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 Moccasin Creek Tidal (WBID 1530)

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Acknowledgments

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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 Load (TMDL) for fecal coliform bacteria for the tidal portion of Moccasin Creek within the Tampa Bay Basin. This waterbody was verified as impaired for fecal coliform and therefore was included on the Verified List of impaired waters for the Tampa Bay Basin that was adopted by Secretarial Order on June 3, 2008. The TMDL establishes the allowable fecal coliform loadings to Moccasin Creek Tidal that would restore the waterbody so that it meets its applicable water quality criterion for fecal coliform.

1.2 Identification of Waterbody

Moccasin Creek Tidal is located in the northeast portion of Pinellas County (**Figure 1.1**). About 1.75 miles in length, it flows primarily southeast, entering Tampa Bay at its northwestern edge approximately 2 miles southeast of Lake Tarpon, and drains an area of about 0.89 square miles. The Moccasin Creek Tidal watershed is located in the central portion of the city of Oldsmar, which has a population of approximately 13,477 (U.S. Census Bureau, 2007). Additional information about the creek's hydrology and geology are 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 **w**ater**b**ody **id**entification (WBID) number for each watershed or stream reach. Moccasin Creek Tidal is WBID 1530 (**Figure 1.2**).

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).

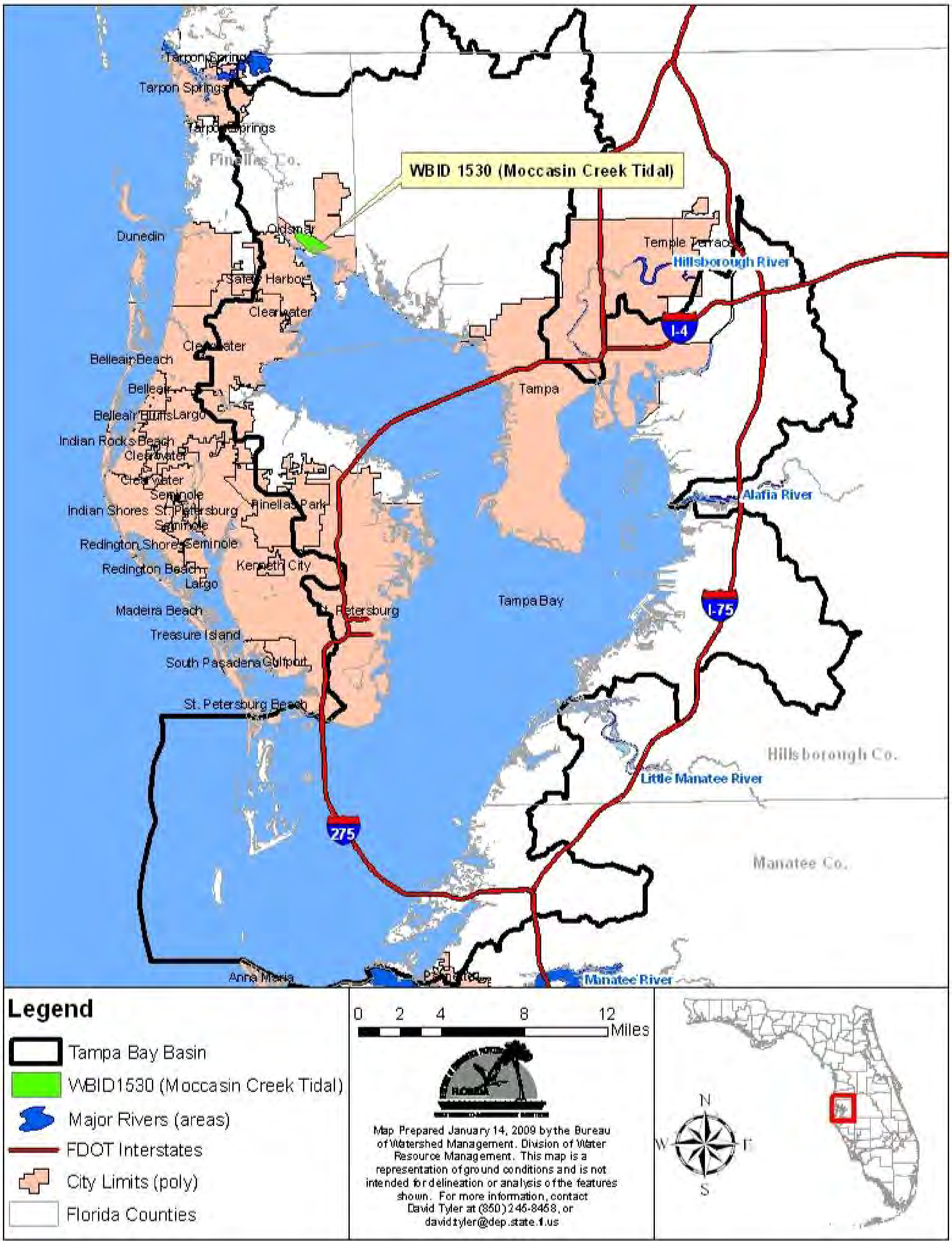


Figure 1.1. Location of the Moccasin Creek Tidal Watershed (WBID 1530) in the Tampa Bay Basin and Major Geopolitical Features in the Area

