FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Environmental Assessment and Restoration, Bureau of Watershed Restoration

SOUTHWEST DISTRICT • TAMPA BAY BASIN

Final TMDL Report

Fecal Coliform TMDL for Brushy Creek (WBID 1498), Sweetwater Creek (WBID 1516), Rocky Creek (WBID 1507), and Lower Rocky Creek (WBID 1563)

David Tyler

July 28, 2010

Acknowledgments

This TMDL analysis could not have been accomplished without significant contributions from staff in Hillsborough County, the Florida Department of Environmental Protection's Southwest District Office, and its Watershed Evaluation and TMDL Section in Tallahassee.

Editorial assistance provided by Jan Mandrup-Poulsen and Linda Lord.

For additional information on the watershed management approach and impaired waters in the Tampa Bay Basin, contact:

Terry Hansen
Florida Department of Environmental Protection
Bureau of Watershed Restoration
Watershed Planning and Coordination Section
2600 Blair Stone Road, Mail Station 3565
Tallahassee, FL 32399-2400
Email: terry.hansen@dep.state.fl.us
Phone: (850) 245–8561
Fax: (850) 245–8434

Access to all data used in the development of this report can be obtained by contacting:

David Tyler
Florida Department of Environmental Protection
Bureau of Watershed Restoration
Watershed Evaluation and TMDL Section
2600 Blair Stone Road, Mail Station 3555
Tallahassee, FL 32399-2400
Email: david.tyler@dep.state.fl.us
Phone: (850) 245–8458
Fax: (850) 245–8536

Contents

List of Tables

List of Figures

Websites

Florida Department of Environmental Protection, Bureau of Watershed Restoration

TMDL Program

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

Identification of Impaired Surface Waters Rule

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

STORET Program

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

2008 Integrated Report

http://www.dep.state.fl.us/water/docs/2008_Integrated_Report.pdf

Criteria for Surface Water Quality Classifications

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

Basin Status Report for the Tampa Bay Basin

http://www.dep.state.fl.us/water/basin411/tampa/status.htm

Basin Water Quality Assessment Report for the Tampa Bay Basin

http://www.dep.state.fl.us/water/basin411/tampa/assessment.htm

U.S. Environmental Protection Agency

Region 4: Total Maximum Daily Loads in Florida

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

National STORET Program

http://www.epa.gov/storet/

Chapter 1: INTRODUCTION

1.1 Purpose of Report

This report presents the Total Maximum Daily Loads (TMDL) for fecal coliform bacteria for Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek within the Tampa Bay Basin. These waterbodies were verified as impaired for fecal coliform and therefore were included on the Verified List of impaired waters for the Tampa Bay Basin that was adopted by Secretarial Order on June 3, 2008. The TMDLs establish the allowable fecal coliform loadings to Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek that would restore these waterbodies so that they meet their applicable water quality criterion for fecal coliform.

1.2 Identification of Waterbody

Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek are located in the northwest portion of Hillsborough County along the Interstate 275 corridor (**Figure 1.1**). None of these waterbodies lies within the limits of a major city. The city of Tampa (about 336,823 people) is located just south of Lower Rocky Creek and southwest of Sweetwater Creek. There are 7 incorporated areas (Census Designated Places, or CDPs) intersecting with these watersheds: Citrus Park (20,226 people), Town 'n' Country (72,523), Greater Northdale (20,461 people), Greater Carrollwood (33,519 people), Egypt Lake-Leto (32,782 people), Lake Magdalene (28,755 people), and Westchase (11,116 people).

Brushy Creek (about 5.41 miles in length) flows southwest, feeding into the upstream portion of Rocky Creek, with its upstream portion stemming from Greater Northdale. Rocky Creek (about 7.94 miles long) flows southwest, feeding into Lower Rocky Creek, with its upstream portion stemming from Citrus Park and Greater Carrollwood. Lower Rocky Creek (about 5.07 miles in length) flows southwest into Tampa Bay, with its watershed located within Town 'n' Country. Sweetwater Creek (about 9.06 miles long) flows southwest, feeding into the downstream portion of Rocky Creek, with its upstream portion stemming from Lake Magdalene. Additional information about all these creeks' hydrology and geology is available in the Basin Status Report for the Tampa Bay Basin (Florida Department of Environmental Protection [Department], 2001). For assessment purposes, the Department has divided the Tampa Bay Basin into water assessment polygons with a unique waterbody identification (WBID) number for each watershed or stream reach. Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek are WBIDs 1498, 1516, 1507, and 1563, respectively (**Figure 1.2**).

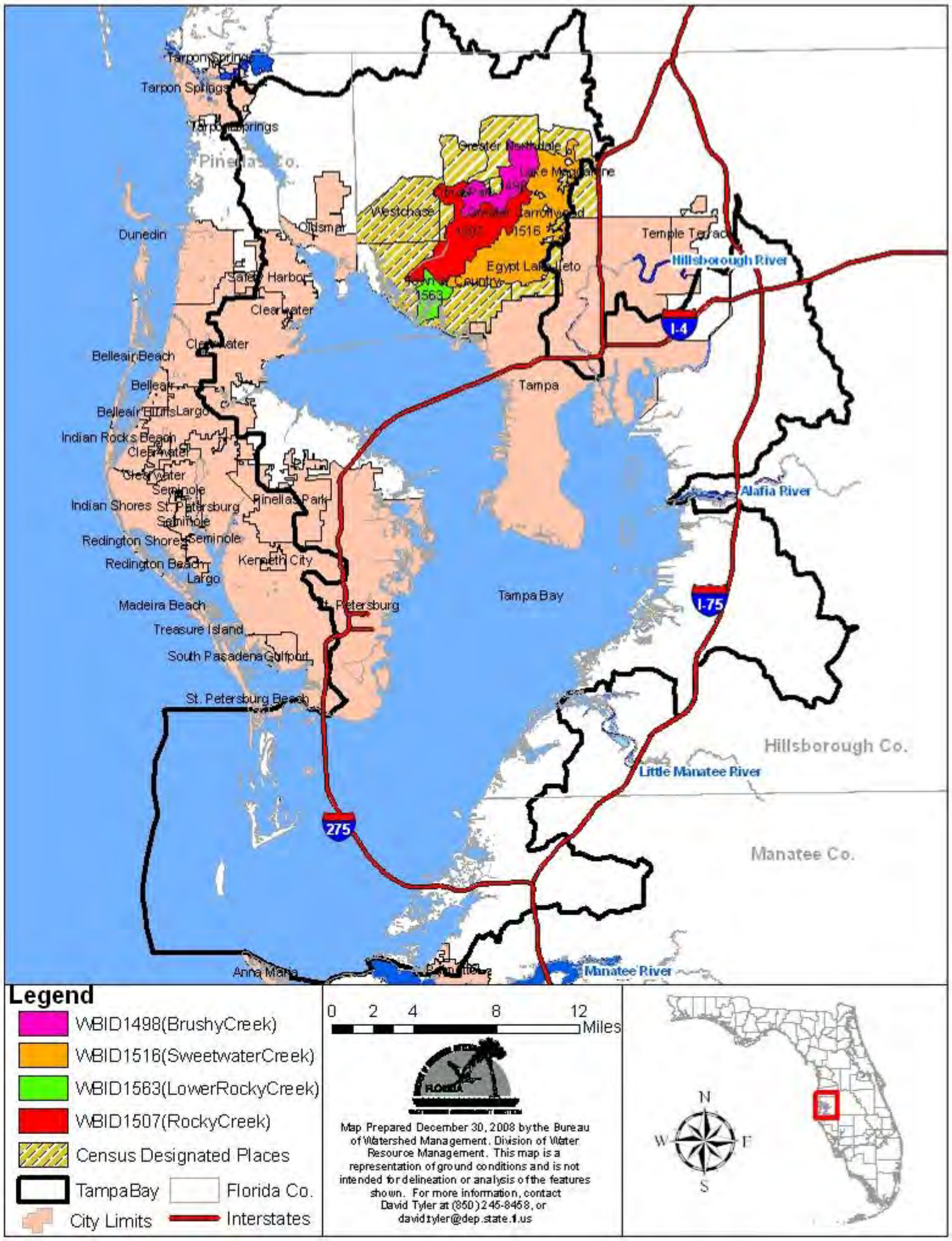


Figure 1.1. Location of the Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek Watersheds in the Tampa Bay Basin and Major Geopolitical Features in the Area

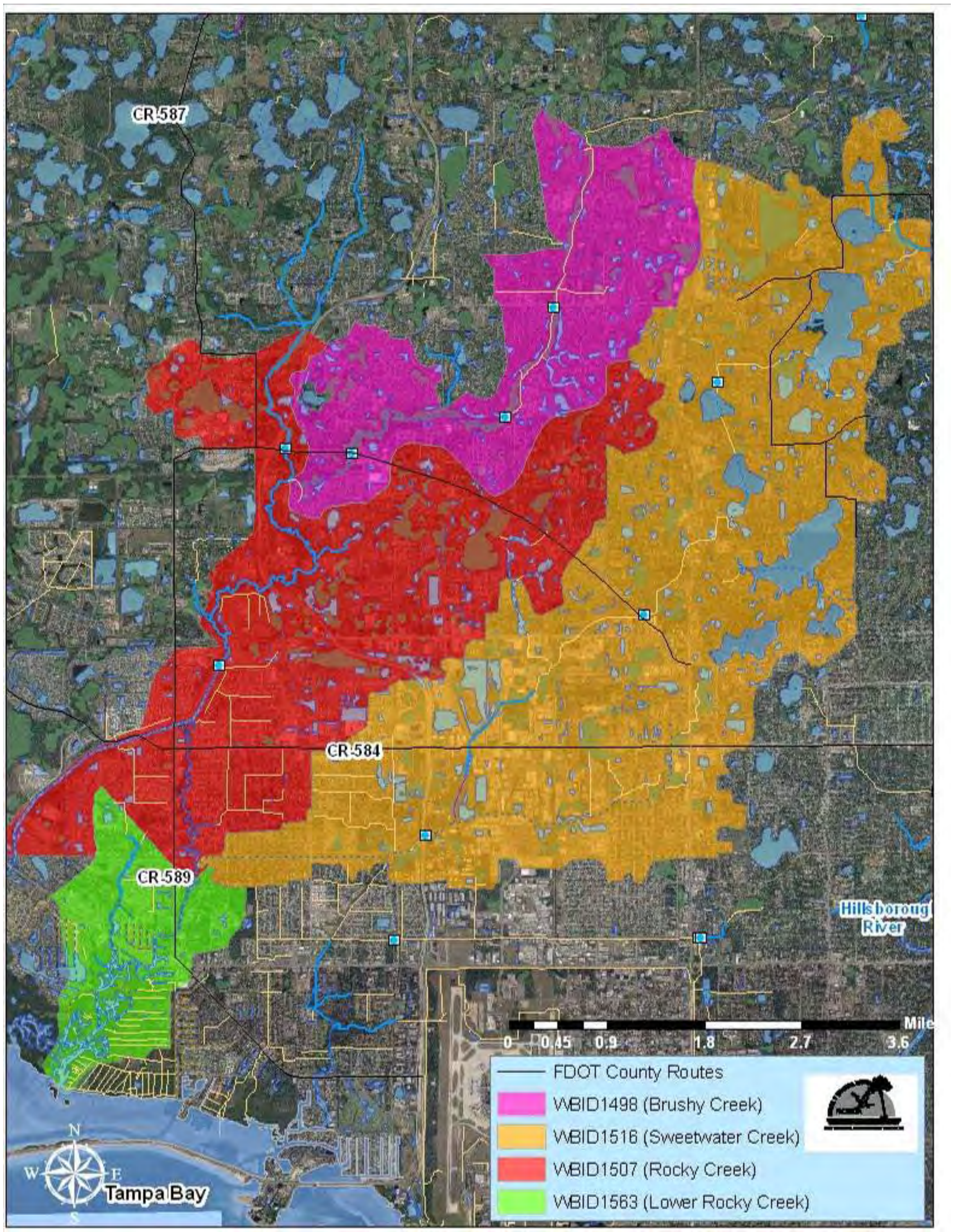


Figure 1.2. Location of the Brushy Creek (WBID 1498), Sweetwater Creek (WBID 1516), Rocky Creek (WBID 1507), and Lower Rocky Creek (WBID 1563) Watersheds in Hillsborough County

1.3 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, 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 Basin Management Action Plan, or BMAP, designed to reduce the amount of fecal coliform that caused the verified impairment of Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek. These activities will depend heavily on the active participation of the Southwest Florida Water Management District (SWFWMD), Hillsborough County's Environmental Protection Commission (HEPC), 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 U.S. Environmental Protection Agency (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 47 waterbodies in the Tampa Bay Basin. However, the FWRA (Section 403.067, F.S.) stated that all previous Florida 303(d) lists 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.C.) (Identification of Impaired Surface Waters Rule, or IWR), in April 2001; the rule was modified in 2004 and 2007.

