FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Water Resource Management, Bureau of Watershed Management

SOUTHWEST DISTRICT • SARASOTA BAY–PEACE–MYAKKA BASINS

TMDL Report

Fecal Coliform TMDL for the Peace River above Bowlegs Creek, WBID 1623J

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Contents

List of Tables

List of Figures

Web sites

Florida Department of Environmental Protection, Bureau of Watershed Management

Total Maximum Daily Load (TMDL) Program

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

Identification of Impaired Surface Waters Rule

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

Florida STORET Program

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

2006 305(b) Report

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

Water Quality Status and Assessment Reports for the Sarasota Bay–Peace–Myakka Basins

http://www.dep.state.fl.us/water/basin411/groups/group3.htm

Allocation Technical Advisory Committee (ATAC) Report

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

U.S. Environmental Protection Agency, National STORET Program

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 Peace River above Bowlegs Creek, which is located in the Upper Peace River Planning Unit, which in turn is part of the larger Sarasota Bay–Peace–Myakka Basins. The stream was verified as impaired for fecal coliform bacteria, and was included on the Verified List of impaired waters for the Sarasota Bay–Peace–Myakka Basins that was adopted by Secretarial Order in June 2005. The TMDL establishes the allowable loadings to Peace River above Bowlegs Creek that would restore the waterbody so that it meets its applicable water quality criteria for fecal coliform bacteria.

1.2 Identification of Waterbody

The Peace River above Bowlegs Creek waterbody segment is located within the Upper Peace River Basin, in central Polk County, Florida, at the headwaters of Lake Hancock. It receives drainage from the Saddle Creek and Peace Creek Canal sub-basins located upstream. These sub-basins have a combined drainage area of 373 square miles. The adjacent land area draining directly to the river segment is 39 square miles **(Figure 1.1).** The Peace River watershed has a total surface area of 2,350 square miles. Ninety percent of the watershed lies within Polk, Hardee, DeSoto, and Charlotte Counties, and the remainder is within Lee, Highlands, Manatee, Hillsborough, Glades, and Sarasota Counties.

The river is free flowing over its entire reach and flows generally southward for about 75 miles (through Polk, Hardee, DeSoto, and Charlotte Counties), discharging into the northeastern portion of Charlotte Harbor near the town of Punta Gorda. Two tributaries have regulated flows, including a control structure (P-11) on Saddle Creek south of Lake Hancock and a dam at the city of Punta Gorda's water supply reservoir on Shell Creek. Water withdrawals are made at the Peace River/Manasota Regional Water Supply Authority water plant south of Arcadia.

Land use in the watershed is predominantly agricultural, mainly pasture and citrus cultivation. Major urban areas include Lakeland, Auburndale, Haines City, Winter Haven, and Bartow to the north, as well as unincorporated Port Charlotte and Cape Coral at the southern end. Other population centers, situated along the middle reaches of the Peace River, include Fort Meade, Zolfo Springs, Bowling Green, and Arcadia. In 2000, the population of the watershed was about 366,000 people. By 2020, that number is projected to increase to approximately 480,000. Additional information about the river's hydrology and geology are available in the Basin Status Report for the Sarasota Bay–Peace–Myakka Basins (Florida Department of Environmental Protection [Department], June 2003).

For assessment purposes, the Department divided the Upper Peace River Basin into water assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each water segment or stream reach. The Peace River above Bowlegs Creek is WBID 1623J **(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).

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 the Peace River above Bowlegs Creek. 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.