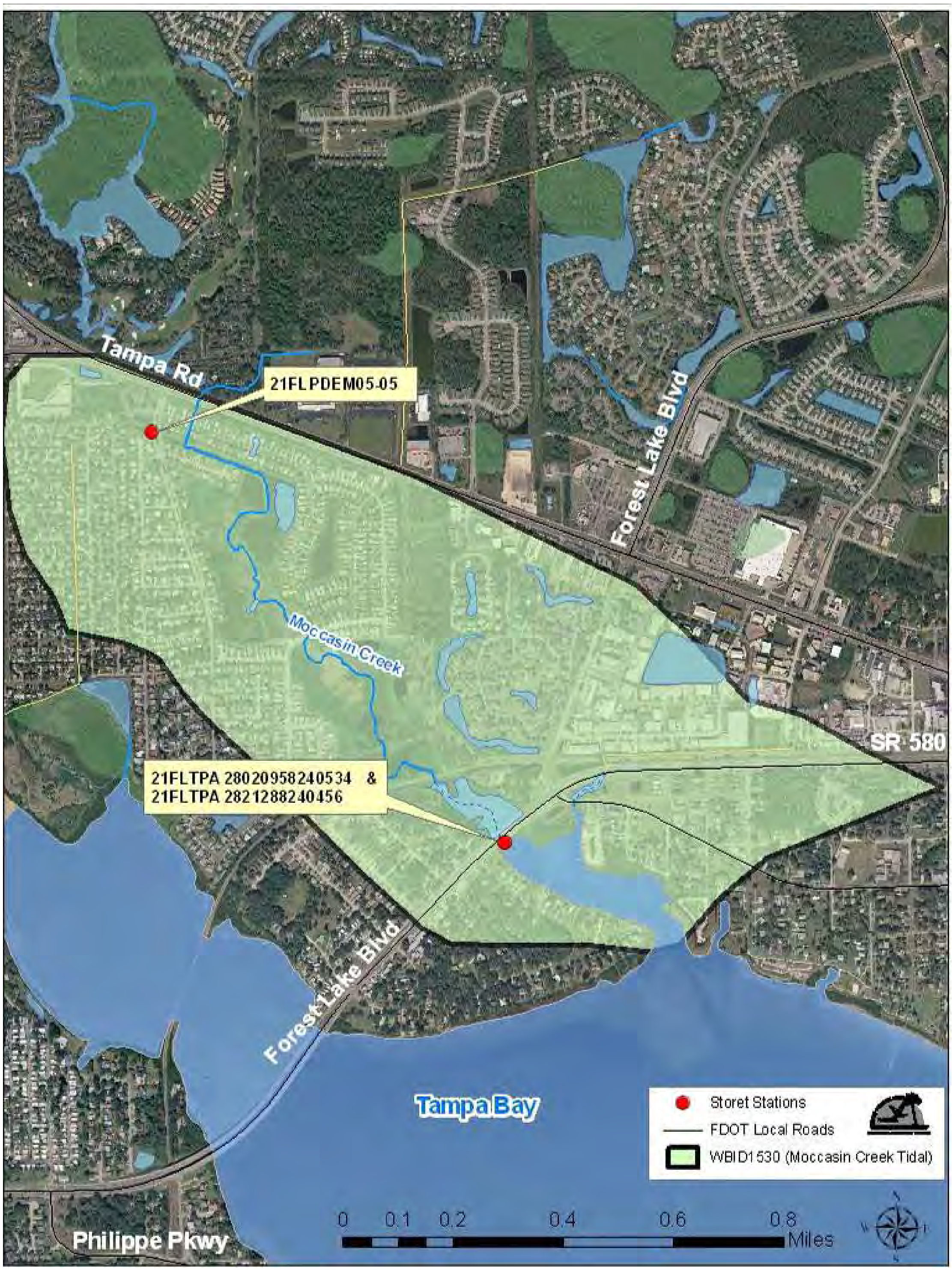


Figure 1.2. Location of the Moccasin Creek Tidal Watershed (WBID 1530) in the City of Oldsmar and STORET Monitoring Stations

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 may 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 Moccasin Creek Tidal. These activities will depend heavily on the active participation of the Southwest Florida Water Management District (SWFWMD), Pinellas County's Department of Environmental Management (PDEM), 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 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 2006 and 2007.

2.2 Information on Verified Impairment

The Department used the IWR to assess water quality impairments in the tidal portion of Moccasin Creek (WBID 1530) and verified the impairments during the second cycle of the TMDL Program (**Table 2.1**). **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 Moccasin Creek Tidal was 2008, but the Settlement Agreement between 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 TMDL. As such, this TMDL must be adopted and submitted to the EPA by September 30, 2009.

This waterbody was verified as impaired based on fecal coliform because, using the IWR methodology, more than 10 percent of the values exceeded the Class III marine criterion of 400 counts per 100 milliliters (counts/100mL) for fecal coliform (9 out of 15 samples in the verified period exceeded the criterion). The fecal coliform data used in this report are based on the IWR Run32 database. Station 21FLPDEM05-05 (with 5 fecal coliform samples) was recently assigned to Moccasin Creek Tidal due to its proximity.

The verified impairments were based on data collected by Pinellas County and the Department's Southwest District. **Figure 1.2** shows the WBID location and STORET monitoring stations. **Figure 2.1** displays the fecal coliform data collected during the verified period (January 1, 2000, to June 30, 2007) for Moccasin Creek Tidal.

Table 2.1. Verified Impairments for Moccasin Creek Tidal (WBID 1530)

[1] – Class III Marine
[2] Moccasin Creek Tidal (WBID 1530) was placed on the 1998 303(d) list for fecal coliform and dissolved oxygen, with a TMDL priority of low and due date of 2008.