2.2 Information on Verified Impairment

The Department used the IWR to assess water quality impairments in the Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek watersheds and verified the impairments during the second cycle of the TMDL Program (**Table 2.1**). Because these waterbodies are spatially and hydrologically connected, the Department has included all four WBIDs in this report to address the fecal coliform impairments. **Table 2.2** summarizes the fecal coliform data collected during the verified period (January 1, 2000, through June 30, 2007). The projected year for the 1998 303(d) listed fecal coliform bacteria TMDL for Brushy Creek, Sweetwater Creek, and Lower Rocky Creek was 2008, but the Settlement Agreement between the EPA and Earthjustice, which drives the TMDL development schedule for waters on the 1998 303(d) list, allows an additional nine months to complete the TMDLs. As such, these TMDLs must be adopted and submitted to the EPA by September 30, 2009.

During the first cycle assessment, the Department placed Rocky Creek on the Planning List for fecal coliform (stating that additional monitoring and evaluation were required to verify the impairment). However, the EPA was required to satisfy the 2003 projected year for the 1998 303(d) listed fecal coliform TMDL for Rocky Creek; as a result, the agency developed and proposed a fecal coliform TMDL for Rocky Creek in September 2004. During the second cycle assessment, the Department verified the fecal coliform impairment for the creek. A Department TMDL will be submitted to the EPA for approval. Once the TMDL is approved, the EPA will replace its fecal coliform TMDL for Rocky Creek with the Department's TMDL.

These waterbodies were verified as impaired based on fecal coliform because, using the IWR methodology, more than 10 percent of the values exceeded the Class III freshwater criterion (for Brushy Creek, Sweetwater Creek, and Rocky Creek) and the Class II criterion (for Lower Rocky Creek) of 43 counts per 100 milliliters (counts/100mL). During the verified period, Brushy Creek

(Stream – 11 out of 31 samples), Sweetwater Creek (Stream – 24 out of 99 samples), Rocky Creek (Stream – 48 out of 133 samples), and Lower Rocky Creek (Estuary – 85 out of 96 samples) exceeded the criterion. The fecal coliform data used in this report are based on the data from IWR Runs 32 and 34.

The verified impairments were based on data collected by Hillsborough County and the Department's Southwest District. **Figure 5.1** shows the WBID locations and STORET stations. **Figures 2.1a, 2.1b, 2.1c,** and **2.1d** display the fecal coliform data collected from 2000 through 2007 for each watershed.

Table 2.1. Verified Impairments for Brushy Creek (WBID 1498), Sweetwater Creek (WBID 1516), Rocky Creek (WBID 1507), and Lower Rocky Creek (WBID 1563)

[1] IIIF = Class III freshwater
[2] II = Class II
[3] N/A – Not applicable

WBID	Waterbody Segment	Waterbody Type	Waterbody Class	1998 303(d) Parameters of Concern	Parameter Causing Impairment
1498	Brushy Creek	Stream	IIIF[1]	Coliform	Fecal Coliform
1516	Sweetwater Creek	Stream	IIIF[1]	Coliform	Fecal Coliform
				Dissolved Oxygen	Dissolved Oxygen
				N/A[3]	Nutrients (Historical Chlorophyll *a*)
1507	Rocky Creek	Stream	IIIF[1]	Coliform	Fecal Coliform
				Dissolved Oxygen	Dissolved Oxygen
				Nutrients	Nutrients (Historical Chlorophyll *a*)
1507	Lower Rocky Creek	Estuary	II[2]	Coliform	Fecal Coliform
				Dissolved Oxygen	Dissolved Oxygen
				Nutrients	Nutrients (Chlorophyll *a*)

Table 2.2. Summary of Fecal Coliform Data for Brushy Creek (WBID 1498), Sweetwater Creek (WBID 1516), Rocky Creek (WBID 1507), and Lower Rocky Creek (WBID 1563) During the Verified Period (January 1, 2000–June 30, 2007)

[1] Exceedances represent values above 400 counts/100mL for WBIDs 1498, 1516, and 1507, and 43 counts/100mL for WBID 1563.
[2] Coliform counts are #/100mL.

WBID	Total Number of Samples	IWR-Required Number of Exceedances for the Verified List[1]	Number of Observed Exceedances[1]	Number of Observed Nonexceedances[1]	Number of Seasons Data Were Collected	Mean[2]	Median[2]	Min[2]	Max[2]
1498	31	6	11	20	4	534	320	80	2,460
1516	99	15	24	75	4	343	140	0	4,000
1507	133	19	48	85	4	759	265	0	18,100
1563	96	14	85	11	4	475	240	0	4,000

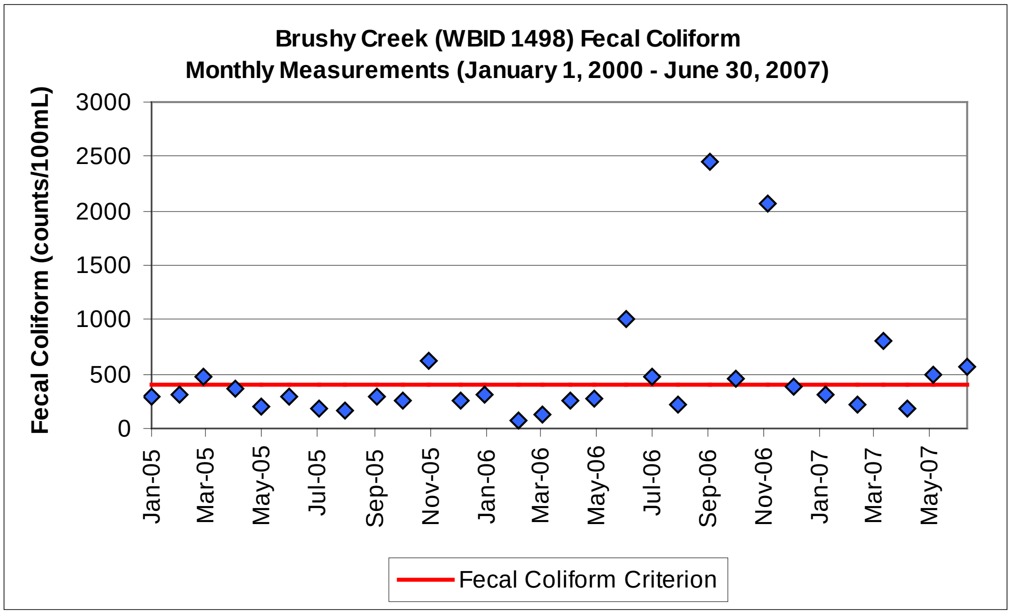


Figure 2.1a. Fecal Coliform Measurements for Brushy Creek (WBID 1498) During the Verified Period (January 1, 2000–June 30, 2007)

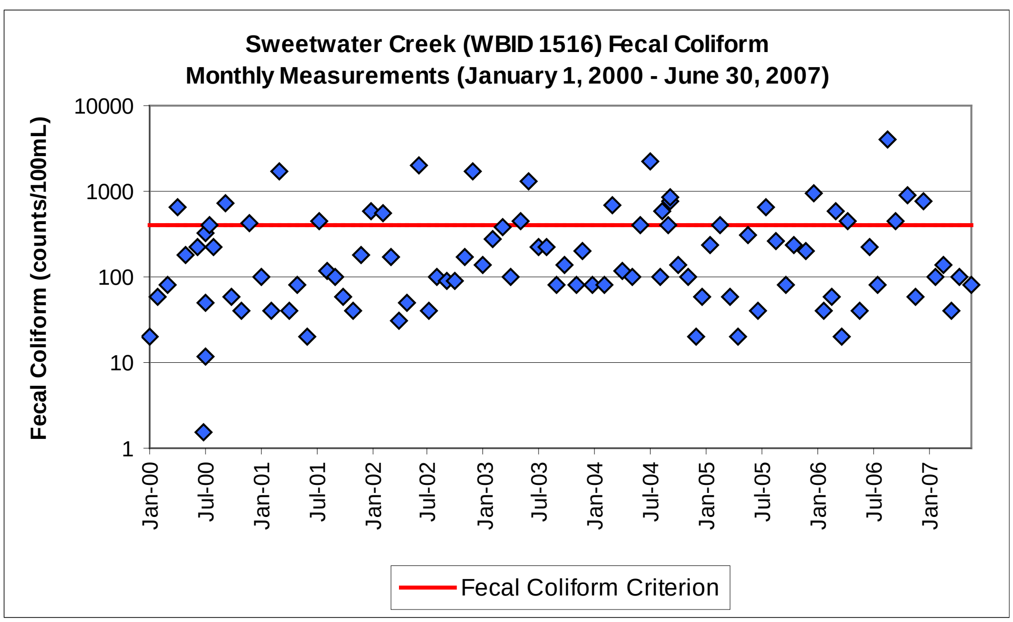


Figure 2.1b. Fecal Coliform Measurements for Sweetwater Creek (WBID 1516) During the Verified Period (January 1, 2000–June 30, 2007)

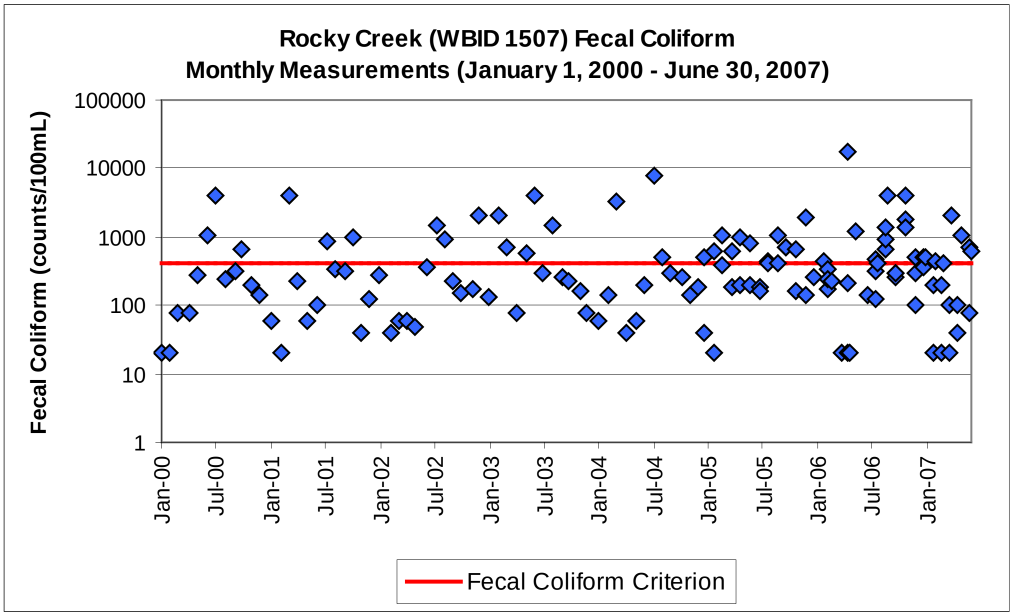


Figure 2.1c. Fecal Coliform Measurements for Rocky Creek (WBID 1507) During the Verified Period (January 1, 2000–June 30, 2007)

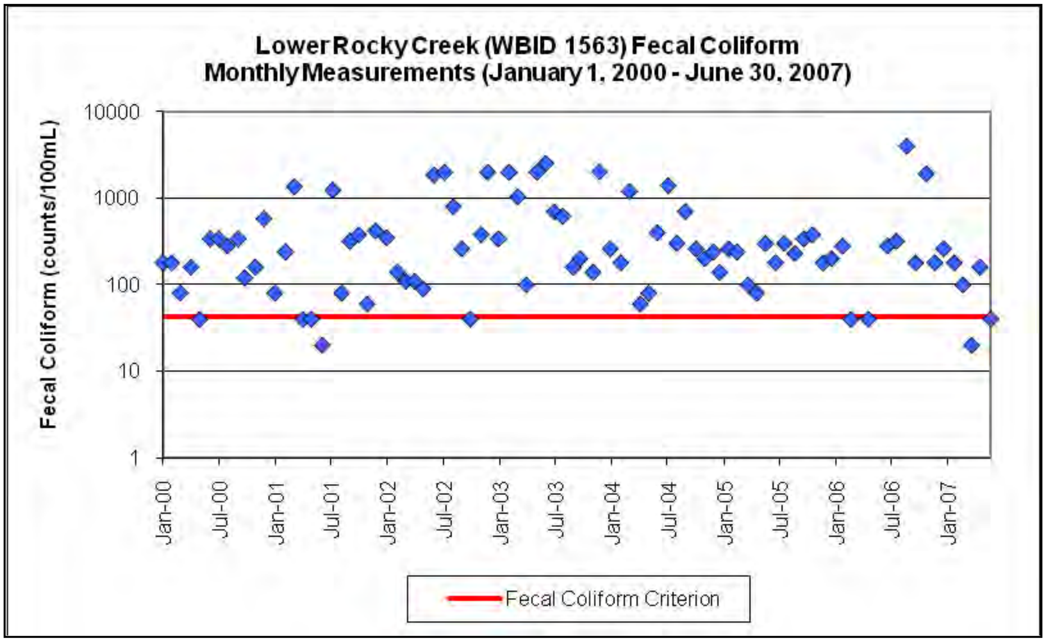


Figure 2.1d. Fecal Coliform Measurements for Lower Rocky Creek (WBID 1563) During the Verified Period (January 1, 2000–June 30, 2007)

Chapter 3. DESCRIPTION OF APPLICABLE WATER QUALITY STANDARDS AND TARGETS

3.1 Classification of the Waterbody and Criteria Applicable to the TMDLs

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)**

Brushy Creek, Sweetwater Creek, and Rocky Creek are Class III waterbodies with a designated use of recreation, propagation, and the maintenance of a healthy, well-balanced population of fish and wildlife. Lower Rocky Creek is Class II waterbody with a designated use of shellfish propagation or harvesting and the criteria applicable to these TMDLs is the Class II and III criteria for fecal coliform.

