FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
Division of Environmental Assessment and Restoration,
Water Quality Evaluation and TMDL Program
NORTHEAST DISTRICT • SUWANNEE RIVER BASIN •
UPPER, LOWER AND MIDDLE SUWANNEE PLANNING UNITS

TMDL Report

Fecal Coliform TMDL for the Suwannee River Basin

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Florida Department of Environmental Protection, Water Quality Evaluation and TMDL

TMDL Program

http://www.dep.state.fl.us/water/tmdl/index.htm

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http://www.dep.state.fl.us/legal/Rules/shared/62-303/62-303.pdf

Florida STORET Program

http://www.dep.state.fl.us/water/storet/index.htm

2012 Integrated Report

http://www.dep.state.fl.us/water/docs/2012_integrated_report.pdf

Criteria for Surface Water Quality Classifications

http://www.dep.state.fl.us/water/wqssp/classes.htm

Water Quality Status Report: Suwannee River Basin

http://waterwebprod.dep.state.fl.us/basin411/suwannee/status/SUWANNEE.pdf

Water Quality Assessment Report: Suwannee River Basin

http://waterwebprod.dep.state.fl.us/basin411/suwannee/assessment/Suwannee-GP1AR-WEBX.pdf

U.S. Environmental Protection Agency

Region 4: TMDLs in Florida

http://www.epa.gov/region4/water/tmdl/florida/

National STORET Program

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Chapter 1: INTRODUCTION

1.1 Purpose of Report

This report presents a regional Total Maximum Daily Load (TMDL) for fecal coliform bacteria for waterbodies in the Suwannee River Basin (**Figure 1.1**). This TMDL establishes the allowable fecal coliform loading to the Suwannee River Basin that would restore impaired waterbodies so that they meet the applicable water quality criteria for fecal coliform. **Appendix C** lists the verified impaired waterbodies assessed in this report, and **Appendices D and E** describe in more detail the individual verified impaired waterbodies. Spatial locations of these impaired waterbodies in the Suwannee River Basin are shown in **Figures E.1 and E.2** in **Appendix E**.

Currently, the Department evaluates each waterbody that has been verified as impaired for fecal coliforms, identifies the reductions needed and assigns reductions to source categories as part of waterbody-specific, standalone reports. The strength of this approach is that it focuses on site-specific data and (by examining temporal and spatial trends) can be an effective tool for identifying the pollution sources causing or contributing to that particular waterbody impairment that need to be further evaluated as part of the subsequent pollutant load reduction implementation strategy. The weakness of this approach is that it is labor and time intensive, and fails to focus limited resources on the standard restoration strategies already well-accepted in addressing fecal coliform impairments and typically required independently by laws other than the Florida Watershed Restoration Act (section 403.067, Florida Statutes). Additionally, the Department often lacks widespread data throughout the entire basin (i.e., in surrounding watersheds), so the waterbody-specific approach can fail to take into account other nearby waterbodies which may also be impaired or are at risk of becoming impaired. This creates the potential for an inefficient and inequitable approach to solving the pollution problems in the state. Based on feedback received by the Department, some stakeholders have suggested that the Department implement a more universally applicable approach to setting Total Maximum Daily Loads (TMDL) for waterbodies impaired by fecal coliform indicators. One way to accomplish this goal is through a regional TMDL, as described in this report.

Briefly, the approach laid out in the pages that follow extends the evaluation of data and impairments to the 8-digit Hydrologic Unit Code (HUC) scale. The HUC ID for the Upper Suwannee River Basin is 03110201 and 03110205 for the Lower Suwannee River Basin. In this case, all of the available data for the entire period of record for the Suwannee River HUC watershed are examined. In keeping with the requirements of section 403.067, Florida Statutes, the fecal coliform TMDL proposed in this report is only relevant for those waters in the Suwannee River Basin that are verified for fecal coliform impairment. However, instead of setting waterbody-by-waterbody TMDL reduction targets, the Department is proposing to establish a single basin-wide concentration-based TMDL. The concentration target for the fecal coliform TMDL is 400 counts/100 mL, which is consistent with the applicable bacteriological criteria for Class III waterbodies and is defined in the State's Surface Water Quality Standard (62-302.530(6), F. A. C).

This basin-wide TMDL will similarly apply to other waterbodies in this same 8-digit HUC when and if those waterbodies are verified as impaired for fecal coliforms in the future. However, the implementation strategies (primarily source identification and use of applicable Best Management Practices) for those waterbodies verified as impaired in the future will be no different from those applied now to the currently verified impaired waterbodies in the HUC basin.

This HUC-based TMDL does not independently result in obligations to implement source identification and fecal indicator minimization strategies for any particular waterbody until such time as that waterbody is verified impaired. But because a source monitoring and pollutant reduction strategy that is applied across-the-board is more equitable and protective, the Department encourages all interested stakeholders to participate in a basin-wide cooperative effort to restore and protect Florida's waters and the health of our citizens.

Based on input from the U.S. Environmental Protection Agency, individual reduction targets must still be established for those waterbodies needing a percent reduction of fecal indicator counts. Although information related to the estimated percent reduction needed to meet the TMDL is included in this report, it is for informational purposes only. In the case of fecal indicators in particular, focusing on standard restoration strategies (source identification and fecal indicator minimization) is more effective and protective than trying to achieve a specific percent reduction number. First and foremost, and as the name implies, "fecal indicators" are only indicators of the pathogens that are the true health risk. Elevated fecal indicator counts signal that the presence of pathogens and a potential human health risk is more likely, but universal source reduction efforts will provide a greater level of assurance that the risk is being minimized. Second, attempting to achieve a specific percent reduction is challenging, as the tools available (particularly for nonpoint sources) to reduce fecal coliform counts are not based on an exact engineering solution, but rather usually represent a good-faith effort to minimize anthropogenic inputs. Third, fecal coliforms (and other fecal indicators) can also be present as a result of natural sources (e.g., birds and deer), such that even when all man-created sources have been removed from a watershed, there may still be natural sources that can cause samples with elevated fecal coliform levels to be collected, measured, and reported. Note: animals such as horses, cattle, poultry and dogs are not considered to be wildlife.

The basin-wide TMDL will apply to waterbodies in the basin that become verified impaired for fecal coliform in the future, assuming all of the circumstances and assumptions underlying this basin-wide TMDL still hold true. When these new waterbodies become verified for fecal coliform impairment, the Department will amend the TMDL report and submit the new waters to EPA for approval and incorporation into the basin-wide TMDL. The intent of the basin-wide approach is to provide a more efficient process, since the rule language in Chapter 62-304, F. A. C., will not need to be updated. The Department will update the TMDL report, however, to include the characteristics of the new WBIDs as well as analyses that the facts and circumstances assumed during the development of the basin-wide TMDL continue to apply to the new WBIDs under consideration. For example, this TMDL applies to all the Class III freshwater segments in the Suwannee River Basin. If a given waterbody segment verified for fecal coliform impairment is not a Class III freshwater segment, a separate fecal coliform TMDL will be developed and proposed for the waterbody segment.

The Department intends to revise the TMDL report in the future by adding brief but sufficiently detailed information about the new WBIDs to allow the EPA to approve incorporating the new waterbodies into the basin-wide TMDL. The Department will add new impaired waterbodies to the appendix of the TMDL report, in a “fact sheet” format that allows the general public to quickly and easily understand the basis for the impairment listing, lists the general land use types and possible sources in the watershed of the impaired water segment, includes the critical condition analysis, and calculates the needed percent reduction to achieve the TMDL target.

An opportunity for public review and a point of entry for a challenge to the TMDL will both be provided to the general public for TMDLs of newly verified waterbodies. The public notice about these TMDLs will occur at the time of listing, when the verified impaired list is adopted by

Secretary Order. The waterbodies newly verified for fecal coliform impairment in the Suwannee River Basin will be put into an assessment category of 4A, indicating that those waterbodies are verified for impairment but TMDLs have been developed. Although the adoption of the Verified List and Delist List is not a rule making process, it is a public process, with opportunities for stakeholder engagement in the vicinity of the impacted waters and a chance for affected parties to challenge the Department's action.

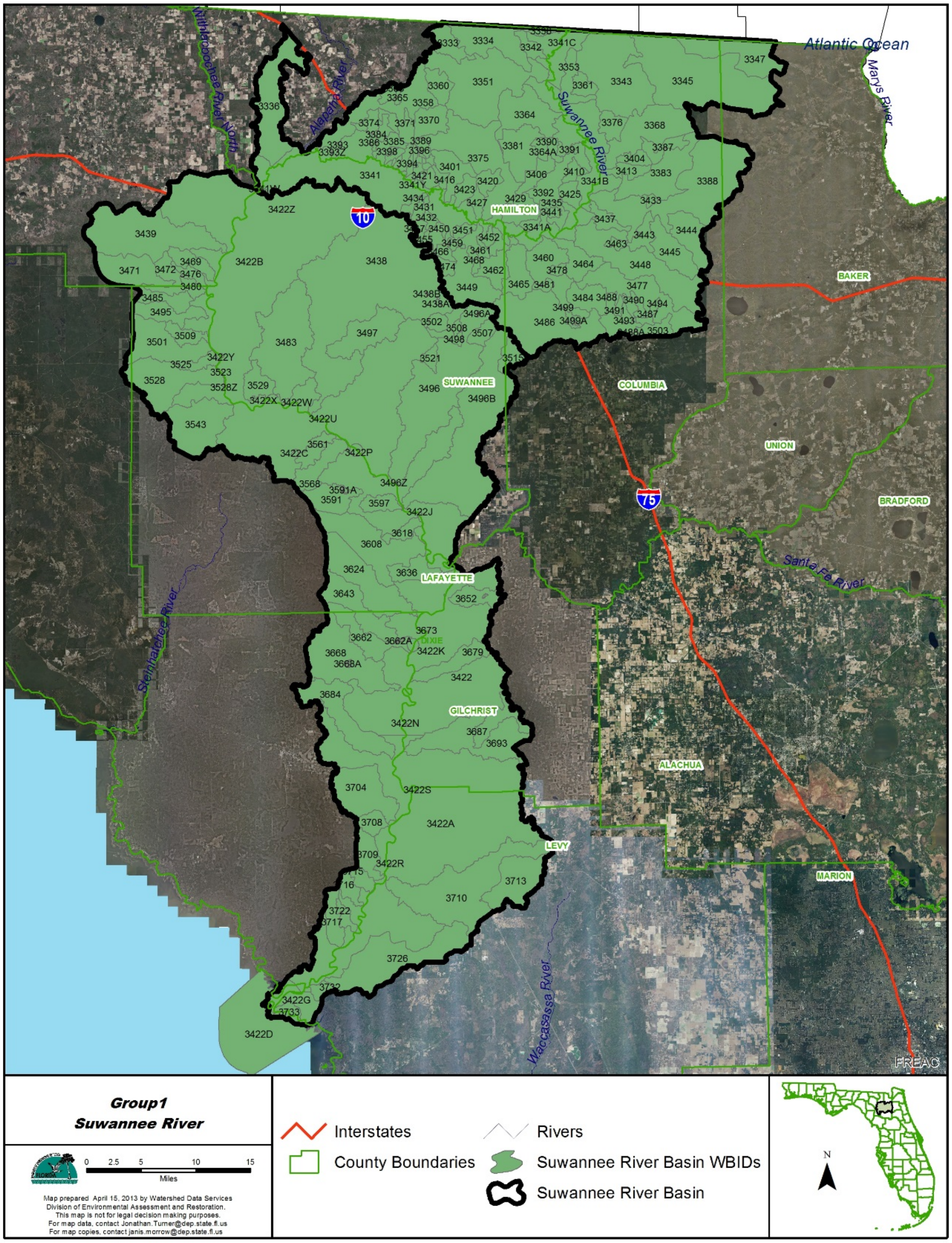

Figure 1.1. Suwannee River Basin and all WBIDs Located within the Basin

1.2 Report Format

This document contains the following sections:

Description of Water Quality Problem (Chapter 2) – This section includes an overview of the 303(d) listing process for the bacteria impaired waters in the Suwannee River Basin.

Description of Applicable Water Quality Standards and Targets (Chapter 3) - Provides an overview of Florida's surface water designated use classifications and a brief summary of Florida's bacteria standards for surface waters and the applicable criterion for waters in the Suwannee River Basin.

Assessment of Sources (Chapter 4) – Defines point and non-point sources of bacteria pollution and provides examples of bacteria sources that affect the Suwannee River Basin.

Determination of Assimilative Capacity (Chapter 5) – Provides the temporal, spatial and critical condition analyses for the Suwannee River Basin and provides a description of the regional TMDL development process.

Determination of the TMDL (Chapter 6) – Provides the key required elements for TMDL expression and load allocation.

TMDL Implementation (Chapter 7) - Provides a description of the implementation process, including coordination with local stakeholders and development of watershed based plans.

Background Information on Federal and State Stormwater Programs (Appendix A)

Estimates of Fecal Coliform Loadings from Potential Sources (Appendix B) – provides estimates of fecal coliform loadings from potential sources (e.g. pets, sanitary sewer overflows, septic tanks, and livestock) in each WBID.

Information on Verified Impairment for Individual WBIDs in the Suwannee River Basin (Appendix C) – shows the information used for determination of the verified impairment for the waterbodies in the Suwannee River Basin. Includes data from each of the IWR run Cycles in which it was determined there were verified impaired WBIDs.

WBID Specific Bacteria Data Summaries and Reductions (Appendix D) – Provides information specific to the fecal coliform impaired segments in the Suwannee River Basin surface waters. The data is organized by WBID.

WBID Summaries for the Suwannee River Basin (Appendix E) – Provides general summaries of each of the verified impaired WBIDs, as well as information on any NPDES-permitted facilities and other potential point and non-point sources.

1.3 Identification of the Basin and Waterbodies

For assessment purposes, the Department has divided the Suwannee River Basin into water assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or stream reach. **Appendix E** contains summaries of all the WBIDs which have verified as impaired for fecal coliform in the Suwannee River Basin.

There are 204 waterbody segments in the Lower, Middle and Upper Planning Units of the Suwannee River Basin. Planning units are groups of smaller watersheds (WBIDs) that are part of a larger basin unit, in this case the Suwannee River Basin.
The Suwannee Group 1 Basin includes the watersheds of the following river basins, as identified by their eight-digit hydrologic unit code—Aucilla, Econfina-Steinhatchee, Alapaha, Withlacoochee, Upper Suwannee, Lower Suwannee, Santa Fe, and Waccasassa. The Lower, Middle and Upper Planning Units of the Suwannee River Basin cover approximately 2,483 square miles (1,589,354 acres) (**Table 1.1**) in north central Florida within all or part of 11 counties (**Figure 1.2**).

