

Cattle pasture (location: 34.2943413 N, -80.1592448 W) with cattle near the intersection of County Routes S-31-150 and S-31-222 in Lee County (Date of Photograph: March 17, 2011).

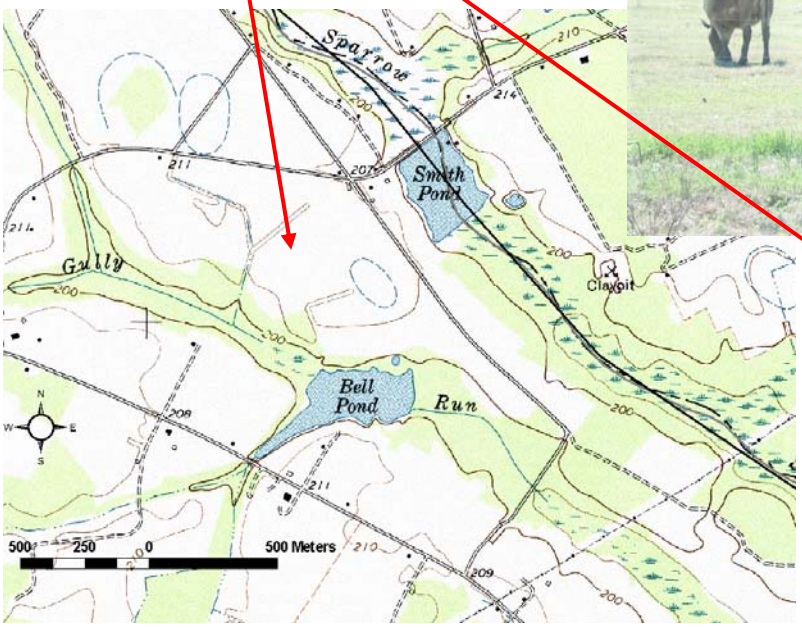


Figure C-3

Cattle pasture (location: 34.2999831 N, -80.1525273 W) with cattle near the intersection of County Routes S-16-65 and S-16-936 in Darlington County (Date of Photograph: March 17, 2011).

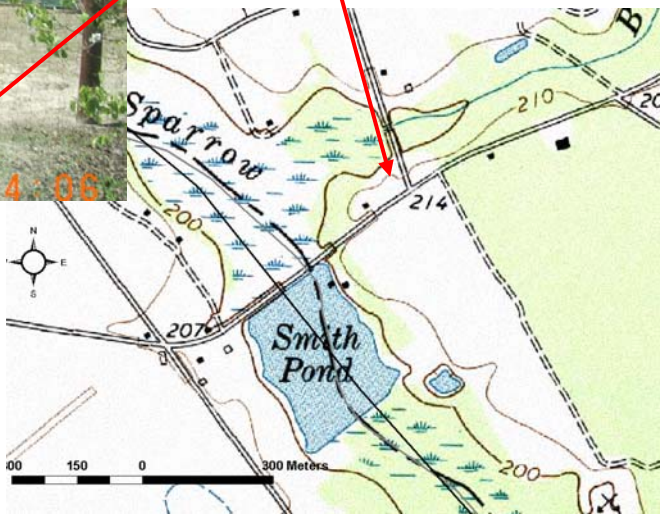


Figure C-4

Horses in pasture (location: 34.3004494 N, -80.1514216 W) near the intersection of County Routes S-16-65 and S-16-936 in Darlington County (Date of Photograph: March 17, 2011).

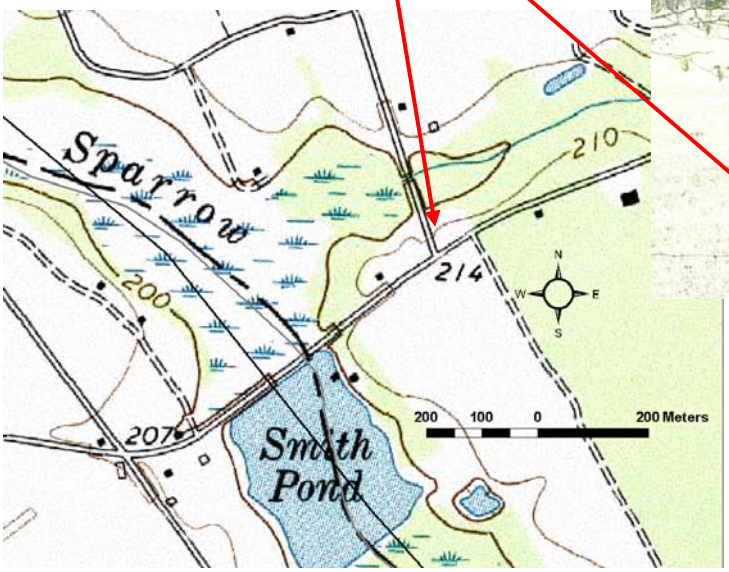


Figure C-5

Cattle pasture (location: 34.2079403 N, -80.1002994 W) with cattle near the intersection of County Routes S-16-32 and S-16-131 in Darlington County (Date of Photograph: March 17, 2011).