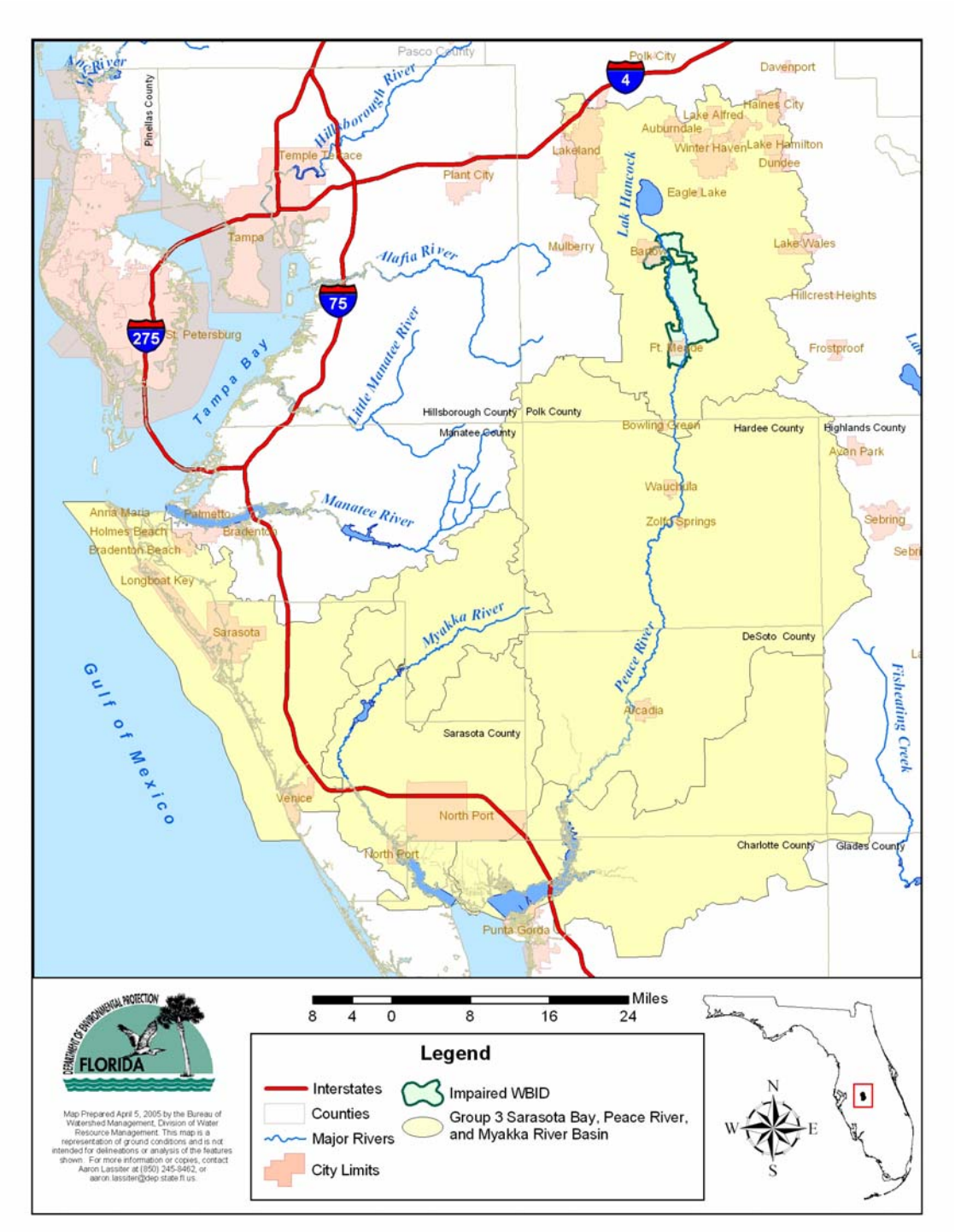

Figure 1.1. Peace River above Bowlegs Creek, WBID 1623J, and Major Geopolitical Features in the Sarasota Bay–Peace–Myakka Basins