Table 1.1. Area within the Suwannee River Basin Square Miles and Acres

This is a three-column table. Column 1 lists the basin name, Column 2 lists the basin area in square miles and Column 3 lists the basin area in acres.

Basin	Area (square miles)	Area (acres)
Suwannee River Basin	2,483	1,589,354

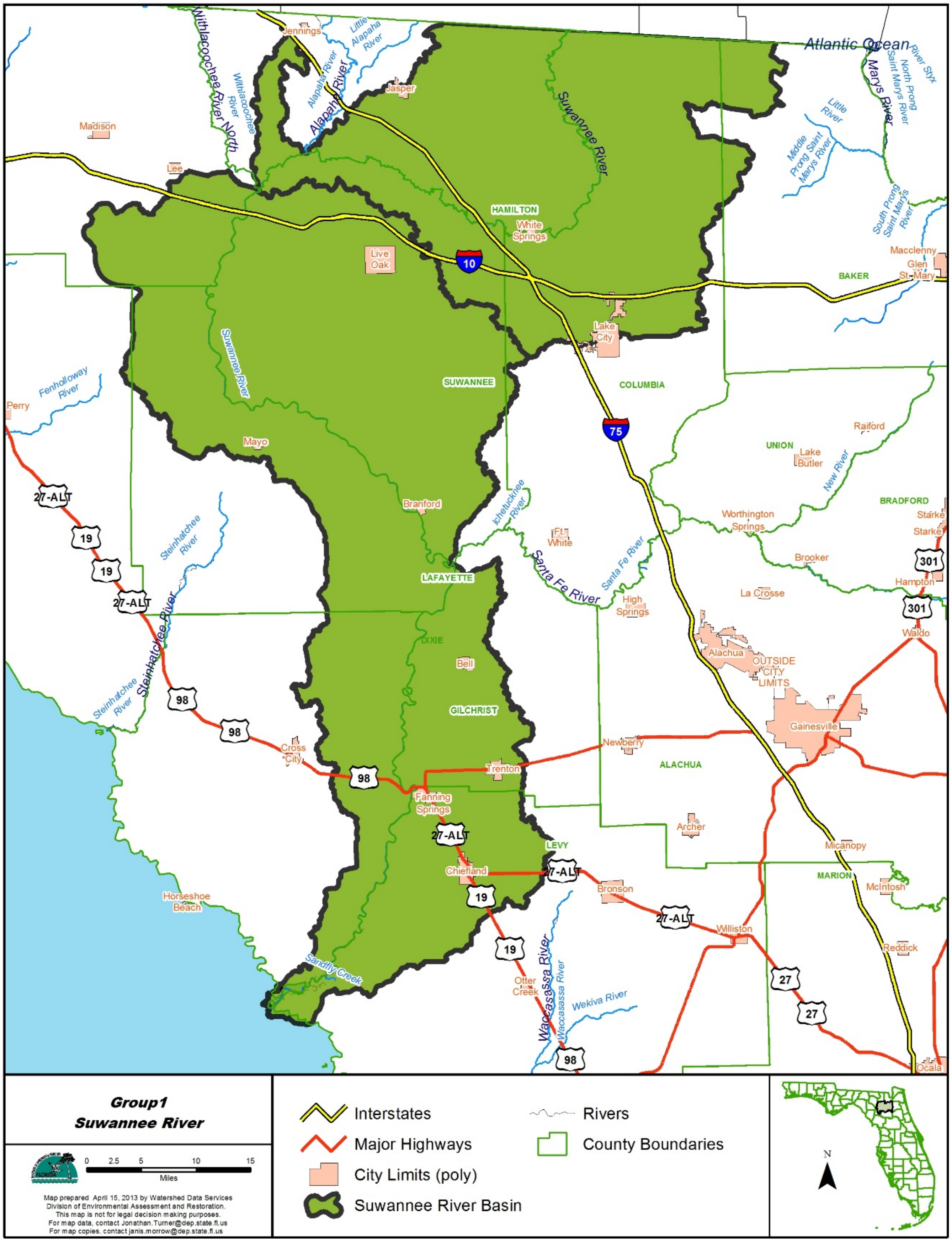

Figure 1.2. Location of the Suwannee River Basin and Major Hydrologic and Geopolitical Features in the Area

Suwannee River Basin

The Suwannee River Basin, located in southern Georgia and north-central Florida (**Figure 1.2**), is one of the largest and most ecologically unique black water river systems of the southeastern United States (Katz and Raabe, 2005). The basin contains a unique combination of subtropical and temperate forests, swamps, fresh and tidal wetlands, springs, black water rivers, and estuarine habitats. The diverse habitats in the basin support a range of species from temperate to subtropical, including several federally or State endangered and protected species (Katz and Raabe, 2005).

The Suwannee River, one of only a few rivers within the U.S. that has not been overly affected by human activities (e.g. damming, channeling, redirection, or the introduction of large quantities of contaminants), has been referred to as one of the most pristine and undeveloped river systems in the United States (Katz and Raabe, 2005), and has been designated an Outstanding Florida Water by the FDEP. Several protected natural areas are located within the basin, including 3 national wildlife refuges, 10 state parks or preserves, other public lands, and the Big Bend Seagrasses Aquatic Preserve (FDEP, 2001).

The Suwannee Basin drains approximately 10,000 square miles of South Georgia and north Florida. In terms of flow, it is the second largest river in Florida. Originating in the Okefenokee Swamp and gaining contributions from the Alapaha, Withlacoochee and Little Rivers, the Suwannee River meanders for over 248 miles through southern Georgia and northern Florida before emptying into the Gulf of Mexico.

The Suwannee River Basin contains two major physiographic regions, the Northern Highlands and the Gulf Coastal Lowlands. The Northern Highlands consist of gently rolling topography, generally from 100-200 feet above mean sea level. Soils typically range from sand to clayey sand. Clayey sediments in the subsurface are the base for the Surficial Aquifer System, they constitute portions of the Intermediate Aquifer and Confining System, slow down infiltration of rainwater into the underlying Floridan Aquifer System (Schneider et al., 2005). As a result there are abundant surface-water features (streams, lakes and ponds) throughout the Northern Highlands.

The lowlands are characterized by elevations from sea level to about 100 feet above mean sea level. Carbonate rock (limestone, dolostone) is at or near land surface throughout much of the Gulf Coastal Lowlands. The land surface is characterized by relatively flat, karstic topography and shallow, sandy soils with muck in many wetland areas. Karst landforms are widespread in the lowlands, with abundant sinkholes, sinking streams, and springs, and the surface water and ground water systems are highly interconnected (Schneider et al., 2005). Although the highlands contain some springs, most of the Basin's more than 250 springs are in the lowlands. Springs are especially abundant along the Suwannee River where the river has cut into the upper portion of the limestone bedrock. The surface-water features in the Gulf Coastal Lowlands typically represent the water table which occurs within the Upper Floridan Aquifer.

Watersheds located in karst regions are extremely vulnerable to contamination. Many of these karst features infiltrate the water table, forming a direct connection between the land surface and the underlying aquifer systems, allowing interactions between surface and ground water (SWFWMD 2002) and increasing the threat of ground water contamination from surface water pollutants (Trommer 1987). Potential sources of contamination include saltwater encroachment and the infiltration of contaminants carried in surface water, the direct infiltration of contaminants (such as chemicals or pesticides applied to or spilled on the land, or fertilizer carried in surface runoff), landfills, septic tanks, sewage plant treatment ponds, and wells used to dispose of stormwater runoff or industrial waste (Miller 1990).

Separating the Northern Highlands and the Gulf Coastal Lowlands is the Cody Scarp. This escarpment is the most prominent topographic feature in the state (FDEP, 2001), and is a region characterized by active sinkhole formation, large sinkholes and lakes, springs, sinking streams, and river resurgences (Schneider et al., 2005).

As mentioned before, three aquifer systems are found in the Suwannee River Basin: the Surficial Aquifer System, the Intermediate Aquifer System and Confining Beds, and the Floridan Aquifer System. The Surficial Aquifer System, the uppermost aquifer within the Basin, consists of undifferentiated sands, shell material, silts and clayey sands of varying thickness (Causseaux 1985). This system is locally utilized for domestic well water (Schneider et al., 2005). However, due to dissolved organics, color, odor and iron problems, water quality is generally poor (Upchurch, 1992). The Intermediate Aquifer System has a clay-rich strata that minimizes recharge to the underlying Florida Aquifer System and perches ground and surface water within the Surficial Aquifer System. As a result, areas where the Intermediate Aquifer System is well developed are also areas with well-developed stream and lake systems, high surface-water runoff, and low groundwater recharge potential (Schneider et al., 2005). Due to the low yield to wells, use of this aquifer system in the Suwannee River Basin is limited. The Floridan aquifer system consists primarily of highly permeable carbonate rocks and is separated into subdivided into three horizons consisting of the fresh potable water of the Upper Floridan Aquifer, the Middle Confining Unit, a low hydraulic conductivity, carbonate and evaporate unit, and the highly mineralized water of the Lower Floridan Aquifer (Schneider et al., 2005). In the Suwannee River Basin, only the Floridan aquifer is the utilized for water supply and is the primary source of drinking and irrigation water.

Historically, the Suwannee River Basin has been largely rural, sparsely populated and undeveloped (Katz and Raabe, 2005); the region contains six of Florida's least densely populated counties. In 2000, population density was about 38 people per square mile within the boundaries of the Suwannee River Water Management District (SRWMD), compared with the statewide average of 286 people per square mile (FDEP, 2001). In the Suwannee Basin, approximately 18 percent of the total land area is publicly or privately owned as conservation lands; the remaining 82 percent is privately owned (FDEP, 2001).

Agriculture, including silviculture, row crops and pasture, accounts for most of the developed land uses within the Basin. The forest industry (primarily pine plantations), is active in large areas of the Basin and provides timber and fiber for mills. The dominant land uses to the west of the Suwannee River are silviculture and agriculture. Although these land uses also dominate to the east of the river, the amount of urbanized land is distinctly greater than west of the river. Timber companies hold most of the coastal lowlands in large tracts, where large plantations of intensively managed, planted pine have replaced the native forest. In southeastern Hamilton County phosphate mining has altered a large part of the original landscape (FDEP, 2001).

Additional information about the Basin's hydrologic setting, including climate, physiography, and surface water and ground water resources, as well as its ecological and socioeconomic setting is available in the FDEP publication *Suwannee Basin Status Report* (FDEP, 2001)

1.4 Background

This report was developed as part of the Department's watershed management approach for restoring and protecting state waters and addressing TMDL Program requirements. The watershed approach, which is implemented using a cyclical management process that rotates through the state's 52 river basins over a 5-year cycle, provides a framework for implementing the TMDL Program–related requirements of the 1972 federal Clean Water Act and the 1999 Florida Watershed Restoration Act (FWRA) (Chapter 99-223, Section 403.067, Laws of Florida).

A TMDL represents the maximum amount of a given pollutant that a waterbody can assimilate and still meet water quality standards, including its applicable water quality criteria and its designated uses. TMDLs are developed for waterbodies that are verified as not meeting their water quality standards. They provide important water quality restoration goals that will guide restoration activities.

This TMDL report will be followed by the development and implementation of a restoration plan designed to reduce the amount of fecal coliform that caused the verified impairment of the watersheds in the Suwannee River system, as well as any other water segments verified as impaired in the Upper, Lower and Middle Suwannee Planning Units of the Suwannee River Basin in the future. These activities will depend heavily on the active participation of the SWFWMD, local governments, businesses, and other stakeholders. The Department will work with these organizations and individuals to undertake or continue reductions in the discharge of pollutants and achieve the established TMDLs for impaired waterbodies.

Chapter 2: DESCRIPTION OF WATER QUALITY PROBLEM

2.1 Statutory Requirements and Rulemaking History

Section 303(d) of the federal Clean Water Act requires states to submit to the EPA lists of surface waters that do not meet applicable water quality standards (impaired waters) and establish a TMDL for each pollutant causing the impairment of listed waters on a schedule. The Department has developed such lists, commonly referred to as 303(d) lists, since 1992. The list of impaired waters in each basin, referred to as the Verified List, is also required by the FWRA (Subsection 403.067[4], Florida Statutes [F.S.]); the state's 303(d) list is amended annually to include basin updates.

Florida's 1998 303(d) list included 571 waterbodies in the Suwannee River Basin. However, the FWRA (Section 403.067, F.S.) stated that all Florida 303(d) lists created before the adoption of the FWRA were for planning purposes only and directed the Department to develop, and adopt by rule, a new science-based methodology to identify impaired waters. After a long rulemaking process, the Environmental Regulation Commission adopted the new methodology as Rule 62-303, Florida Administrative Code (F.A.D.) (Identification of Impaired Surface Waters Rule, or IWR), in April 2001; the rule was modified in 2006 and 2007.

2.2 Information on Verified Impairment for the Suwannee River Basin

Appendix C lists the impairment information for all WBIDs identified as being verified impaired for fecal coliforms. Any waterbodies verified impaired for fecal coliforms in the future will be included in this section.

Chapter 3. DESCRIPTION OF APPLICABLE WATER QUALITY STANDARDS AND TARGETS

3.1 Classification of the Waterbody and Criterion Applicable to the TMDL

Florida's surface waters are protected for five designated use classifications, as follows:

Class I	**Potable water supplies**
Class II	**Shellfish propagation or harvesting**
Class III	**Recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife**
Class IV	**Agricultural water supplies**
Class V	**Navigation, utility, and industrial use (there are no state waters currently in this class)**

All WBIDs in the Suwannee River Basin addressed covered by this report are Class III freshwater waterbodies, with a designated use of recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The criterion applicable to the regional TMDL is the Class III (freshwater and marine) criterion for fecal coliform. Any future impairments to waterbodies which are not Class III would result in a waterbody-specific evaluation taking place.