WBID	Waterbody Segment	Waterbody Type	Waterbody Class	1998 303(d) Parameters of Concern	Parameter Causing Impairment	Priority for TMDL Development
1530	Moccasin Creek Tidal	Estuary	IIIM[1]	Coliform[2]	Fecal Coliform	Low
1530	Moccasin Creek Tidal	Estuary	IIIM[1]	Dissolved Oxygen[2]	Dissolved Oxygen	Low

Table 2.2. Summary of Fecal Coliform Data for Moccasin Creek Tidal (WBID 1530) During the Verified Period (January 1, 2000–June 30, 2007)

[1] Exceedances represent values above 400 counts/100mL.
[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]
1530	15	5	9	6	4	800	510	30	4,000

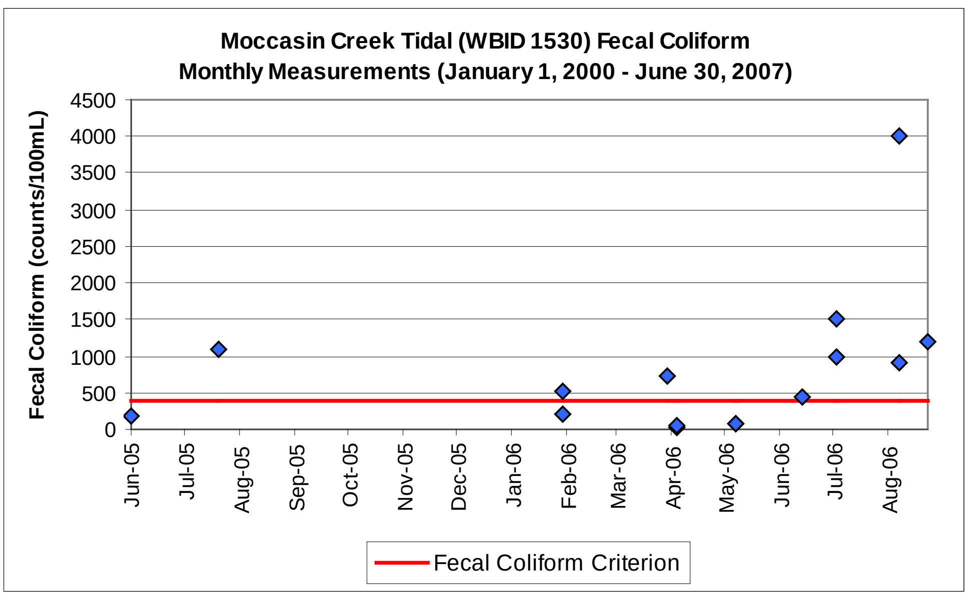


Figure 2.1. Fecal Coliform Measurements for Moccasin Creek Tidal (WBID 1530) During the Verified Period (January 1, 2000–June 30, 2007)

Chapter 3. DESCRIPTION OF APPLICABLE WATER QUALITY STANDARDS AND TARGETS

3.1 Classification of the Waterbody and Criteria Applicable to the 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)**

Moccasin Creek Tidal is a Class III waterbody, with a designated use of recreation, propagation, and the maintenance of a healthy, well-balanced population of fish and wildlife. The criterion applicable to this TMDL is the Class III criterion 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 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.*

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 TMDL (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 criterion selected for the TMD was not to exceed 400 MPN/100mL 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 TMDL 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 Moccasin Creek Tidal Watershed

4.2.1 Point Sources

There are no NPDES-permitted facilities discharging fecal coliform bacteria directly or indirectly into Moccasin Creek Tidal.

Municipal Separate Storm Sewer System Permittees

The stormwater collection systems owned and operated by Pinellas County and co-permittees (Florida Department of Transportation [FDOT] District 7 and City of Oldsmar) are covered by a Phase I NPDES municipal separate storm sewer system (MS4) permit (FLS000005). There are no Phase II MS4 permits identified for Moccasin Creek Tidal.

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 Moccasin Creek Tidal watershed. 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. There is no agricultural land in the Moccasin Creek Tidal 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 **Table 4.1. Figure 4.1** shows the acreage of the principal land uses in the watershed.

As shown in **Table 4.1,** the Moccasin Creek Tidal watershed drains about 573 acres of land. The dominant land use category is urban land (urban and built-up; medium- and high-density residential; and transportation, communication, and utilities), which accounts for 82 percent of the watershed's total area. Natural land uses, which include water/wetlands, occupy about 17 percent of the total watershed area.

Table 4.1. Classification of Land Use Categories for the Moccasin Creek Tidal Watershed (WBID 1530)

- = Empty cell

Level 1 Code	Land Use	Acreage	% Acreage
1000	Urban and Built-Up	126	21.99%
1200	Medium-Residential Density	79	13.79%
1300	High-Residential Density	243	42.41%
3000	Rangeland	4	0.70%
5000	Water	56	9.77%
6000	Wetlands	41	7.16%
8000	Transportation, Communication, and Utilities	24	4.19%
-	**Total:**	**573**	**100.00%**

