FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Water Resource Management, Bureau of Watershed Management

SOUTHWEST DISTRICT • SPRINGS COAST BASIN •
ANCLOTE RIVER/COASTAL PINELLAS COUNTY PLANNING UNIT

TMDL Report

Fecal Coliform TMDL for the Klosterman Bayou Tidal Segment, WBID 1508

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Identification of Impaired Surface Waters Rule

http://www.dep.state.fl.us/water/tmdl/docs/AmendedIWR.pdf

STORET Program

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

2006 Integrated Water Quality Assessment for Florida

http://www.dep.state.fl.us/water/tmdl/docs/2006_Integrated_Report.pdf

Criteria for Surface Water Quality Classifications

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

Status Report, Springs Coast Basin

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

U.S. Environmental Protection Agency

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Chapter 1: INTRODUCTION

1.1 Purpose of Report

This report presents the Total Maximum Daily Load (TMDL) for fecal coliform bacteria for the tidal segment of Klosterman Bayou, which is located in the Anclote River/Coastal Pinellas County Planning Unit, and is part of the larger Springs Coast Basin. This waterbody segment was verified as impaired for fecal coliform bacteria, and was included on the Verified List of impaired waters for the Springs Coast Basin that was adopted by Secretarial Order in December 2007.

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and provides water quality targets needed to achieve compliance with applicable water quality standards based on the relationship between pollution sources and instream water quality. This TMDL establishes the allowable loadings to the Klosterman Bayou tidal segment that would restore the waterbody so that it meets its applicable water quality criterion for fecal coliform bacteria.

1.2 Identification of Waterbody

The Klosterman Bayou watershed is located in the Springs Coast Basin, in a densely populated region of northern Pinellas County, Florida, south of the city of Tarpon Springs **(Figure 1.1).** The watershed lies entirely within Pinellas County. The tidal segment receives drainage from the freshwater segment of Klosterman Creek, originating to the southeast. The total channel length from the headwaters to the bayou's mouth at St. Joseph Sound is about 2.4 miles, with approximately the last 1.1 miles being influenced by tides.

Klosterman Bayou originates as a small creek draining residential and golf course areas and becomes tidally influenced upstream of alternate U.S. Highway 19. The marine portion of the bayou is heavily modified and channelized, and located in a residential area. The primary land uses in the watershed are residential areas and recreational areas, predominantly golf courses. Further discussion of these land uses can be found in Chapter 4 of this report. Additional information about the region's hydrology and geology are available in the Basin Status Report for the Springs Coast (Florida Department of Environmental Protection [Department], 2006).

For assessment purposes, the Department divided the Springs Coast Basin into water assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or stream reach. Klosterman Bayou is divided into the Klosterman Bayou tidal segment (WBID 1508) shown in **Figure 1.2,** and the freshwater segment (WBID 1508A), which flows into the tidal segment **(Figure 1.1).** The tidal segment of Klosterman Bayou (WBID 1508) has an adjoining drainage area of approximately 650 acres. Additionally, water from incoming tides may influence the freshwater segment at least as far upstream as ponds located on the Innisbrook golf course property, which are located upstream of the line dividing the tidal and freshwater segments.

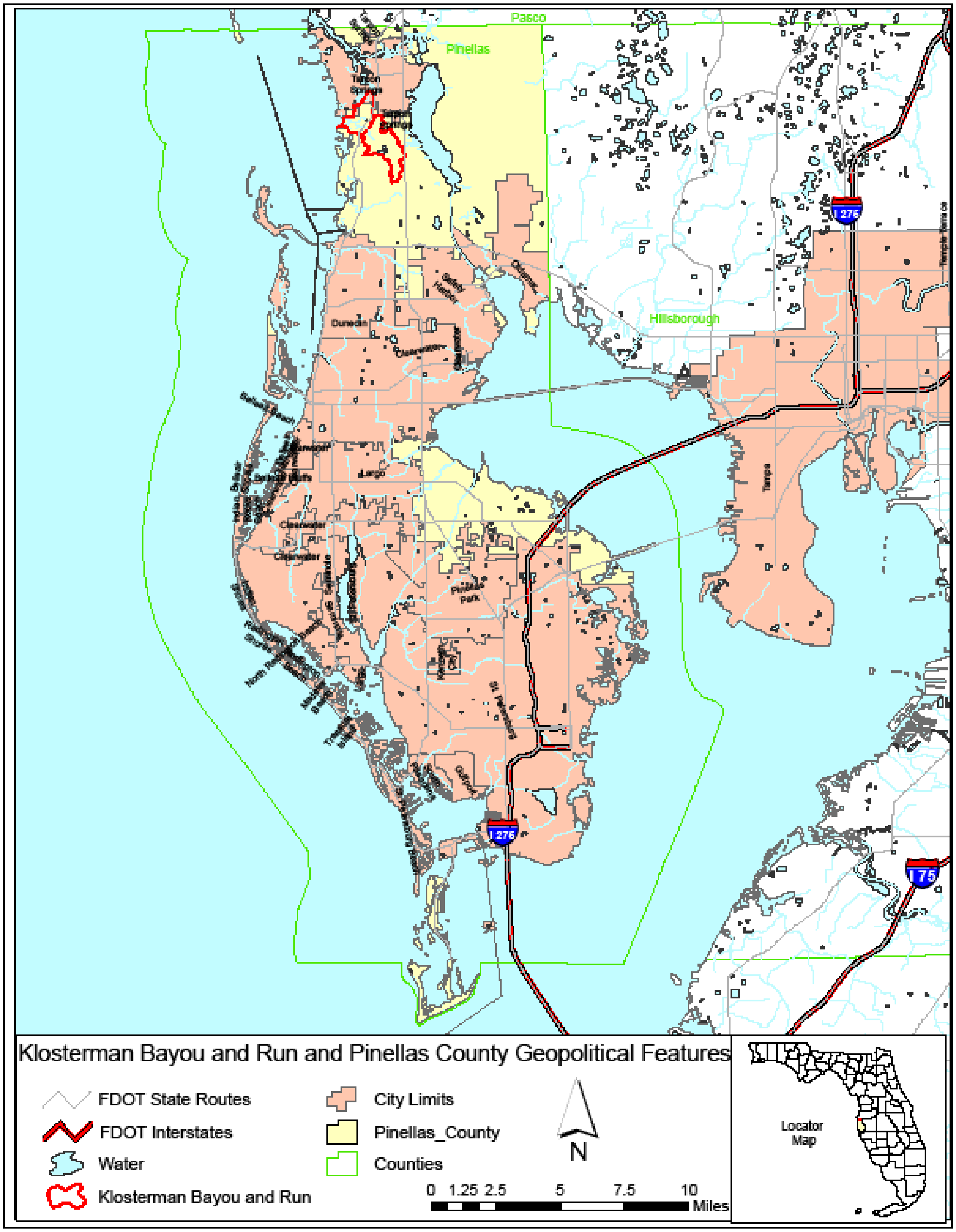

Figure 1.1. Location of the Klosterman Bayou Watershed, WBIDs 1508 and 1508A, and Major Geopolitical Features in Pinellas County