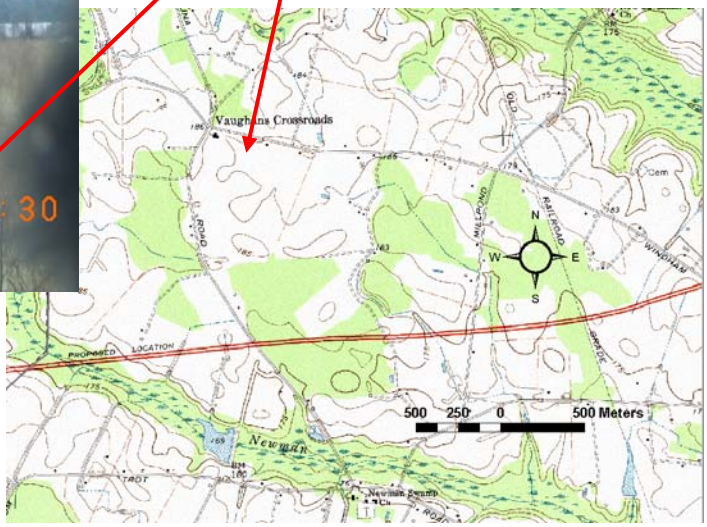


Figure C-6

Goats in a pen (location: 34.189084 N, -80.088570 W) on Possum Trot Road in Darlington County (Date of Photograph: March 17, 2011).

Figure C-7

Horses in pasture (location: 34.2075272 N, -80.0812844 W) near the intersection of Mill Pond Road and Windham Town Road in Darlington County (Date of Photograph: March 17, 2011).

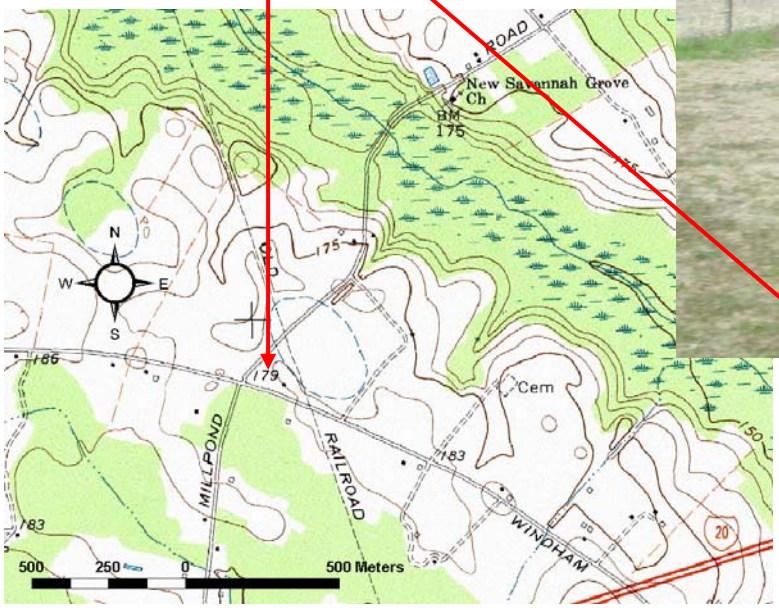
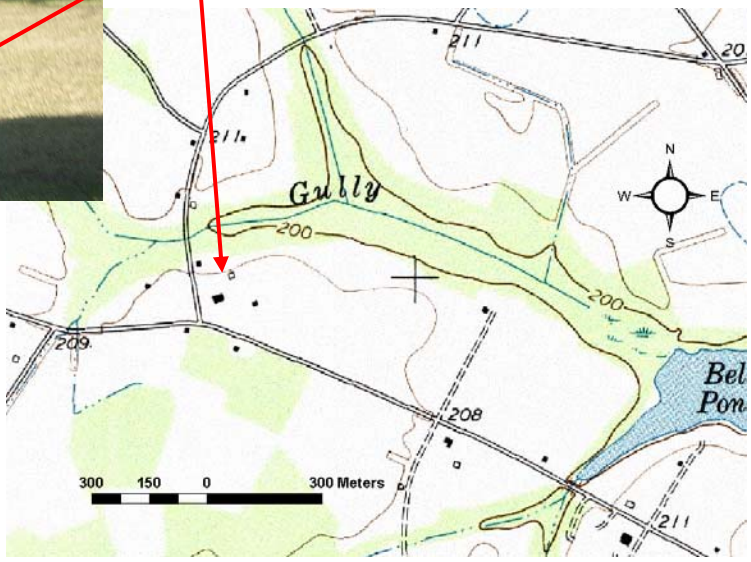