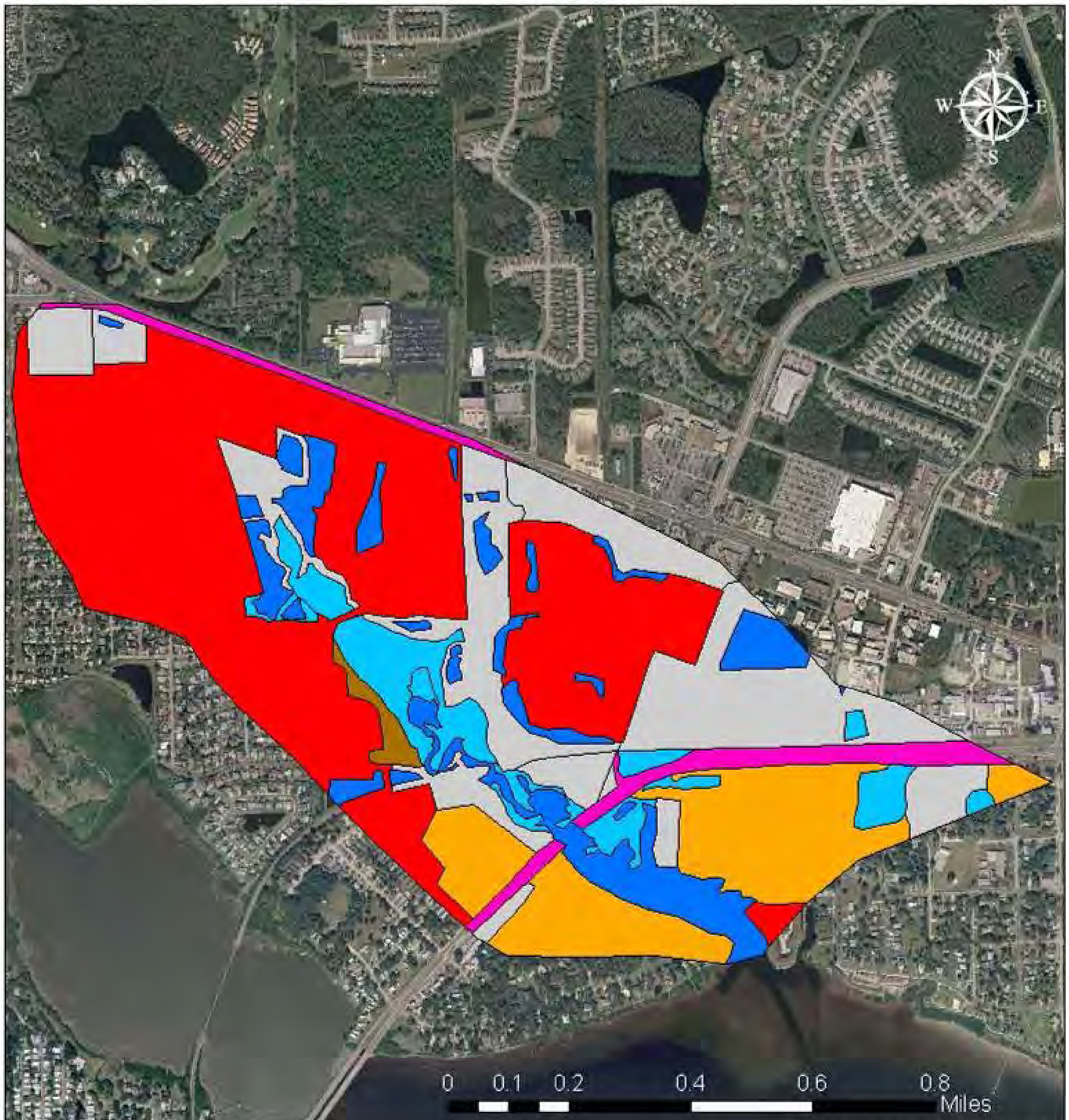
Urban Development

Pets (especially dogs) could be a significant source of coliform pollution through surface runoff in the Moccasin Creek Tidal watershed. 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.



Level 1 Code	Landuse	Acreage	% Acreage
1000	Urban and Built-Up	126	21.99
1200	Medium-residential density	79	13.79
1300	High-residential density	243	42.41
3000	Rangeland	4	0.70
5000	Water	56	9.77
6000	Wetlands	41	7.16
8000	Transportation, Communication, & Utilities	24	4.19
	Total	573	100.00

Figure 4.1. Principal Land Uses in the Moccasin Creek Tidal Watershed (WBID 1530) 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 Moccasin Creek Tidal watershed 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 Moccasin Creek Tidal watershed calculated from the census track using Tiger Track 2000 data (the Department's GIS library) was approximately 2,555. According to the U.S. Census Bureau (2005–07: 3-year estimates), there were 2.19 people per household in Pinellas County. This results in an estimated 1,167 households in the Moccasin Creek Tidal watershed. Assuming that 40 percent of the households in this area have 1 dog, the total number of dogs in the Moccasin Creek Tidal watershed is about 533.

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 in the Moccasin Creek Tidal watershed is 2.11×10^{11} counts/day.

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/grams)
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 the watershed can be made using **Equation 4.1**:

$$L = 37.85 * N * Q * C * F \qquad \textbf{Equation 4.1}$$

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), there was only 1 housing unit (*N*) identified as being on a septic tank in the Moccasin Creek Tidal watershed, (**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 Pinellas County is about 2.19 people/household. The same population density was assumed for the Moccasin Creek Tidal watershed. 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).

No measured septic tank failure rate data were available for the watershed when this TMDL analysis was conducted. Therefore, the failure rate was derived from the number of septic tank and septic tank repair permits for Pinellas 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. The reported number of septic tank repair permits was also obtained from the FDOH Website.

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 Pinellas County is about 0.69 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 3.5 percent. Based on **Equation 4.1**, the estimated fecal coliform loading from failed septic tanks in the Moccasin Creek Tidal watershed is approximately 2.03×10^8 counts/day.