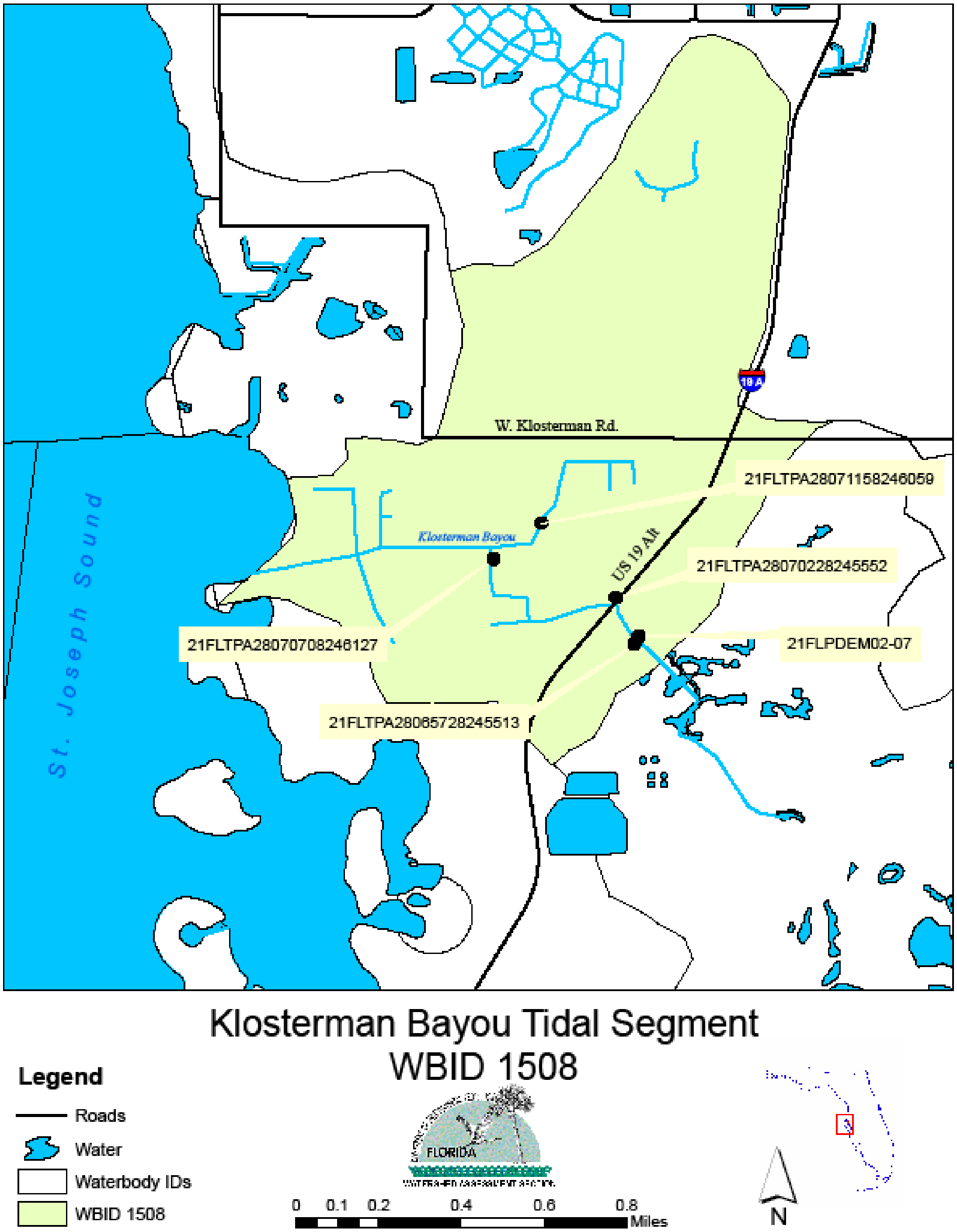

Figure 1.2. Monitoring Locations in the Klosterman Bayou Tidal Segment, WBID 1508

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, to reduce the amount of fecal coliform bacteria that caused the verified impairment of Klosterman Bayou. These activities will depend heavily on the active participation of the Southwest Florida Water Management District (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 U.S. Environmental Protection Agency (EPA) a list of surface waters that do not meet applicable water quality standards (impaired waters) and establish a TMDL for each pollutant identified as causing the impairment of the 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.]), and the state's 303(d) list is amended annually to include basin updates.

Florida's 1998 303(d) list included 22 waterbodies (WBIDs) in the Springs Coast 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. 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, and as amended in 2006 and 2007.

2.2 Information on Verified Impairment

The Department used the IWR to assess water quality impairments in the Klosterman Bayou tidal segment and verified the impairment for fecal coliform bacteria **(Table 2.1). Table 2.2** summarizes the data collected during the verified period (January 1, 1999–June 30, 2006). The creek was verified as impaired for fecal coliform bacteria because more than 10 percent of the values exceeded the Class III freshwater fecal coliform criterion of 400 counts per 100 milliliters (counts/100mL). Seven out of 37 total samples in the verified period exceeded the criterion of 400 counts/100mL.

The verified impairment was based on data collected by the Pinellas County Watershed Management Division and the Department's Southwest District Office. The assessment was based on data from one Pinellas County STORET station (21FLPDEM02-07) and four Department STORET stations (21FLTPA28065728245513, 21FLTPA28070228245552, 21FLTPA28070708246127, and 21FLTPA28071158246059). **Figure 1.2** shows the locations of the sampling sites in WBID 1508. **Figure 2.1** displays the fecal coliform data collected during the verified period, and **Appendix A** tabulates and graphically displays all the available fecal coliform data for the waterbody collected between 1994 and 2006.

All the data are provided, as the larger database was used to make comparisons with precipitation events and to look at the seasonal distribution of the data, as discussed in Chapter 5. However, only the fecal coliform values exceeding the criterion of 400 counts/100mL during the verified period were used to develop the TMDL.

Table 2.1. Verified Impairment in the Klosterman Bayou Watershed Tidal Segment, WBID 1508

Parameter Causing Impairment	Priority for TMDL Development	Projected Year for TMDL Development*
Fecal Coliform	High	2006[1]

* The TMDL was scheduled to be completed by December 31, 2006, based on a Consent Decree between the EPA and EarthJustice, but the Consent Decree allows a nine-month extension for completing the TMDL.

Table 2.2. Summary of Fecal Coliform Data for the Klosterman Bayou Tidal Segment, WBID 1508 (February 24, 2004–June 20, 2006)

Parameter Causing Impairment	Total Number of Samples	30-Day Geometric Mean	% Fecal Coliform Samples > 400 counts/100mL	Minimum Concentration (counts/100mL)	Maximum Concentration (counts/100mL)
Fecal Coliform	37	N/A	18.9	1	3,700

N/A – Not applicable.