Figure C-8

Unrestrained dog (location: 34.2916609 N, -80.1722917 W) near the intersection of County Routes S-31-26 and S-31-222 in Lee County (Date of Photograph: March 17, 2011).



Responsiveness Summary
Sparrow Swamp TMDL Document

Comments Received

In response to the May 14, 2011 public notice for the TMDL document, comments were received from the Darlington County Planning Commission (DCPC). Below, given in red type, are the comments received from the DCPC. And, following each comment is the Department's response to the comment.

General Comments:
Be consistent with the use of SC, South Carolina or the State.

Response to General Comments:
The Sparrow Swamp TMDL document will be amended to consistently use "South Carolina."

Comment #1: Section 1.1 Background
This first paragraph of this section should be rewritten. The discussion of gastrointestinal illness incorrectly infers that fecal coliform are directly responsible for these illness and it needs to be clarified that fecal coliform is simply an indicator for the possible presence of harmful pathogens and not a pathogen itself. The discussion of historical disease outbreaks should be excluded from a TMDL document unless an outbreak has occurred within the study area as a result of bacterial infection.

Response to Comment #1:
Section 1.1 of the document provides the background for the development of the TMDL. And, the section does stipulate that fecal coliform bacteria are used as an "indicator" of pathogens. However, for clarity, the second sentence of the first paragraph will be changed to read, "Acute gastrointestinal illnesses caused by pathogens affect millions…" And, since this is the background section, a discussion of historical disease outbreaks provides the rationale for developing a TMDL.

Comment #2: Section 1.2 Watershed Description
Please include, in this section, a percentage breakdown of watershed in each of the municipalities, both incorporated and unincorporated. There is a strong focus within this document on MS4 compliance, and a summary of all municipalities needs to be included in this section should these areas fall under MS4 permit regulations in the future.

Response to Comment #2:
A percentage breakdown of the TMDL watershed into incorporated and unincorporated municipalities would not be particularly helpful it terms of establishing MS4 responsibility. The Sparrow Swamp watershed is predominantly rural and, besides the SCDOT, there are currently no MS4s subject to regulation under the NPDES permitting program for storm water discharges. However, should another MS4 in the watershed become subject to permitting under the NPDES permitting program, then, as given in Section 5.3.2 of the TMDL document, "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." And, as stated in Section 5.7 of the document, "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."

Comment #3: Section 1.2 Watershed Description
References should be corrected from "the Sparrow Swamp" to "Sparrow Swamp". "The" is only necessary when describing the basin or watershed as a whole.

Response to Comment #3:
The Sparrow Swamp TMDL document will be amended accordingly.

Comment #4: Section 1.3 Water Quality Standard
This section needs to include a description of the use classification for the waterbody. In this case, "Recreation" classification should be defined and described. There is vague reference to this, but as a TMDL document the impairment is directly correlated to the use classification and this should be clearly defined.

Response to Comment #4:
The Department considered your comments, but believes that Section 1.3 is sufficient in describing the classification of the waterbody. The primary purpose of the section was to first identify the classification of the subject waterbody, and then to identify the water quality standard for that classification. The purpose of establishing a TMDL is to bring an impaired waterbody of a given classification back to the standard. However, for further information or definitions of terms within the description you may go to Regulation 61-68 at the following link: http://www.scdhec.gov/environment/water/regs/r61-68.pdf.

Comment #5: Section 2.0 Water Quality Assessment
The first paragraph states: *"The graph shows that there is little to no correlation between the amount of precipitation and the temporal FC exceedences of water quality standards"*

While it is understood that FC concentrations can vary significantly based on time of year, rainfall volumes and other environmental factors, the above statement is ambiguous to the point that it discredits the methodology used within the document establishing the WLA reductions. If rainfall amounts, and subsequently flow volumes, do not have a direct correlation to FC concentrations, it could be concluded that a load duration curve could not be developed that would accurately determine load reduction quantities that would satisfy water quality improvements. This is especially critical should an MS4 designation be placed in the watershed. The above statement implies that there is simply not enough data to support the development of a TMDL as written in the document (see Comment 13 for further discussion).