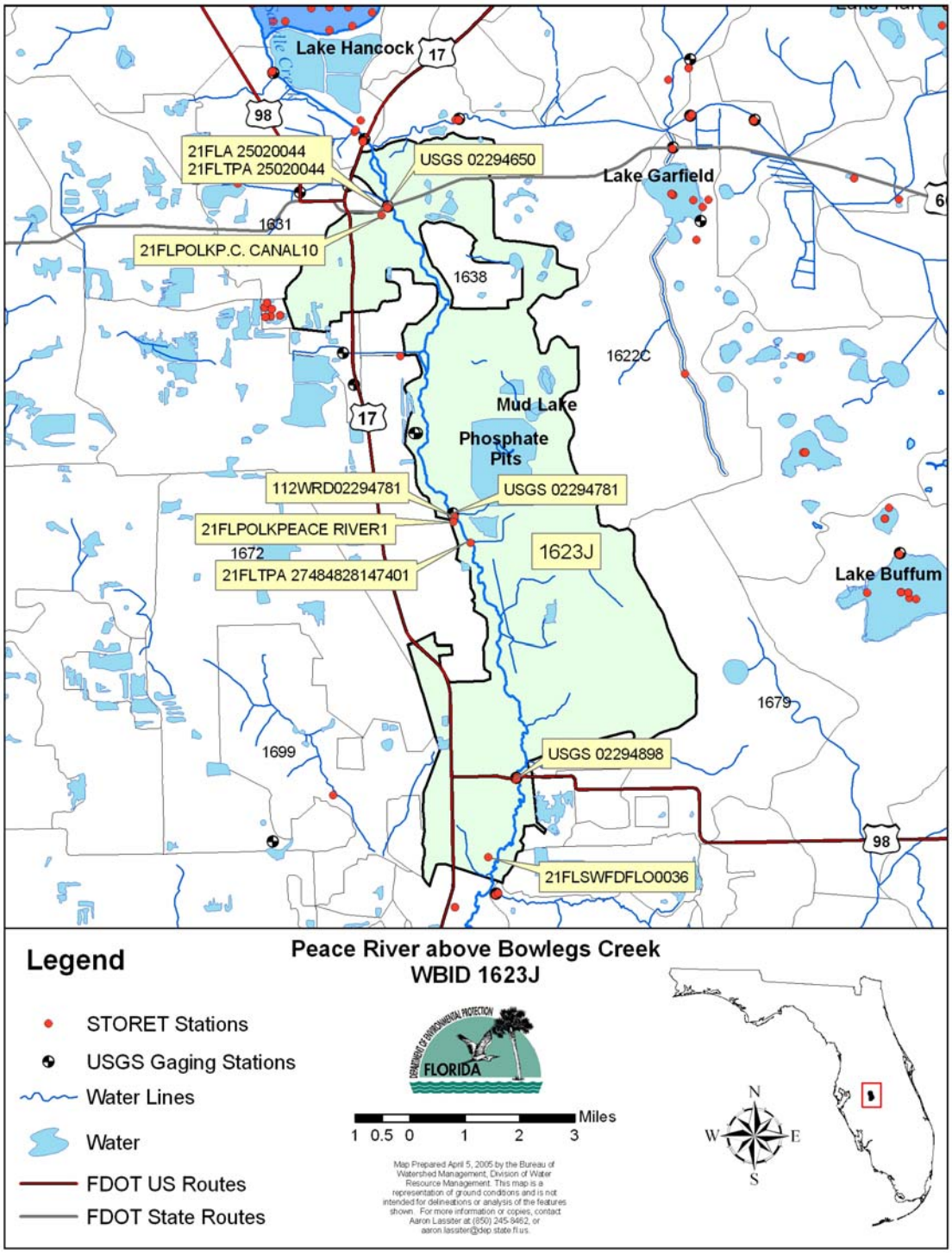

Figure 1.2. Peace River above Bowlegs Creek, WBID 1623J, and Monitoring Locations

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 84 waterbodies in the Sarasota Bay–Peace–Myakka Basins. 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.

2.2 Information on Verified Impairment

The Department used the IWR to assess water quality impairments in the Peace River above Bowlegs Creek and verified the impairments for fecal coliform **(Table 2.1). Table 2.2** summarizes the data collected during the verification period (January 1, 1997, to June 30, 2004). The segment was verified as impaired for fecal coliform because more than 10 percent of values exceeded the Class III freshwater criterion of 400 counts per 100 milliliters (counts/100mL) for fecal coliform (7 out of 32 samples in the verified period exceeded the criteria of 400 counts/100mL).