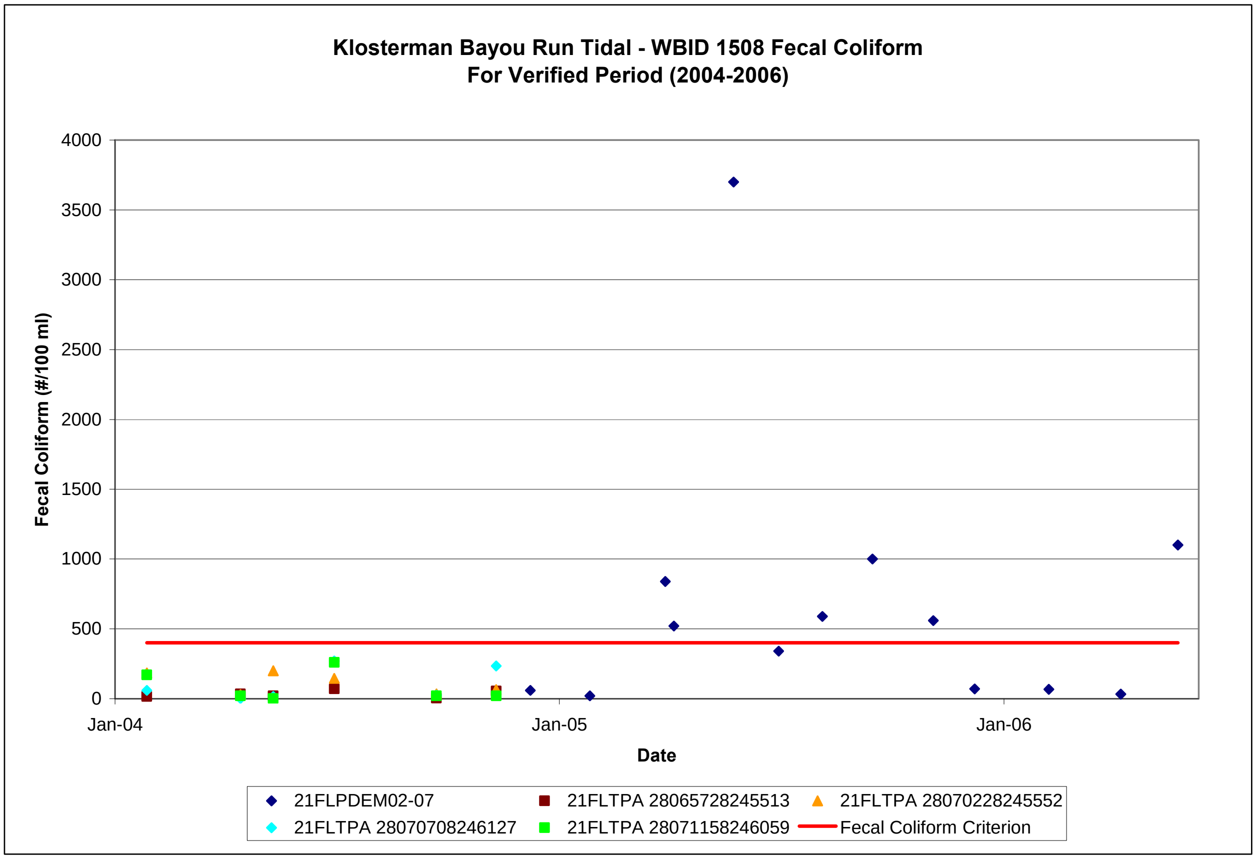

Figure 2.1. Fecal Coliform Measurements for the Klosterman Bayou Tidal Segment, WBID 1508, in the Verified Period (2004—06)

Chapter 3: DESCRIPTION OF APPLICABLE WATER QUALITY STANDARDS

3.1 Classification of the Waterbody and Criteria 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)**

Klosterman Bayou is a Class III waterbody, with a designated use of recreation and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The Class III water quality criterion applicable to the impairment addressed by this TMDL is for fecal coliform bacteria.

3.2 Applicable Water Quality Standards and Numeric Water Quality Target

3.2.1 Fecal Coliform Criterion

Numeric criteria for bacterial quality are expressed in terms of fecal coliform bacteria concentrations. The water quality criterion for the protection of Class III waters, as established by Rule 62-302, F.A.C., 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.*

For fecal coliform, 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. However, during the development of percent reduction loads for the impaired waterbody (as described in subsequent chapters), 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 fecal coliform criterion selected for the TMDL is that values are not to exceed 400 counts/100mL in more than 10 percent of the samples. The 10 percent exceedance allowed by the water quality criterion was not used directly in estimating the target load, but was included in the TMDL margin of safety (MOS) (described in **Section 6.4**).

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 the pollutant causing impairment in the waterbody and the amount of pollutant loading 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, including those from local government master drainage systems, construction sites over 5 acres, and a wide variety of industries (see **Appendix B** 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 Bacteria in the Klosterman Bayou Watershed

4.2.1 Point Sources

There is one permitted domestic wastewater treatment facility in the watershed: the William Dunn Water Reclamation Facility (NPDES No. 0128775). This facility does not discharge coliform bacteria loads directly into Klosterman Bayou. However, the effluent from the facility is used for irrigation in the watershed that may indirectly contribute coliform bacteria loads to Klosterman Bayou via runoff. This potential source is further discussed in the Reclaimed Water Usage section.

The Suncoast Primate Sanctuary is a small rehabilitation and retirement facility for apes and monkeys that houses 45 primates, primarily common chimpanzees (*Pan troglodytes*). The sanctuary is located on alternate U.S. 19 near the eastern border of the tidal WBID. Sewage handling at the facility is carried out through connections with the municipal systems, and there is no extant evidence of overflow events from this location.

Short-term point source discharge episodes may occur when there is an accidental release from the county's sewage-handling systems. On July 7, 2007, one such overflow event occurred. The Pinellas County Utilities Department cleaned up the spill and monitored the downstream portions of Klosterman Bayou. None of the data involved in the determination of the TMDL come from this period, and there is no evidence of prior spills to surface waters. The data used to determine the TMDL are believed to be representative of ambient surface water conditions and not of episodic events.

Municipal Separate Storm Sewer System Permittees

Municipal separate storm sewer systems (MS4s) may also discharge pollutants to waterbodies in response to storm events. To address stormwater discharges, the EPA developed the NPDES stormwater permitting program in two phases. Phase 1, promulgated in 1990, addresses large and medium-size MS4s located in incorporated areas and counties with populations of 100,000 or more. Phase 2 permitting began in 2003. Regulated Phase 2 MS4s are defined in Section 62-624.800, F.A.C., and typically cover urbanized areas serving jurisdictions with a population of at least 10,000 or discharging into Class I or Class II waters, or into Outstanding Florida Waters.

The stormwater collection systems in the Klosterman Bayou watershed, which are owned and operated by Pinellas County in conjunction with the Florida Department of Transportation (FDOT), are covered by a Phase 1 MS4 permit. The Klosterman Bayou watershed falls under the Pinellas County Phase 1 MS4 Permit (Number FLS000005). The city of Tarpon Springs and FDOT District 1 are copermittees, each with portions of their jurisdictions located in the watershed. Currently, no local governments in the watershed have applied for coverage under the Phase 2 NPDES MS4 permit.

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 could include loadings from surface runoff, wildlife, livestock, pets, leaking sewer lines, and leaking septic tanks.

Wildlife

Wildlife deposit coliform bacteria along 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. No attempt has been made to assess the fecal coliform contribution from nonanthropogenic sources such as wildlife. The BMAP process will further explore these possible sources.

Agricultural Animals

Agricultural animals can be the source of several types of coliform loading to streams; however, there is no agriculture taking place within the Klosterman Bayou watershed. With no significant rangeland, pastureland, or livestock, the contribution from agricultural animals is considered to be negligible.

Land Uses

The spatial distribution and acreage of different land use categories were identified using the SWFWMD 2004 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 **(Table 4.1).** To take into account upstream contributions to the Klosterman Bayou tidal segment, both the tidal segment (WBID 1508) and the freshwater segment (WBID 1508A) land area were included in land use calculations.

Figure 4.1 shows the acreage of the principal land uses in the watershed. Land use is predominately urban open land and residential, with 41 percent of the land area developed into residential areas. Of this area, 32 percent is considered to be high density (6 or more dwellings/acre), 5 percent is medium-density residential (2 to 5 dwellings/acre), and the remaining 4 percent is low-density residential (less than 2 dwellings/acre). The next largest land use is recreation at 27 percent of the combined watershed land area, and most of that recreational area comprises golf courses. Water and wetlands represent 14 percent of the area. Another 4 percent is dedicated to transportation, communication, and utilities activities.