In addition, include in this section a brief description of sampling and testing standard procedures. Describe possible sources of error in both collecting and testing the samples.

Response to Comment #5:
Figure 3 is included in the document to demonstrate that FC bacteria sampling events may occur during all climatic or hydrologic conditions. The figure is also included to demonstrate if a correlation exists between FC bacteria concentration and rainfall. For Sparrow Swamp, there seems to be no significant correlation between precipitation and the temporal exceedences of the instantaneous water quality standard for FC bacteria.

Figure 5 in Section 4.0 shows that the greatest number of water quality standard exceedences occurs during flows characterized as dry conditions, and demonstrates that reductions are needed in dry conditions. This would support that dry weather contributions of FC bacteria need to be reduced.

An electronic copy of the State of South Carolina Water Quality Monitoring Strategy approved by the USEPA can be found at the following link: http://www.scdhec.gov/environment/water/docs/strategy.pdf. Note that the monitoring strategy is an SCDHEC-approved QAPP.

An electronic copy of the QMP developed by the Department and approved by the USEPA can be found at the following link: http://www.scdhec.gov/environment/envserv/docs/QMPJuly2008.pdf

Data are also collected in accordance with the Environmental Quality Control Environmental Investigations Standard Operating Procedures and Quality assurance Manual. Because the manual is subject to periodic revisions, an active link to the document online is unavailable. However, a copy of the most updated document is available through the SCDHEC Freedom of Information Office upon request.

Ambient data that are not collected in accordance with the aforementioned are considered invalid and not used by the Department for regulatory purposes.

Comment #6: Section 3.0 Source Assessment and Load Allocation
In the second paragraph, remove the parentheses from CWA.

Response to Comment #6:
Parentheses have been removed from CWA.

Comment #7: Section 3.0 Source Assessment and Load Allocation
"These point sources are required by the (CWA) to obtain a NPDES permit. "

Please clarify in this paragraph that these facilities are required to obtain an Industrial Permit, Surface Water Discharge Permit et al, as opposed to the following paragraph that describes the MS4 areas. The industrial permit discussion should be included in this paragraph as opposed to the following one describing the MS4 regulatory process.

Response to Comment #7:
The fourth sentence in paragraph two in Section 3.0 has been changed to read, "These continuous point sources are required by the CWA to obtain an NPDES permit to discharge treated process or sanitary effluent."

And, the first sentence in paragraph three in Section 3.0 has been changed to read, "Non-continuous point sources required to obtain NPDES permits that may be a source of pathogens include Municipal Separate Storm Sewer Systems (MS4s) and storm water discharges from construction or industrial sites."

Comment #8: Section 3.0 Source Assessment and Load Allocation
The paragraph describing the MS4 permit requirements for discharges is not factually accurate. The MS4 does not regulate industrial permits, please revise. Construction permits within an MS4 are covered under the MS4 permit and all that the MS4 would require of the developer would be permit coverage under the MS4 permit. Additionally, a construction site is not required to meet WLA reductions as prescribed in the TMDL if within the MS4 jurisdiction. This is up to the MS4 to determine how the overall point discharges from their regulated area will be addressed and evaluated in terms of TMDL compliance.

Since this watershed is highly undeveloped, and 2000 and 2010 census data comparison does not indicate significant increase in population densities within urban centers (Lamar), it is recommended that an additional paragraph be added regarding the discussion of compliance with the Construction General Permit, which is regulated by DHEC.

Response to Comment #8:
This paragraph does not intend to say that an operator of an MS4 regulates industrial permits. What the paragraph intends to say is that if the operator of an MS4 engages in one of the eleven categories of activity deemed to have storm waters discharges associated with industrial activity (including conducting a construction project impacting five or more acres), then that MS4 operator would be required to obtain an NPDES permit for storm water discharges under the NPDES permit program. Therefore, for clarity, the second sentence in paragraph three in Section 3.0 has been changed to read, "And, the operator of an MS4 will require an NPDES permit for storm water discharges from industrial and construction activities under the NPDES storm water regulations, if that operator engages in industrial and construction activities under the regulations."