The verified impairments were based on data collected mainly by the Polk County Natural Resources Division and the Department. Polk County STORET stations include 21FLPOLKP.C. CANAL10 and 21FLPOLKPEACE RIVER1. The Department's stations include STORET Stations 21FLA 25020044 and 21FLTPA 27484828147401. The SWFWMD provided additional data for Station 21FLSWFDFLO0036. **Figure 1.2** shows the locations of the sampling sites. **Figure 2.1** displays the fecal coliform data collected from 1992 through 2003, and **Appendix A** tabulates all available fecal coliform data for the impaired segment. Fecal coliform values exceeding the criteria of 400 counts/100mL during this period were used to develop the TMDL, as described in Chapter 5.

Table 2.1. Verified Impairment in the Peace River above Bowlegs Creek, WBID 1623J

Parameter Causing Impairment	Priority for TMDL Development	Projected Year for TMDL Development
Fecal Coliform	High	2004

*The TMDL was scheduled to be completed by December 31, 2004, 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 Peace River above Bowlegs Creek, WBID 1623J, January 1997–June 2004

Parameter Causing Impairment	Total Number of Samples	30-Day Geometric Mean	Percent Fecal Coliform Samples > 400 counts/100mL	Minimum Concentration (counts/100mL)	Maximum Concentration (counts/100mL)
Fecal Coliform	32	N/A	21.8	15	15,000

N/A – Not available.