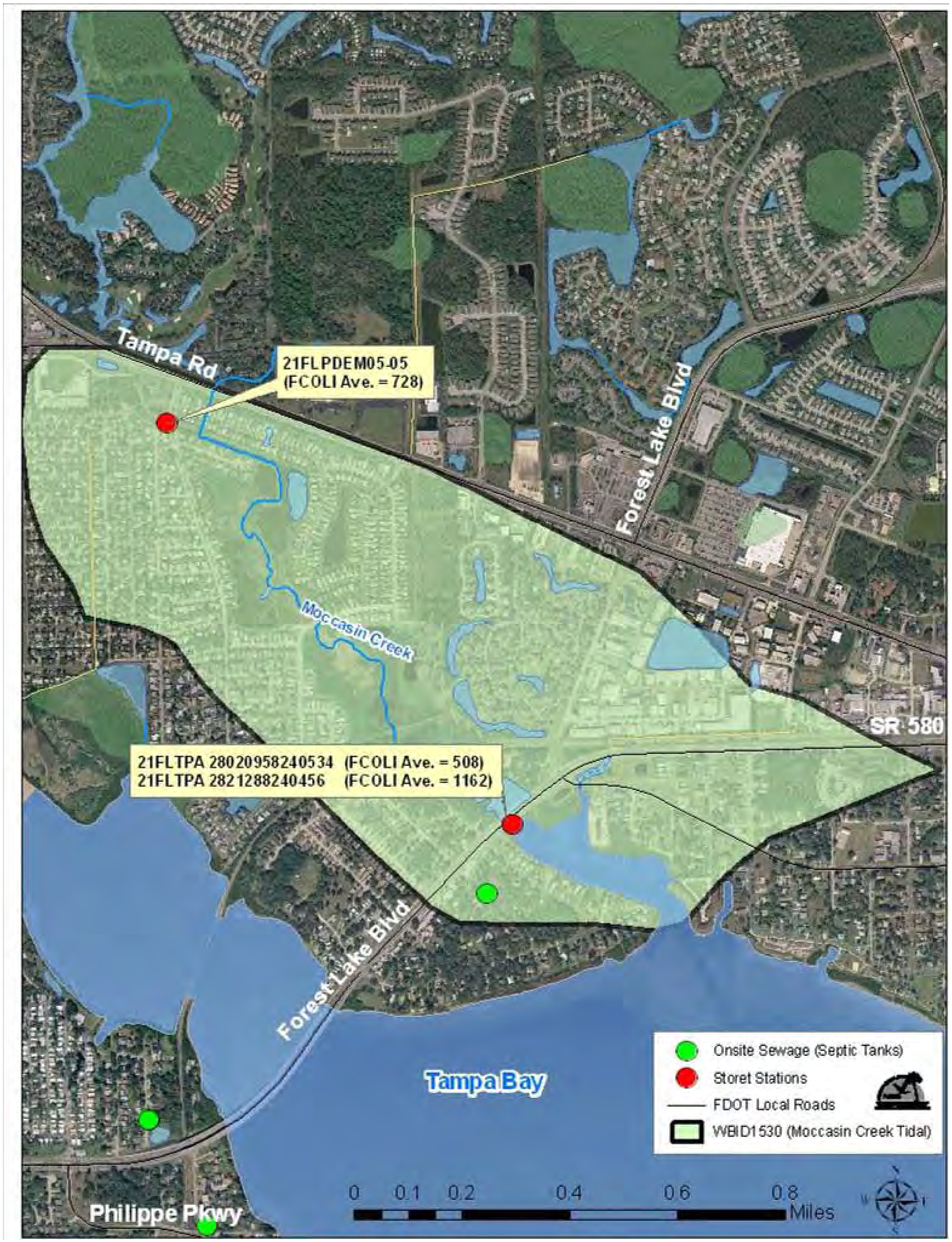


Figure 4.2. Distribution of Onsite Sewage Systems (Septic Tanks) in the Moccasin Creek Tidal Watershed (WBID 1530)

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

- = Empty cell
* The failure rate is 5 times the failure discovery rate.

-	2002	2003	2004	2005	2006	2007	Average
New installation (septic tanks)	54	47	43	43	36	34	43
Accumulated installation (septic tanks)	23,578	23,632	23,679	23,722	23,765	23,801	23,696
Repair permit (septic tanks)	141	193	168	180	149	150	164
Failure discovery rate (%)	0.60%	0.82%	0.71%	0.76%	0.63%	0.63%	0.69%
Failure rate (%)*	3.0%	4.1%	3.5%	3.8%	3.1%	3.2%	3.5%

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 Moccasin Creek Tidal watershed 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 Moccasin Creek Tidal watershed that use the sewer line is 1,166 (total households minus septic tank households). The discharge rate through the sewer line from each household (*Q*) was calculated by multiplying the average household size (2.19 people) by the per capita wastewater production rate per day (70 gallons). The commonly cited concentration (*C*) for domestic wastewater is 1×10^6 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 Moccasin Creek Tidal watershed is about 3.38×10^{10} counts/day.

There is only one septic tank reported in the Moccasin Creek Tidal waterbody, as shown in **Figure 4.2**; therefore, the Department does not believe that septic tanks significantly affect fecal coliform counts in this waterbody.

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 (wildlife, for example, is missing) 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 Moccasin Creek Tidal.

Table 4.5. Summary of Estimated Fecal Coliform Loadings from Dogs, Septic Tanks, and SSOs in the Moccasin Creek Tidal Watershed (WBID 1530)

Waterbody	Dogs (counts/day)	Septic Tanks (counts/day)	SSOs (counts/day)
Moccasin Creek Tidal	2.11 x 1011	2.03 x 108	3.38 x 1010

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Determination of Loading Capacity

The fecal coliform TMDL calculation was developed using the "percent reduction" approach. 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 for this TMDL report were provided by Pinellas County (Station: 21FLPDEM05-05) and the Department's Southwest District (Stations: 21FLTPA 28020958240534 and 21FLTPA 2821288240456) (**Table 5.1**). **Figure 5.1** shows the locations of the water quality sites from which fecal coliform data were collected. **Figure 2.1** displays the data used in this analysis. Station 21FLPDEM05-05 (5 fecal samples) was recently assigned to Moccasin Creek Tidal due to its proximity to the WBID.

5.1.1 TMDL Development Process for Moccasin Creek Tidal

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**:

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

The fecal coliform TMDL for Moccasin Creek Tidal was calculated as the median of the percent reductions needed over the data range where exceedances occurred (see **Table 5.2**) for data. As noted in the next section, exceedances occurred throughout the data period for Moccasin Creek Tidal, and the median percent reduction for this period was 60 percent.