Table 4.1. Classification of Land Use Categories in the Freshwater and Tidal Segments of the Klosterman Bayou Watershed (WBIDs 1508 and 1508A), Based on 2004 Data

Code	Land Use	Acres	$Miles^2$	% of Total
1000	Urban Open	673	1.05	32%
1100	Residential Low Density	90	0.14	4%
1200	Residential Medium Density	109	0.17	5%
1300	Residential High Density	671	1.05	32%
2000	Agriculture	0	0.00	0%
3000	Rangeland	3	0.01	0%
4000	Upland forests	150	0.23	7%
5000	Water	116	0.18	6%
6000	Wetlands	174	0.27	8%
8000	Transportation, Communication, and Utilities	87	0.14	4%
	Total	**2,075**	**5.88**	**100%**

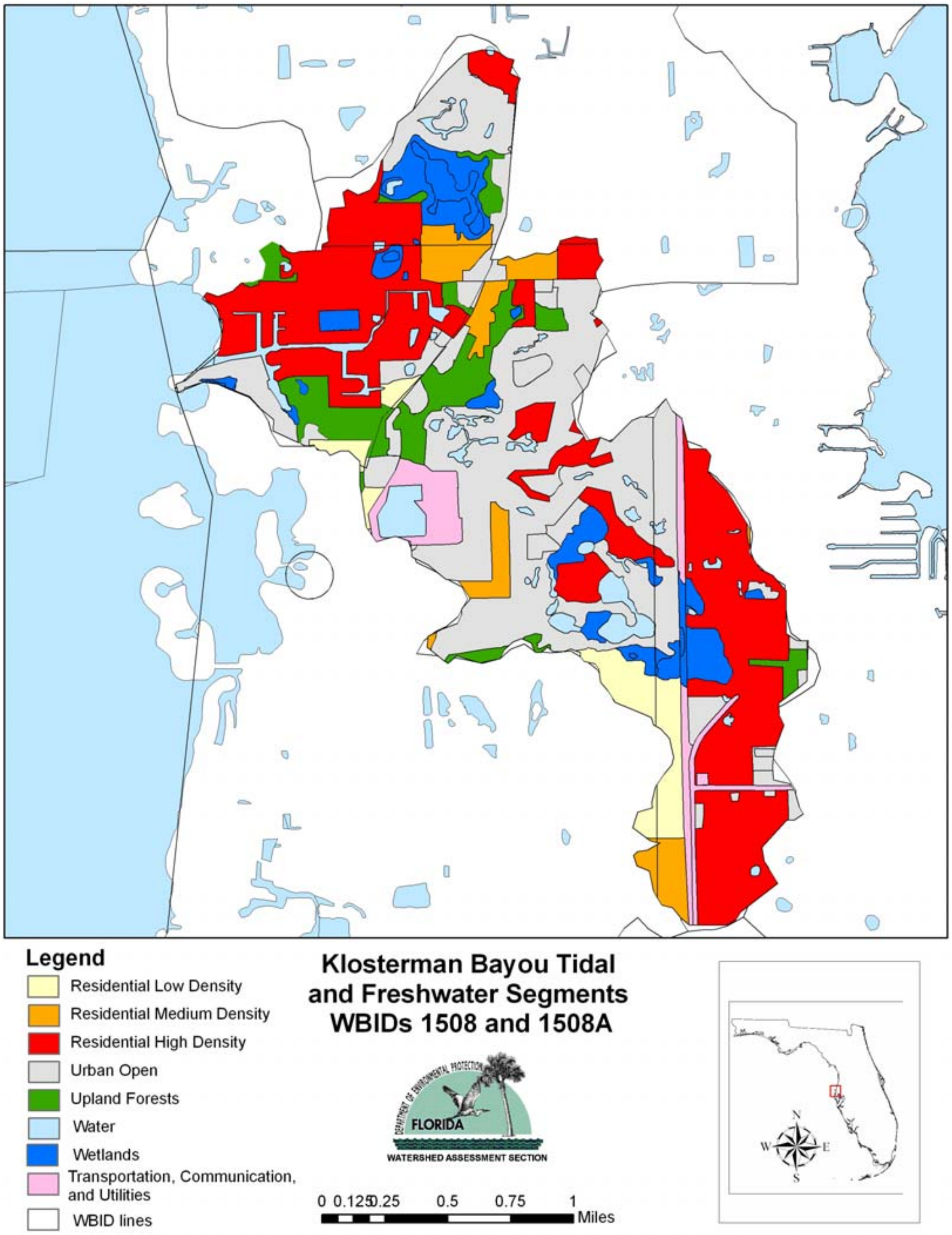

Figure 4.1. Principal Land Uses in the Klosterman Bayou Watershed, WBIDs 1508 and 1508A, in 2004

Urban Development

Coliform loading from urban areas is attributable to multiple sources, including stormwater runoff, leaks and overflows from sanitary sewer systems, illicit discharges of sanitary waste, runoff from improper disposal of waste materials, leaking septic systems, and domestic animals. Since 55 percent of the watershed's land area is residential, pets (especially dogs) may be having an impact on Klosterman Bayou.

Data on the number of registered dogs and cats in the Klosterman Bayou area are available from the Pinellas County Animal Service Department **(Table 4.2).** Assuming that 10 percent of coliforms reach the waterbody and are viable upon reaching it, the approximate loading from dogs would be 2.05 x 10^{12} organisms/day, and the loading from cats would be 7.45 x 10^{11} organisms/day. This is an estimate, as the actual loading from dogs and cats is not known. For the impairments at Station 21FLPDEM02-07, most of the residential sources are likely to be associated with development within the freshwater segment, WBID 1508A, as this station is located in the upstream, eastern reach of the tidal segment.

Table 4.2. Estimated Loading from Dogs and Cats in the Klosterman Bayou Watershed, WBIDs 1508 and 1508A

Pet	Number of Pets in Bayou[1]	Estimated Counts/Pet/Day[2]	Estimated Counts/Day
Dogs	409	5.00E+09	2.05E+12
Cats	149	5.00E+09	7.45E+11

[1] Data provided by Pinellas County Animal Services Department.
[2] EPA, January 2001, pp. 5–7.

Population

According to the U.S. Census Bureau, the population density in Pinellas County in the year 2006 was at or less than 3,302 people per square mile (mi^2) **(Table 4.3).** The Census Bureau reports that the total population in 2006 for Pinellas County, which includes WBID 1508, was 924,413, with 495,191 housing units. For all of Pinellas County, the bureau reported a housing density of 1,769 houses per mi^2. Pinellas County is well above the average housing density of Florida of 134.3 housing units per mi^2 average (U.S. Census Bureau Website, 2007) and is in fact one of the most densely populated counties in the state. In the Klosterman Bayou watershed, the population density is estimated to be between 2,549 and 6,229 persons per mi^2.

Septic Tanks

Domestic wastewater generated in the Klosterman Bayou watershed is primarily treated by Pinellas County sewage treatment facilities. Although most wastewater is handled by Pinellas County facilities, there are some existing septic tank systems. Based on data obtained from the Florida Department of Health (FDOH), there are 31 permitted septic systems in use within the Klosterman Bayou watershed. Based on this low number of septic tank systems, combined with the normal failure rate, septic tanks are not believed to be a significant contributor of coliforms in the watershed.

Reclaimed Water Usage

Some wastewater treatment plants have the capacity to reuse treated effluent for irrigation. These are known as water reclamation facilities. As mentioned earlier, the William E. Dunn Pinellas County Water Reclamation Facility (NPDES No. FL0128775) is located directly adjacent to WBID 1508.

In a water reclamation system, the effluent is reused as irrigation water for parks, golf courses and other sport fields, parks, cemeteries or other open spaces where supplemental irrigation water is needed. The effluent, although of good water quality, is not considered potable, and direct human contact should be avoided or at least minimized for public health and safety. The effluent is disinfected to destroy fecal coliform, tested daily, and stored before being reused via land application. During periods of significant rainfall, excess water is pumped out through the Klosterman system or is spray irrigated to prevent flooding from the effluent pond systems. The permitted effluent limitation for 75 percent of fecal coliform values is “below detection limits,” and “any one sample shall not exceed 25 fecal coliform values per 100 mL of sample.”

In the Klosterman Bayou watershed, the primary use of reclaimed water is to irrigate golf courses. The main golf course in WBID 1508 is the Tarpon Springs Golf Club, which is in the northern part of the watershed. However, the greatest contribution of water to WBID 1508 comes from the freshwater segment, WBID 1508A, which is also the primary area for golf courses in the watershed. The William E. Dunn Facility provides reclaimed water for the Innisbrook family of golf courses: the Sandpiper/Highlands, Copperhead, and Island Courses. Benchmark monitoring data are available for the period from 2002 to 2006. A review of these data reveal that nearly all fecal coliform samples fell below the critical threshold.