Here it might be helpful to clarify the relationship between developers (or any other entity engaging in construction activity), MS4 operators, and two South Carolina regulations administered by the Department and governing construction activity. The two regulations are the Sediment and Erosion Control Regulations (R.72-300), and the NPDES permits regulations (R.61-9). First of all, a developer engaging in construction activity may be required to obtain permits under both regulations. And, if an MS4 operator is required to obtain an NPDES permit for storm water discharges from its MS4, then that operator is required, under both R.72-300

and R.61-9, to obtain delegation from the Department to administer R.72-300 within its jurisdiction. Therefore, once an MS4 operator acquires delegation to administer R.72-300, then a developer within the MS4's jurisdiction would be required to obtain a construction permit from the MS4 operator, pursuant to R.72-300. However, that same developer would be required to obtain an NPDES permit from the Department for that same construction project if the project met the definition of industrial activity (a project disturbing five or more acres), or met the definition of small construction activity under R.61-9. And, the discharges under the NPDES permits would be required to meet the WLAs in the TMDL.

The paragraph (i.e., the third paragraph), as written, adequately addresses the requirement for compliance with the construction general permit (i.e., one of the two (2) NPDES general permits for storm water discharges associated with industrial activity, and covering only category X (i.e., construction activity) of the eleven categories of industrial activity requiring a permit for storm water discharges). The requirement for the permit would apply whether or not the activity occurred inside or outside the boundaries of an MS4.

Comment #9: Section 3.1.1 Continuous Point Sources

This section states that there are no continuous point sources within the watershed, which is factually correct. However, Section 3.2.4 discusses the City of Lamar's sanitary sewer system within the watershed. While this system does not discharge within the watershed, its system presence should be noted in this section.

Response to Comment #9:

The following was added to Section 3.1.1, Continuous Discharges: "While the City of Lamar may contain the sanitary sewer collection system in the watershed, there are there are no continuous point sources within the Sparrow Swamp Watershed at the current time. The City of Lamar currently has an NPDES permit to discharge treated wastewater from the treatment plant into the Lynches River (permit number: SC0043702). However, the discharge point is outside of the TMDL watershed. For the purposes of this TMDL, no WLA was provided for Lamar."

Comment #10: Section 3.1.2 Non·Continuous Point Sources

The third paragraph on Page 6 states: *"Other than SCDOT, there are currently no permitted sanitary sewer or storm water systems in this watershed".* This is incorrect in that Section 3.2.4 directly refers to the City of Lamar's sanitary sewer system. Please revise this section.

Response to Comment #10:

The subject sentence has been changed to read, "Other than SCDOT owned and/or operated storm sewer systems, there are currently no permitted sanitary sewer or storm water systems that discharge in this watershed."

Comment #11: Section 3.2.2 Agricultural Activities

Language should be included that indicates the number of permitted waste land applications DHEC has permitted and the frequency of DHEC inspections of both animal waste land applications and Animal Feeding Operations (AFOs) to insure compliance. Indicate the compliance inspection strategy (i.e. If resources are scarce, compliance inspections begin with the oldest permitted facility and works toward the latest permitted facility).

Indicate whether or not a test result or series of test results that exceeds 400 cfu/lOOml prompts a compliance inspection of any upstream permitted agricultural facility.

Response to Comment #11:

Section 3.2.2, Agricultural Activities, is an introductory section. It introduces Section 3.2.2.1, Agricultural Animal Facilities, and Section 3.2.2.2, Grazing Animals. Table 4 in Section 3.2.2.1 does give the number of Animal Feeding Operations within the TMDL watershed. And, Section 3.2.2.1 does stipulate that these facilities are routinely inspected for compliance. The details of compliance and enforcement actions for facilities in the TMDL watershed can be obtained through the Department's Florence Environmental Quality Control Office (Telephone: 843 661-4825) and Sumter Environmental Quality Control Office

(Telephone: 803 778-6548). If you cannot contact those offices, then you may contact Tonya O'Cain at the Department's Headquarters in Columbia (Telephone: 803 898-4225).

Comment #12: Section 3.2.3 Leaking Sanitary Sewers and Illicit Discharges
The final sentence states: *"There are currently no entities subject to NPDES MS4 permit within or with impact to the Sparrow Swamp Watershed."* This is incorrect in that the document discusses the SCDOT MS4 coverage in Section 3.1.2. Any SCDOT facilities with the potential to contribute FC to the watershed are regulated. Simply because there are no actual facilities other than roadways currently within the watershed, does not mean that they are not required to comply in the future should relevant facilities be constructed or developed.

Response to Comment #12:
The subject sentence was amended to read, "Besides SCDOT, there are currently no entities subject to NPDES MS4 permit within or with impact to the Sparrow Swamp Watershed."