3.2 Applicable Water Quality Standards and Numeric Water Quality Target

Numeric criteria for bacterial quality are expressed in terms of fecal coliform bacteria concentration. The water quality criterion for the protection of Class III (freshwater and marine) waters, as established by Rule 62-302, F.A.D., states the following:

> ***Fecal Coliform Bacteria:***
>
> *The most probable number (MPN) or membrane filter (MF) counts per 100 mL of fecal coliform bacteria shall not exceed a monthly average of 200, nor exceed 400 in 10 percent of the samples, nor exceed 800 on any one day.*

The criterion states that monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30-day period. There were insufficient data (fewer than 10 samples in a given month) available to evaluate the geometric mean criterion for fecal coliform bacteria. Therefore, the criterion selected for the regional TMDL was not to exceed 400 counts/100mL for fecal coliform.

Chapter 4: ASSESSMENT OF SOURCES

4.1 Types of Sources

An important part of the TMDL analysis is the identification of pollutant source categories, source subcategories or individual sources of pollutants in the impaired waterbody and the amount of pollutant loadings contributed by each of these sources. Sources are broadly classified as either "point sources" or "nonpoint sources." Historically, the term "point sources" has meant discharges to surface waters that typically have a continuous flow via a discernable, confined and discrete conveyance, such as a pipe. Domestic and industrial wastewater treatment facilities (WWTFs) are examples of traditional point sources. In contrast, the term "nonpoint sources" was used to describe intermittent, rainfall-driven, diffuse sources of pollution associated with everyday human activities, including runoff from urban land uses, agriculture, silviculture and mining; discharges from failing septic systems; and atmospheric deposition.

However, the 1987 amendments to the Clean Water Act redefined certain nonpoint sources of pollution as point sources subject to regulation under the EPA's National Pollutant Discharge Elimination System (NPDES) Program. These nonpoint sources included certain urban stormwater discharges, such as those from local government master drainage systems, construction sites over five acres, and a wide variety of industries (see **Appendix A** for background information on the federal and state stormwater programs).

To be consistent with Clean Water Act definitions, the term "point source" will be used to describe traditional point sources (such as domestic and industrial wastewater discharges) *and* stormwater systems requiring an NPDES stormwater permit when allocating pollutant load reductions required by a TMDL (see **Section 6.1**). However, the methodologies used to estimate nonpoint source loads do not distinguish between NPDES stormwater discharges and non-NPDES stormwater discharges, and as such, this source assessment section does not make any distinction between the two types of stormwater.

4.2 Potential Sources of Fecal Coliform within the Boundaries of the Suwannee River Basin

4.2.1 Point Sources

Wastewater Point Sources

Examples can include discharges from wastewater treatment facilities (WWTFs), combined sewer overflows (CSOs) and concentrated animal feeding operations (CAFOs).

WWTFs

Potentially harmful bacteria may enter surface waters via wastewater discharges which contains a variety of organic and inorganic pollutant. This wastewater is treated by WWTFs in order to remove harmful waste products and to render it environmentally acceptable.

CAFOs

CAFOs are generally defined as farms with 700 or more head of livestock confined for more than 45 days. These facilities generally congregate and feed animals, manage their manure, and have production operations on a small land area.

There are 20 active NPDES-permitted facilities located in the Suwannee River Basin. However, of these facilities, typically only Domestic Wastewater facilities that are listed in the Wastewater Facility Regulation (WAFR) database as direct surface water discharge facilities could potentially contribute to observed levels of fecal coliform bacteria within the area they are located.

Table 4.1 lists all NPDES-permitted facilities with permitted surface-water discharge capacity located in the Suwannee River Basin. **Appendix D** lists all the potential point sources for each of the verified impaired WBIDs.

Table 4.1. Wastewater Point Sources: NPDES Permitted in the Suwannee River Basin

This is a four-column table. Column 1 lists the permit number, Column 2 lists the facility name, Column 3 lists the type of facility and Column 4 lists the permitted capacity of wastewater discharge.

Permit ID	Facility Name	Type of Facility	Permitted Capacity (MGD)
FL0027880	City of Jasper - WWTF	Domestic Wastewater	1.2
FLA161977	Oak Grove Dairy, Inc.	Cattle Feeding Operation	0.11
FL0000183	Duke Energy Florida	Industrial Wastewater	342
FL0000655	PCS Phosphate - White Springs	Industrial Wastewater	200
FL0001465	Pilgrim's Pride Processing Plant	Industrial Wastewater	1.04
FLA116521	Alliance Dairies	Cattle Feeding Operation	0.37
FLA116190	Piedmont Dairy	Cattle Feeding Operation	0.045

Municipal Separate Storm Sewer System

Stormwater runoff is water that doesn't soak into the ground during a rain storm, but instead flows over the surface of the ground until it reaches a waterbody. As the runoff moves, it picks up and carries away natural and human-made pollutants, such as soil and manure, eventually depositing them into surface and ground waters. Stormwater runoff is one of the leading sources of impairment of our nation’s waters and often contains high concentrations of bacteria.

There are no NPDES Phase I or Phase II Municipal Separate Storm Sewer System (MS4) permits in the Suwannee River Basin.

4.2.2 Land Uses and Nonpoint Sources

Accurately quantifying the fecal coliform loadings from nonpoint sources requires identifying nonpoint source categories, locating the sources, determining the intensity and frequency with which these sources create high fecal coliform loadings, and specifying the relative contributions from each source. Depending on the land use distribution in a given watershed, frequently cited nonpoint sources in urban areas include failed septic tanks, leaking sewer lines and pet feces. In addition to the sources associated with anthropogenic activities, birds and other wildlife can also act as fecal coliform contributors to receiving waters.

While detailed source information is not always available for accurately quantifying the fecal coliform loadings from different sources, land use information can provide some hints on the potential sources of observed fecal coliform impairment.

Land Uses

The spatial distribution and acreage of different land use categories were identified using the SRWMD's 2006-2008 land use coverage contained in the Department's geographic information system (GIS) library. Land use categories within the boundaries of the Suwannee River Basin were aggregated using the Florida Land Use Code and Classification System (FLUCCS) expanded Level 1 codes (including low-, medium-, and high-density residential) and tabulated in **Table 4.2**. **Table 4.2** also shows the total area within the Suwannee River Basin. **Figure 4.1** shows the spatial distribution of the principal land uses within the Suwannee River Basin boundary**.** Figures showing the spatial distribution of the principal land uses within each verified impaired WBID are presented in **Appendix D** (**Figures D.1.3** to **D.8.3**).

Within the Suwannee River Basin boundary, the dominant land use categories are low-impact land uses (primarily upland forests and wetlands), which account for approximately 68% of the total acreage for the Suwannee River Basin. Areas covered by agricultural lands and residential (low-, medium-, or high-density) and urban built-up (commercial and services, industrial, institutional, and recreational) land uses are relatively small. In the Basin, agricultural lands cover approximately 19.2% of the total acreage. Residential and urban built-up land uses cover approximately 8% of the total acreage in the Basin.

Table 4.2. Classification of Land Use Categories for the Suwannee River Basin in 2006-2008

This is a 4-column table. Column 1 lists the Level 1 land use code, Column 2 lists the land use description and Columns 3 list the acreage of each land use in the Suwannee River Basin and Column 4 lists the percent acreage of each land use in the Suwannee River Basin.

Level 1	Land Use	Basin Wide Acreage	Basin Wide % Acreage
1000	Urban and built-up	48,312.8	3.0%
-	Low-density residential	59,316.4	3.7%
-	Medium-density residential	10,896.7	0.7%
-	High-density residential	2,188.9	0.1%
2000	Agriculture	307,225.4	19.2%
3000	Rangeland	46,010.7	2.9%
4000	Upland forest	772,537.5	48.3%
5000	Water	17,725.3	1.1%
6000	Wetland	319,637.2	20.0%
7000	Barren land	4,061.7	0.3%
8000	Transportation, communication, and utilities	11,140.9	0.7%
	TOTAL	**1,599,053.4**	**100.0%**

Forests

Based on the land use distribution listed in **Table 4.2**, fecal coliform bacteria from forest runoff will be a significant nonpoint source of coliform in the Suwannee River Basin and within the individual WBID boundaries.

Although remote, pristine forested lands might appear to be unlikely candidates for pathogen sources, fecal coliform sources in these areas can include runoff from wildlife. Many wildlife species present in these areas act as sources and transport pathways for pathogens, and harbor microorganisms that can be pathogenic to themselves, other wildlife and humans (See **Wildlife** section below).

Wetlands

Given that the dominant land use categories in the Basin and the individual WBIDs include wetland areas, significant contributions of fecal coliform pollution are expected from these systems. Streams draining largely undeveloped watersheds with extensive riparian wetlands can still be important natural sources of fecal bacteria. Animal bacteria from saturated wetland surfaces is a known mechanism for bacterial transport to the streams draining them, as has been observed in a wetland dominated watersheds free of bacteria sources related to development (Weiskel et al., 1996).

Wildlife

Wildlife can be a significant contribution to fecal coliform exceedances in the Suwannee River Basin. Many wildlife species are reservoirs of microorganisms that are potentially pathogenic to themselves and to humans (USEPA, 2001). Wildlife such as raccoons, beavers, muskrats, river otters, deer, and feral hogs have direct access to waterbodies and can deposit their feces directly into the water. They also deposit coliform bacteria with their feces onto land surfaces, where they can be transported during storm events to nearby streams. Waterfowl such as geese, ducks and heron also can act as direct nonpoint sources of bacteria and contaminate surface water with microbial pathogens (USEPA, 2001) especially in wetlands, lakes, ponds and rivers.

Urban Development

Although urban land use is not dominant within the Suwannee River Basin boundary, contributions from residential areas may still be possible sources for fecal coliform loadings due to failed septic tanks, sewer line leakages and pet feces that are disposed of inappropriately. A preliminary quantification of the fecal coliform loadings from these sources for each of the 8 verified impaired WBIDs was conducted to demonstrate the relative contributions. **Appendix B** provides detailed load estimates and describes the methods used for the quantification. It should be noted that the information included in **Appendix B** was only used to demonstrate the possible relative contributions from different sources and were not used in the development of the TMDL.

Livestock

Although agricultural land use is not dominant within the Suwannee River Basin boundary, livestock and other agricultural animals are a potentially important nonpoint source of coliform in agricultural areas. Agricultural animal waste is associated with various pathogens in streams; these can include *E. coli, Salmonella, Giardia, Campylobacter, Shigella and Cryptosporidiumparvum* (Landry and Wolfe, 1999). Agricultural activities, including runoff from pastureland and cattle in streams, can affect water quality. **Appendix B** provides detailed load estimates for each of the verified impaired WBIDs and describes the methods used for the quantification. It should be noted that the information included in **Appendix B** was only used to demonstrate the possible relative contributions from different sources and were not used in the development of the TMDL.

Sediments

Studies have shown that fecal coliform bacteria can survive and reproduce in streambed sediments and can be resuspended in surface water when conditions are right (Jamieson *et al.* 2005; Desmarais *et al.* 2002). Extended survival patterns have especially been noted for bacteria that are attached to sediment particles and settled to the bottom of streams and lakes (Burton et al. 1987). The survival of fecal bacteria in sediments is primarily attributed to the availability of soluble organics (Davies et al., 1995) and to increased protection from predatory protozoans (Enzinger and Cooper, 1976). Several studies have shown that concentrations of indicator organisms are typically higher in sediment as opposed to the overlying water column in both marine and freshwater systems (Burton et al. 1987; Sherer et al. 1992).

Current source identification methodologies cannot quantify the exact amount of fecal coliform loading from wildlife and/or sediment sources.

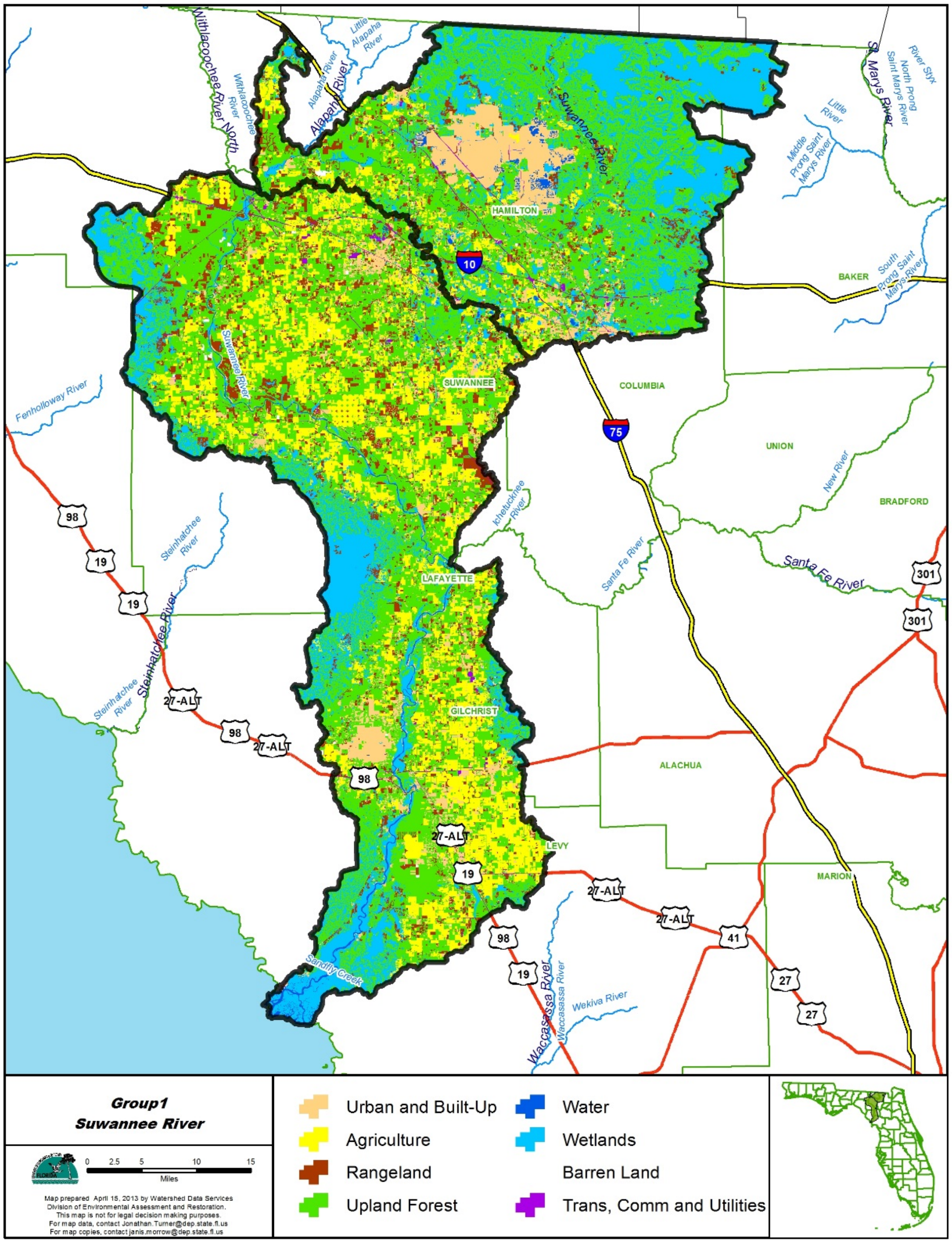

Figure 4.1. Principal Land Uses within the Suwannee River Basin Boundary in 2006-2008

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Determination of Loading Capacity

The Suwannee River Basin fecal coliform TMDL is a concentration-based TMDL. The concentration target for the TMDL is 400 counts/100 mL, which is consistent with the bacteriological criteria defined in the State's Surface Water Quality Standard (62-302.530(6), F. A. C.) for Class III waters. This concentration target is applicable to all the Class III waterbodies in the Suwannee River Basin that are verified for fecal coliform impairment. To show the difference between the existing fecal coliform concentration and the target fecal coliform concentration in waters verified for the fecal coliform impairment, a needed percent reduction to achieve the target concentration is calculated for each impaired waterbody and is included in this TMDL report. It should be noted that the needed percent reduction only represents the relative difference between the existing and target fecal coliform concentrations. It is provided in this report for informational purpose only. It should not be interpreted as the needed percent reduction of fecal coliform loads entering the impaired waters.