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 criteria for the protection of Class II and III waters, as established by Rule 62-302, F.A.C., states the following:

Fecal Coliform Bacteria for Class II:

The most probable number (MPN) counts per 100 milliliters (mL) of fecal coliform bacteria shall not exceed a median value of 14 with not more than, 10 % of the samples exceeding 43, nor exceed 800 on any one day.

Fecal Coliform Bacteria for Class III:

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 state that monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30-day period. During the development of the TMDLs (as described in subsequent sections), 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 criteria selected for the TMDLs was not to exceed 400 MPN/100mL for Class III waterbodies and 43 MPN/100 mL for Class II waterbody in any sampling event for fecal coliform. The 10 percent exceedance allowed by the water quality criterion for fecal coliform bacteria was not used directly in estimating the target load, but was included in the TMDLs' margin of safety (as described in subsequent chapters).

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 in the Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek Watersheds

4.2.1 Point Sources

There are two NPDES permitted domestic wastewater facilities (DWF) that discharge fecal coliform loads directly (Permit No. FL0027821) and indirectly (Permit No. FL0041670) into Rocky Creek (**Figure 4.2**). The Hillsborough County Rivers Oaks Advanced Wastewater Treatment Facility (AWWTF) (FL0027821) has two discharge sites (D-001 and D-002), located in the downstream portion of Rocky Creek near Hillsborough County's water quality station 21FLHILL141.

D-001 is an existing 10.0 million-gallon-per-day (MGD) 12-month average daily flow (12-MADF) permitted discharge to Channel A (Class III surface waters) and Rocky Creek, and then to Old Tampa Bay. The outfall structure is approximately 20 feet in length and discharges at a depth of approximately 2 feet.

D-002 is an existing 5.0 MGD 12-MADF permitted discharge to Channel A (Class III surface waters) and Rocky Creek, and then to Old Tampa Bay. This outfall is a combined outfall for effluents generated by the Hillsborough County Northwest Regional Water Reclamation Facility (WRF) (FL0041670) and the River Oaks AWWTP. The outfall structure is approximately 1 foot in length and discharges at a depth of approximately 2 feet. FL0041670 has an additional outfall (D-003) that discharges effluent in response to rain events to Emerald Greens Golf Course Storage Lake, which is located in the northeast portion of the Rocky Creek watershed.

There is one NPDES domestic wastewater facility (FL0036820–Hillsborough County Dale Mabry AWWTP) that directly discharges (at D-001) fecal coliform loads directly into Brushy Creek (**Figure 4.2**). This existing 6.0 MGD 12-MADF permitted discharge goes to Brushy Creek, to Rocky Creek, and then to Channel A to Tampa Bay (Class III waters). The outfall is at the shoreline and discharges at a depth of approximately 4 feet. Furthermore, the facility serves as a source plant for up to 6.0 MGD (12-MADF) of reclaimed water. The reclaimed water and effluent are transferred to the Hillsborough County Northwest Master Reuse System (FL0041670), and have an intermediate disinfection level requirement (Subsection 62-600.440[6][c], F.A.C.).

Municipal Separate Storm Sewer System Permittees

The stormwater collection systems owned and operated by Hillsborough County and co-permittees (Florida Department of Transportation [FDOT] District 7, Florida's Turnpike Enterprise, and city of Plant City) are covered by a Phase I NPDES municipal separate storm sewer system (MS4) permit (FLS000006). There are no Phase II MS4 permits identified for Brushy Creek, Sweetwater Creek, Rocky Creek, or Lower Rocky Creek.

4.2.2 Land Uses and Nonpoint Sources

Nonpoint source pollution, unlike pollution from industrial and sewage treatment plants, comes from many diffuse sources. Nonpoint pollution is caused by rainfall moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and even underground sources of drinking water (EPA, 1994). Potential nonpoint sources of coliform include loadings from surface runoff, wildlife, livestock, pets, leaking sewer lines, and leaking septic tanks. **Table 4.5** provides estimated fecal coliform loadings from dogs, septic tanks, and sanitary sewer overflows (SSOs) for the Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek watersheds. The information provided for septic tanks and sewers in this report is for information purposes only, and is designed to give a rough estimate of the fecal coliform counts/day from septic tank leakage and SSOs.

Wildlife

Wildlife deposit coliform bacteria with their feces onto land surfaces, where they can be transported during storm events to nearby streams. Some wildlife (such as otters, beavers, raccoons, and birds) deposit their feces directly into the water. The bacterial load from naturally occurring wildlife is assumed to be background. In addition, any strategy employed to control this source would probably have a negligible impact on attaining water quality standards.

Agricultural Animals

Agricultural animals are the source of several types of coliform loading to streams. Agricultural activities, including runoff from pastureland and cattle in streams, can affect water quality. Agricultural land (croplands and pasturelands; specialty farms) occupies less than 2 percent of the total land area in each watershed.

Land Uses

The spatial distribution and acreage of different land use categories were identified using the SWFWMD's 2006 land use coverage (scale 1:40,000) contained in the Department's geographic information system (GIS) library. Land use categories in the watershed were aggregated using the simplified Level 1 codes and tabulated in **Tables 4.1a, 4.1b, 4.1c,** and **4.1d**. **Figure 4.1** shows the acreage of the principal land uses in each of the watersheds.

As shown in **Tables 4.1a, 4.1b, 4.1c,** and **4.1d,** the Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek watersheds drain about 3,697, 11,873, 7,061, and 1,695 acres of land, respectively. The dominant land use category for Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek is urban land (urban and built-up; low-, medium-, and high-density residential; and transportation, communication, and utilities), which accounts for 81, 77, 77, and 56 percent, respectively, of these watersheds' total area. Natural land uses for the Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek watersheds, including water/wetlands, upland forest, and barren land, occupy about 18, 21, 19, and 44 percent, respectively, of the watersheds' total area.

Table 4.1a. Classification of Land Use Categories for the Brushy Creek Watershed (WBID 1498)

- = Empty cell

Level 1 Code	Land Use	Acreage	% Acreage
1000	Urban and Built-Up	504	13.62%
1100	Low-Density Residential	160	4.33%
1200	Medium-Density Residential	164	4.43%
1300	High-Density Residential	2,066	55.87%
2000	Agriculture	31	0.84%
3000	Rangeland	4	0.12%
4000	Forest/Rural Open	23	0.62%
5000	Water	182	4.92%
6000	Wetlands	470	12.70%
8000	Transportation, Communication, and Utilities	94	2.55%
-	**Total:**	**3,697**	**100.00%**

Table 4.1b. Classification of Land Use Categories for the Sweetwater Creek Watershed (WBID 1516)

- = Empty cell

Level 1 Code	Land Use	Acreage	% Acreage
1000	Urban and Built-Up	2,871	24.18%
1100	Low-Density Residential	395	3.32%
1200	Medium-Density Residential	1,736	14.62%
1300	High-Density Residential	3,670	30.91%
2000	Agriculture	118	1.00%
3000	Rangeland	142	1.20%
4000	Forest/Rural Open	143	1.20%
5000	Water	1,333	11.23%
6000	Wetlands	1,037	8.74%
7000	Barrenland	10	0.09%
8000	Transportation, Communication, and Utilities	417	3.52%
-	**Total:**	**11,873**	**100.00%**

Table 4.1c. Classification of Land Use Categories for the Rocky Creek Watershed (WBID 1507)

- = Empty cell

Level 1 Code	Land Use	Acreage	% Acreage
1000	Urban and Built-Up	1,197	16.95%
1100	Low-Density Residential	442	6.26%
1200	Medium-Density Residential	862	12.21%
1300	High-Density Residential	2,448	34.67%
2000	Agriculture	151	2.14%
3000	Rangeland	108	1.53%
4000	Forest/Rural Open	103	1.46%
5000	Water	340	4.82%
6000	Wetlands	917	12.99%
8000	Transportation, Communication, and Utilities	493	6.98%
-	**Total:**	**7,061**	**100.00%**

Table 4.1d. Classification of Land Use Categories for the Lower Rocky Creek Watershed (WBID 1563)

- = Empty cell

Level 1 Code	Land Use	Acreage	% Acreage
1000	Urban and Built-Up	117	6.90%
1100	Low-Density Residential	19	1.12%
1200	Medium-Density Residential	238	14.04%
1300	High-Density Residential	532	31.39%
4000	Forest/Rural Open	60	3.54%
5000	Water	229	13.51%
6000	Wetlands	461	27.20%
8000	Transportation, Communication, and Utilities	39	2.30%
-	**Total:**	**1,695**	**100.00%**

Urban Development

Pets (especially dogs) could be a significant source of coliform pollution through surface runoff in the Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek watersheds. In addition to pets, other animal fecal coliform contributors commonly seen in urban areas include rats, pigeons, and sometimes raccoons.

Studies report that up to 95 percent of the fecal coliform found in urban stormwater can come from 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 for fecal coliform and fecal streptococcus bacteria. Trial et al. (1993) also reported that cats and dogs were the primary source of fecal coliform in urban watersheds. Using bacteria source tracking techniques, Watson (2002) found that the amount of fecal coliform bacteria contributed by dogs in Stevenson Creek in Clearwater, Florida, was as important as that from septic tanks.

According to the American Pet Products Manufacturers Association (APPMA), about 4 out of 10 U.S. households include at least one dog. A single gram of dog feces contains about 23 million fecal coliform bacteria (Van der Wel, 1995). Unfortunately, statistics show that about 40 percent of American dog owners do not pick up their dogs' feces.

Table 4.2 shows the fecal coliform concentrations of surface runoff measured in two urban areas (Bannerman et al., 1993; Steuer et al., 1997). While bacteria levels were widely different in the two studies, both indicated that residential lawns, driveways, and streets were the major source areas for bacteria.