Comment #13: Section 3.2.5 Urban Runoff
The assumption that *..... the town is likely to be a significant source of FC to the watershed"* is an unproven statement and should be removed. Lamar, as defined in the same paragraph, represents only 1 % of the entire watershed. Forested and pasture lands make up approximately 23% of the total watershed, with wetlands and open water comprising an additional 23% of the watershed. The contribution from wildlife and water fowl is more likely to have a significant contribution to the FC concentrations. Additionally, if the urban runoff was a significant source, it could be concluded that there would be a stronger correlation between rainfall and FC levels. Please revise to say that urban runoff is simply a potential source.

Response to Comment #13:
The fourth sentence in Section 3.2.5 has been changed to read, "The incorporated area of Lamar occupies 1.14 square miles, and represents only 1% of the watershed. However, given the impervious areas and well-defined storm water conveyances in urban areas, the town could be a contributing source of FC to the watershed."

Comment #14: Section 4.0 Load Duration Curve Method
The selection of the gage used for the flow-duration curve should be explained. The gage selected utilizes flow measurements downstream of the Lake Robinson dam. Thus, peak discharges are attenuated due to the dam functioning as a reservoir. In that instance, the peak flow is lower, but the duration of higher flows is greater than in a naturally uncontrolled watershed such as Sparrow Swamp. Thus, total load would be difficult to correlate with significant accuracy between the two watershed conditions. Additionally, this TMDL also states that there is no correlation between FC concentration and rainfall events. The development of the WLA requirements does not seem to have adequate justification.

Response to Comment #14:
Based on the best available information at the time of TMDL development, this seemed to be the most appropriate choice of gage. There are limited active USGS continuous record gages located near the Sparrow Swamp watershed. The watershed for the gage is located in the same ecoregion as the TMDL watershed. And, the watershed for the gage is close enough in size to the size of the TMDL watershed. Also, Lake Robinson is a small lake (the surface area is only 3.5 miles^2) and occupies only 2% of the drainage area for the gage. In addition, Lake Robinson was constructed primarily for hydroelectric generation, and not for flood control. Therefore, the Department believes that the gage is appropriate for the Sparrow Swamp watershed.

The correlation between FC concentration and rainfall events has been addressed in response to Comment #5.

Comment #15: Section 5.1 Critical Conditions
Please revise the reference to *"Figure* 4 ", it should reference Figure 5.

Response to Comment #15:
The referenced has been changed in the document from Figure 4 to Figure 5.

Comment #16: Section 5.3.2 Non Continuous Point Sources
The third paragraph of this section and other sections throughout this document, reference regulatory requirements of MS4 entities as processes for meeting WLA of the TMDL. Whereas this TMDL was developed with the WLA based on dry conditions, it is an indication of the potential for pollution from illicit discharges, stormwater runoff and consistent wildlife contributions. It is not the responsibility of the TMDL to define regulatory requirements of the MS4s other than to outline WLA requirements, if known. The NPDES permit serves as the guide for all MS4s that are located within TMDL watersheds. Those permit conditions define compliance with the TMDL and the extent to which the MS4 is required to meet WLA to the MEP. Thus, the third paragraph of this section, including the subsequent bulleted list, should be removed or revised.

Response to Comment #16:
While the critical condition for this TMDL may be based on dry conditions, and while critical conditions based on dry conditions my be indicative of continuous point source discharges as being the culprits in WQS excursions, non-continuous point source discharges do, nonetheless, occur during dry conditions. So, inasmuch as there will be storm water discharges from the municipal separate storm sewer systems of MS4s having NPDES permits for storm water discharges even during dry conditions, such MS4s will be required to meet the percentage reduction given in the TMDL. The NPDES permit will not serve as a guide. The permit will set the reduction requirement. And, yes, the treatment standard for meeting that reduction requirement is MEP.

Comment #17: Section 5.3.2 Non Continuous Point Sources
The final two sentences referencing the SCDOT MS4 should be revised. Regardless of SCDOT's ability to levy taxes or regulate land use, should they, in the future, develop property within the watershed that has the potential for pollutant discharge of FC to the receiving waters, they should be required to comply with the regulation of the TMDL. The way this is worded seems to indicate that they are exempt from complying with the requirements of the TMDL.

Response to Comment #17:
SCDOT is not exempt from meeting the requirements of their MS4 permit.

In Abstract, page ii and Section 6.1.2, page 17, Non-Continuous Point Sources, the following is included in the document: “For SCDOT, existing and future NPDES MS4 permittees, compliance with terms and conditions of its NPDES permit is effective implementation of the WLA to the MEP.”