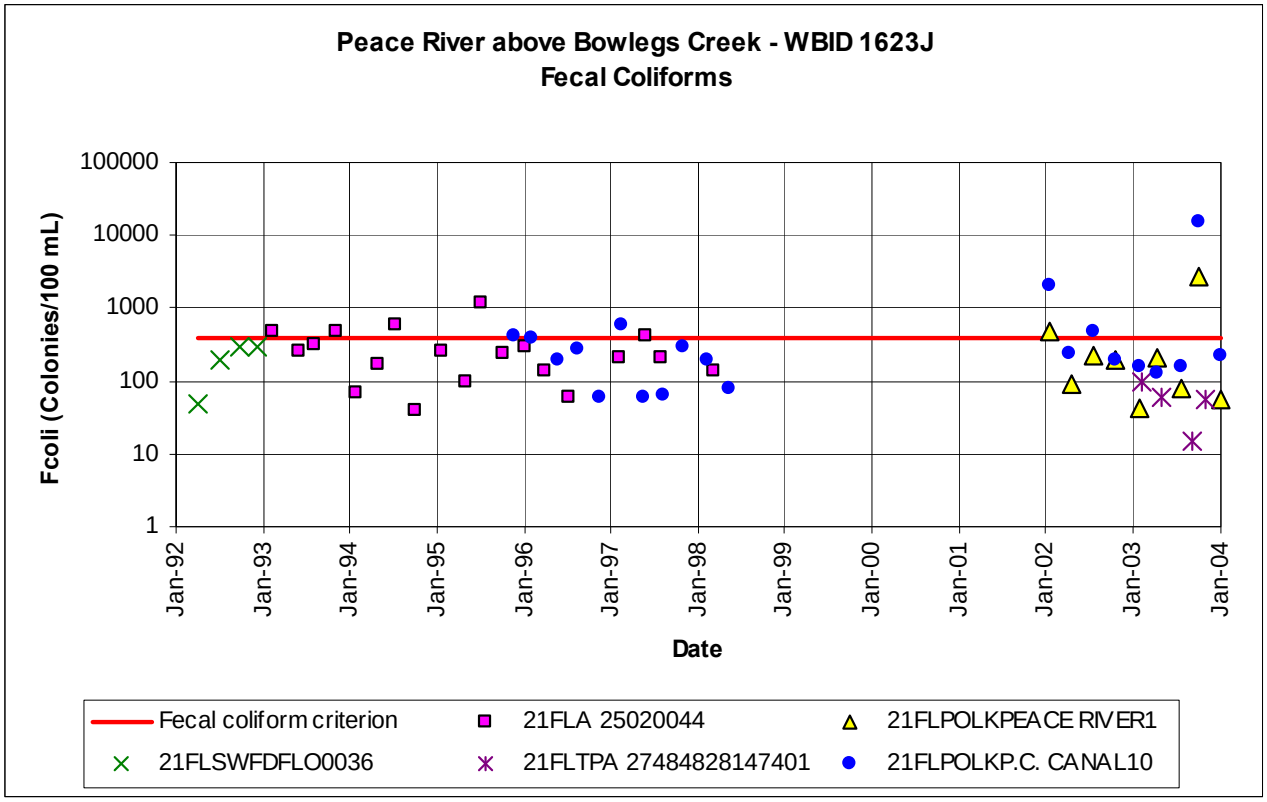

Figure 2.1. Fecal Coliform Measurements for the Peace River above Bowlegs Creek, WBID 1623J, January 1992–December 2003

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)**

The Peace River above Bowlegs Creek is a Class III waterbody, with a designated use of recreation, 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., is as follows:

> ***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 load curves for the impaired segment (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 watershed 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 Peace River above Bowlegs Creek, WBID 1623J

4.2.1 Point Sources

There are no permitted domestic WWTFs that discharge fecal coliform loads directly into the Peace River above Bowlegs Creek. One facility, the city of Winter Haven WWTP # 3 (Wahneta Plant) (NPDES No. FL0036048), discharges indirectly to the river. The facility, a 5.0-million-gallon-per-day (mgd) Type I WWTP, discharges to a 150-acre overland flow system, but the effluent is collected in an open ditch and discharged through D001 into an unnamed tributary of the Peace Creek Drainage Canal, which is a Class III freshwater body, and ultimately into the Peace River. The potential impacts from this discharge are examined and addressed in the fecal coliform TMDL for the Peace Creek Drainage Canal, WBID 1539.

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 I, promulgated in 1990, addresses large and medium-size MS4s located in incorporated areas and counties with populations of 100,000 or more. Phase II permitting began in 2003. Regulated Phase II MS4s, defined in Section 62-624.800, F.A.C., 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.

A Phase I MS4 permit covers the stormwater collection systems in the Peace River above Bowlegs Creek that are owned and operated by Polk County in conjunction with the Florida Department of Transportation (FDOT). Currently, no local governments in the watershed have applied for coverage under the Phase II NPDES MS4 permit.

The Peace River above Bowlegs Creek falls under the Polk County Phase I MS4 permit (No. FLS000015). The cities of Fort Meade and Bartow, as well as FDOT District 1, are copermittees, with portions of their jurisdictions located within the segment.

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.

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. **Table 4.1** contains livestock data from the 2002 *Agricultural Census Report* for Polk County (U.S. Department of Agriculture, 2002).

Land Uses

The spatial distribution and acreage of different land use categories were identified using the SWFWMD 1999 land use coverage (scale 1:40,000) contained in the Department's geographic information system (GIS) library. Land use categories in the Peace River above Bowlegs Creek were aggregated using the simplified Level 1 codes **(Table 4.2). Figure 4.1** shows the acreage of the principal land uses in this segment. The urban and built-up category predominates, covering 60.1 percent of the area. Seventy-six percent of the urban and built-up land consists

of mined areas associated with the phosphate-mining industry. The other significant land use is agriculture (18 percent), while natural land uses (water and wetlands) represent approximately 19.2 percent of the watershed.

Table 4.1. Livestock Distribution for Polk County

Livestock Distribution	Polk County (number of livestock)
Cattle/Calves	108,126
Milk cows	888
Hogs/Pigs	893
Poultry layers > 13 weeks	(D)
Poultry broilers	144
Sheep/Lambs	125
Horses	2,562

(D) – Data withheld to avoid disclosing data for individual farms.
Source: U.S. Department of Agriculture, 2002.