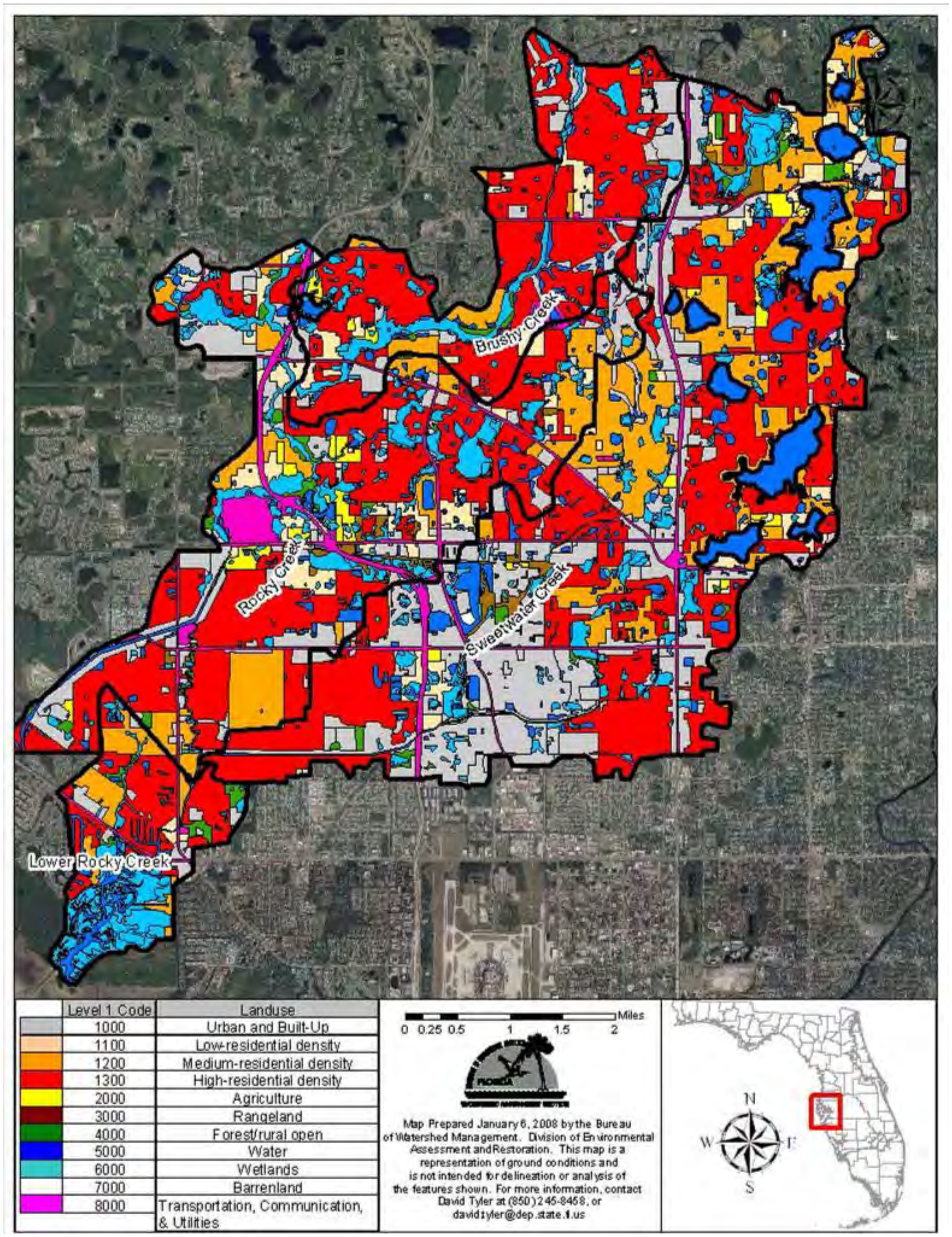


Figure 4.1. Principal Land Uses in the Brushy Creek (WBID 1498), Sweetwater Creek (WBID 1516), Rocky Creek (WBID 1507), and Lower Rocky Creek (WBID 1563) Watersheds in 2006

Table 4.2. Concentrations (Geometric Mean Colonies/100 mL) of Fecal Coliform from Urban Source Areas (Steuer et al., 1997; Bannerman et al., 1993)

Geographic Location	Marquette, Michigan	Madison, Wisconsin
Number of storms sampled	12	9
Commercial parking lot	4,200	1,758
High-traffic street	1,900	9,627
Medium-traffic street	2,400	56,554
Low-traffic street	280	92,061
Commercial rooftop	30	1,117
Residential rooftop	2,200	294
Residential driveway	1,900	34,294
Residential lawns	4,700	42,093
Basin outlet	10,200	175,106

The number of dogs in the Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek watersheds is not known. Therefore, this analysis used the statistics produced by APPMA to estimate the possible fecal coliform loads contributed by dogs. The human population in the Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek watersheds calculated from the census track using Tiger Track 2000 data (the Department's GIS library) is approximately 16,652, 46,545, 31,438, and 6,462, respectively. According to the U.S. Census Bureau, there were 2.50 people per household in Hillsborough County in 2007. This results in an estimated 6,661, 18,618, 12,575, and 2,585 households in the Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek watersheds, respectively. Assuming that 40 percent of the households in this area have 1 dog, the total number of dogs in the Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek Creek watersheds is about 2,664, 7,447, 5,030, and 1,034, respectively.

According to the waste production rate for dogs and the fecal coliform counts per gram of dog wastes listed in **Table 4.3**, and assuming that 40 percent of dog owners do not pick up dog feces, the total waste produced by dogs and left on the land surface of residential areas is 577,080 grams/day. The total fecal coliform produced by dogs for the Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek watersheds is 1.05×10^{12}, 2.95×10^{12}, 1.99×10^{12}, and 4.09×10^{11} counts/day, respectively.

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

Table 4.3. Dog Population Density, Wasteload, and Fecal Coliform Density

* Number from APPMA.
Source: Weiskel et al., 1996.

Type	Population density (an/household)	Wasteload (grams/an-day)	Fecal coliform density (fecal coliform/gram)
Dog	0.4*	450	2,200,000

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, in areas with a relatively high ground water table, the drainage field can be flooded during the rainy season, and coliform bacteria can pollute the surface water through storm runoff. 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 go into the well and once the polluted water is used to irrigate lawns, coliform bacteria may reach the land surface and wash into surface waters during the rainy season.

A rough estimate of fecal coliform loads from failed septic tanks in each watershed can be made using **Equation 4.1**:

$$L = 37.85 * N * Q * C * F \qquad \text{(Equation 4.1)}$$

Where:

L is the fecal coliform daily load (counts/day);
N is the total number of septic tanks in the watershed (septic tanks);
Q is the discharge rate for each septic tank;
C is the fecal coliform concentration for the septic tank discharge; and
F is the septic tank failure rate.

Based on 2007 Florida Department of Health (FDOH) onsite sewage GIS coverage (available: http://www.doh.state.fl.us/environment/programs/EhGis/EhGisDownload.htm), about 120, 887, 363, and 223 housing units (*N*) were identified as being on septic tanks in the Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek watersheds, respectively (**Figure 4.2**). 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 U.S. Census Bureau, the average household size for Hillsborough County is about 2.50 people/household. The same population density was assumed for the Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek watersheds. A commonly cited value for per capita wastewater production rate is 70 gallons/day/person (EPA, 2001). The commonly cited concentration (*C*) for septic tank discharge is 1×10^6 counts/100mL for fecal coliform (EPA, 2001).

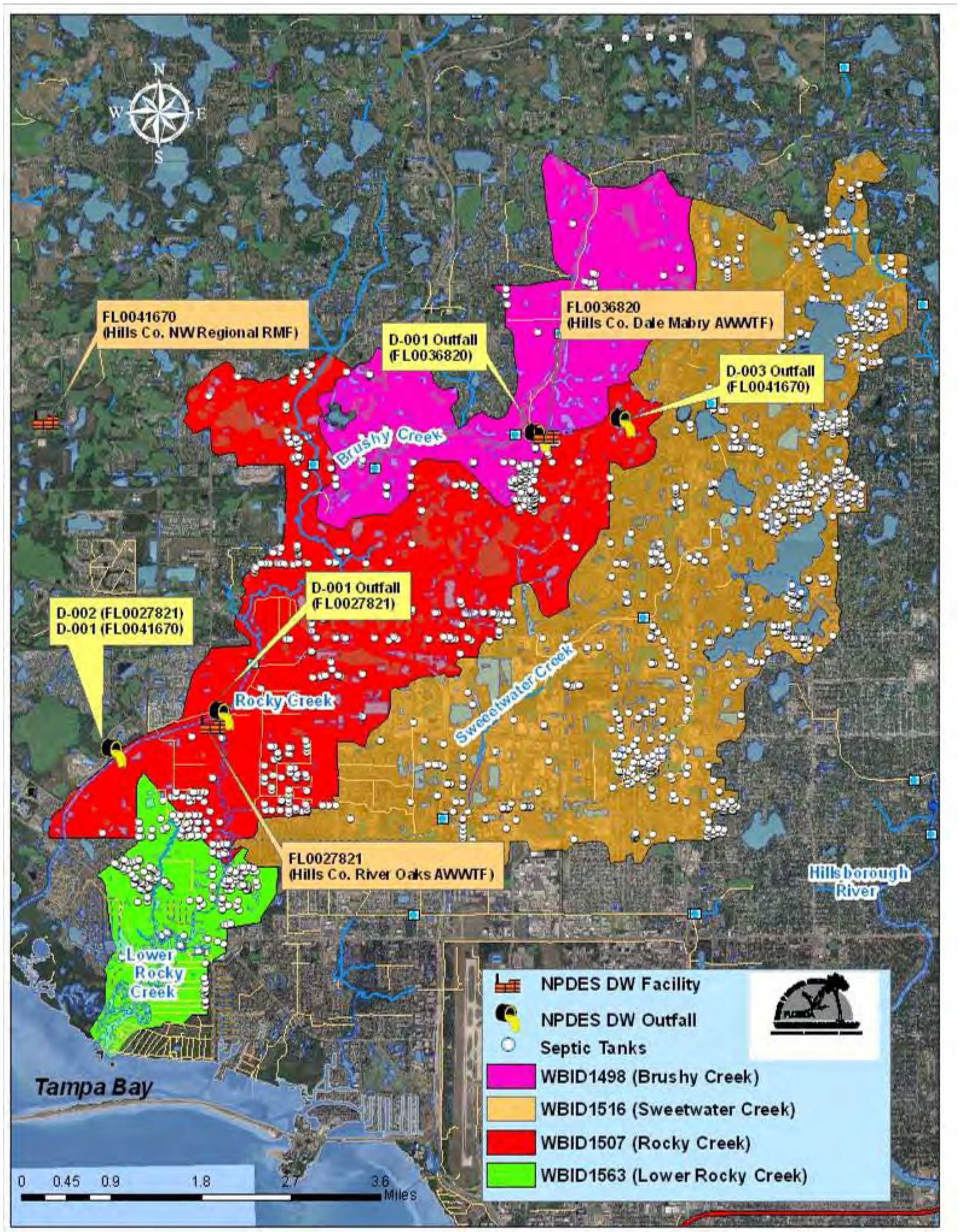


Figure 4.2. Distribution of Onsite Sewage Systems (Septic Tanks) in the Brushy Creek (WBID 1498), Sweetwater Creek (WBID 1516), Rocky Creek (WBID 1507), and Lower Rocky Creek (WBID 1563) Watersheds

No measured septic tank failure rate data were available for the watersheds when this TMDL analysis was conducted. Therefore, the failure rate was derived from the number of septic tank and septic tank repair permits for Hillsborough County published by FDOH (available: http://www.doh.state.fl.us/environment/OSTDS/statistics/ostdsstatistics.htm). The number of septic tanks in the county was calculated assuming that none of the installed septic tanks will be removed after being installed (**Table 4.4**). The reported number of septic tank repair permits was also obtained from the FDOH Website (**Table 4.4**).

Based on this information, a discovery rate of failed septic tanks for each year between 2002 and 2007 was calculated and listed in **Table 4.4**. Using the table, the average annual septic tank failure discovery rate for Hillsborough County is about 0.81 percent. 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, or 4.0 percent. Based on **Equation 4.1**, the estimated fecal coliform loading from failed septic tanks in the Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek watersheds is approximately 3.18×10^{10}, 2.35×10^{11}, 9.62×10^{10}, and 5.91×10^{10} counts/day, respectively.

Table 4.4. Estimated Septic Numbers and Septic Failure Rates for Hillsborough County, 2002–07

\- = Empty cell
[1] The failure rate is 5 times the failure discovery rate.

-	2002	2003	2004	2005	2006	2007	Average
New installation (septic tanks)	986	1,031	1,005	1,314	1,236	487	1,010
Accumulated installation (septic tanks)	100,483	101,469	102,500	103,505	104,819	106,055	103,139
Repair permit (septic tanks)	998	929	735	815	751	754	830
Failure discovery rate (%)	0.99%	0.92%	0.72%	0.79%	0.72%	0.71%	0.81%
Failure rate (%)[1]	5.0%	4.6%	3.6%	3.9%	3.6%	3.6%	4.0%

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.

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 the typical fecal coliform concentration 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 overflows of sanitary sewer in the Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek Creek watersheds can be made using **Equation 4.2**:

$$L = 37.85 * N * Q * C * F \qquad \textbf{(Equation 4.2)}$$

Where:

- *L* is the fecal coliform daily load (counts/day);
- *N* is the number of households using sanitary sewer in the watershed;
- *Q* is the discharge rate for each household;
- *C* is the fecal coliform concentration for the domestic wastewater discharge; and
- *F* is the sewer line leakage rate.

The number of households (*N*) in the Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek watersheds that use the sewer line is 6,541, 17,731, 12,212, and 2,362 (total households minus septic tank households), respectively. The discharge rate through the sewer line from each household (*Q*) was calculated by multiplying the average household size (2.50 people) by the per capita wastewater production rate per day (70 gallons). The commonly cited concentration (*C*) for domestic wastewater is $1x10^6$ counts/100mL for fecal coliform (EPA, 2001). Of the total number of households using the sewer line, 0.5 percent (*F*) was assumed as the sewer line leakage rate (Culver et al., 2002). Based on **Equation 4.2**, the estimated fecal coliform loading from sewer line leakage in the Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek watersheds is about 2.17×10^{11}, 5.87×10^{11}, 4.05×10^{11}, and 7.82×10^{10} counts/day, respectively.