Table 4.3. Population Density in Pinellas County, Florida

Persons per Square Mile	Total Population	Houses per Square Mile	Housing Units
3,302	924,413	1,769	495,191

Source: U.S. Census Bureau Website, 2005.

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Method Used To Determine Loading Capacity

The fecal coliform bacteria TMDL for the Klosterman Bayou tidal segment is based on the "percent reduction" methodology. Under this method, the percent reduction needed to meet the applicable criterion is calculated for each measured value above the criterion, and then the median of the percent reductions is calculated. As described in Chapter 3, criterion concentrations of 400 counts/100mL for fecal coliform were used, as specified in Florida's Surface Water Quality Standards.

5.2 Data Used in the Determination of Loading Capacity

The primary collectors of water quality data in the Klosterman Bayou tidal segment are the Department and the Pinellas County Watershed Management Division. Data for the Verified Period from Pinellas County came from STORET Station 21FLPDEM02-07. The Department sampled at STORET Stations 21FLTPA28065728245513, 21FLTPA28070228245552, 21FLTPA28070708246127, and 21FLTPA28071158246059. **Figure 1.2** shows the locations of these sites, while **Table 2.2** provides a statistical overview of the observed data at the sites. **Figure 2.1** displays the data for fecal coliform bacteria used in this analysis, and **Appendix A** lists the water quality monitoring results for fecal coliform bacteria.

5.3 TMDL Development Process

5.3.1 Attempts to Use the Load Duration Method

Coliform bacteria TMDLs are commonly developed using load duration curves. This method requires daily flow data (typically a U.S. Geological Survey [USGS] gaged site in the watershed) to calculate coliform loads. However, continuous flow data were not available for Klosterman Bayou for the period when coliform data were collected. When flow data are not available, the approach used to estimate a TMDL is based on the percent reduction required to reduce the coliform count exceedances to the water quality criterion.

According to USGS methods, flows can be estimated at ungaged sites using drainage area ratios in instances where the ungaged site to gaged site drainage ratio is in the range of 0.5 to 1.5 (Ries and Friesz, 2000). However, there are no gages in nearby streams that adequately represent the hydrologic conditions in Klosterman Bayou during the verified period. A flow gage station has been added on the main channel of the freshwater portion of Klosterman Bayou Run within the Innisbrook golf course, but this station has only been operating since August 2006.

Additional problems arise when attempting to apply the load duration method to a tidally influenced system, because the method fundamentally assumes stream flow to be the primary driver in pollutant delivery. This is not the case in tidal and coastal segments, where flows can be reversed and where the tide diminishes the contribution of upstream pollutants.

5.3.2 Calculation of Required Percent Reduction

To calculate the required percent reduction in fecal coliform counts needed to meet the water quality criterion, the state's criterion for fecal coliform bacteria (400 counts/100mL) was subtracted from each fecal coliform sample exceedance, respectively, divided by the sample result, and then multiplied by 100. This value provides the percent reduction required to achieve the instream concentration criterion established for fecal coliform bacteria.

The median value of the percent reduction values for each sample exceedance for fecal coliform bacteria was then calculated and used as the overall percent reduction required to meet water quality standards. As shown in **Table 5.1**, a 52.4 percent reduction in fecal coliform bacteria is required to achieve an instream concentration of 400 counts/100mL.

Table 5.1. Summary of Fecal Coliform Sample Exceedances for the Klosterman Bayou Tidal Segment, WBID 1508

Station ID	Date	Time	Fecal Coliform (counts/100mL)	% Reduction
21FLPDEM02-07	4/25/2005	1028	840	52.38
21FLPDEM02-07	5/2/2005	1202	520	23.08
21FLPDEM02-07	6/20/2005	1058	3,700	89.19
21FLPDEM02-07	9/1/2005	1021	590	32.20
21FLPDEM02-07	10/12/2005	1253	1,000	60.00
21FLPDEM02-07	12/1/2005	1008	560	28.57
21FLPDEM02-07	6/20/2006	1403	1,100	63.64
Median % Reduction of Fecal Coliform				**52.38**

5.4 Critical Conditions/Seasonality

The critical condition for the coliform bacteria loading from nonpoint sources is typically an extended dry period followed by a rainfall runoff event. Nonpoint sources of coliform bacteria generally, but not always, involve the accumulation of coliform bacteria on land surfaces that wash off as a result of storm events. Wildlife and ground water polluted by sources such as central sewer system leaks/breaks may also contribute additional bacteria. Due to the tidal nature of the system and the lack of flow data, flow and coliform bacteria counts could not be correlated.

The determination of the required percent reduction is sufficiently protective because the method analyzed all of the exceedances. The approach is considered conservative because only the exceedances were used, and this excludes conditions when the fecal coliform criterion is met in the bayou. Seasonality was addressed by assessing water quality in the impaired waterbody based on data collected throughout the year (i.e., values were collected during four seasons in 2004 and 2005, and two seasons in 2006 [winter and spring]).

Table 5.2 shows the number of samples and number of exceedances broken into seasonal and monthly categories for the entire period of record from 1994 to 2006. Percentage exceedances are listed to illustrate which periods had the highest number of exceedances. The largest frequency of exceedances occurred during the spring, from April to June, and in the fall, from September to November.

Table 5.2. Summary of Fecal Coliform Observations by Season and Month for the Klosterman Bayou Tidal Segment, WBID 1508

Summary of Historical Data			
	# of Samples	# of Exceedances	% Exceedances
SEASONS			
Winter	23	1	4%
Spring	20	5	25%
Summer	26	3	12%
Fall	26	4	15%
MONTHS			
Jan	6	1	17%
Feb	10	0	0%
Mar	7	0	0%
Apr	5	1	20%
May	11	2	18%
Jun	10	2	20%
Jul	10	1	10%
Aug	4	0	0%
Sep	6	2	33%
Oct	10	1	10%
Nov	4	2	50%
Dec	12	1	8%

Fecal coliform exceedances in Klosterman Bayou were also investigated for possible associations with rainfall. If there is a large contribution of fecal coliform bacteria from land runoff after rain events, then the pattern should be recognizable in the data. Precipitation data were available for the Tarpon Springs Sewage Treatment Plant located near the Klosterman Bayou watershed. Simple regression analyses were performed on the data for varying intervals after rainfall events: on the same day, three days prior to the fecal coliform measurement, and seven days prior to the fecal coliform measurement. No significant relationships were detected. The majority of the exceedances were found to occur during dry and low rainfall events, as shown in **Figure 5.1**. Therefore, source identification and any future reduction implementation plans should initially focus on sources other than those that are storm event driven.