Abstract, Page ii and Section 5.7, page 15, footnote 4 also states: “By implementing best management practices that are prescribed in either the SCDOT annual SWMP or the SCDOT MS4 Permit to address fecal coliform, the SCDOT will comply with this TMDL and its applicable WLA to the maximum extent practicable (MEP) as required by its MS4 permit.”

Regarding all MS4s, in Abstract, page ii and Section 6.1.2, page 17, Non-Continuous Point Sources, the following is included in the document: “The Department acknowledges that progress with the assumptions and requirements of the TMDL by MS4s is expected to take one or more permit iteration. Achieving the WLA reduction for the TMDL 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.”

Comment #18: Section 6.1.2 Non-Continuous Point Sources
Requirements of the NPDES Stormwater permit should not be included in a TMDL as part of implementation strategies. They are permit requirements of the NPDES program and should be included in the TMDL document by reference only. Should the NPDES permit revise the MCMs, the MS4 should not be required to follow the implementation strategy of the TMDL if better approaches are identified or outlined in future NPDES stormwater permit cycles.

Response to Comment #18:
Section 6.1.2 is given as recommendations and suggestions for implementing TMDLs. The reference to the Department’s NPDES general permit for small MS4s is only to give the example of the iterative BMP approach

in that permit in achieving the TMDL. And, the section explicitly states that, for current and future entities subject to regulation under the NPDES storm water permitting program, compliance with terms and conditions of an NPDES permit issued to those entities for storm water discharges will be effective implementing the WLA portion of the TMDL. Along these lines, the Department agrees with your comment that if a better means of achieving the percentage reduction is given in a future NPDES permit for an MS4, then the MS4 would be required to follow the future NPDES permit, as opposed to being required to follow implementation strategies in the TMDL.

Amendments to the Sparrow Swamp TMDL Document

As a result of the comments received from the DCPC during the May 14, 2011 to June 13, 2011 comment period, the Sparrow Swamp TMDL document was amended. Below are paragraphs, in whole, that were amended. The amended portions of the paragraphs, whether whole sentences or parts of sentences, are given in red type.

Amendment 1: Abstract, second paragraph, page *ii*

Probable sources of fecal contamination include direct loading of 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 (slightly below water quality standards) for Sparrow Swamp and tributaries, reductions in the existing loads of up to 19% will be necessary at station PD-072. For SCDOT, existing 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). 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.

Amendment 2: Section 1.1, first paragraph, page 1

FC bacteria are widely used as an indicator of pathogens in surface waters and wastewater. Acute gastrointestinal illnesses caused by pathogens affect millions of people in the United States and cause billions of dollars of costs each year (Gaffield et al. 2003). Of these illnesses many are caused by contaminated drinking water. Untreated stormwater runoff has been associated with a number of disease outbreaks, most notably an outbreak in Milwaukee that caused many deaths in 1993.

Amendment 3: Section 1.1, second paragraph, page 1

Though occurring at low levels from natural sources, the concentration of FC bacteria can be elevated in water bodies as the result of pollution. Sources of FC bacteria are usually diffuse or nonpoint in nature and originate from stormwater runoff, failing septic systems, agricultural runoff, leaking sewers among other sources. Occasionally, the source of the pollutant is a point source. Section 303(d) of the 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).

Amendment 4: Section 1.2, first paragraph, page 2

The Sparrow Swamp Watershed consists of Sparrow Swamp and its tributaries and is located in Darlington and Lee Counties. The watershed occupies 87.0 mi^2 (55,685.5 acres) of the Southeastern Plains ecoregion of South Carolina. Sparrow Swamp drains into the Lynches River approximately 5.6 miles south of the city of Florence, South Carolina. There is approximately a total of 238 stream miles in the watershed and they are all classified as freshwater.

Amendment 5: Section 3.0, second paragraph, page 5
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 continuous point sources are required by the CWA to obtain an NPDES permit to discharge treated process or sanitary effluent. In South Carolina NPDES permits require that dischargers of sanitary wastewater must meet the state standard for FC at the point of discharge. Municipal and private sanitary wastewater treatment facilities may occasionally be sources of pathogen or FC bacteria pollution. 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.

Amendment 6: Section 3.0, third paragraph, page 5
Non-continuous point sources required to obtain NPDES permits that may be a source of pathogens include Municipal Separate Storm Sewer Systems (MS4s) and stormwater discharges from construction or industrial sites. And, the operator of an MS4 will require an NPDES permit for storm water discharges from industrial and construction activities under the NPDES Stormwater regulations, if that operator engages in industrial and construction activities under the 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 FC bacteria impairment.