Nonpoint Source Summary

Table 4.5 summarizes the loading estimates from various nonpoint sources. It is important to note that this is not a complete list and represents estimates of potential loadings. Proximity to each waterbody, rainfall frequency and magnitude, soil types, drainage features, and temperature are just a few of the factors that could influence and determine the actual loadings from these sources that reach Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek.

Table 4.5. Estimated Fecal Coliform Loadings from Dogs, Septic Tanks, and SSOs in the Brushy Creek (WBID 1498), Sweetwater Creek (WBID 1516), Rocky Creek (WBID 1507), and Lower Rocky Creek (WBID 1563) Watersheds

Waterbody	Dogs (counts/day)	Septic Tanks (counts/day)	SSOs (counts/day)
Brushy Creek	1.05 x 1012	3.18 x 1010	2.17 x 1011
Sweetwater Creek	2.95 x 1012	2.35 x 1011	5.87 x 1011
Rocky Creek	1.99 x 1012	9.62 x 1010	4.05 x 1011
Lower Rocky Creek	4.09 x 1011	5.91 x 1010	7.82 x 1010

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Determination of Loading Capacity

The load duration curve method, or "Kansas approach," was considered for Brushy Creek, Sweetwater Creek, and Rocky Creek. However, the Department found the "percent reduction" approach to be more conservative than the "Kansas approach"; thus, the "percent reduction" approach was chosen to develop the fecal coliform TMDLs for these waterbodies. For information purposes and to identify critical periods, the Department included results from the load duration curve method in this report (**Appendix B**).

The fecal coliform TMDL calculation was developed using the "percent reduction" approach for Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek. For this method, the percent reduction needed to meet the applicable criterion is calculated for each value above the criterion, and then a median percent reduction is calculated.

5.1.1 Data Used in the Determination of the TMDL

The data used to develop this TMDL were provided by Hillsborough County, the Department's Southwest District, and the Department of Environmental Protection from the following stations:

- *Brushy Creek — Stations – 21FLHILL161 and 21FLGW 22075;*
- *Sweetwater Creek — Stations: 21FLHILL142, 21FLTPA 24040112, and 21FLGW – (22094, 22088, 22072, 7628, 7658, 7629, and 7637);*
- *Rocky Creek — Stations: 21FLHILL – (160, 170, and 141) and 21FLTPA – (280357008233568, 280305908233390, and 280223708234300); and*
- *Lower Rocky Creek — Station: 21FLHILL103.*

Figure 5.1 shows the locations of the water quality sites where fecal coliform data were collected. **Figures 2.1a, 2.1b, 2.1c,** and **2.1d** display the data for fecal coliform used in this analysis.

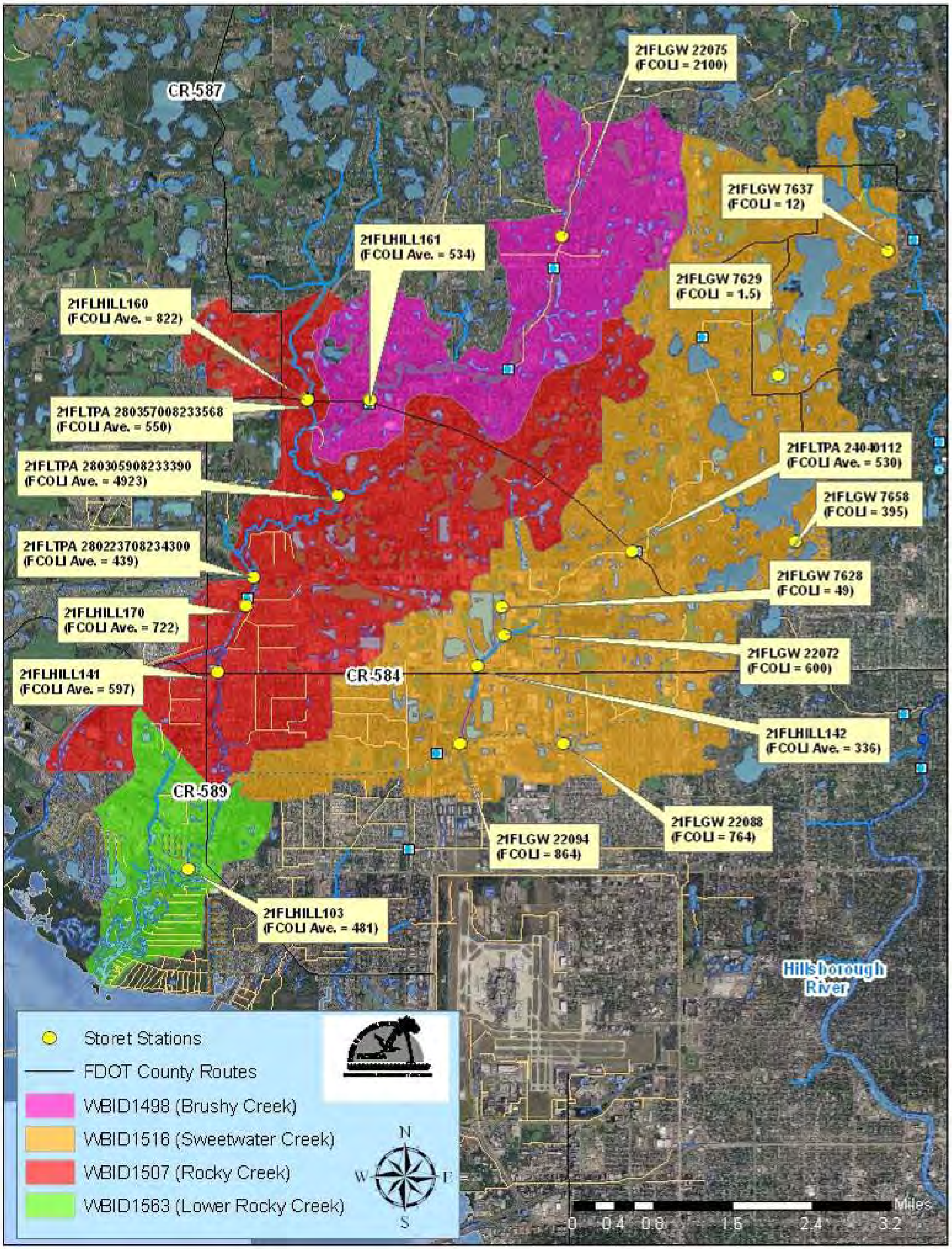


Figure 5.1. Locations of Water Quality Stations where Water Quality Data Were Collected for This Report

5.1.2 TMDL Development Process for Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek

As described in **Section 5.1**, the percent reduction needed to meet the fecal coliform criterion was determined for each individual exceedance using **Equation 5.1**:

$$\frac{[\text{measured exceedance} - \text{criterion}]*100}{\text{measured exceedance}} \qquad \text{(Equation 5.1)}$$

The fecal coliform TMDLs for Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek were calculated as the median of the percent reductions needed over the data range where exceedances occurred (see **Tables 5.1a, 5.1b, 5.1c,** and **5.1d** for data). As noted in the next section, exceedances occurred throughout the data period for Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek, and the median percent reductions for this period were 36, 44, 58, and 71 percent, respectively.

Table 5.1a. Calculation of Percent Reduction in Fecal Coliform Necessary To Meet the Water Quality Standard of 400 Colonies/100mL in Brushy Creek (WBID 1498)

- = Empty cell
[1] Exceedances represent values above 400 counts/100mL.
[2] Coliform counts are #/100mL.

Date	Station	Fecal Coliform Exceedances[1, 2]	Fecal Coliform Target[2]	% Reduction
10/4/2006	21FLHILL161	460	400	13.04%
3/1/2005	21FLHILL161	480	400	16.67%
7/5/2006	21FLHILL161	480	400	16.67%
5/8/2007	21FLHILL161	500	400	20.00%
6/13/2007	21FLHILL161	560	400	28.57%
11/2/2005	21FLHILL161	620	400	35.48%
3/13/2007	21FLHILL161	800	400	50.00%
6/7/2006	21FLHILL161	1,000	400	60.00%
11/8/2006	21FLHILL161	2,060	400	80.58%
9/1/2004	21FLGW 22075	2,100	400	80.95%
9/5/2006	21FLHILL161	2,460	400	83.74%
-	**-**	**-**	**Median:**	**35.48%**

Table 5.1b. Calculation of Percent Reduction in Fecal Coliform Necessary To Meet the Water Quality Standard of 400 Colonies/100mL in Sweetwater Creek (WBID 1516)

- = Empty cell
[1] Exceedances represent values above 400 counts/100mL.
[2] Coliform counts are #/100mL.

Date	Station	Fecal Coliform Exceedances[1, 2]	Fecal Coliform Target[2]	% Reduction
9/5/2006	21FLHILL142	4,000	400	90.00%
7/20/2004	21FLHILL142	2,200	400	81.82%
6/18/2002	21FLHILL142	2,000	400	80.00%
3/20/2001	21FLHILL142	1,720	400	76.74%
12/10/2002	21FLHILL142	1,720	400	76.74%
6/17/2003	21FLHILL142	1,340	400	70.15%
1/3/2006	21FLHILL142	940	400	57.45%
11/8/2006	21FLHILL142	920	400	56.52%
9/22/2004	21FLGW 22094	864	400	53.70%
9/22/2004	21FLGW 22088	764	400	47.64%
1/3/2007	21FLHILL142	760	400	47.37%
9/19/2000	21FLHILL142	720	400	44.44%
3/16/2004	21FLHILL142	700	400	42.86%
8/2/2005	21FLHILL142	660	400	39.39%
4/18/2000	21FLHILL142	640	400	37.50%
8/24/2004	21FLGW 22072	600	400	33.33%
3/21/2006	21FLTPA 24040112	600	400	33.33%
1/15/2002	21FLHILL142	570	400	29.82%
2/19/2002	21FLHILL142	550	400	27.27%
7/24/2001	21FLHILL142	460	400	13.04%
5/20/2003	21FLHILL142	460	400	13.04%
4/24/2006	21FLTPA 24040112	460	400	13.04%
10/4/2006	21FLHILL142	440	400	9.09%
12/12/2000	21FLHILL142	420	400	4.76%
-	**-**	**-**	**Median:**	**43.65**%

Table 5.1c. Calculation of Percent Reduction in Fecal Coliform Necessary To Meet the Water Quality Standard of 400 Colonies/100mL in Rocky Creek (WBID 1507)

- = Empty cell
[1] Exceedances represent values above 400 counts/100mL.
[2] Coliform counts are #/100mL.

Date	Station	Fecal Coliform Exceedances[1, 2]	Fecal Coliform Target[2]	% Reduction
4/24/2006	21FLTPA 280305908233390	18,100	400	97.79%
7/20/2004	21FLHILL141	8,000	400	95.00%
11/8/2006	21FLHILL170	4,100	400	90.24%
3/20/2001	21FLHILL141	4,000	400	90.00%
6/17/2003	21FLHILL141	4,000	400	90.00%
7/18/2000	21FLHILL141	4,000	400	90.00%
9/5/2006	21FLHILL141	4,000	400	90.00%
3/16/2004	21FLHILL141	3,200	400	87.50%
4/10/2007	21FLHILL160	2,040	400	80.39%
2/18/2003	21FLHILL141	2,000	400	80.00%
12/10/2002	21FLHILL141	2,000	400	80.00%
12/7/2005	21FLHILL160	1,880	400	78.72%
11/8/2006	21FLHILL160	1,860	400	78.49%
7/23/2002	21FLHILL141	1,480	400	72.97%
8/12/2003	21FLHILL141	1,460	400	72.60%
8/29/2006	21FLTPA 280223708234300	1,367	400	70.74%
11/8/2006	21FLHILL141	1,360	400	70.59%
5/22/2006	21FLTPA 280357008233568	1,220	400	67.21%
6/20/2000	21FLHILL141	1,080	400	62.96%
3/1/2005	21FLHILL160	1,060	400	62.26%
9/6/2005	21FLHILL160	1,060	400	62.26%
5/8/2007	21FLHILL160	1,040	400	61.54%
5/4/2005	21FLHILL160	1,020	400	60.78%
10/16/2001	21FLHILL141	960	400	58.33%
8/29/2006	21FLTPA 280305908233390	940	400	57.45%
8/20/2002	21FLHILL141	900	400	55.56%
7/24/2001	21FLHILL141	840	400	52.38%
6/2/2005	21FLHILL160	800	400	50.00%
10/5/2005	21FLHILL160	720	400	44.44%
3/18/2003	21FLHILL141	700	400	42.86%
6/6/2007	21FLHILL170	700	400	42.86%
10/5/2005	21FLHILL141	700	400	42.86%
8/29/2006	21FLTPA 280357008233568	680	400	41.18%
11/2/2005	21FLHILL160	680	400	41.18%
10/10/2000	21FLHILL141	660	400	39.39%
2/2/2005	21FLHILL160	620	400	35.48%
6/13/2007	21FLHILL160	620	400	35.48%
4/6/2005	21FLHILL160	600	400	33.33%
5/20/2003	21FLHILL141	560	400	28.57%

Date	Station	Fecal Coliform Exceedances[1, 2]	Fecal Coliform Target[2]	% Reduction
1/9/2007	21FLHILL160	520	400	23.08%
12/6/2006	21FLHILL160	520	400	23.08%
1/3/2007	21FLHILL170	500	400	20.00%
1/4/2005	21FLHILL160	500	400	20.00%
8/17/2004	21FLHILL141	500	400	20.00%
7/31/2006	21FLTPA 280357008233568	470	400	14.89%
2/8/2006	21FLHILL141	440	400	9.09%
2/13/2007	21FLHILL160	440	400	9.09%
8/2/2005	21FLHILL160	440	400	9.09%
-	-		**Median:**	**57.89%**

Table 5.1d. Calculation of Percent Reduction in Fecal Coliform Necessary To Meet the Water Quality Standard of 400 Colonies/100mL in Lower Rocky Creek (WBID 1563)

- = Empty cell
[1] Exceedances represent values above 400 counts/100mL.
[2] Coliform counts are #/100mL.