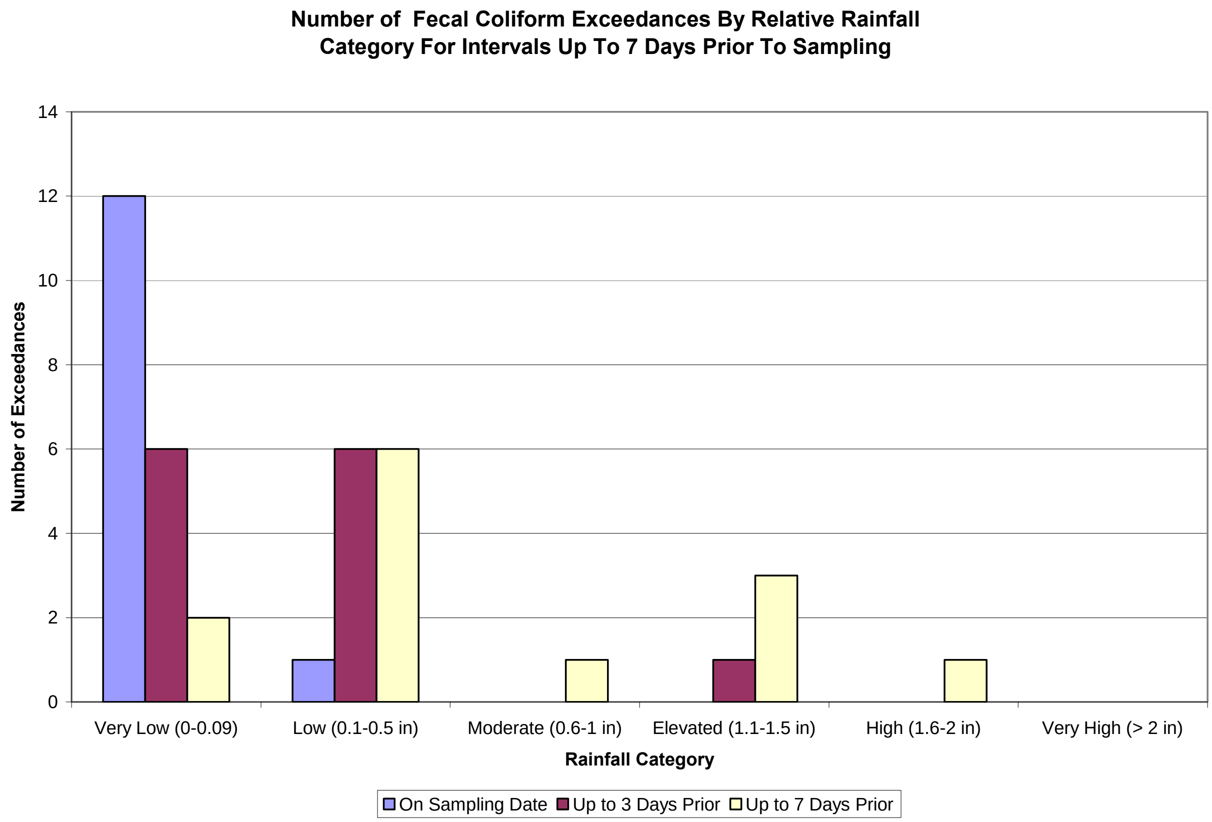

Figure 5.1. Summary of Fecal Coliform Exceedances by Precipitation Events (1994–2006)

Due to the tidal nature of Klosterman Bayou, pollutant loads generated in the lower reaches of the bayou may be transported upstream on incoming tides. A graph of fecal coliform counts versus salinity was prepared to investigate the tidal conditions under which the exceedances are occurring (**Figure 5.2**). Low-salinity values are indicative of outgoing tides, and higher-salinity values correspond with incoming tides. The graph shows that exceedances occur during both high- and low-salinity sampling events. This suggests that the elevated counts are originating from both upstream sources in the watershed and downstream sources that are being transported upstream on incoming tides.

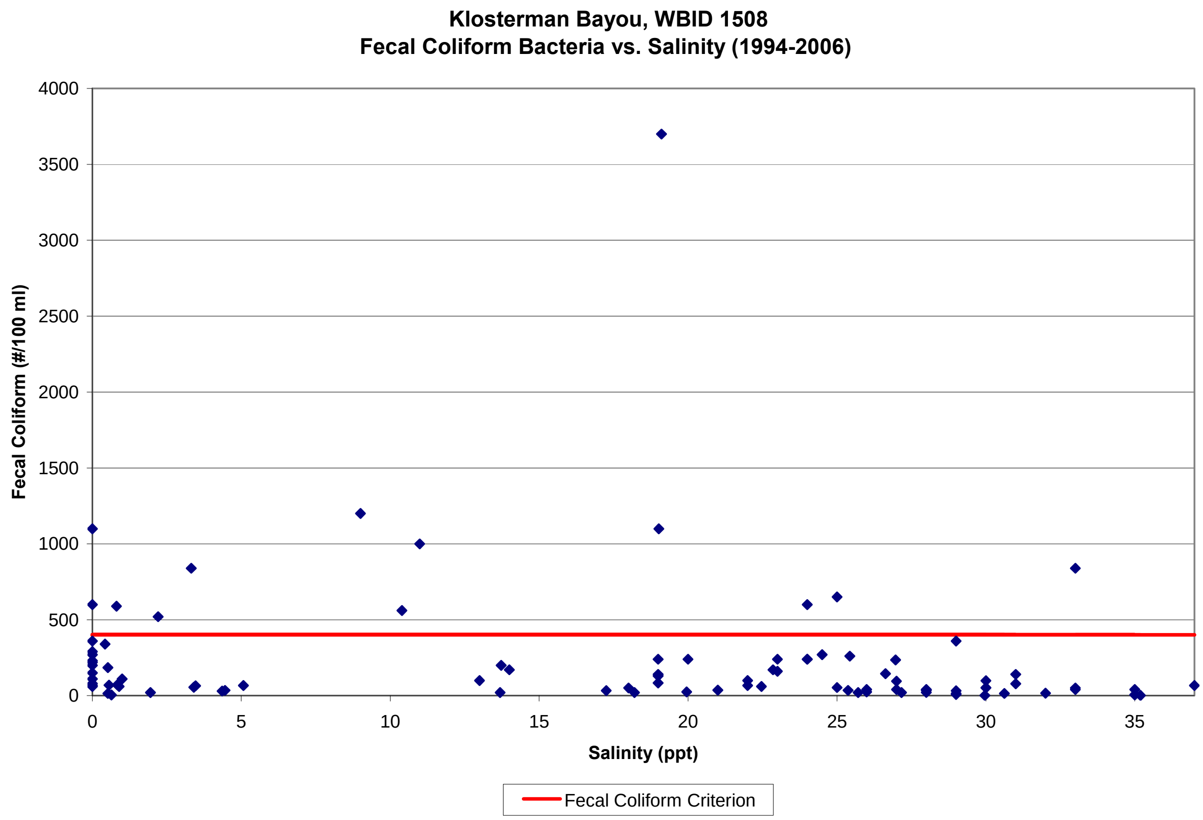

Figure 5.2. Fecal Coliform Counts versus Salinity (1994–2006)

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 fecal coliform TMDL for the Klosterman Bayou tidal segment is expressed as the “median percent reduction” required to reduce the observed water quality exceedances to the state’s water quality criterion (**Table 6.1**). The percent reduction value for fecal coliform bacteria was determined by taking the median of the percent reductions for each sample result that exceeded the criterion. The percent reduction was calculated as 52.4 percent to achieve an instream concentration of 400 counts/100mL.

Table 6.1. TMDL Components for the Klosterman Bayou Watershed Tidal Segment, WBID 1508

Parameter	TMDL (% reduction)	WLA		LA (% reduction)	MOS
		Wastewater (counts/day)	NPDES Stormwater (% reduction)		
Fecal Coliform	52.4	N/A	52.4	52.4	Implicit

N/A – Not applicable.

6.2 Load Allocation

Based on the percent reduction approach, the load allocation for nonpoint sources is a 52.4 percent reduction of instream fecal coliform concentrations. It should be noted that the LA includes loading from regulated stormwater discharges that are not part of the NPDES stormwater program (see **Appendix B**).

6.3 Wasteload Allocation

6.3.1 NPDES Wastewater Discharge

No NPDES-permitted wastewater treatment facilities discharge coliform bacteria directly to surface waters in the Klosterman Bayou watershed. Thus, the wasteload allocation for wastewater facilities is not applicable. Any facilities permitted to discharge to the Klosterman Bayou watershed in the future will be required to meet the state Class III criterion for fecal coliform bacteria.

6.3.2 NPDES Stormwater Discharges

The WLA for the Pinellas County, City of Tarpon Springs, and FDOT MS4 permit addresses anthropogenic sources contributing to the criteria exceedances in the basin, to result in a 52.4 percent reduction of in-stream fecal coliform concentrations. It should be noted that any MS4 permittee is only responsible for reducing the 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.

It should also be noted that upstream portions of Klosterman Bayou Run in the freshwater segment, WBID 1508A, are owned and operated by the Innisbrook Resort and Golf Club. This drainage system is a primary contributor to the tidal WBID. Therefore, this potential source should be taken into account when planning load reductions.