The percent reduction needed to meet the applicable target is calculated based on the 90th percentile of all measured concentrations collected during the period of record (1966-2013). WBID-specific percent reductions needed to achieve the target concentration are provided in **Appendix D**. The percent reduction needed to achieve the concentration-based TMDL in each WBID was listed in the summary for each WBID in **Appendix E.**

Because bacteriological counts in water are not normally distributed, a nonparametric method is more appropriate for the analysis of fecal coliform data (Hunter 2002). The Hazen method, which uses a nonparametric formula, was used to determine the 90th percentile. The percent reduction of fecal coliform needed to meet the applicable criterion was calculated as described in **Section 5.1.3**.

5.1.1 Data Used in the Determination of the Needed Percent Reduction to Achieve the Target Concentration

Data used for determining the needed percent reduction to achieve the target concentration in each impaired WBID were primarily collected by the Department, the Department's Northeast District, the Suwannee River Water Management District, the US Geological Survey and USEPA Region 4. These data correspond to the period of record data available for each of the impaired WBIDs, which are presented in **Appendix D. Appendix D** has figures for each verified impaired waterbody in the Suwannee River Basin which show locations of the water quality stations where fecal coliform data were collected. **Appendix D** shows the descriptive statistics of the fecal coliform concentration data collected from each of these impaired waterbodies. **Appendix D** also shows the data being used to characterize the hydrology and the spatial and temporal distributions of fecal coliform in all impaired waters included in this TMDL.

Temporal Patterns

Monthly and Seasonal Trends

The Suwannee River Basin is located in an environment with a mixture of warm temperate and subtropical conditions (Farrell et al., 2005). The mean annual temperature in the Basin is 68.6 °F, with a maximum and minimum average monthly temperatures of 81.3 °F (in July) and 54.2 °F (January), respectively (Farrell et al., 2005). Average annual rainfall in the Basin is approximately 53.4 inches (Farrell et al., 2005), but varies spatially from 46 inches in the upper basin to over 60 inches near the Gulf coast. There is a gradient in seasonal climatic conditions from the northern to southern regions of the basin (Farrell et al., 2005), with a strong seasonal pattern in the southern portion of the Basin where a pronounced wet season occurs in the summer months (June-September). Summer rainfall in this area is associated with localized, convectional thunderstorms or periodic tropical weather systems (hurricanes, tropical storms). The more northerly portions of the basin are characterized by lower average annual rainfall, and a weaker seasonal pattern with precipitation more evenly distributed between the warmer and cooler months. Winter rainfall to the north is somewhat higher than to the south.

Seasonally, in impaired waters influenced mainly by nonpoint sources, higher fecal coliform concentrations and exceedance rates are expected during the third quarter (summer, July–September), when conditions are rainy and warm, and lower concentrations and exceedance rates are expected in the first and fourth quarters (winter, January–March; and fall, October–December), when conditions are drier and colder. However, in the Suwannee River Basin exceedances occurred during both the wet and dry seasons, as described in more specifically for the impaired WBIDs in **Appendix D**. Individual WBID monthly and seasonal trend analyses are presented in **Appendix D.**

Rainfall Patterns

Using rainfall data collected at various CLIMOD stations (available: http://acis.sercD.com/), it was possible to compare monthly rainfall with monthly fecal coliform exceedance rates, as well as average quarterly rainfall with average quarterly fecal coliform exceedance rates at all stations in the verified impaired WBIDs.

Individual WBID rainfall pattern analyses are presented in **Appendix D.**

Period Of Record Trend

Individual WBID period of record trends are presented in **Appendix D**, however a historical plot of fecal coliform data against time revealed no significant increasing or decreasing trends for the period of record (1966-2013) in the Suwannee River Basin, fecal coliform concentrations that exceed the state criterion are frequently recorded in the Basin. Many of these samples are collected during periods of low or no rainfall, indicating that exceedances in concentrations may not be a consequence of stormwater discharges but rather local sources. It is expected that restoration, best management practice implementation and infrastructure improvement efforts will result in future water quality improvements in the Suwannee River Basin.

Spatial Patterns

Data from all stations in the verified impaired WBIDs in the Suwannee River Basin were analyzed to detect spatial trends. Given the presumed sources of fecal coliform bacteria in the Suwannee River Basin it would be expected to see patterns depending on the location of the station and proximity to different sources (e.g. NPDES facilities, failing septic tanks, leaking sewer lines, land use, etc.). Summary statistics of the fecal coliform monitoring data by station for the period of record are presented in **Appendix D**. Results show a wide range of reported values which is consistent with the behavior of bacteria in natural systems.

Results for the individual WBIDs are presented in their entirety in **Appendix D**. Data analyzed to detect spatial trends in the individual WBIDs are presented in **Appendix D**. The spatial distribution of the principal land uses and the locations of the water quality stations within each of the verified impaired WBIDs are presented in **Appendix D**.

5.1.2 Critical Condition

The critical condition for coliform loadings in a given watershed depends on many factors, including the presence of point sources and the land use pattern in the watershed. Typically, the critical condition for nonpoint sources is an extended dry period followed by a rainfall runoff event. During the wet weather period, rainfall washes off coliform bacteria that have built up on the land surface under dry conditions, resulting in the wet weather exceedances. However, significant nonpoint source contributions can also appear under dry conditions without any major surface runoff event. This usually happens when nonpoint sources contaminate the surficial aquifer, and fecal coliform bacteria are brought into the receiving waters through baseflow. In addition, the fecal coliform contribution of wildlife with direct access to the receiving water can be more noticeable by contributing to exceedances during dry weather. The critical condition for point source loading typically occurs during periods of low stream flow, when dilution is minimized.

Hydrologic conditions were analyzed using rainfall. A flow duration curve–type chart that would normally be applied to flow events was created for the individual WBIDs using precipitation data from the CLIMOD rainfall gauge stations. The chart was divided in the same manner as if flow were being analyzed, where extreme precipitation events represent the upper percentiles (0–5th percentile), followed by large precipitation events (5th–10th percentile), medium precipitation events (10th–40th percentile), small precipitation events (40th–60th percentile), and no recordable precipitation events (60th–100th percentile). Event precipitation ranges for the Suwannee River Basin and the individual WBIDs were derived based on these percentile ranges.

Individual WBID critical condition analyses are presented in **Appendix D.**

Three-day (the day of and 2 days prior to sampling) precipitation accumulations were used in the analysis for the verified impaired WBIDs (**Appendix D.**).

Historical data in the Basin show that fecal coliform exceedances occurred over all sampled hydrologic conditions, with percentages of exceedances greater than 24% occurring after all sampled events.

Given that exceedance rates and exceedances in concentrations followed all of the sampled precipitation events and that there are no traditional point source dischargers which would contribute to observed levels of fecal coliform bacteria within the Suwannee River Basin boundary, it can be assumed that various nonpoint sources are a major contributing factor to high fecal coliform concentrations in the Basin. While the lowest percentage of exceedances occurred after periods of no or little rainfall, the exceedance rate should not be considered insignificant and might indicate that local sources are contributing to elevated fecal coliform concentrations. **Appendix D** shows fecal coliform data by hydrologic condition for the each of the impaired waterbodies in the basin.

5.1.3 Determination of Percent Reduction

To show the difference between the existing fecal coliform concentration and the target fecal coliform concentration in waters verified for the fecal coliform impairment, a needed percent reduction to achieve the target concentration was calculated for each impaired waterbody. It should be noted that the needed percent reduction only represents the relative difference between the existing and target fecal coliform concentrations, and is provided in this report for informational purpose only. It should not be interpreted as the needed percent reduction of fecal coliform loads entering the impaired waters. The percent reduction needed to reduce the pollutant load was calculated by comparing the existing concentrations and target concentration using **Formula 1**:

$$\text{Needed \% Reduction} = \frac{\text{Existing } 90^{\text{th}} \text{ Percentile Concentration} - \text{Allowable Concentration}}{\text{Existing } 90^{\text{th}} \text{ Percentile Concentration}} \qquad \textbf{Formula 1}$$

Using the Hazen method for estimating percentiles, as described in Hunter (2002), the existing condition concentration was defined as the 90th percentile of all the fecal coliform data collected during the period of record. The 90th percentile is also called the 10% exceedance event. This will result in a target condition that is consistent with the state bacteriological water quality assessment threshold for Class III waters.

In applying this method, all of the available data are ranked (ordered) from the lowest to the highest, and **Formula 2** is used to determine the percentile value of each data point:

$$\text{Percentile} = \frac{\text{Rank} - 0.5}{\text{Total Number of Samples Collected}} \qquad \textbf{Formula 2}$$

If none of the ranked values is shown to be the 90th percentile value, then the 90th percentile number (used to represent the existing condition concentration) is calculated by interpolating between the two data points adjacent (above and below) to the desired 90th percentile rank using **Formula 3,** as described below.

$$90^{\text{th}} \text{ Percentile Concentration} = C_{\text{lower}} + (P_{90\text{th}} * R) \qquad \textbf{Formula 3}$$

Where:

- *C_{lower} is the fecal coliform concentration corresponding to the percentile lower than the 90th percentile*
- *P_{90th} is the percentile difference between the 90th percentile and the percentile number immediately lower than the 90th percentile*
- *R is a ratio defined as R = (fecal coliform concentration $_{upper}$ – fecal coliform concentration $_{lower)}$ / (percentile $_{upper}$ – percentile $_{lower}$).*

To calculate *R*, the percentile values below and above the 90th percentile are identified. Next, the fecal coliform concentrations corresponding to the lower and upper percentile values are identified. The fecal coliform concentration difference between the lower and higher percentiles is then calculated and divided by the unit percentile. The unit percentile difference is the difference between the lower and upper percentiles. R is then calculated as (fecal coliform concentration $_{upper}$ – fecal coliform concentration $_{lower}$) /(percentile $_{upper}$ – percentile $_{lower}$) = R.

The C_{lower}, P_{90th}, and R, are substituted into **Formula 3** to calculate the 90th percentile fecal coliform concentration.

The percent reduction needed to achieve the target concentration in each WBID was calculated by following the process explained above and is presented in detail in **Appendix D**.

Chapter 6: DETERMINATION OF THE TMDL

6.1 Expression and Allocation of the TMDL

The objective of a TMDL is to provide a basis for allocating acceptable loads among all of the known pollutant sources in a watershed so that appropriate control measures can be implemented and water quality standards achieved. A TMDL is expressed as the sum of all point source loads (wasteload allocations, or WLAs), nonpoint source loads (load allocations, or LAs), and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$\mathbf{TMDL = \sum WLAs + \sum LAs + MOS}$$

As discussed earlier, the WLA is broken out into separate subcategories for wastewater discharges and stormwater discharges regulated under the NPDES Program:

$$\mathbf{TMDL \cong \sum WLAs_{wastewater} + \sum WLAs_{NPDES\ Stormwater} + \sum LAs + MOS}$$

It should be noted that the various components of the revised TMDL equation may not sum up to the value of the TMDL because (1) the WLA for NPDES stormwater is typically based on the percent reduction needed for nonpoint sources and is also accounted for within the LA, and (2) TMDL components can be expressed in different terms (for example, the WLA for stormwater is typically expressed as a percent reduction, and the WLA for wastewater is typically expressed as mass per day).

While not applicable in the Suwannee River Basin, WLAs for stormwater discharges are typically expressed as "percent reduction" because it is very difficult to quantify the loads from MS4s (given the numerous discharge points) and to distinguish loads from MS4s from other nonpoint sources (given the nature of stormwater transport). The permitting of stormwater discharges also differs from the permitting of most wastewater point sources. Because stormwater discharges cannot be centrally collected, monitored and treated, they are not subject to the same types of effluent limitations as wastewater facilities, and instead are required to meet a performance standard of providing treatment to the "maximum extent practical" through the implementation of best management practices (BMPs).

This approach is consistent with federal regulations (40 CFR § 130.2[I]), which state that TMDLs can be expressed in terms of mass per time (e.g., pounds per day), toxicity, or other appropriate measure. The regional TMDL for the Suwannee River Basin is expressed as a concentration-based TMDL target (400 counts/100 mL) (**Table 6.1**).

The basin-wide fecal coliform TMDL for the Suwannee River Basin is a concentration based TMDL with the target fecal coliform concentration being 400 counts/100 mL, following the State bacteriological criteria. Because there were no local data available at the time when this TMDL was developed that allowed the Department to explicitly quantify the fecal coliform "loads" from all the sources within the watershed of each impaired waterbody segment and link the "loads" with the in-stream fecal coliform concentration, the WLA for stormwater discharge under the NPDES MS4 permits and the load allocation (LA) were implicitly considered as the appropriate restoration activities to bring the fecal coliform concentration in the impaired water below the 400 counts/100 mL target level. Because the restoration activities needed to restore different waterbodies impaired for fecal coliform are essentially the same, The Department created an implementation guidance document for fecal coliform TMDLs (http://www.dep.state.fl.us/water/watersheds/docs/fcg_toolkit.pdf) that outlines the typical activities for different types of sources (e.g., sewer infrastructure, onsite sewage treatment and disposal systems and stormwater).