Date	Station	Fecal Coliform Exceedances[1, 2]	Fecal Coliform Target[2]	% Reduction
9/5/2006	21FLHILL103	4000	43	98.93%
6/17/2003	21FLHILL103	2540	43	98.31%
12/9/2003	21FLHILL103	2020	43	97.87%
7/23/2002	21FLHILL103	2000	43	97.85%
12/10/2002	21FLHILL103	2000	43	97.85%
2/18/2003	21FLHILL103	2000	43	97.85%
5/20/2003	21FLHILL103	2000	43	97.85%
11/8/2006	21FLHILL103	1920	43	97.76%
6/18/2002	21FLHILL103	1870	43	97.70%
7/20/2004	21FLHILL103	1400	43	96.93%
3/20/2001	21FLHILL103	1360	43	96.84%
7/24/2001	21FLHILL103	1240	43	96.53%
3/16/2004	21FLHILL103	1200	43	96.42%
3/18/2003	21FLHILL103	1040	43	95.87%
8/20/2002	21FLHILL103	800	43	94.63%
8/8/2007	21FLHILL103	780	43	94.49%
7/15/2003	21FLHILL103	700	43	93.86%
9/14/2004	21FLHILL103	700	43	93.86%
8/12/2003	21FLHILL103	620	43	93.06%
10/3/2007	21FLHILL103	620	43	93.06%
12/12/2000	21FLHILL103	580	43	92.59%

9/5/2007	21FLHILL103	560	43	92.32%
12/11/2001	21FLHILL103	420	43	89.76%
6/15/2004	21FLHILL103	400	43	89.25%
10/16/2001	21FLHILL103	380	43	88.68%
11/19/2002	21FLHILL103	380	43	88.68%
11/2/2005	21FLHILL103	380	43	88.68%
1/15/2002	21FLHILL103	350	43	87.71%
6/20/2000	21FLHILL103	340	43	87.35%
7/18/2000	21FLHILL103	340	43	87.35%
9/19/2000	21FLHILL103	340	43	87.35%
1/14/2003	21FLHILL103	340	43	87.35%
10/5/2005	21FLHILL103	340	43	87.35%
9/18/2001	21FLHILL103	320	43	86.56%
8/2/2006	21FLHILL103	320	43	86.56%
8/17/2004	21FLHILL103	300	43	85.67%
6/2/2005	21FLHILL103	300	43	85.67%
8/2/2005	21FLHILL103	300	43	85.67%
8/15/2000	21FLHILL103	280	43	84.64%
2/8/2006	21FLHILL103	280	43	84.64%
7/5/2006	21FLHILL103	280	43	84.64%
9/17/2002	21FLHILL103	260	43	83.46%
1/13/2004	21FLHILL103	260	43	83.46%
10/19/2004	21FLHILL103	260	43	83.46%
2/2/2005	21FLHILL103	260	43	83.46%
1/3/2007	21FLHILL103	260	43	83.46%
2/20/2001	21FLHILL103	240	43	82.08%
12/14/2004	21FLHILL103	240	43	82.08%
3/1/2005	21FLHILL103	240	43	82.08%
9/6/2005	21FLHILL103	230	43	81.30%
10/7/2003	21FLHILL103	200	43	78.50%
11/16/2004	21FLHILL103	200	43	78.50%
1/3/2006	21FLHILL103	200	43	78.50%
1/18/2000	21FLHILL103	180	43	76.11%
2/15/2000	21FLHILL103	180	43	76.11%
2/17/2004	21FLHILL103	180	43	76.11%
7/5/2005	21FLHILL103	180	43	76.11%
12/7/2005	21FLHILL103	180	43	76.11%
10/4/2006	21FLHILL103	180	43	76.11%
12/6/2006	21FLHILL103	180	43	76.11%
2/7/2007	21FLHILL103	180	43	76.11%

4/18/2000	21FLHILL103	160	43	73.13%
11/14/2000	21FLHILL103	160	43	73.13%
9/16/2003	21FLHILL103	160	43	73.13%
5/1/2007	21FLHILL103	160	43	73.13%
11/7/2007	21FLHILL103	160	43	73.13%
2/19/2002	21FLHILL103	140	43	69.29%
11/18/2003	21FLHILL103	140	43	69.29%
1/4/2005	21FLHILL103	140	43	69.29%
10/10/2000	21FLHILL103	120	43	64.17%
7/11/2007	21FLHILL103	120	43	64.17%
3/19/2002	21FLHILL103	110	43	60.91%
4/16/2002	21FLHILL103	110	43	60.91%
4/15/2003	21FLHILL103	100	43	57.00%
4/6/2005	21FLHILL103	100	43	57.00%
3/7/2007	21FLHILL103	100	43	57.00%
5/14/2002	21FLHILL103	90	43	52.22%
3/14/2000	21FLHILL103	80	43	46.25%
1/16/2001	21FLHILL103	80	43	46.25%
8/21/2001	21FLHILL103	80	43	46.25%
5/18/2004	21FLHILL103	80	43	46.25%
5/4/2005	21FLHILL103	80	43	46.25%
12/5/2007	21FLHILL103	80	43	46.25%
11/13/2001	21FLHILL103	60	43	28.33%
4/20/2004	21FLHILL103	60	43	28.33%
-	-	**Median**		**83%**

5.1.3 Critical Conditions/Seasonality

The critical conditions for coliform loadings in a given watershed depend on the existence of point sources and land use patterns in the watershed. Typically, the critical condition for nonpoint sources is an extended dry period, followed by a rainfall runoff event. During wet weather periods, coliform bacteria that have built up on the land surface under dry weather conditions are washed off by rainfall, resulting in wet weather exceedances. However, significant nonpoint source contributions could also occur under dry weather conditions without any major surface runoff event. This usually happens when nonpoint sources contaminate the surficial aquifer, and coliform bacteria are brought into the receiving waters through baseflow. Livestock with direct access to the receiving water could also contribute to the exceedances during dry weather conditions. The critical condition for point source loading typically occurs during periods of low stream flow, when dilution is minimized.

As mentioned earlier in the report, the Department did not use the load duration curve methodology to calculate the overall fecal coliform load reduction for Brushy Creek, Sweetwater Creek, and Rocky Creek. However, the information provided in these load duration curves is useful for determining the critical conditions for fecal coliform for each waterbody. Furthermore, exceedances occurred over the entire range of flow conditions in the Brushy Creek, Sweetwater Creek, and Rocky Creek watersheds, as shown in **Appendix B**. Based on the dominant land use (urban land) in these watersheds, it is likely that many of the exceedances are from nonpoint sources entering the waters through surface runoff. However, there are also exceedances occurring during dry conditions—hence the possible point source influence and baseflow contribution.

For Lower Rocky Creek, the Department used rainfall data to compare with the measured fecal coliform data for the creek. Measurements were sorted by month and season (the calendar year was divided into quarters) to determine whether there was a temporal pattern of exceedances. Monthly rainfall data from Tampa Bay International (088788) were also included in the analysis. **Tables 5.2a** and **5.2b** present summary statistics by month and season, respectively, for fecal coliform measurements (*Winter*: January–March; *Spring*: April–June; *Summer*: July–September; *Fall*: October–December). Fecal coliform exceedances occur throughout all seasons in Lower Rocky Creek, implying potential fecal coliform bacteria sources during both baseflow and surface runoff events. However, during the summer months, as the amount of rainwater entering this waterbody increases, there seems to be a corresponding increase in the percentage of fecal coliform exceedances, suggesting that surface runoff is contributing to the fecal coliform levels. **Figure 5.2** shows this information graphically.

Table 5.2a. Summary Statistics of Fecal Coliform Data for Lower Rocky Creek (WBID 1563) by Month

[1] Coliform counts are #/100mL.
[2] Exceedances represent values above 400 counts/100mL.

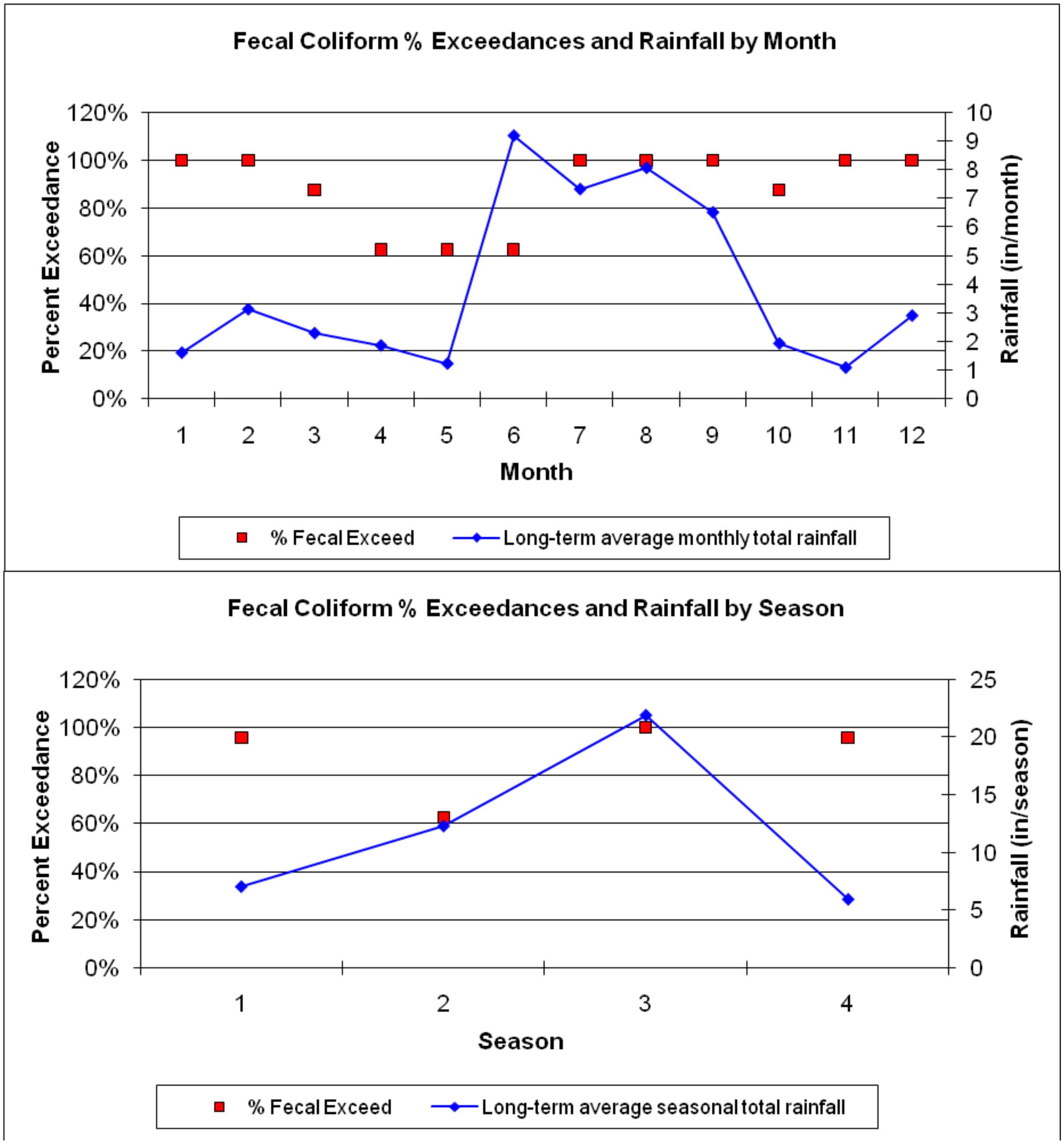
Month	Number of Cases	Minimum[1]	Maximum[1]	Median[1]	Mean[1]	Number of Exceedances[2]	% Exceedances of Cases	Rainfall Mean (inches)
1	8	80	350	230	226	8	100.00%	1.62
2	8	140	2,000	210	433	8	100.00%	3.13
3	8	40	1,360	175	521	7	87.50%	2.3
4	8	0	80	74	84	5	62.50%	1.87
5	8	40	2,000	80	316	5	62.50%	1.24
6	8	0	320	787	915	5	62.50%	9.17
7	8	120	2,000	520	783	8	100.00%	7.31
8	8	80	800	310	383	8	100.00%	8.05
9	8	160	4,000	330	821	8	100.00%	6.5
10	8	40	620	230	268	7	87.50%	1.94
11	8	60	1,920	180	425	8	100.00%	1.1
12	8	80	2,020	330	713	8	100.00%	2.91

Table 5.2b. Summary Statistics of Fecal Coliform Data for Lower Rocky Creek (WBID 1563) by Season

[1] Coliform counts are #/100mL.
[2] Exceedances represent values above 400 counts/100mL.