5.1.2 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.

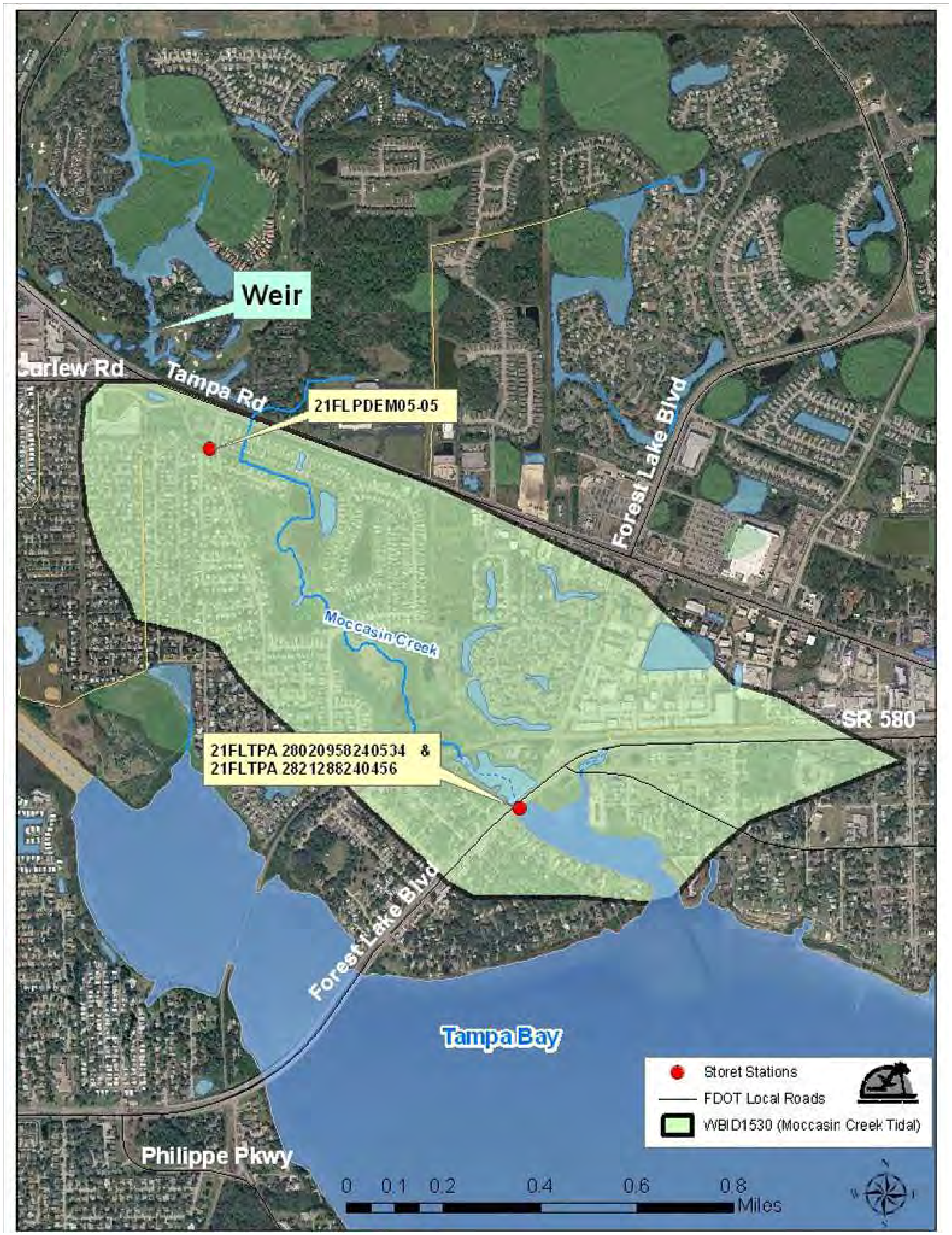


Figure 5.1. Locations of Water Quality Stations in Moccasin Creek Tidal (WBID 1530)

Table 5.1. Fecal Coliform Data for Moccasin Creek Tidal (WBID 1530)

Station	Date	Fecal Coliform (counts/100mL)
21FLTPA 2821288240456	4/18/2006	30
21FLTPA 2821288240456	5/22/2006	70
21FLTPA 2821288240456	2/13/2006	210
21FLTPA 2821288240456	7/17/2006	1,500
21FLTPA 2821288240456	8/21/2006	4,000
21FLTPA 28020958240534	4/18/2006	60
21FLTPA 28020958240534	5/22/2006	70
21FLTPA 28020958240534	2/13/2006	510
21FLTPA 28020958240534	8/21/2006	900
21FLTPA 28020958240534	7/17/2006	1,000
21FLPDEM05-05	6/16/2005	180
21FLPDEM05-05	6/28/2006	440
21FLPDEM05-05	4/13/2006	720
21FLPDEM05-05	8/4/2005	1,100
21FLPDEM05-05	9/6/2006	1,200

Table 5.2. Calculation of Percent Reduction in Fecal Coliform Necessary To Meet the Water Quality Standard of 400 Colonies/100mL in Moccasin Creek Tidal (WBID 1530)

- = Empty cell

Station	Date	Fecal Coliform Exceedances (#/100mL)	Fecal Coliform Target (#/100mL)	% Reduction
21FLTPA 2821288240456	8/21/2006	4,000	400	90.00%
21FLTPA 2821288240456	7/17/2006	1,500	400	73.33%
21FLPDEM05-05	9/6/2006	1,200	400	66.67%
21FLPDEM05-05	8/4/2005	1,100	400	63.64%
21FLTPA 28020958240534	7/17/2006	1,000	400	60.00%
21FLTPA 28020958240534	8/21/2006	900	400	55.56%
21FLPDEM05-05	4/13/2006	720	400	44.44%
21FLTPA 28020958240534	2/13/2006	510	400	21.57%
21FLPDEM05-05	6/28/2006	440	400	9.09%
-	-	-	**Median:**	**60.00%**