The regional concentration-based TMDL target will be applied to all verified impaired WBIDs and, as future assessments identify additional bacteria impaired Class III waterbodies in the Suwannee River Basin, the concentration-based target will be applied to those waters.

6.2 Load Allocation

Table 6.1 presents the load allocation for fecal coliform from nonpoint sources for the Basin, based on a concentration-based approach. It should be noted that the LA includes loading from stormwater discharges regulated by the Department and the water management districts that are not part of the NPDES Stormwater Program (see **Appendix A**).

Table 6.1. TMDL Components for Fecal Coliform in Suwannee River Basin

This is a seven-column table. Column 1 lists the Basin, Column 2 lists the parameter, Column 3 lists the TMDL (counts/100mL), Column 4 lists the wasteload allocation for wastewater (counts/100mL), Column 6 lists the wasteload allocation for NPDES stormwater, Column 7 lists the load allocation and Column 7 lists the margin of safety.

[1] N/A = Not applicable

Basin	Parameter	TMDL (counts/100mL)	WLA for Wastewater (counts/100mL)	WLA for NPDES Stormwater (count/100mL)	LA (counts/100mL)	MOS
Suwannee River Basin	Fecal Coliform	400	400 for areas covered with MS4 Permit	Must meet permit limits when applicable	400	Implicit

6.3 Wasteload Allocation

6.3.1 NPDES Wastewater Discharges

Wastewater Point Sources

There are seven NPDES-permitted wastewater facilities situated in the Suwannee River Basin boundary. **Table 4.1** lists all the NPDES-permitted wastewater facilities with permitted surface-water discharge.

It should be noted that the state requires all NPDES-permitted wastewater point source dischargers to meet bacteria criteria at the end of the pipe. It is the Department's current practice not to allow mixing zones for bacteria. Any future point sources that may discharge in the WBID in the future will also be required to meet end-of-pipe standards for coliform bacteria.

6.3.2 NPDES Stormwater Discharges

There are no NPDES Phase I or Phase II Municipal Separate Storm Sewer System (MS4) permits in the Suwannee River Basin boundary. It should be noted that any MS4 permittee is only responsible for reducing the anthropogenic loads associated with stormwater outfalls that it owns or otherwise has responsible control over, and it is not responsible for reducing other nonpoint source loads in its jurisdiction.

6.4 Margin of Safety

As recommended by the Allocation Technical Advisory Committee (Department, 2001), a Margin of Safety (MOS) needs to be considered in the TMDL development to ensure that the TMDL target is protective of the designated use even under the influence of the uncertainty associated with the TMDL approach and natural variation. The MOS could be explicit or implicit. The explicit MOS usually takes the form of setting a TMDL target at a certain percentage below the protective target. An implicit MOS can be achieved by making conservative assumptions or using conservative approaches when developing a TMDL.

For the Suwannee River Basin fecal coliform TMDL, the MOS is implicit. The implicit MOS was included because this TMDL assumes that the 400 counts/100 ml of fecal coliform are all from anthropogenic sources while, in reality, certain percentage of the 400 counts/100 ml can be from natural sources or regrowth of fecal coliform in the natural environment. This makes the allowable anthropogenic contribution lower than the 400 counts/100 ml, and, therefore, adds to the MOS.

Chapter 7: TMDL IMPLEMENTATION

7.1 Basin Management Action Plan

Following the adoption of the regional TMDL by rule, the Department will determine the best course of action regarding its implementation. Depending on the pollutant(s) causing the waterbody impairment and the significance of each waterbody, the Department will select the best course of action leading to the development of a plan to restore the waterbodies. Often this will be accomplished cooperatively with stakeholders by creating a Basin Management Action Plan, referred to as the BMAP. BMAPs are the primary mechanism through which TMDLs are implemented in Florida (see Subsection 403.067[7], F.S.). A single BMAP may provide the conceptual plan for the restoration of one or many impaired waterbodies.

If the Department determines that a BMAP is needed to support the implementation of this TMDL, a BMAP will be developed through a transparent, stakeholder-driven process intended to result in a plan that is cost-effective, is technically feasible and meets the restoration needs of the applicable waterbodies. Once adopted by order of the Department Secretary, BMAPs are enforceable through wastewater and municipal stormwater permits for point sources and through BMP implementation for nonpoint sources. Among other components, BMAPs typically include the following:

- *Water quality goals (based directly on the TMDL);*
- *Refined source identification;*
- *Load reduction requirements for stakeholders (quantitative detailed allocations, if technically feasible);*
- *A description of the load reduction activities to be undertaken, including structural projects, nonstructural BMPs, and public education and outreach;*
- *A description of further research, data collection, or source identification needed in order to achieve the TMDL;*
- *Timetables for implementation;*
- *Implementation funding mechanisms;*
- *An evaluation of future increases in pollutant loading due to population growth;*
- *Implementation milestones, project tracking, water quality monitoring, and adaptive management procedures; and*
- *Stakeholder statements of commitment (typically a local government resolution).*

BMAPs are updated through annual meetings and may be officially revised every five years. Completed BMAPs in the state have improved communication and cooperation among local stakeholders and state agencies; improved internal communication within local governments; applied high-quality science and local information in managing water resources; clarified the obligations of wastewater point source, MS4, and non-MS4 stakeholders in TMDL implementation; enhanced transparency in the Department's decision making; and built strong relationships between the Department and local stakeholders that have benefited other program areas.

7.2 Other TMDL Implementation Tools

However, in some basins, and for some parameters, particularly those with fecal coliform impairments, the development of a BMAP using the process described above will not be the most efficient way to restore a waterbody, such that it meets its designated uses. This is because fecal coliform impairments result from the cumulative effects of a multitude of potential sources, both natural and anthropogenic. Addressing these problems requires good old-fashioned detective work that is best done by those in the area.

Many assessment tools are available to assist local governments and interested stakeholders in this detective work. The tools range from the simple (such as Walk the WBIDs and GIS mapping) to the complex (such as bacteria source tracking). Department staff will provide technical assistance, guidance and oversight of local efforts to identify and minimize fecal coliform sources of pollution. Based on work in the Lower St Johns River Tributaries and Hillsborough Basins, the Department and local stakeholders have developed a logical process and tools to serve as a foundation for this detective work.

The Department has released a guidance document developed from the Department's experiences in collaborating with local stakeholders during BMAP efforts around the state (http://www.dep.state.fl.us/water/watersheds/docs/fcg_toolkit.pdf). The document provides local stakeholders useful information for identifying sources of fecal coliform bacteria in their watersheds and examples of management actions to address these sources. Tools such as the guidance document will assist local stakeholders with the development of local implementation plans to address fecal coliform impairments. In such cases, the Department will rely on these local initiatives as a more cost-effective and simplified approach to identify the actions needed to put in place a road map for restoration activities, while still meeting the requirements of Subsection 403.067(7), F.S.

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Appendices

Appendix A: Background Information on Federal and State Stormwater Programs

In 1982, Florida became the first state in the country to implement statewide regulations to address the issue of nonpoint source pollution by requiring new development and redevelopment to treat stormwater before it is discharged. The Stormwater Rule, as authorized in Chapter 403, F.S., was established as a technology-based program that relies on the implementation of BMPs that are designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Rule 62-40, F.A.D. In 1994, the Department's stormwater treatment requirements were integrated with the stormwater flood control requirements of the water management districts, along with wetland protection requirements, into the Environmental Resource Permit (ERP) regulations.

Rule 62-40, F.A.D., also requires the state's water management districts to establish stormwater pollutant load reduction goals (PLRGs) and adopt them as part of a Surface Water Improvement and Management (SWIM) plan, other watershed plan or rule. Stormwater PLRGs are a major component of the load allocation part of a TMDL. To date, they have been established for Tampa Bay, Lake Thonotosassa, the Winter Haven Chain of Lakes, the Everglades, Lake Okeechobee and Lake Apopka.

In 1987, the U.S. Congress established Section 402(p) as part of the federal Clean Water Act Reauthorization. This section of the law amended the scope of the federal NPDES permitting program to designate certain stormwater discharges as "point sources" of pollution. The EPA promulgated regulations and began implementing the Phase I NPDES Stormwater Program in 1990. These stormwater discharges include certain discharges that are associated with industrial activities designated by specific standard industrial classification (SIC) codes, construction sites disturbing 5 or more acres of land, and the master drainage systems of local governments with a population above 100,000, which are better known as MS4s. However, because the master drainage systems of most local governments in Florida are interconnected, the EPA implemented Phase I of the MS4 permitting program on a countywide basis, which brought in all cities (incorporated areas), Chapter 298 urban water control districts and FDOT throughout the 15 counties meeting the population criteria. The Department received authorization to implement the NPDES Stormwater Program in 2000.

An important difference between the federal NPDES and the state's Stormwater/ERP Programs is that the NPDES Program covers both new and existing discharges, while the state's program focus on new discharges only. Additionally, Phase II of the NPDES Program, implemented in 2003, expands the need for these permits to construction sites between 1 and 5 acres, and to local governments with as few as 1,000 people. While these urban stormwater discharges are now technically referred to as "point sources" for the purpose of regulation, they are still diffuse sources of pollution that cannot be easily collected and treated by a central treatment facility, as are other point sources of pollution such as domestic and industrial wastewater discharges. It should be noted that all MS4 permits issued in Florida include a reopener clause that allows permit revisions to implement TMDLs when the implementation plan is formally adopted.

Appendix B: Estimates of Fecal Coliform Loadings from Potential Sources for the Verified Impaired WBIDs

The Department provides these estimates for informational purposes only and did not use them to calculate the TMDL. These estimates are intended to give the public a general idea of the relative importance of each source in the waterbodies. The estimates were based on the best information available to the Department when the calculation was made. The numbers provided do not represent the actual loadings from the sources.

Pets

Pets (especially dogs) could be a significant source of coliform pollution through surface runoff within the WBID boundaries. Studies report that up to 95% of the fecal coliform found in urban stormwater can have nonhuman origins (Alderiso *et al.* 1996; Trial *et al.* 1993).

The most important nonhuman fecal coliform contributors appear to be dogs and cats. In a highly urbanized Baltimore catchment, Lim and Olivieri (1982) found that dog feces were the single greatest source of fecal coliform and fecal strep bacteria. Trial *et al.* (1993) also reported that cats and dogs were the primary source of fecal coliform in urban subwatersheds. Using bacteria source tracking techniques, it was found in Stevenson Creek in Clearwater, Florida, that the amount of fecal coliform bacteria contributed by dogs was as important as that from septic tanks (Watson 2002).

According to the American Pet Products Manufacturers Association (APPMA), about 4 out of 10 U.S. households include at least 1 dog. A single gram of dog feces contains about 2.2 million fecal coliform bacteria (van der Wel, 1995). USA Today reports that studies have shown that about 40 percent of American dog owners do not pick up their dogs' feces (http://www.usatoday.com/news/science/2002-06-07-dog-usat.htm).

A rough estimate of fecal coliform loads from dogs within the WBID boundaries can be made using **Equation B.1**:

Load produced by dogs = # dogs in the WBID*450*0.4*2,200,000 Equation B.1

Where:

# of dogs is the estimated dog population within the WBID boundary;
450 is the waste production rate for a dog (grams/animal/day);
0.4 is the percent of dog owners that do not pick up their dog's waste; and
2,200,000 is the fecal coliform counts per gram of dog waste (counts/gram);

Given that the number of dogs within the WBID boundaries is unknown, the statistics produced by APPMA were used in this analysis to estimate the possible fecal coliform loads contributed by dogs.

Using information from the Florida Department of Revenue's (DOR) 2012 Cadastral tax parcel and ownership coverage contained in the Department's GIS library, residential parcels were identified using DOR's land use codes. The final number of households within each individual WBID boundary was calculated by adding the number of residential units on the parcels for all improved residential land use codes. **Table B.1** shows the estimated number of households within each of the WBID boundaries.

Based on literature (Weiskel et al., 1996), the waste production rate for a dog is 450 grams/animal/day, and the fecal coliform counts per gram of dog waste is 2,200,000 counts/gram (**Table B.1**). The total waste produced by dogs and left on the land surface in residential areas, assuming that 40 percent of dog owners do not pick up their dog's feces is presented in **Table B.1**.

Based on **Equation B.1,** the estimated fecal coliform loading from dog waste within the WBID boundaries are presented in **Table B.1**.

It should be noted that these loads only represent the fecal coliform load created in the WBIDs and are not intended to be used to represent a part of the existing loads that reach the receiving waterbody. The fecal coliform loads that eventually reach the receiving waterbody could be significantly less than this value due to attenuation in overland transport.

Table B.1. Values used for the Estimation of Dog Waste Loading within the WBID Boundaries

This is an eight-column table. Column 1 lists the WBID number, Column 2 lists the estimated number of households in each WBID, Column 3 lists the estimated number of dogs in each WBID, Column 4 lists the percent of dog owners who do not pick up dog's waste, Column 5 lists per dog wasteload, Column 6 lists the fecal coliform density, Column 7 lists the waste produced by dogs left on land surface and Column 8 lists the estimated dog waste loading to each WBID.

WBID	Estimated # Households	Estimated # of Dogs	Percent of Dog Owners Who Do Not Pick Up Dog's Waste	Wasteload (grams/ animal-day)	Fecal Coliform Density (counts/gram)	Waste Not Picked Up (grams/day)	Loading (counts/day)
3364	25	10	0.4	450	2,200,000	1.80E+03	3.96E+09
3368	10	4	0.4	450	2,200,000	7.20E+02	1.58E+09
3375	72	28.8	0.4	450	2,200,000	5.18E+03	1.14E+10
3388	79	31.6	0.4	450	2,200,000	5.69E+03	1.25E+10
3389	21	8.4	0.4	450	2,200,000	1.51E+03	3.33E+09
3401	22	8.8	0.4	450	2,200,000	1.58E+03	3.48E+09
3477	220	88	0.4	450	2,200,000	1.58E+04	3.48E+10
3480	15	6	0.4	450	2,200,000	1.08E+03	2.38E+09

Septic Tanks

Septic tanks are another potentially important source of coliform pollution in urban watersheds. When properly installed, most of the coliform from septic tanks should be removed within 50 meters of the drainage field (Minnesota Pollution Control Agency, 1999). However, the physical properties of an aquifer, such as thickness, sediment type (sand, silt, and clay), and location play a large part in determining whether contaminants from the land surface will reach the ground water (USGS, 2010). The risk of contamination is greater for unconfined (water-table) aquifers than for confined aquifers because they usually are nearer to land surface and lack an overlying confining layer to impede the movement of contaminants (USGS, 2010).