Season	Number of Cases	Minimum[1]	Maximum[1]	Median[1]	Mean[1]	Number of Exceedances[2]	% Exceedances of Cases	Total Rainfall Mean (inches)
1	24	40	2,000	210	393	23	95.83%	7.05
2	24	0	2,540	80	360	15	62.50%	12.28
3	24	80	4,000	330	680	24	100.00%	21.86
4	24	40	2,020	220	468	23	95.83%	5.95

Figure 5.2. Fecal Coliform Exceedances and Rainfall for Lower Rocky Creek (WBID 1563) by Month and Season, 2000–08



5.1.4 Spatial Patterns

The majority of the fecal coliform data for Brushy Creek, Sweetwater Creek, and Lower Rocky Creek were collected from one water quality station in each waterbody (see **Table 5.3);** therefore, no spatial pattern could be identified.

The majority of the data were collected from Stations: 21FLHILL – 141,160, and 170 for Rocky Creek. However, Station 21FLTPA 280305908233390 (located midstream off a side tributary flowing into Rocky Creek) recorded the highest maximum fecal coliform value (18,100 counts/100mL on April 24, 2006) among all water quality stations (**Table 5.3**). The Department compared same-day sampling events on April 24, 2006, from the upstream (21FLTPA 2800357008233568) and downstream (21FLTPA 280223708234300) stations, to see if the high fecal coliform values were site specific. The results showed that the upstream station recorded fecal coliform values an order of magnitude higher than the downstream station (210 counts/100mL at 21FLTPA 2800357008233568 and 20 counts/100 mL at 21FLTPA 280223708234300).

The land use surrounding Station 21FLTPA 280305908233390 includes natural areas (forested mixed wetlands and open land) and anthropogenic areas (specialty farms, tree crops, and low-density residential) that could potentially influence the fecal coliform counts. However, further investigations are needed to carry out a more detailed analysis of potential sources contributing to the high fecal coliform maximum value.

Table 5.3. Station Summary Statistics of Fecal Coliform Data for Brushy Creek (WBID 1498), Sweetwater Creek (WBID 1516), Rocky Creek (WBID 1507), and Lower Rocky Creek (WBID 1563)

[1] Exceedances represent values above 400 counts/100mL.
[2] Coliform counts are #/100mL.

WBID	Station	# Samples	# Exceedances[1]	% Exceedances[1]	Average[2]	Min[2]	Max[2]
1498	21FLGW 22075	1	1	100%	2,100	2,100	2,100
1498	**21FLHILL161**	**30**	**10**	**33%**	**481**	**80**	**2,460**
1516	21FLGW 22072	1	1	100%	600	600	600
1516	21FLGW 22088	1	1	100%	764	764	764
1516	21FLGW 22094	1	1	100%	864	864	864
1516	21FLGW 7628	1	0	0%	49	49	49
1516	21FLGW 7629	1	0	0%	2	1.5	1.5
1516	21FLGW 7637	1	0	0%	12	12	12
1516	21FLGW 7658	1	0	0%	395	395	395
1516	**21FLHILL142**	**90**	**19**	**21%**	**336**	**0**	**4,000**
1516	21FLTPA 24040112	2	2	100%	530	460	600
1507	21FLHILL141	90	21	23%	597	0	8,000
1507	21FLHILL160	21	18	86%	822	180	2,040

WBID	Station	# Samples	# Exceedances[1]	% Exceedances[1]	Average[2]	Min[2]	Max[2]
1507	21FLHILL170	9	3	33%	722	100	4,100
1507	21FLTPA 280223708234300	4	1	25%	439	20	1,367
1507	21FLTPA 280305908233390	4	2	50%	4,923	310	18,100
1507	21FLTPA 280357008233568	5	3	60%	550	170	1,220
1563	**21FLHILL103**	**96**	**85**	**89%**	**475**	**0**	**4,000**

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:

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

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

$$\textbf{TMDL} \cong \sum \textbf{WLAs}_{\textbf{wastewater}} + \sum \textbf{WLAs}_{\textbf{NPDES Stormwater}} + \sum \textbf{LAs} + \textbf{MOS}$$

It should be noted that the various components of the revised TMDL equation may not sum up to the value of the TMDL because (a) 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 (b) 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).

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 TMDLs for Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rock Creek are expressed in terms of a percent reduction, these TMDLs represent the maximum daily fecal coliform loads the streams can assimilate and maintain the fecal coliform criterion (**Table 6.1**).

Table 6.1. TMDL Components for Fecal Coliform in Brushy Creek (WBID 1498), Sweetwater Creek (WBID 1516), Rocky Creek (WBID 1507), and Lower Rocky Creek (WBID 1563)

[1] See permit specifications in the NPDES Wastewater Discharges section.
[2] N/A – Not applicable.

WBID	Waterbody Name	Parameter	TMDL (counts/100mL)	Wasteload Allocation for Wastewater (counts/day)	Wasteload Allocation for NPDES Stormwater (% reduction)	LA (% reduction)	MOS
1498	Brushy Creek	Fecal Coliform	400	Must Meet Permit Limits[1]	36	36	Implicit
1516	Sweetwater Creek	Fecal Coliform	400	N/A[2]	44	44	Implicit
1507	Rocky Creek	Fecal Coliform	400	Must Meet Permit Limits[1]	58	58	Implicit
1563	Lower Rocky Creek	Fecal Coliform	43	N/A[2]	83	83	Implicit

6.2 Load Allocation

A fecal coliform reduction of 36, 44, 58, and 83 percent is needed from nonpoint sources in the Brushy Creek, Sweetwater Creek, Rocky Creek, and Lower Rocky Creek watersheds, respectively. 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**).

6.3 Wasteload Allocation

6.3.1 NPDES Wastewater Discharges

The Hillsborough County Rivers Oaks AWWTF (FL0027821) has two discharge sites (D-001 and D-002) located in the downstream portion of Rocky Creek near Hillsborough County's water quality station 21FLHILL141:

- ***D-001:*** *An existing 10.0 MGD (12-MADF) permitted discharge to Channel A (Class III surface waters) and Rocky Creek, and then to Old Tampa Bay. The outfall structure is approximately 20 feet in length and discharges at a depth of approximately 2 feet.*

- ***D-002:*** *An existing 5.0 MGD (12-MADF) permitted discharge to Channel A (Class III surface waters) and Rocky Creek, and then to Old Tampa Bay. This outfall is a combined outfall for effluents generated by the Hillsborough County Northwest Regional WRF (FL0041670) and the River Oaks AWWTP, and is conveyed to the outfall (identified as D-001 in the Northwest Regional WRF) through the Northwest Hillsborough County Master Reuse System. FL0041670 has an additional outfall (D-003) that discharges effluent in response to rain events to Emerald Greens Golf Course Storage Lake, located in the northeast portion of Rocky Creek (**Section 1.A.2** of the permit [Subsection 62-610.830(4), 08-08-99, F.A.C.]). The Hillsborough County Dale Mabry*

AWWTP (FL0036820) has an existing 6.0 MGD 12-MADF permitted discharge to Brushy Creek to Rocky Creek then to Channel A to Tampa Bay (Class III waters) at D-001. The outfall is at the shoreline and discharges at a depth of approximately 3.85 feet. Furthermore, the facility serves as a source plant for up to 6.0 MGD (12-MADF) of reclaimed water. The reclaimed water and effluent are transferred to the Hillsborough County Northwest Master Reuse System (FL0041670), and have an intermediate disinfection level requirement (see permit limits below).

These permits include effluent discharge limits for fecal coliform bacteria. Each of these facilities must meet its permit limits for fecal coliform as stated in its permit specifications.

Section I.A.6 (FL0027821) and **Section I.A.7** (FL0041670) of the permit read as follows:

Over a 30-day period, at least 75 percent of the fecal coliform values shall be below the detection limits. No sample shall exceed 25 fecal coliforms per 100 mL. No sample shall exceed 5.0 mg/L of total suspended solids (TSS) at a point before the application of the disinfectant (Subsection 62-600.440[5][f], F.A.C.).

Section I.A.6 (FL0036820) of the permit reads as follows:

The arithmetic mean of the monthly fecal coliform values collected during an annual period shall not exceed 14 per 100 mL of effluent sample. The median value of the fecal coliform values for a miniumum number of 10 samples of effluent each collected on a separate day during a period of 30 consecutive days (monthly), shall not exceed 14 per 100 mL of sample. No more than 10 percent of the samples collected (the 90th percentile value) during a period of 30 consecutive days shall exceed 43 fecal coliform values per 100 mL of sample. Any one sample shall not exceed 86 fecal coliform values per 100 mL of sample (Subsection 62-600.440[6][c], F.A.C.).

6.3.2 NPDES Stormwater Discharges

The WLA for stormwater discharges with an MS4 permit is a 36, 44, 58, and 83 percent reduction in current fecal coliform for Brushy Creek (WBID 1498), Sweetwater Creek (WBID 1516), Rocky Creek (WBID 1507), and Lower Rocky Creek (WBID 1563). 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

Consistent with the recommendations of the Allocation Technical Advisory Committee (Department, 2001), an implicit MOS was used in the development of this TMDL by meeting the water quality criterion of 400 colonies/100mL, while the actual criterion allows for a 10 percent exceedance over that level.

Chapter 7: NEXT STEPS: IMPLEMENTATION PLAN DEVELOPMENT AND BEYOND

7.1 Basin Management Action Plan

Following the adoption of this TMDL by rule, the next step in the TMDL process is to develop an implementation plan for the TMDL, referred to as the BMAP. This document will be developed over the next year in cooperation with local stakeholders, who will attempt to reach consensus on detailed allocations and on how load reductions will be accomplished. The BMAP will include, among other things:

- *Appropriate load reduction allocations among the affected parties;*
- *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;*
- *Confirmed and potential funding mechanisms;*
- *Any applicable signed agreement(s);*
- *Local ordinances defining actions to be taken or prohibited;*
- *Any applicable local water quality standards, permits, or load limitation agreements;*
- *Milestones for implementation and water quality improvement; and*
- *Implementation tracking, water quality monitoring, and follow-up measures.*

An assessment of progress toward the BMAP milestones will be conducted every five years, and revisions to the plan will be made as appropriate, in cooperation with basin stakeholders.

References

Alderiso, K., D. Wait, and M. Sobsey. 1996. Detection and characterization of make-specific RNA coliphages in a New York City reservoir to distinguish between human and nonhuman sources of contamination. In*: Proceedings of a Symposium on New York City Water Supply Studies*, J.J. McDonnell et al. (eds.). TPS-96-2. Herndon, VA: American Water Resources Association.

Association of Metropolitan Sewerage Agencies. 1994. *Separate sanitary sewer overflows: What do we currently know?* Washington, DC.

Bannerman, R., D. Owens, R. Dodds, and N. Hornewer. 1993. Sources of pollutants in Wisconsin stormwater. *Water Science and Technology 28(3-5): 241-259.*

Cleland, B. August 15, 2002. *TMDL Development from the bottom up–Part II: Using load duration curves to connect the pieces*. Washington, DC: America's Clean Water Foundation.

———. September 2003. *TMDL development from the bottom up–Part III: Duration curves and wet-weather assessments*. Washington, DC: America's Clean Water Foundation.