For Moccasin Creek Tidal, rainfall data were compared with the measured fecal coliform data. Measurements were sorted by month and season (the calendar year was divided into quarters) to determine whether there was a temporal pattern of exceedances. The analysis also included monthly rainfall data from Tarpon Springs Sewage Plant (088824). **Tables 5.3a** and **5.3b** present summary statistics by month and season, respectively, for fecal coliform measurements (*Winter*: January–March; *Spring*: April–June; *Summer*: July–September; *Fall*: October–December). There were no fecal coliform samples collected during the fall (October–December) and no data collected during January and March; therefore, it is difficult to determine any critical seasonal trends for the fecal coliform data. This being the case, fecal coliform increased slightly during the summer (see **Figure 5.2**), suggesting surface runoff from increased rainfall.

Table 5.3a. Summary Statistics of Fecal Coliform Data for Moccasin Creek Tidal (WBID 1530) by Month, 2000–07

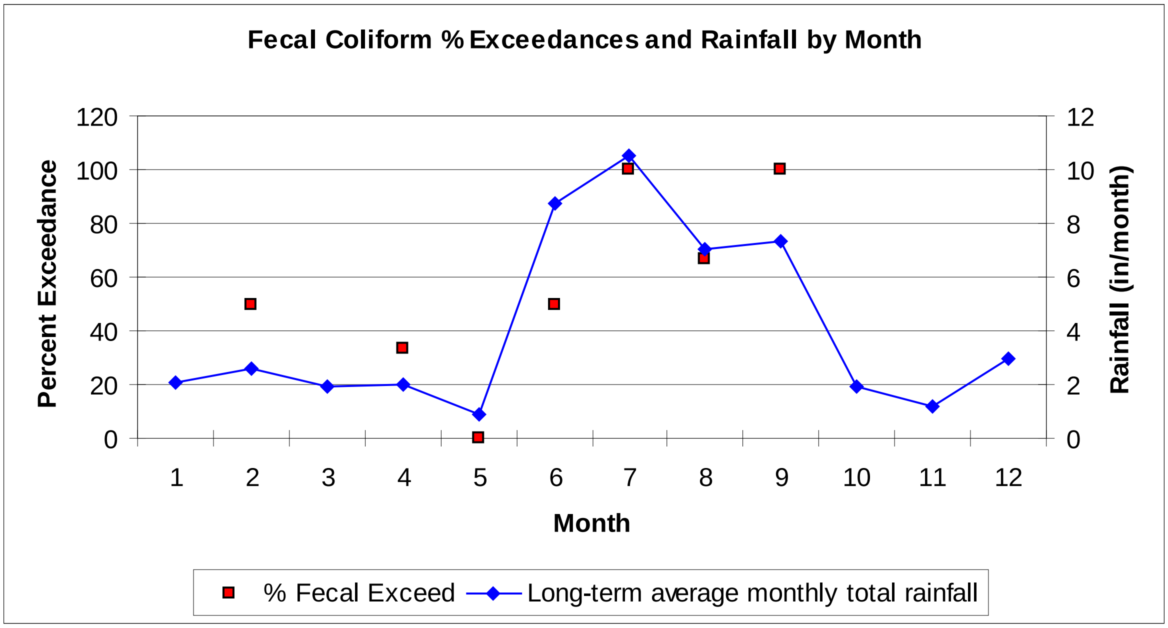
- = Empty cell/no data
[1] Coliform counts are #/100mL.
[2] Exceedances represent values above 400 counts/100mL.

Month	Number of Cases	Minimum[1]	Maximum[1]	Median[1]	Mean[1]	Number of Exceedances[2]	% Exceedances of Cases	Rainfall Mean (inches)
1	-	-	-	-	-	-	-	2.04
2	2	210	510	360	360	1	50.00%	2.6
3	-	-	-	-	-	-	-	1.9
4	3	30	720	45	270	1	33.33%	2.01
5	2	70	70	70	70	0	0.00%	0.87
6	2	180	440	310	310	1	50.00%	8.77
7	2	1,000	1,500	1,250	1,250	2	100.00%	10.53
8	3	1,100	4,000	1,100	2,550	2	66.67%	7.03
9	1	1,200	1,200	1,200	1,200	1	100.00%	7.3
10	-	-	-	-	-	-	-	1.9
11	-	-	-	-	-	-	-	1.22
12	-	-	-	-	-	-	-	2.94

Table 5.3b. Summary Statistics of Fecal Coliform Data for Moccasin Creek Tidal, WBID 1530, by Season, 2000–07

- = Empty cell/no data
[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	2	210	510	360	360	1	50.00%	6.54
2	7	30	720	70	217	2	27.78%	11.65
3	6	1,000	4,000	1,200	1,667	5	88.89%	24.86
4	-	-	-	-	-	-	-	6.06