While the LA and WLA for fecal bacteria have been expressed as the percent reduction needed to attain the applicable Class III criteria, it is the combined reductions from both anthropogenic point and nonpoint sources that will result in the required reduction of instream fecal coliform concentrations. However, it is not the intent of the TMDL to abate natural background conditions.

6.4 Margin of Safety

Consistent with the recommendations of the Allocation Technical Advisory Committee (Department, February 2001), an implicit MOS was used in the development of this TMDL. An implicit MOS was provided by the conservative decisions associated with the analytical assumptions and the development of assimilative capacity, which only focuses on exceedances of the state criterion. A MOS was included in the TMDL by not allowing any exceedances of the state criterion, even though intermittent natural exceedances would be expected and would be taken into account when determining impairment. Additionally, the implicit MOS is appropriate, as existing loads are based on instream coliform measurements. These measurements include decay processes occurring instream and do not represent the maximum load that can be applied to the land and transported to Klosterman Bayou during a rain event. Furthermore, the Department used 400 MPN/100mL of fecal coliform as the water quality target for each and every sampling event, instead of using the minimal criterion that less than 10 percent of the samples should exceed 400 MPN/100mL.

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.

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Appendices

Appendix A: Summary of Monitoring Results for Fecal Coliform Bacteria in the Klosterman Bayou Tidal Segment (January 1994–June 2006)

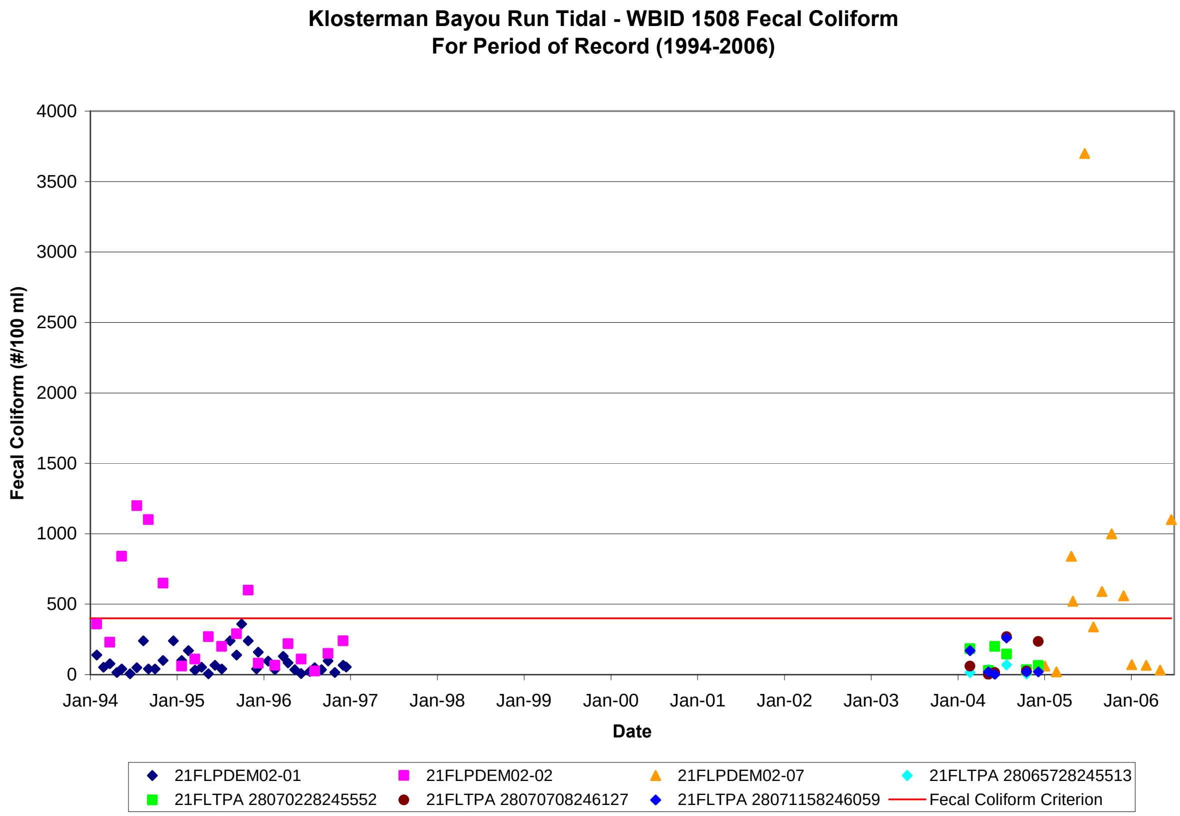
HUC	WBID	Station	Date	Time	Result	Code	Period
3100207	1508	21FLPDEM02-01	1/5/1994	1055	**600**	L	Planning
3100207	1508	21FLPDEM02-01	2/2/1994	810	140	—	Planning
3100207	1508	21FLPDEM02-02	2/2/1994	1225	360	—	Planning
3100207	1508	21FLPDEM02-01	3/2/1994	1140	52	B	Planning
3100207	1508	21FLPDEM02-02	3/29/1994	935	230	—	Planning
3100207	1508	21FLPDEM02-01	3/29/1994	950	78	—	Planning
3100207	1508	21FLPDEM02-01	4/27/1994	952	16	B	Planning
3100207	1508	21FLPDEM02-02	5/18/1994	1012	**840**	—	Planning
3100207	1508	21FLPDEM02-01	5/18/1994	1035	40	—	Planning
3100207	1508	21FLPDEM02-01	6/22/1994	1005	6	B	Planning
3100207	1508	21FLPDEM02-02	7/20/1994	932	**1,200**	L	Planning
3100207	1508	21FLPDEM02-01	7/20/1994	949	50	B	Planning
3100207	1508	21FLPDEM02-01	8/17/1994	940	240	L	Planning
3100207	1508	21FLPDEM02-02	9/7/1994	950	**1,100**	—	Planning
3100207	1508	21FLPDEM02-01	9/7/1994	1005	40	—	Planning
3100207	1508	21FLPDEM02-01	10/5/1994	959	40	—	Planning
3100207	1508	21FLPDEM02-02	11/8/1994	935	**650**	—	Planning
3100207	1508	21FLPDEM02-01	11/8/1994	955	100	—	Planning
3100207	1508	21FLPDEM02-01	12/21/1994	1000	240	—	Planning
3100207	1508	21FLPDEM02-02	1/25/1995	905	60	B	Planning
3100207	1508	21FLPDEM02-01	1/25/1995	921	100	—	Planning
3100207	1508	21FLPDEM02-01	2/22/1995	957	170	—	Planning
3100207	1508	21FLPDEM02-02	3/22/1995	913	110	B	Planning
3100207	1508	21FLPDEM02-01	3/22/1995	934	32	B	Planning
3100207	1508	21FLPDEM02-01	4/19/1995	936	52	—	Planning
3100207	1508	21FLPDEM02-02	5/17/1995	857	270	—	Planning
3100207	1508	21FLPDEM02-01	5/17/1995	937	6	B	Planning
3100207	1508	21FLPDEM02-01	6/14/1995	1108	66	—	Planning
3100207	1508	21FLPDEM02-02	7/12/1995	923	200	—	Planning
3100207	1508	21FLPDEM02-01	7/12/1995	939	40	B	Planning
3100207	1508	21FLPDEM02-01	8/16/1995	952	240	—	Planning
3100207	1508	21FLPDEM02-02	9/13/1995	914	290	—	Planning
3100207	1508	21FLPDEM02-01	9/13/1995	929	140	—	Planning
3100207	1508	21FLPDEM02-01	10/4/1995	956	360	—	Planning
3100207	1508	21FLPDEM02-02	11/1/1995	955	**600**	—	Planning
3100207	1508	21FLPDEM02-01	11/1/1995	1017	240	—	Planning
3100207	1508	21FLPDEM02-01	12/6/1995	1027	40	B	Planning
3100207	1508	21FLPDEM02-01	12/13/1995	1043	160	—	Planning