Table 4.2. Classification of Land Use Categories in the Peace River above Bowlegs Creek, WBID 1623J

Code	Land Use	Acreage	% of Total
1000	Urban Open	12,514	49.95%
1100	Residential Low Density (< 2 Dwelling Units/Acre)	274	1.09%
1200	Residential Medium Density (2-5 Dwelling Units/Acre)	2,137	8.53%
1300	Residential High Density (6 or more Dwelling Units/Acre)	136	0.54%
2000	Agriculture	4,498	17.95%
3000	Rangeland	4	0.02%
4000	Upland Forests	517	2.06%
5000	Water	634	2.53%
6000	Wetlands	4,187	16.71%
7000	Barren Land	29	0.12%
8000	Transportation, Communication, and Utilities	122	0.49%
	TOTAL:	**25,052**	**100.00%**

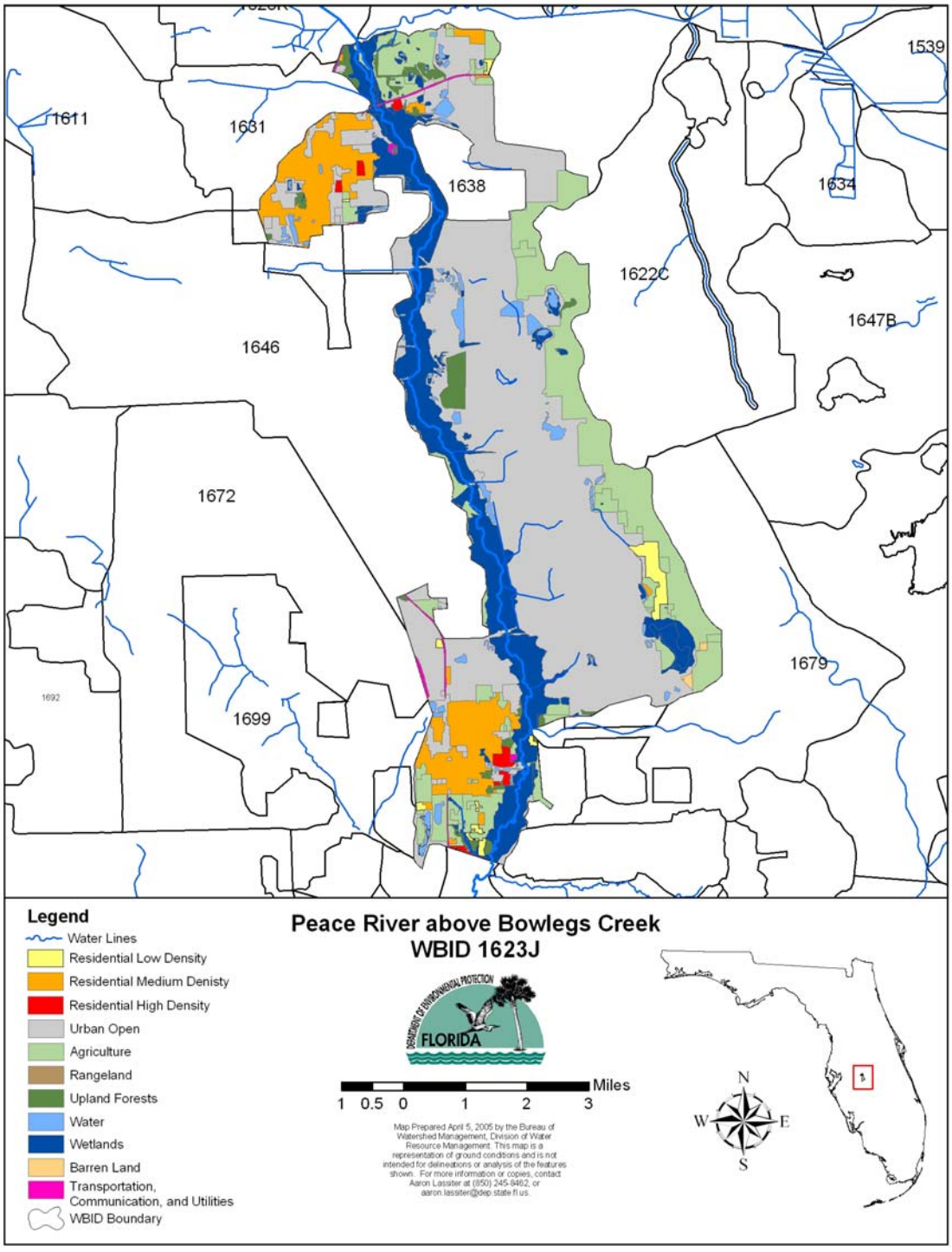

Figure 4.1. Principal Land Uses in the Peace River above Bowlegs Creek, WBID 1623J, in 1999