Amendment 7: Section 3.1.1, first paragraph, page 5
There are no continuous point sources within the Sparrow Swamp Watershed at the current time. Future NPDES discharges in the referenced watershed are required to implement the WLA and demonstrate consistency with the assumptions and requirements of the TMDL. While the City of Lamar may contain the sanitary sewer collection system in the watershed, there are there are no continuous point sources within the Sparrow Swamp Watershed at the current time. The City of Lamar currently has an NPDES permit to discharge treated wastewater from the treatment plant into the Lynches River (permit number: SC0043702). However, the discharge point is outside of the TMDL watershed. For the purposes of this TMDL, no WLA was provided for Lamar.

Amendment 8: Section 3.1.2, first paragraph, page 6
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 regulated under South Carolina *Water Pollution Control Permits* Regulation 122.26(b)(14)&(15). All regulated MS4 entities have the potential to contribute FC pollutant loadings in the delineated drainage area used in the development of this TMDL.

Amendment 9: Section 3.1.2, fourth paragraph, page 6
Other than SCDOT owned and/or operated storm sewer systems, there are currently no permitted sanitary sewer or stormwater systems that discharge in this watershed. Future permitted sanitary sewer or stormwater systems in the referenced watershed are required to comply with the load reductions prescribed in the WLA and demonstrate consistency with the assumptions and requirements of the TMDL.

Amendment 10: Section 3.2.2.1, first paragraph, pages 7 and 8
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.

Amendment 11: Section 3.2.2.1, second paragraph, page 8
There are currently seven active (AFOs) with regulated structures or activities in the Sparrow Swamp Watershed (Table 4). These facilities consist of three turkey operations and four poultry operations and are located within the Sparrow Swamp watershed. The three turkey operations are considered AFOs and the four poultry operations are considered according to Section 122.23 of South Carolina Regulation 61-9, *Water Pollution Control Permits*. There may also be land application sites associated with these facilities. 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.

Amendment 12: Section 3.2.3, second paragraph, page 9
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 SCDOT, there are currently no entities subject to NPDES MS4 permit within or with impact to the Sparrow Swamp Watershed.

Amendment 13: Section 3.2.4, first paragraph, page 9
Studies demonstrate that wastewater located four feet below properly functioning septic systems contain on average less than one FC bacteria organism per 100 mL (Ayres Associates 1993). Failed or non-conforming septic systems, however, can be a major contributor of FC to Sparrow Swamp and tributaries. 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.

Amendment 14: Section 3.2.5, first paragraph, page 9
Dogs, cats, and other domesticated pets are the primary source of FC deposited on the urban landscape. There are also 'urban' wildlife, squirrels, raccoons, pigeons, and other birds, all of which contribute to the FC load. The Town of Lamar is located in the downstream portion of the Sparrow Swamp Watershed. The incorporated area of Lamar occupies 1.14 square miles, and represents only 1% of the watershed. However, given the impervious areas and well-defined storm water conveyances in urban areas, the town could be a contributing source of FC to the watershed. The Town of Lamar is not a designated MS4.

Amendment 15: Section 5.1, first paragraph, page 12
This TMDL is 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 5 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 Sparrow Swamp Watershed pathogen impaired segments are listed in Table 5. This data indicates that for station PD-072, dry conditions result in larger bacteria loads and is therefore the critical condition for this station.

Amendment 16: Section 5.3.2, first paragraph, page 13
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 South Carolina *Water Pollution Control Permits* Regulation 122.26(b)(14) & (15) (SCDHEC 2003) 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. Other non-urbanized areas may be required under the NPDES Phase II Stormwater Regulations to obtain a permit for the discharge of stormwater. At the time of the TMDL development, no part of the Sparrow Swamp Watershed is classified as urbanized area.

Amendment 17: Section 5.4, first paragraph, page 14
The Load Allocation applies to the nonpoint sources of FC 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 7. There may be other unregulated MS4s located in the Sparrow Swamp Watershed that are subject to the LA component of this TMDL. At such

time that the referenced entities, or other future unregulated entities become regulated NPDES MS4 entities and are subject to applicable provisions of South Carolina Regulation 61-68D, they will be required to meet load reductions prescribed in the WLA component of the TMDL. This also applies to future discharges associated with industrial and construction activities that will be subject to South Carolina R. 122.26(b)(14) & (15)(SCDHEC 2003).

Amendment 18: Section 6.0, fifth paragraph, page 16

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 portion of this TMDL and reduce nonpoint source FC loading to Sparrow Swamp and its tributaries. Congress amended the 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 or within any permitted jurisdictional MS4 area. Additional resources are provided in Section 7.0 of this TMDL document.