HUC	WBID	Station	Date	Time	Result	Code	Period
3100207	1508	21FLPDEM02-02	12/13/1995	1101	80	—	Planning
3100207	1508	21FLPDEM02-01	1/24/1996	1021	96	—	Planning
3100207	1508	21FLPDEM02-02	2/21/1996	944	66	—	Planning
3100207	1508	21FLPDEM02-01	2/21/1996	1000	36	B	Planning
3100207	1508	21FLPDEM02-01	3/27/1996	940	130	—	Planning
3100207	1508	21FLPDEM02-02	4/16/1996	920	220	—	Planning
3100207	1508	21FLPDEM02-01	4/16/1996	938	84	—	Planning
3100207	1508	21FLPDEM02-01	5/15/1996	1008	36	B	Planning
3100207	1508	21FLPDEM02-02	6/11/1996	1000	110	—	Planning
3100207	1508	21FLPDEM02-01	6/11/1996	1028	7	B	Planning
3100207	1508	21FLPDEM02-01	7/17/1996	956	22	B	Planning
3100207	1508	21FLPDEM02-02	8/7/1996	925	25	Z	Planning
3100207	1508	21FLPDEM02-01	8/7/1996	941	50	Z	Planning
3100207	1508	21FLPDEM02-01	9/4/1996	955	36	B	Planning
3100207	1508	21FLPDEM02-02	10/2/1996	933	150	B	Planning
3100207	1508	21FLPDEM02-01	10/2/1996	957	98	—	Planning
3100207	1508	21FLPDEM02-01	10/30/1996	1126	15	—	Planning
3100207	1508	21FLPDEM02-01	12/4/1996	931	66	—	Planning
3100207	1508	21FLPDEM02-02	12/4/1996	1111	240	—	Planning
3100207	1508	21FLPDEM02-01	12/17/1996	942	54	—	Planning
3100207	1508	21FLTPA 28071158246059	2/24/2004	950	170	—	Verified
3100207	1508	21FLTPA 28070708246127	2/24/2004	1030	60	B	Verified
3100207	1508	21FLTPA 28065728245513	2/24/2004	1105	15	B	Verified
3100207	1508	21FLTPA 28070228245552	2/24/2004	1145	185	—	Verified
3100207	1508	21FLTPA 28070708246127	5/11/2004	1000	1	K	Verified
3100207	1508	21FLTPA 28071158246059	5/11/2004	1010	20	B	Verified
3100207	1508	21FLTPA 28065728245513	5/11/2004	1045	35	B	Verified
3100207	1508	21FLTPA 28070228245552	5/11/2004	1105	30	B	Verified
3100207	1508	21FLTPA 28071158246059	6/7/2004	930	1	K	Verified
3100207	1508	21FLTPA 28070708246127	6/7/2004	945	15	B	Verified
3100207	1508	21FLTPA 28065728245513	6/7/2004	1015	20	B	Verified
3100207	1508	21FLTPA 28070228245552	6/7/2004	1035	200	—	Verified
3100207	1508	21FLTPA 28071158246059	7/27/2004	925	260	—	Verified
3100207	1508	21FLTPA 28070708246127	7/27/2004	945	270	—	Verified
3100207	1508	21FLTPA 28070228245552	7/27/2004	1000	145	—	Verified
3100207	1508	21FLTPA 28065728245513	7/27/2004	1015	70	B	Verified
3100207	1508	21FLTPA 28065728245513	10/19/2004	1055	5	B	Verified
3100207	1508	21FLTPA 28071158246059	10/19/2004	1120	20	B	Verified
3100207	1508	21FLTPA 28070708246127	10/19/2004	1130	25	B	Verified
3100207	1508	21FLTPA 28070228245552	10/19/2004	1145	35	B	Verified
3100207	1508	21FLTPA 28071158246059	12/7/2004	950	20	B	Verified
3100207	1508	21FLTPA 28070708246127	12/7/2004	1005	235	—	Verified
3100207	1508	21FLTPA 28065728245513	12/7/2004	1030	55	B	Verified
3100207	1508	21FLTPA 28070228245552	12/7/2004	1055	65	B	Verified
3100207	1508	21FLPDEM02-07	1/4/2005	1159	60	—	Verified
3100207	1508	21FLPDEM02-07	2/22/2005	1246	20	B	Verified

HUC	WBID	Station	Date	Time	Result	Code	Period
3100207	1508	21FLPDEM02-07	4/25/2005	1028	**840**	—	Verified
3100207	1508	21FLPDEM02-07	5/2/2005	1202	**520**	—	Verified
3100207	1508	21FLPDEM02-07	6/20/2005	1058	**3,700**	—	Verified
3100207	1508	21FLPDEM02-07	7/27/2005	1117	340	B	Verified
3100207	1508	21FLPDEM02-07	9/1/2005	1021	**590**	—	Verified
3100207	1508	21FLPDEM02-07	10/12/2005	1253	**1,000**	—	Verified
3100207	1508	21FLPDEM02-07	12/1/2005	1008	**560**	—	Verified
3100207	1508	21FLPDEM02-07	1/4/2006	1120	71	—	Verified
3100207	1508	21FLPDEM02-07	3/6/2006	1015	67	B	Verified
3100207	1508	21FLPDEM02-07	5/4/2006	1031	33	B	Verified
3100207	1508	21FLPDEM02-07	6/20/2006	1403	**1,100**	—	Verified

Note: Bold numbers represent measurements that exceeded the water quality criterion.

Remark Code: **—**No remark code.
B – Results based on colony counts outside the acceptable range. This code applies to microbiological tests and specifically to membrane filter colony counts. The code is used if the colony count is generated from a plate in which the total number of coliform colonies is outside the method indicated ideal range. The code is not used if a 100 mL sample has been filtered and the colony count is less than the lower value of the ideal range.
K – Off-scale low. Actual value is known to be less than the value given. This code is used if: (1) The value is less than the lowest calibration standard and the calibration curve is known to be non-linear; or (2) the value is known to be less than the reported value based on sample size, dilution. This code shall not be used to report values that are less than the laboratory practical quantitation limit or laboratory method detection limit.
L – Off-scale high. Actual value is known to be greater than value given. To be used when the concentration of the analyte is above the acceptable level for quantitation (exceeds the linear range or highest calibration standard) and the calibration curve is known to exhibit a negative deflection.
Z – Too many colonies were present (TNTC); the numeric value represents the filtration volume.


Klosterman Bayou Run Tidal - WBID 1508 Fecal Coliform
For Period of Record (1994-2006)
Fecal Coliform (#/100 ml)
4000
3500
3000
2500
2000
1500
1000
500
0
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Date
21FLPDEM02-01
21FLPDEM02-02
21FLPDEM02-07
21FLTPA 28065728245513
21FLTPA 28070228245552
21FLTPA 28070708246127
21FLTPA 28071158246059
Fecal Coliform Criterion

Appendix B: 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.

The rule 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. No PLRG had been developed for Newnans Lake at the time this report was developed.

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 stormwater permitting program to designate certain stormwater discharges as "point sources" of pollution. 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 has implemented Phase 1 of the MS4 permitting program on a countywide basis, which brings in all cities (incorporated areas), Chapter 298 urban water control districts, and FDOT throughout the 15 counties meeting the population criteria.

An important difference between the federal and state stormwater permitting programs is that the federal program covers both new and existing discharges, while the state program focuses on new discharges. Additionally, Phase 2 of the NPDES Program will expand the need for these permits to construction sites between 1 and 5 acres, and to local governments with as few as 10,000 people. The revised rules require that these additional activities obtain permits by 2003. 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. The Department recently accepted delegation from the EPA for the stormwater part of the NPDES Program. It should be noted that most MS4 permits issued in Florida include a reopener clause that allows permit revisions to implement TMDLs once they are formally adopted by rule.

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