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 10 percent of the land area in the watershed is residential, it is possible that pets, especially dogs, are affecting the Peace River above Bowlegs Creek. The Department has been unable to obtain data on the number of dogs in the area; however, estimates can be made **(Table 4.3)** using household-to-dog ratio estimates from the American Veterinary Medical Association (AVMA). Assuming that 10 percent of coliforms reach the waterbody and are viable upon reaching it, the approximate loading would be 7.55×10^{11} organisms/day. This is an estimate, as the actual loading from dogs is not known.

Table 4.3. Estimated Coliform Loading from Dogs in the Peace River above Bowlegs Creek, WBID 1623J

Pet	Estimated Number of Households in 1580	Estimated Household: Pet Ratio[1]	Estimated Total Dog Population in Watershed	Estimated Loading of Total	Estimated Number of Pets with Impact to Canal	Estimated Counts/Pet/Day[2]	Estimated Counts/Day
Dogs	4,174	0.361	1507	10%	151	5E+9	7.55E+11

[1] From the AVMA Web site, which states the original source as the *U.S Pet Ownership and Demographics Sourcebook,* 2002.
[2] From the EPA document, *Protocol for Developing Pathogen TMDLs*, January 2001.

Population

According to the U.S. Census Bureau, the population density in Polk County in the year 2000 was at or less than 258.2 people per square mile **(Table 4.4).** The Census Bureau reports that the total population in 2000 for Polk County, which includes (but is not exclusive to) WBID 1623J, was 483,924, with 226,376 housing units. For all of Polk County, the bureau reported a housing density of 120.8 houses per square mile. Polk County is just below the average housing density of Florida of 134.3 housing units per square mile (U.S. Census Bureau Web site, 2005). In the Peace River above Bowlegs Creek, the population density is between 235 and 427 people per square mile **(Figure 4.2)**.

Table 4.4. Population Density in Polk County, Florida, in 2000

Persons per Square Mile	Total Population	Houses per Square Mile	Housing Units
258.2	483,924	120.8	226,376

Source: U.S. Census Bureau Web site, 2005.