Culver, T.B. Y. Jia, R. Tikoo, J. Simsic, and R. Garwood. 2002. *Development of the Total Maximum Daily Load (TMDL) for fecal coliform bacteria in Moore's Creek, Albemarle County, Virginia.* Virginia Department of Environmental Quality.

Florida Administrative Code. *Rule 62-302, Surface water quality standards.*

———. *Rule 62-303, Identification of impaired surface waters.*

Florida Department of Environmental Protection. February 2001. *A report to the Governor and the Legislature on the allocation of Total Maximum Daily Loads in Florida.* Tallahassee, FL: Bureau of Watershed Management.

———. 2003. *Basin status report: Tampa Bay Basin.* Tallahassee, FL: Bureau of Watershed Management.

———. September 2003. *Water quality assessment report: Tampa Bay Basin.* Tallahassee, FL: Bureau of Watershed Management.

Florida Department of Health Website. 2008. Available: http://www.doh.state.fl.us/environment/OSTDS/statistics/ostdsstatistics.htm.

Florida Watershed Restoration Act. *Chapter 99-223, Laws of Florida.*

Lim, S., and V. Olivieri. 1982. *Sources of microorganisms in urban runoff.* Jones Falls Urban Runoff Project. Baltimore, MD: Johns Hopkins School of Public Health and Hygiene.

Minnesota Pollution Control Agency. 1999. *Effect of septic systems on ground water quality.* Ground Water and Assessment Program. Baxter, MN.

Steuer, J., W. Selbig, N. Hornewer, and J. Prey. 1997. *Sources of contamination in an urban basin in Marquette, Michigan and an analysis of concentrations, loads, and data quality.* U.S. Geological Survey Water Resources Investigation Report 97-4242. Middleton, MI.

Stiles, T. 2002. *A simple method to define bacteria TMDLs in Kansas*. Topeka, KS: Kansas Department of Health and Environment.

Trial, W., et al. 1993. Bacterial source tracking: Studies in an urban Seattle watershed. *Puget Sound Notes 30: 1-3.*

U.S. Census Bureau Website. 2007. Available: http://www.census.gov/.

U.S. Department of Agriculture. 2002. *Agricultural census report*.

U.S. Environmental Protection Agency. January 2001. *Protocol for developing pathogen TMDLs.* 1st ed. Assessment and Watershed Protection Division. EPA 841-R-00-002.

———. 1994. *Nonpoint source pollution: The nation's largest water quality problem.* Pointer No. 1. EPA-841-F-94-005. Available: http://www.epa.gov/owow/nps/facts/point1.htm.

Van der Wel, B. 1995. Dog pollution. *The Magazine of the Hydrological Society of South Australia, 2(1) 1.*

Watson, T. June 6, 2002. Dog waste poses threat to water. *USA Today.*

Weiskel, P.K., B.L Howes, and G.R. Heufflder. 1996. Coliform contamination of a coastal embayment: Sources and transport pathway. *Environmental Science and Technology 1872-1881.*

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.C. 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 regulations.

Rule 62-40 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, stormwater PLRGs 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 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 the 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/environmental resource permitting 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: Load Duration Curve Approach and Results

Approach:

The information provided in Appendix B is for information purposes only!
Also known as the "Kansas approach" because it was developed by the state of Kansas, this method has been well documented in the literature, with improved modifications used by the EPA, Region 4. Basically, the method relates the pollutant concentration to the flow of the stream, in order to establish the existing loading capacity and the allowable pollutant load (TMDL) under a spectrum of flow conditions. It then determines the maximum allowable pollutant load and load reduction requirement based on the analysis of the critical flow conditions. This method requires four steps to develop the TMDL and establish the required load reduction:

1. *Develop the flow duration curve,*
2. *Develop the load duration curve for both the allowable load and existing loading,*
3. *Define the critical conditions, and*
4. *Establish the needed load reduction by comparing the existing loading with the allowable load under critical conditions.*

Results:

Figures B.1, B.2, and **B.3** show the load duration curves for Brushy Creek, Sweetwater Creek, and Rocky Creek, respectively.

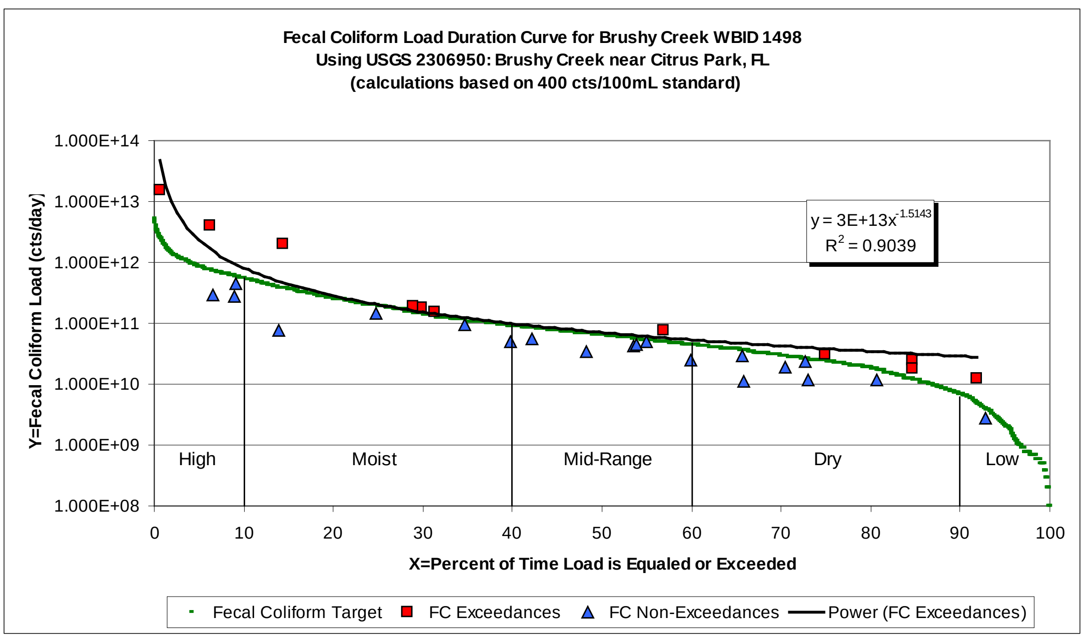


Figure B.1. Load Duration Curve for Fecal Coliform in Brushy Creek (WBID 1498)

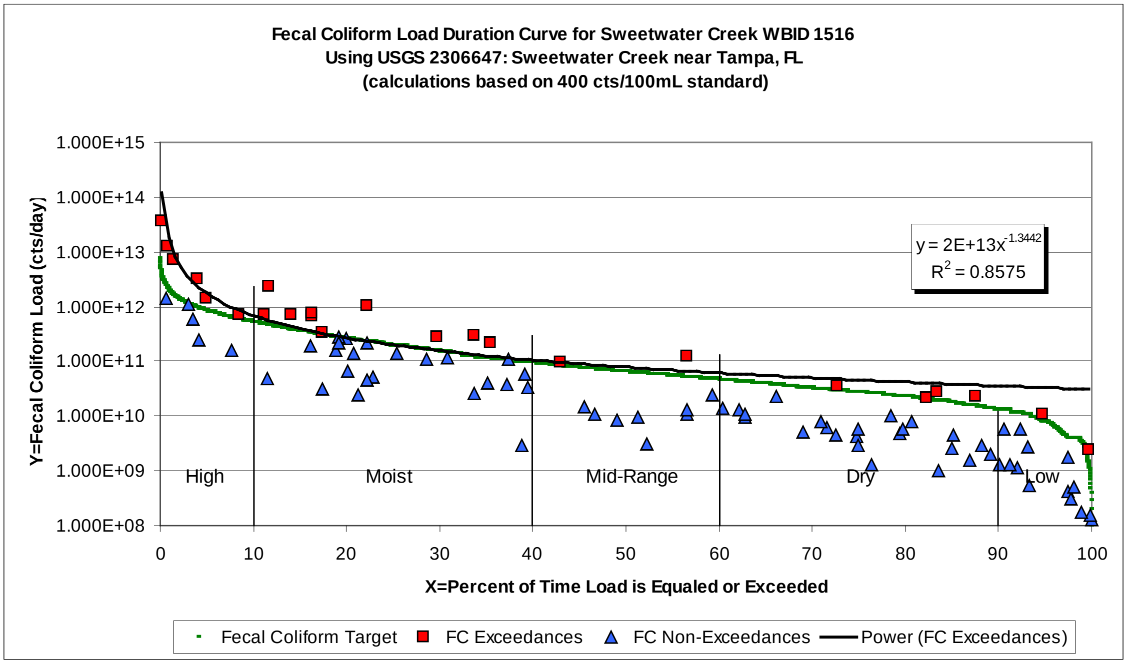


Figure B.2. Load Duration Curve for Fecal Coliform in Sweetwater Creek (WBID 1516)

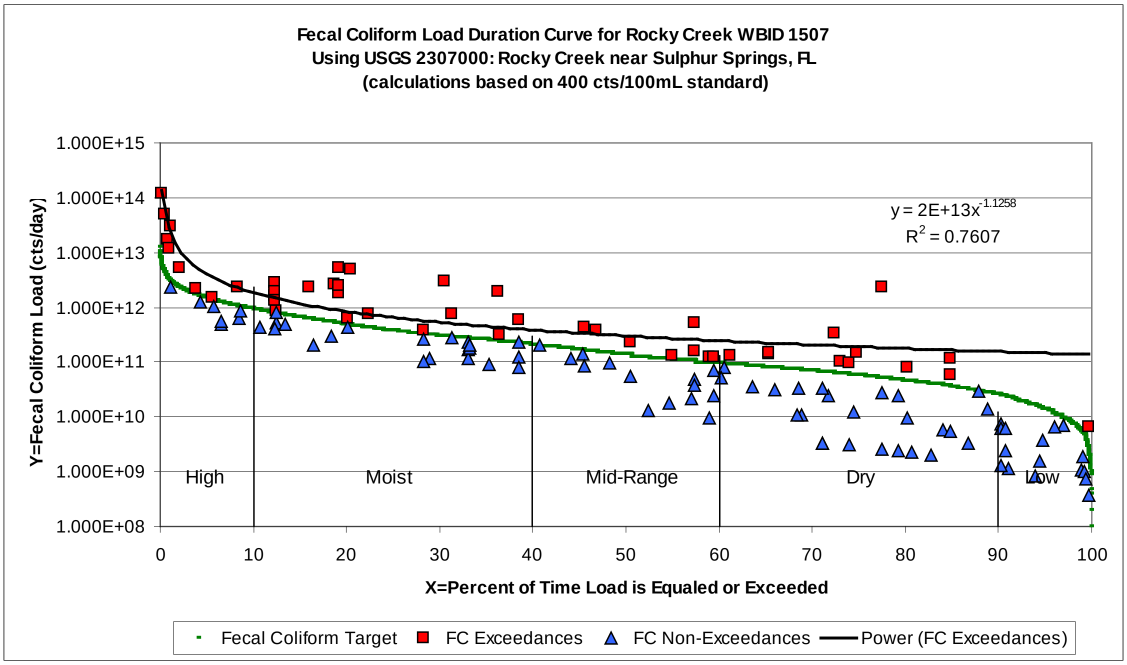


Figure B.3. Load Duration Curve for Fecal Coliform in Rocky Creek (WBID 1563)

In general, exceedances on the right side of the curve typically occur during low-flow events, which implies a contribution from either point sources or baseflow, which could come from the load from failed septic tanks and sewer line leakage that interacts with surface water. The exceedances that appear on the left side of the curve usually represent loading from stormwater-related sources. In this case, the potential sources may include contributions from pets such as dogs and cats, wild animals, failed septic tanks, and sewer line leakage.

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 base flow. In addition, wildlife having direct access to the receiving water can contribute to the exceedance during dry weather. The critical condition for point source loading typically occurs during periods of low stream flow, when dilution is minimized.

For Brushy Creek, Sweetwater Creek, and Rocky Creek, because exceedances occurred throughout the flow record, no critical flow condition was defined for these TMDLs. The Department used the flow records and water quality data available for the 10^{th} to 90^{th} percentile flow duration interval for the TMDL analysis. Flow conditions that were exceeded less than 10 percent of the time were not used because they represent abnormally high-flow events, and flow conditions occurring greater than 90 percent of the time were not used because they are extreme low-flow events. The percent reductions obtained for Brushy Creek, Sweetwater Creek, and Rocky Creek using the load duration curve method were 40, 44, and 27 percent, respectively.

Florida Department of Environmental Protection
Division of Environmental Assessment and Restoration
Bureau of Watershed Restoration
2600 Blair Stone Road, Mail Station 3565
Tallahassee, Florida 32399-2400