Sediment type (sand, silt and clay) also determines the risk of contamination in a particular watershed. “Porosity, which is the proportion of a volume of rock or soil that consists of open spaces, tells us how much water rock or soil can retain. Permeability is a measure of how easily water can travel through porous soil or bedrock. Soil and loose sediments, such as sand and gravel, are porous and permeable. They can hold a lot of water, and it flows easily through them. Although clay and shale are porous and can hold a lot of water, the pores in these fine-grained materials are so small that water flows very slowly through them. Clay has a low permeability (USGS, 2010).”

Also, the risk of contamination is increased for areas with a relatively high ground water table. The drain field can be flooded during the rainy season, resulting in ponding and coliform bacteria can pollute the surface water through stormwater runoff. Additionally, in these circumstances, a high water table can result in coliform bacteria pollution reaching the receiving waters through baseflow.

Septic tanks may also cause coliform pollution when they are built too close to irrigation wells. Any well that is installed in the surficial aquifer system will cause a drawdown. If the septic tank system is built too close to the well (e.g., less than 75 feet), the septic tank discharge will be within the cone of influence of the well. As a result, septic tank effluent may enter the well, and once the polluted water is used to irrigate lawns, coliform bacteria may reach the land surface and wash into surface waters through stormwater runoff.

A rough estimate of fecal coliform loads from failed septic tanks within the WBID boundaries can be made using **Equation B.2**:

$$L = 37.85 * N * Q * C * F \qquad \textbf{Equation B.2}$$

Where:

L is the fecal coliform daily load (counts/day);
N is the number of households using septic tanks in the WBID;
Q is the discharge rate for each septic tank (gallons/day);
C is the fecal coliform concentration for the septic tank discharge (counts/100mL);
F is the septic tank failure rate; and
37.85 is a conversion factor (100mL/gallon).

Based on the estimated total number of households within each WBID and Onsite Sewage Treatment Disposal Systems (OSTDS) data obtained from FDOH (available: http://www.doh.state.fl.us/environment/programs/ehgis/EhGisDownload.htm), the number of housing units *(N)* within each WBID boundary thought to be using septic tanks to treat their domestic wastewater is shown in (**Table B.2**). The location of these housing units is presented in **Figure B.1** through **B.7**.

The discharge rate from each septic tank (*Q*) was calculated by multiplying the average household size by the per capita wastewater production rate per day. Based on the information published by the Census Bureau, the average household size for Columbia County is about 2.64 people/household, about 2.61 people/household for Hamilton County and about 3.2 people/household for Lafayette County. The same population densities for the counties were assumed within each WBID boundary. A commonly cited value for per capita wastewater production rate is 70 gallons/day/person (USEPA, 2001). The commonly cited concentration (*C*) for septic tank discharge is $1x10^6$ counts/100mL for fecal coliform (USEPA, 2001).

No measured septic tank failure rate data were available for the WBID when these TMDLs were developed. Therefore, the failure rate was derived from the number of septic tanks in Columbia, Hamilton and Lafayette Counties based on FDOH's septic tank inventory and the number of septic tank repair permits issued in both counties as published by FDOH (available http://www.myfloridaeh.com/ostds/statistics/ostdsstatistics.htm). The cumulative number of septic tanks in each county on an annual basis was calculated by subtracting the number of issued septic tank installation permits for each year from the current number of septic tanks in the county based on FDOH inventory (1970-2011), assuming that none of the installed septic tanks will be removed after being installed. The reported number of septic tank repair permits was also obtained from the FDOH Website.

Based on this information, annual discovery rates of failed septic tanks were calculated, the average annual septic tank failure discovery rate for each county is presented in **Table B.3**. Assuming that failed septic tanks are not discovered for about 5 years, the estimated annual septic tank failure rate is about 5 times the discovery rate (**Table B.3**).

Table B.2 shows the estimated fecal coliform loading from failed septic tanks within each WBID boundary based on **Equation B.2.** This estimated load refers to loading created within the watershed undergoing no attenuation, rather than the loadings eventually reaching the receiving water.

Table B.2. Estimated Number of Households Using Septic Tanks and Estimated Septic Tank Loading within each WBID Boundary

This is a three-column table. Column 1 lists the WBID number, Column 2 lists the number of households with a septic tank and Column 3 lists the septic tank loading.

WBID	# Households Using Septic Tanks	Septic Tanks (counts/day)
3364	8	8.20E+08
3368	0	0.00E+00
3375	69	7.08E+09
3388	6	2.23E+09
3389	10	1.03E+09
3401	11	1.13E+09
3477	49	1.82E+10
3480	1	6.59E+08

Table B.3. Estimated Number of Septic Tanks and Septic Tank Failure Rates for Columbia, Hamilton and Lafayette Counties (1970–2011)

This is a six-column table. Column 1 lists the county, Columns 2 lists the average number of newly installed septic tanks, Column 3 lists the average accumulated number of septic tanks, Column 4 lists the average number of septic tank repair permits issued, Column 5 lists the average failed septic tank discovery rate and Column 6 lists the average final failure rate.

County	Average New installation	Average Accumulated installation	Average Repair permit	Average annual Failure discovery rate (%)	Average Failure rate (%)
Columbia	587.9	13800.8	224.0	1	5.30
Hamilton	96.5	2634.6	10.6	0.3	1.48
Lafayette	96.5	1892.6	41.7	1.55	7.70

Figure B.1. Location of OSTDS Based on FDOH Data in the Residential Land Use Areas within the Hunter Creek WBID Boundary

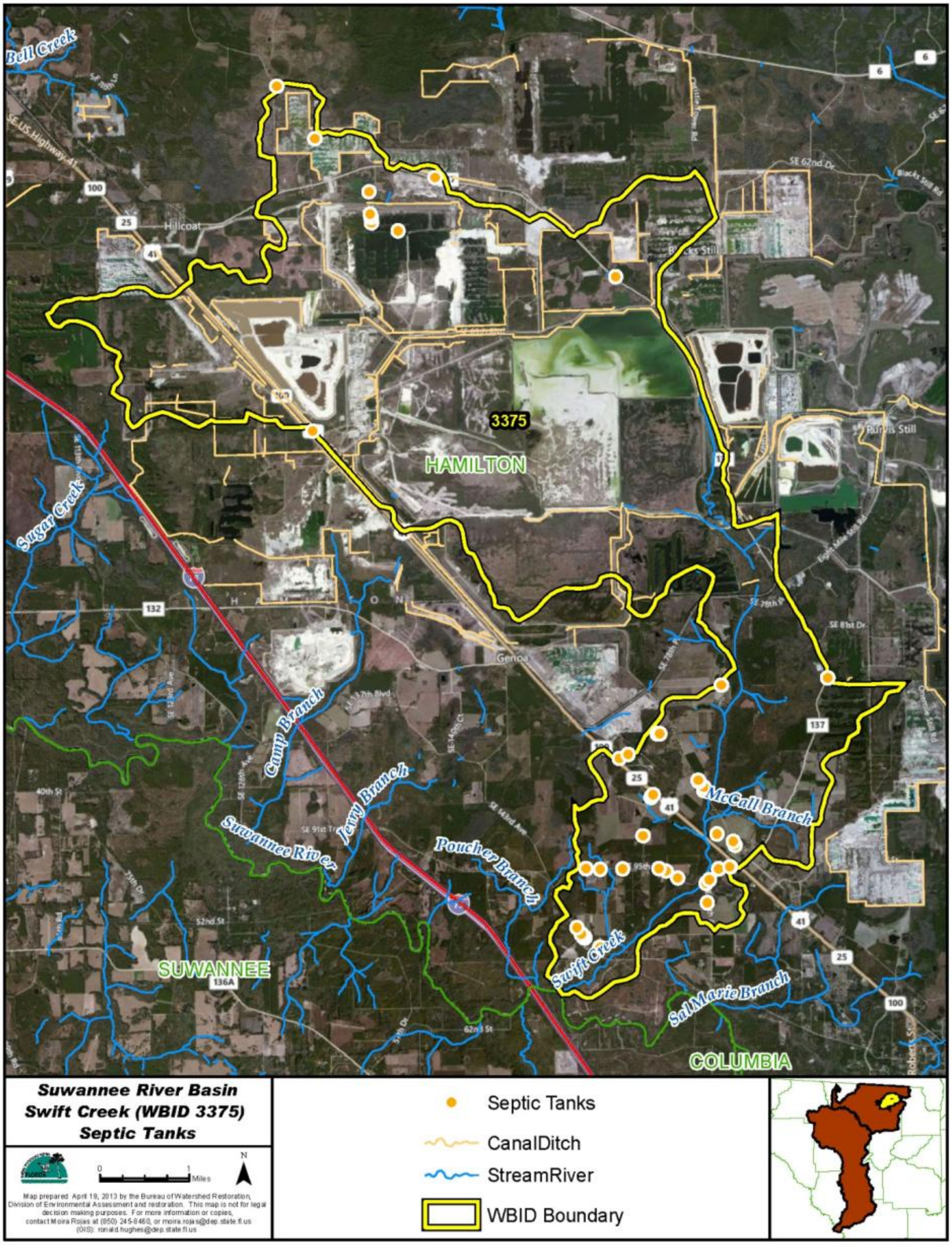

Figure B.2. Location of OSTDS Based on FDOH Data in the Residential Land Use Areas within the Swift Creek WBID Boundary

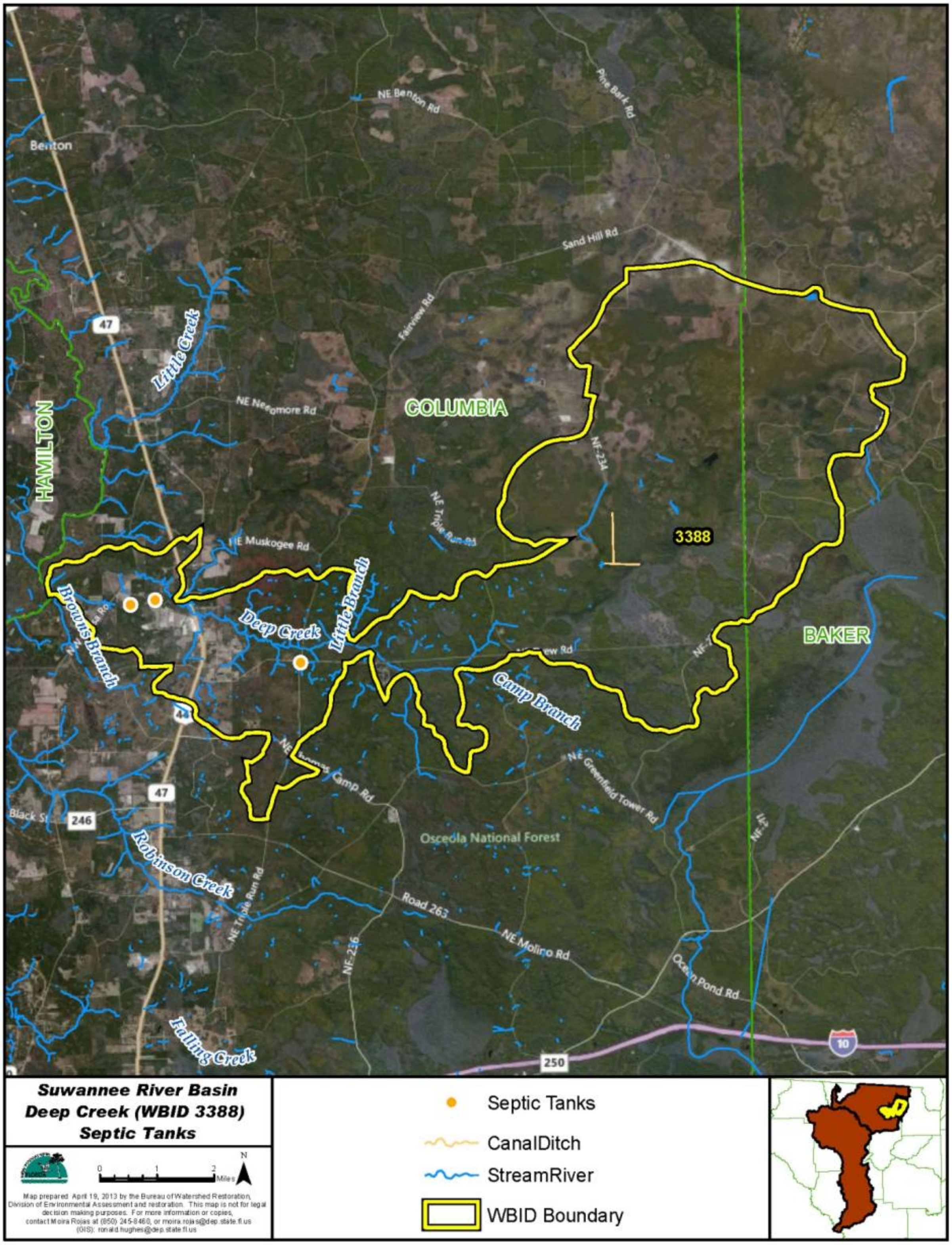

Figure B.3. Location of OSTDS Based on FDOH Data in the Residential Land Use Areas within the Deep Creek WBID Boundary