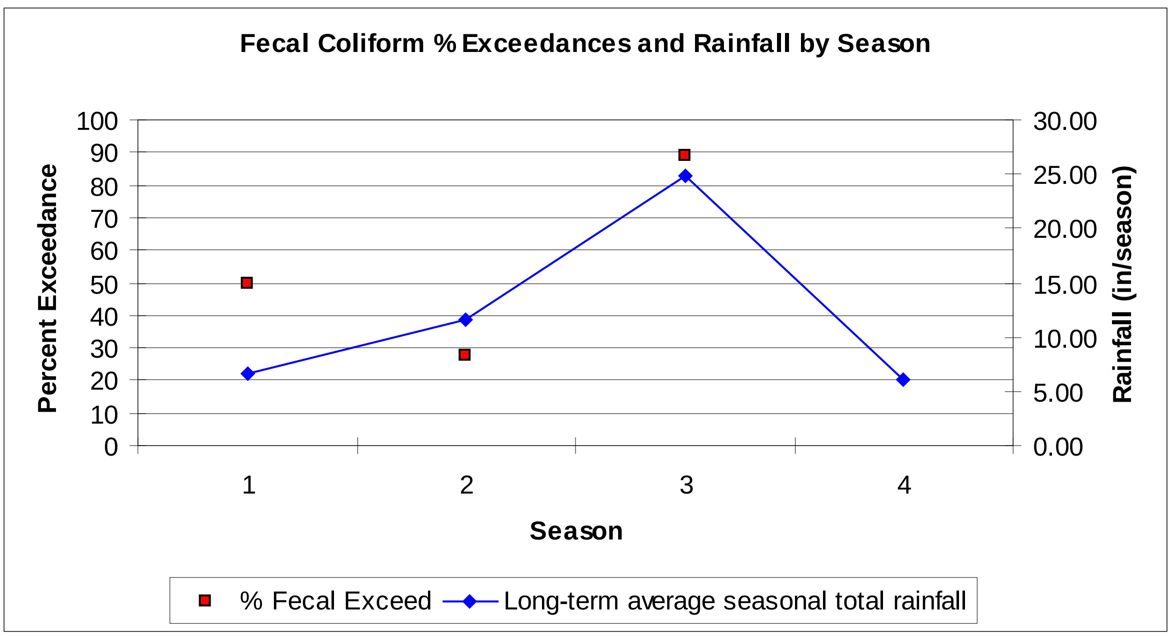


Figure 5.2. Fecal Coliform Exceedances and Rainfall for Moccasin Creek Tidal (WBID 1530) by Month and Season, 2000–07

5.1.3 Spatial Patterns

There were three water quality stations (21FLPDEM05-05, 21FLTPA 28020958240534, and 21FLTPA 2821288240456) for which the Department spatially analyzed the fecal coliform data (**Figure 5.1**). Stations 21FLTPA 28020958240534 and 21FLTPA 2821288240456 are at the same location; thus these two stations were spatially compared with Station 21FLPDEM05-05. Overall, there was no spatial correlation using the fecal coliform data. **Table 5.4** summarizes the fecal coliform data for each station.

Table 5.4. Station Summary Statistics of Fecal Coliform Data for Moccasin Creek Tidal (WBID 1530)

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

Station	Average[1]	# Samples	# Exceedances[2]	Minimum[1]	Maximum[1]
21FLPDEM05-05	728	5	4	180	1,200
21FLTPA 28020958240534	508	5	3	60	1,000
21FLTPA 2821288240456	1,162	5	2	30	4,000

5.1.4 Discussion

The fecal coliform data collected at Station 21FLPDEM05-05 were only sampled when water was flowing from the upstream lake portion of Moccasin Creek (WBID 1530A) into Moccasin Creek Tidal (WBID 1530). Further, no fecal coliform data were collected during conditions of no flow (estuarine influence), making it difficult to analyze potential seasonal and hydrologic patterns in the data. For analysis purposes only, the Department calculated a percent reduction for the upstream and downstream stations separately, to see if the freshwater and estuarine conditions produced dramatically different percent reductions. The results show that Station 21FLPDEM05-05 (upstream) and Stations 21FLTPA 28020958240534 and 21FLTPA 2821288240456 (downstream) showed similar reductions of 54 and 60 percent, respectively; thus no major difference was found between the two hydrologic conditions. For TMDL purposes, as mentioned in the previous section and shown in **Table 6.1**, all exceedances (from all the stations) were used to calculate the percent reduction for Moccasin Creek Tidal.

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 TMDL for Moccasin Creek Tidal is expressed in terms of a percent reduction; this TMDL represents the maximum daily fecal coliform load the estuary can assimilate and maintain the fecal coliform criterion (**Table 6.1**).

Table 6.1. TMDL Components for Fecal Coliform in Moccasin Creek Tidal (WBID 1530)

N/A – Not applicable.

WBID	Parameter	TMDL (counts/100 mL)	Wasteload Allocation for Wastewater (counts/day)	Wasteload Allocation for NPDES Stormwater (% reduction)	LA (% reduction)	MOS
1530	Fecal Coliform	400#/100mL	N/A	60	60	Implicit

6.2 Load Allocation

A fecal coliform reduction of 60 percent for Moccasin Creek Tidal (WBID 1530) is needed from nonpoint sources. 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

No NPDES-permitted wastewater facilities with fecal coliform limits were identified in Moccasin Creek Tidal. The state already requires all NPDES point source dischargers to meet bacteria criteria at the end of the pipe. It is the Department's current practice not to allow mixing zones for bacteria. Any point sources that may discharge in the watershed in the future will also be required to meet end-of-pipe standards for coliform bacteria.

6.3.2 NPDES Stormwater Discharges

The WLA for stormwater discharges with an MS4 permit is a 60 percent reduction in current fecal coliform for Moccasin Creek Tidal. 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.

Cleland, B. 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.

———. November 2001. *Basin Status Report: Tampa Bay Basin.* Tallahassee, FL: Bureau of Watershed Management.

———. Septermber 2003. *Water Quality Assessment Report: Tampa Bay Basin.* Tallahassee, FL: Bureau of Watershed Management.

Florida Department of Health Website. 2008. *Onsite sewage programs statistical data.* 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. Washington, DC: 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.

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