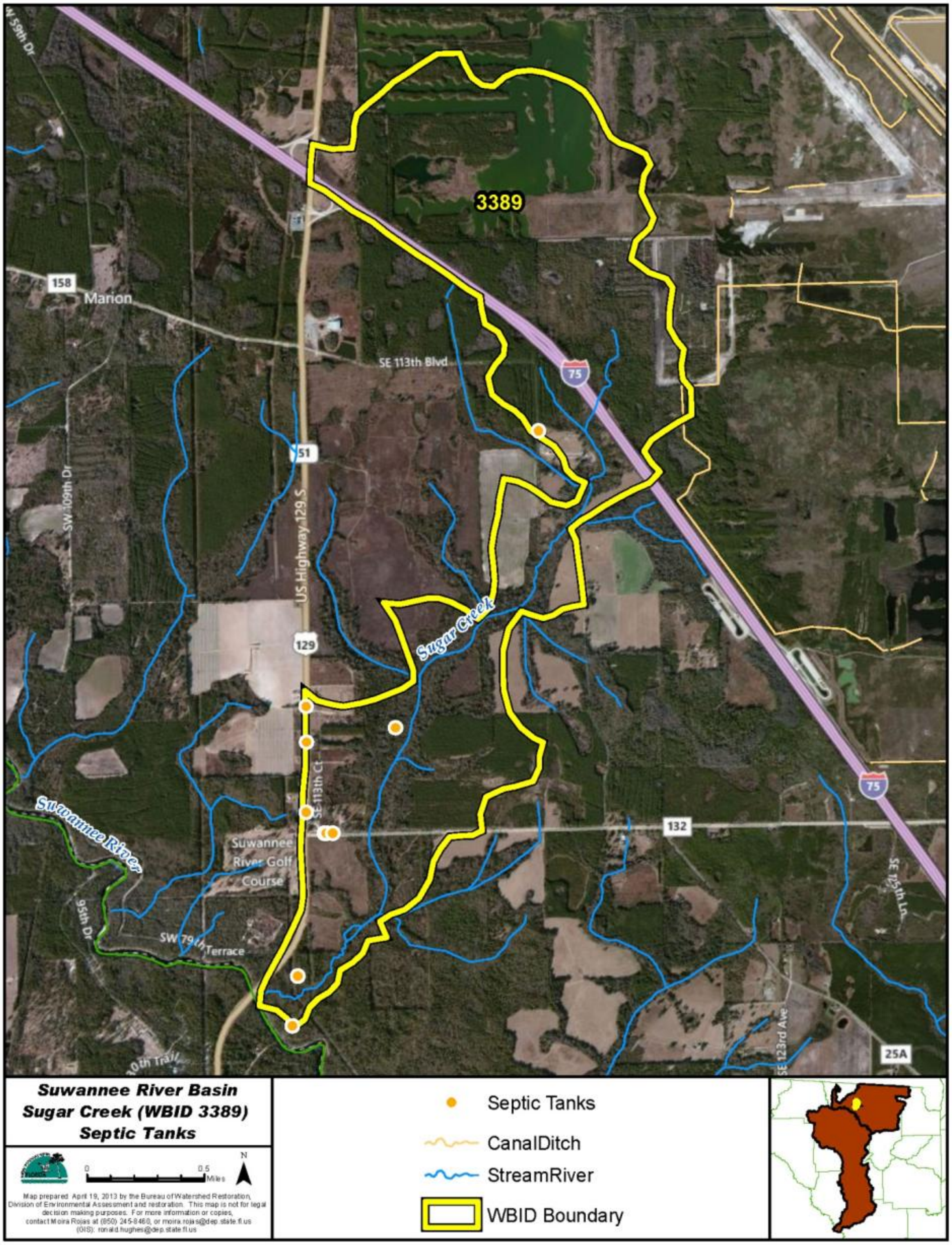

Figure B.4. Location of OSTDS Based on FDOH Data in the Residential Land Use Areas within the Sugar Creek WBID Boundary

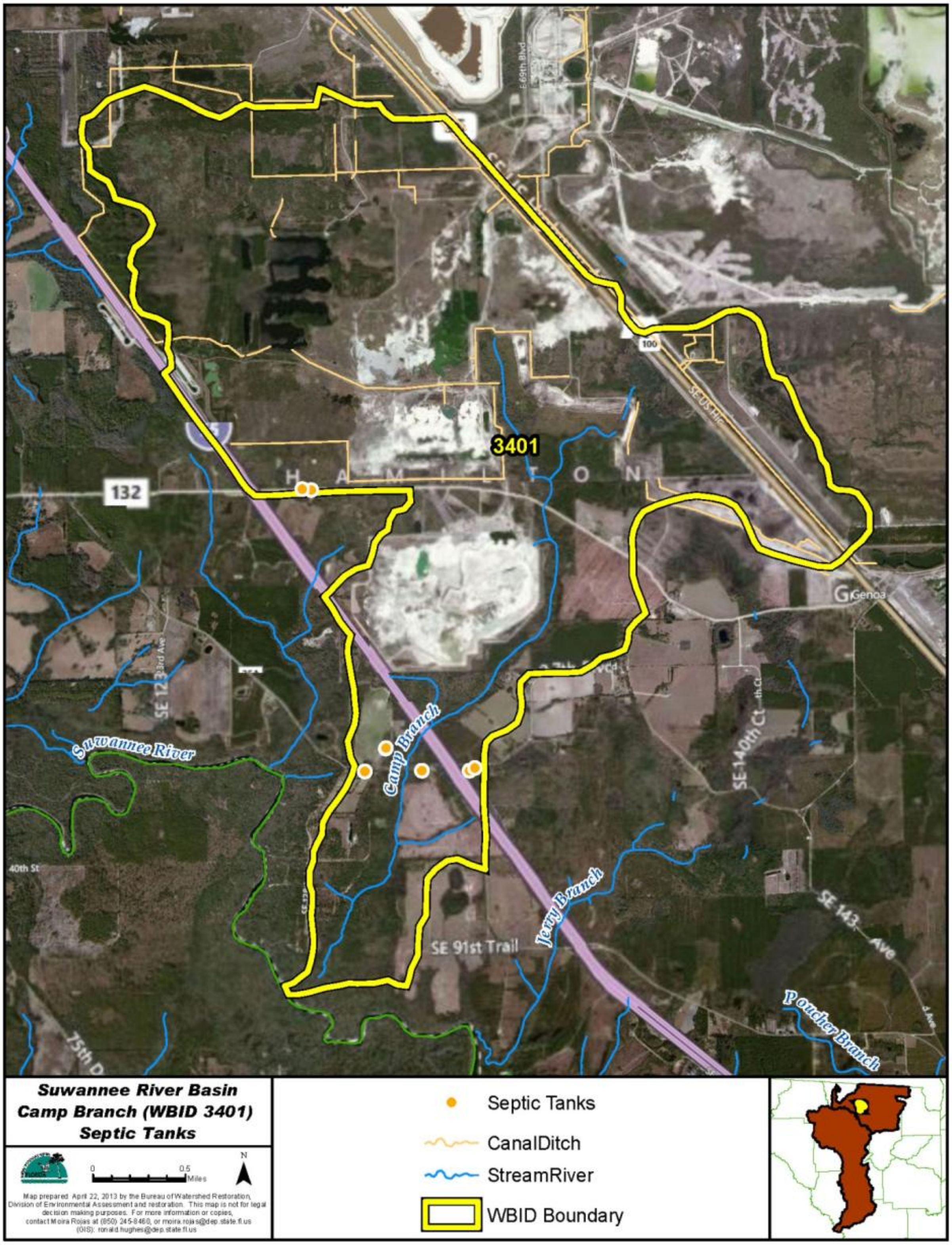

Figure B.5. Location of OSTDS Based on FDOH Data in the Residential Land Use Areas within the Camp Branch WBID Boundary

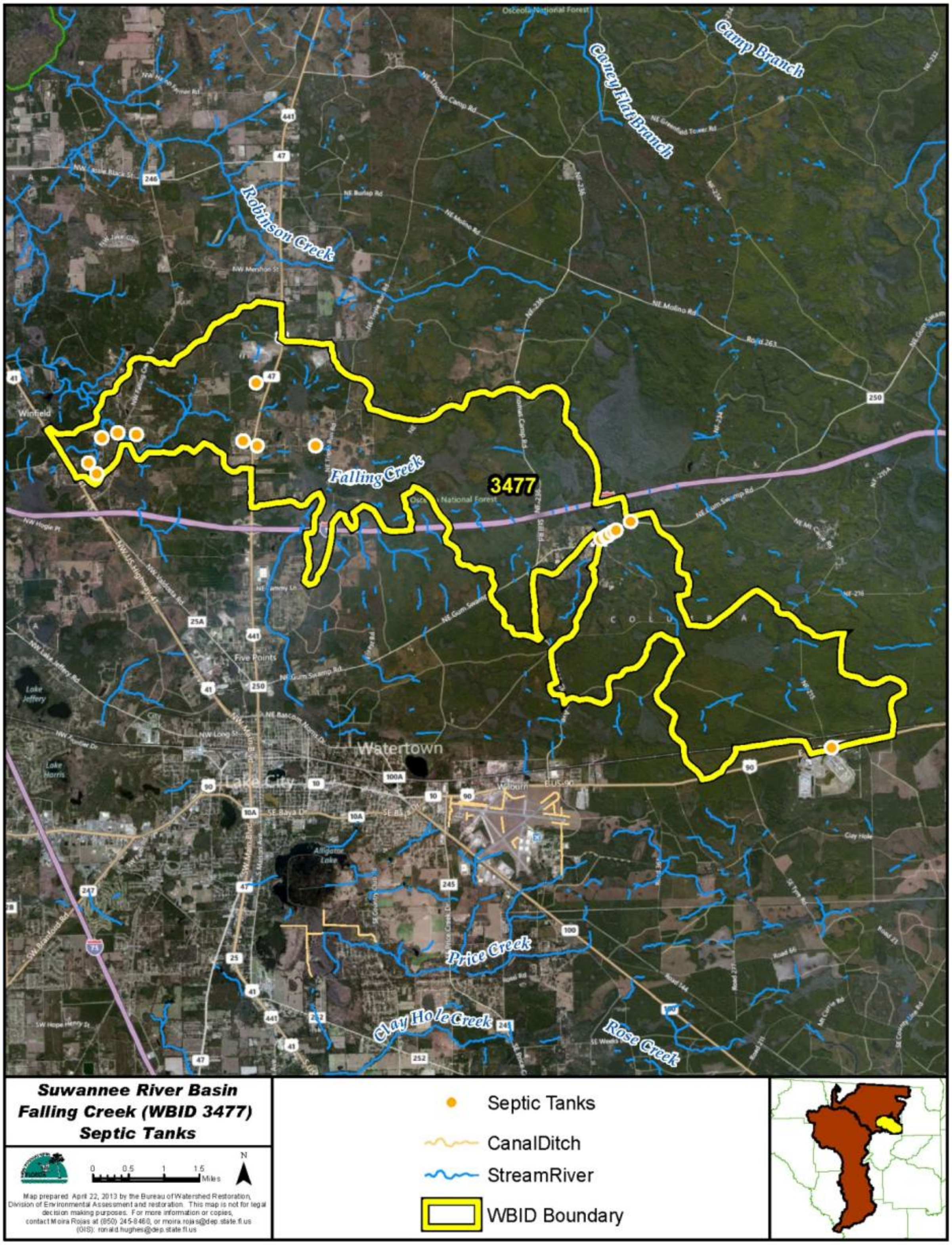

Figure B.6. Location of OSTDS Based on FDOH Data in the Residential Land Use Areas within the Falling Creek WBID Boundary

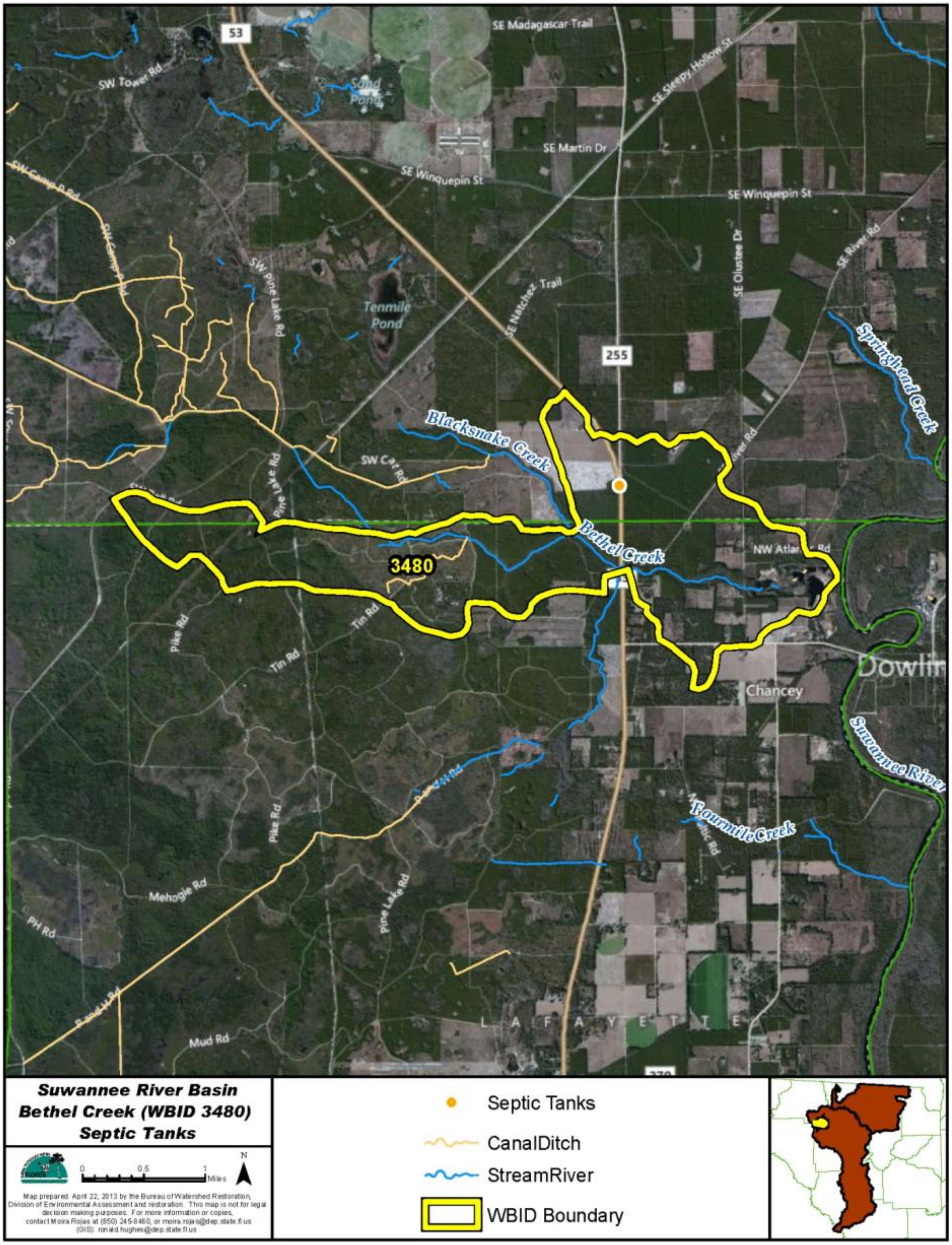

Figure B.7. Location of OSTDS Based on FDOH Data in the Residential Land Use Areas within the Bethel Creek WBID Boundary

Sanitary Sewer Overflows

Sanitary sewer overflows (SSOs) can also be a potential source of fecal bacteria pollution. Human sewage can be introduced into surface waters even when storm and sanitary sewers are separated. Leaks and overflows are common in many older sanitary sewers where capacity is exceeded, high rates of infiltration and inflow occur (i.e., outside water gets into pipes, reducing capacity), frequent blockages occur, or sewers are simply falling apart due to poor joints or pipe materials. Power failures at pumping stations are also a common cause of SSOs. The greatest risk of an SSO occurs during storm events; however, few comprehensive data are available to quantify SSO frequency and bacteria loads in most watersheds. Therefore, in this report, the possible fecal coliform load contributed by sewer line leakage was estimated based on an empirical leakage rate of 0.5 percent of the total raw sewage (Culver et al., 2002) created within the WBIDs by the households connected to the sewer system.

The number of households *(N)* within each individual WBID boundary served by sewer systems is was estimated by subtracting the estimated number of households in the WBID (**Table B.**1) minus the estimated number of households using septic tanks (**Table B.2**). **Table B.4** shows the estimated number of households *(N)* within each WBID boundary estimated to be served by sewer systems.

Fecal coliform loading from sewer line leakage can be calculated based on the number of people in the watershed, typical per household generation rates, and typical fecal coliform concentrations in domestic sewage, assuming a leakage rate of 0.5 percent (Culver et al., 2002). Based on this assumption, a rough estimate of fecal coliform loads from leaks and SSOs within the WBID boundaries can be made using **Equation B.3.**

$$L = 37.85 * N * Q * C * F \qquad \textbf{Equation B.3}$$

Where:

L is the fecal coliform daily load (counts/day);
N is the number of households using sanitary sewer in the WBID;
Q is the discharge rate for each household (gallons/day);
C is the fecal coliform concentration for domestic wastewater (counts/100mL);
F is the sewer line leakage rate; and
37.85 is a conversion factor (100mL/gallon).

The discharge rate through sewers from each household (*Q*) was calculated by multiplying the average household size for each county (2.64 for Columbia County, 2.61 for Hamilton County and 3.2 for Lafayette County, based on U.S. Census Bureau 2010) by the per capita wastewater production rate per day (70 gallons/day/person). The commonly cited concentration (*C*) for domestic wastewater is 1×10^6 counts/100 mL for fecal coliform (USEPA 2001). The contribution of fecal coliform through sewer line leakage was assumed to be 0.5 percent of the total sewage loading created from the population not on septic tanks (Culver *et al.* 2002). Based on **Equation B.3**, the approximate fecal coliform loading from sewer line leakage in each the WBID is summarized in **Table B.4.** This estimated load refers to loading created within the watershed undergoing no attenuation, rather than the loadings eventually reaching the receiving water.

Table B.4. Estimated Number of Households Served by Sanitary Sewers and Estimated Fecal Coliform Loading from Sewer Line Leakage within each WBID Boundary

This is a three-column table. Column 1 lists the WBID number, Column 2 lists the number of households served by sanitary sewers, Column 3 lists the sanitary sewer loading

WBID	# of Households Served by Sanitary Sewers	Sanitary Sewer (counts/day)
3364	17	5.88E+08
3368	10	3.50E+08
3375	3	1.04E+08
3388	73	2.55E+09
3389	11	3.80E+08
3401	11	3.80E+08
3477	171	5.98E+09
3480	14	5.93E+08

Livestock

The presence of livestock and other agricultural animals can result in high loading rates of pathogens to soils and waters. Livestock with direct access to the receiving water can contribute to exceedances during wet and dry weather conditions. Problems with grazing animals and pathogen loading rates derive primarily from animal density (Hubbard et al., 2004). At low animal densities, concerns relate primarily to livestock having free access to waterbodies, where they can directly deposit urine and manure (Hubbard et al., 2004). At high animal densities, concerns relate to the large amounts of urine and feces that are deposited in relatively small areas, increasing the probability of nutrients and pathogens being transported to surface waterbodies via surface runoff, or entering ground water (Hubbard et al., 2004).

Although agricultural land use is not dominant within the individual WBID boundaries, livestock and other agricultural animals are a potentially important nonpoint source of coliform in agricultural areas. Agricultural animal waste is associated with various pathogens in streams; these can include *E. coli, Salmonella, Giardia, Campylobacter, Shigella and Cryptosporidiumparvum* (Landry and Wolfe, 1999). Agricultural activities, including runoff from pastureland and cattle in streams, can affect water quality.

The estimation of fecal coliform loads from livestock for the verified impaired WBIDs was derived from the EPA document, *Protocol for developing pathogen TMDLs: Source assessment* (2001). Data from the U.S. Department of Agriculture (USDA) (2007) were used to obtain the numbers of livestock for Columbia, Hamilton and Lafayette Counties, and data from the 2006-2008 SRWMD's land use coverage were used to obtain total pastureland areas for each county. Livestock counts and pasture areas were used to determine livestock densities (e.g., number of cows per acre of pastureland) by county, with the assumption that livestock are evenly distributed over pasture areas within the county.

Pasture areas of each WBID were used with the livestock density for the corresponding county to obtain livestock counts within each WBID. **Tables B.5a** through **B.5c** summarize pastureland acreage estimated for Columbia, Holmes and Lafayette counties and the individual WBIDs within each county, as well as the livestock densities per acre of pastureland estimated for each county. **Tables B.6** and **B.7** summarizes cattle populations in Hamilton, Columbia and Lafayette counties and estimated livestock populations for the individual WBIDs within each county. As any future impairments are verified, additional tables will be added if WBIDs fall within other counties.

Tables B.6 and **B.7** also include an estimate of fecal coliform loads produced by different livestock (cattle, pigs or goats where applicable) in each WBID. These loads were obtained based on the livestock densities estimated for each WBID and the fecal coliform counts that the American Society of Agricultural Engineers (ASAE) (1998) estimates for fecal indicator concentrations for cattle, goats and pigs.

Table B.5a Summary of Pastureland Acreage in Columbia County and WBIDs 3368, 3388 and 3477, and Livestock Densities per Acre of Pastureland for Columbia County

This is a four-column table. Column 1 lists the geographic area, Column 2 lists the acres of pastureland, Column 3 lists the cattle per acre of pastureland and Column 4 lists the goats per acre of pastureland.

*Assumed to be the same as that of Columbia County

Geographic Area	Acres of Pastureland	Livestock (Cattle) per Acre of Pastureland	Livestock (Goats) per Acre of Pastureland
Columbia County	48,968	0.45	0.037
Little Creek (WBID 3368)	166.10	0.45	0.037
Deep Creek (WBID 3388)	392.99	0.45	0.037
Falling Creek (WBID 3477)	299.69	0.45	0.037

Table B.5b Summary of Pastureland Acreage in Hamilton County and WBIDs 3364, 3375, 3389 and 3401, and Livestock Densities per Acre of Pastureland for Hamilton County

This is a four-column table. Column 1 lists the geographic area, Column 2 lists the acres of pastureland, Column 3 lists the cattle per acre of pastureland and Column 4 lists the pigs per acre of pastureland.

*Assumed to be the same as that of Holmes County

Geographic Area	Acres of Pastureland	Livestock (Cattle) per Acre of Pastureland	Livestock (Pigs) per Acre of Pastureland
Hamilton	15,658	0.53	0.064
Hunter Creek (WBID 3364)	111.73	0.53	0.064
Swift Creek (WBID 3375)	350.88	0.53	0.064
Sugar Creek (WBID 3389)	74.33	0.53	0.064
Camp Branch (WBID 3401)	167.84	0.53	0.064

Table B.5c Summary of Pastureland Acreage in Lafayette County and WBID 3480, and Livestock Densities per Acre of Pastureland for Lafayette County

This is a four-column table. Column 1 lists the geographic area, Column 2 lists the acres of pastureland, Column 3 lists the cattle per acre of pastureland and Column 4 lists the pigs per acre of pastureland.

*Assumed to be the same as that of Holmes County

Geographic Area	Acres of Pastureland	Livestock (Cattle) per Acre of Pastureland	Livestock (Pigs) per Acre of Pastureland	Livestock (Goats) per Acre of Pastureland
Lafayette	175,047	0.18	0.005	0.004
Bethel Creek (WBID 3480)	111.73	0.18	0.005	0.004

Table B.6. Summary of Livestock Populations in Columbia, Hamilton and Lafayette Counties and the individual WBIDs and Livestock Waste Estimates for the individual WBIDs

[1] USDA, 2007

County/WBID	Known Livestock Population in 2007* Cattle	Known Livestock Population in 2007* Goats	Known Livestock Population in 2007* Pigs	Estimated Livestock Population in 2007* Cattle	Estimated Livestock Population in 2007* Goats	Estimated Livestock Population in 2007* Pigs
Columbia	21,929	1,844	NA	-	-	-
Hamilton	8,263	NA	1,007	-	-	-
Lafayette	32,125	622	803	-	-	-
3364	-	-	-	59	-	7
3368	-	-	-	74	6	NA
3375	-	-	-	185	NA	22
3388	-	-	-	176	14	NA
3389	-	-	-	39	NA	4
3401	-	-	-	88	NA	10
3477	-	-	-	134	11	NA
3480	-	-	-	20	0.4	0.5

Table B.7. Summary of Fecal Coliform Loads for Columbia, Hamilton and Lafayette Counties and the individual WBIDs

County/WBID	FC Density (counts/day) Cattle	FC Density (counts/day) Goats	FC Density (counts/day) Pigs
Columbia	2.19E+15	2.21E+13	NA
Hamilton	8.26E+14	NA	1.11E+13
Lafayette	3.21E+15	7.46E+12	8.83E+12
3364	5.90E+12	NA	7.90E+10
3368	7.44E+12	7.51E+10	NA
3375	1.85E+13	NA	2.48E+11
3388	1.76E+13	1.78E+11	NA
3389	3.92E+12	NA	5.26E+10
3401	8.86E+12	NA	1.19E+11
3477	1.34E+13	1.35E+11	NA
3480	2.05E+12	4.76E+09	5.64E+09

Wildlife

Although wildlife is an important and likely possible source of fecal coliform bacteria within the WBID boundaries, they represent natural inputs, and therefore no reductions are assigned to these sources by this TMDL.

Appendix C: Information on Verified Impairment for Individual WBIDs in the Suwannee River Basin

The Department used the IWR to assess water quality impairments in the Suwannee River Basin and has verified waterbody segments which are impaired for fecal coliform bacteria. The verified impairment was based on the observation that, with a 90% confidence limit based on binomial distribution, more than 10% of values exceeded the assessment threshold of 400 counts per 100 milliliters (counts/100mL) in these WBIDs (see **Section 3.2** for details).

WBIDs 3368, 3375, 3388, 3401 and 3480 were verified as impaired during the Group 1 Cycle 2 verified period (January 1, 2000 through June 30, 2007) (based on IWR Run31). During the Cycle 3 verified period assessment (January 1, 2005, through June 30, 2012), fecal coliform was not impaired for any of these waterbodies based on the number of exceedances for the sample size (**Table C.1b**). However, data available during the Cycle 3 assessment did not meet the exceedance ratio required by the IWR (Table 4) for delisting the waterbody; therefore, the parameter remains on the 303(d) list. WBIDs 3364, 3389 and 3477 were verified as impaired during the Group 1 Cycle 3 verified period (January 1, 2005 through June 30, 2012) (based on IWR Run47).

Tables C.1a summarizes fecal coliform monitoring results used for verified impairment for the Cycle 2 verified period for WBIDs 3368, 3375, 3388, 3401 and 3480. **Table C.1b** summarizes fecal monitoring results used for verified impairment for the Cycle 3 assessment (based on IWR Run47) for all the WBIDs verified as impaired.

Table C.1a. Summary of Fecal Coliform Monitoring Data for WBIDs 3368, 3375, 3388, 3401 and 3480 During the Cycle 2 Verified Period (January 1, 2000, through June 30, 2007) based on IWR Run31

This is a six-column table. Column 1 lists the parameter, and Columns 2 through 6 list the WBID number and corresponding Cycle 2 results for each WBID.

Parameter	WBID 3368	WBID 3375	WBID 3388	WBID 3401	WBID 3041
Total number of samples	20	45	25	31	23
IWR-required number of exceedances for the Verified List	5	8	5	6	5
Number of observed exceedances	5	11	6	13	5
Number of observed nonexceedances	15	34	19	18	18
Number of seasons during which samples were collected	4	4	4	4	4
Highest observation (counts/100mL)	2,700	1,450	2,100	2,950	1,091
Lowest observation (counts/100mL)	4	13	4	19	18
Median observation (counts/100mL)	201	154	70	310	192
Mean observation (counts/100mL)	373.3	326.6	236.6	542.4	270.7

Table C.1b. Summary of Fecal Coliform Monitoring Data for WBIDs 3364, 3368, 3375, 3388, 3389, 3401, 3477 and 3480 During the Cycle 3 Verified Period (January 1, 2005, through June 30, 2012) based on IWR Run47

This is a nine-column table. Column 1 lists the parameter, and Columns 2 through 9 list the WBID number and corresponding Cycle 3 results for each WBID.

Parameter	WBID 3364	WBID 3368	WBID 3375	WBID 3388	WBID 3389	WBID 3401	WBID 3477	WBID 3480
Total number of samples	23	10	4	16	23	2	19	20
IWR-required number of exceedances for the Verified List	5	5	NA	5	5	NA	5	5
Number of observed exceedances	18	3	2	4	21	0	6	2
Number of observed nonexceedances	5	7	2	12	2	2	13	18
Number of seasons during which samples were collected	4	3	3	4	4	2	4	4
Highest observation (counts/100mL)	9,900	930	1,050	640	7,600	300	1,670	520
Lowest observation (counts/100mL)	50	4	46	4	270	200	2	18
Median observation (counts/100mL)	1,580	224	281	86.5	1,100	250	140	161
Mean observation (counts/100mL)	2,388.4	312.4	414.5	180.8	1,713	250	330.3	187.3

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