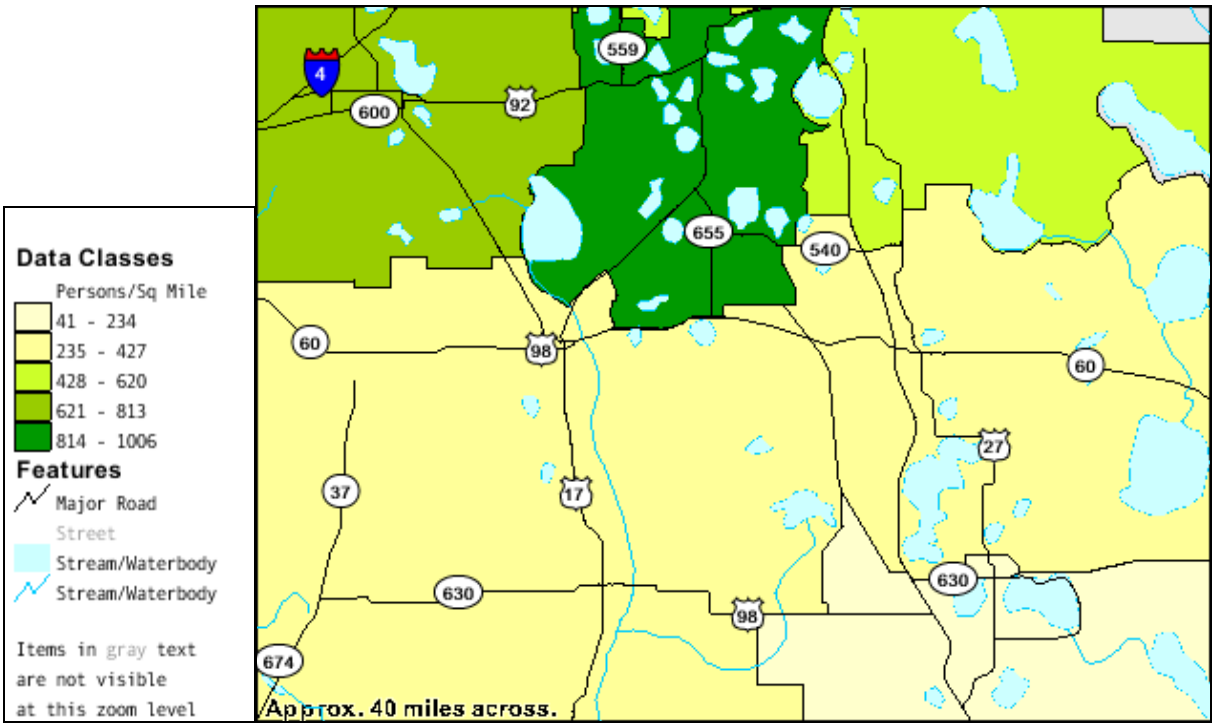

Figure 4.2. Population Density in the Area of the Peace River above Bowlegs Creek, WBID 1623J, in 2000

Septic Tanks

Data for septic tanks are based on the 1970 census results, with year-by-year additions based on new septic tank construction. The data do not reflect septic tanks that have been removed. Polk County has a cumulative registry of 112,848 septic tanks. With 226,376 households in the county, this means that approximately 50 percent of the residences in the county are connected to wastewater treatment plants, with the remaining (50 percent) using septic tanks (Florida Department of Health [FDOH] Web site, 2005).

Based on 2000 U.S. Census Bureau data, there are an estimated 354 persons per square mile in the WBID, or 11,175 in the area of the Peace River above Bowlegs Creek. The average household in this area has 2.7 persons **(Table 4.5).** According to the FDOH, there is an annual average of 1,256 repairs (fiscal years 1993–2004) in Polk County. Based on this, and assuming that the failures are spread evenly throughout the county, there are approximately 21 failures annually in the Peace River above Bowlegs Creek. Using 70 gallons/day/person (EPA, January 2001), a loading of 1.5 x 10^{11} colonies/day is derived. **Table 4.6** shows this estimation.

Table 4.5. Estimation of Average Household Size in the Peace River above Bowlegs Creek, WBID 1623J

Household Size	Number of Households	Percentage of Total	Number of People
1-person household	979	23.46%	979
2-person household	1,356	32.49%	2,712
3-person household	736	17.63%	2,208
4-person household	569	13.62%	2,276
5-person household	302	7.24%	1,510
6-person household	133	3.20%	798
7-or-more-person household	99	2.36%	691
TOTAL:	**4,174**	**100.00%**	**11,174**
		AVERAGE HOUSEHOLD SIZE:	**2.7**

Table 4.6. Estimation of Annual Fecal Coliform Loading from Failed Septic Tanks in the Peace River above Bowlegs Creek, WBID 1623J

Estimated Population Density and Area	WBID Area (mi^2)	Estimated Population in Segment	Estimated Number of Tank Failures[1]	Estimated Load From Failed Tank[2]	Gallons/ Person/ Day[2]	Estimated Number of Persons Per Household[3]	Estimated Load From Failing Tanks (Counts/Day)
354 persons per square mile in WBID 1623J	31.61	11,175	21.17	1.00E+4 mL	70	2.7	1.5E+11

[1] Based on septic tank repair permits issued in the waterbody segment from March 1990 to April 2004 (FDOH)–see text.
[2] From the EPA document, *Protocol for Developing Pathogen TMDLs,* January 2001.
[3] From the U.S Census Bureau; see **Table 4.5** for more information on this estimate.

Domestic Sludge

When domestic wastewater is treated, the solid material that accumulates in the wastewater treatment plant must be removed periodically to keep the plant operating properly. The collected material, called “residuals,” “biosolids,” or more commonly, “sewage sludge,” is the byproduct of these processes. The land application of sludge from domestic wastewater treatment facilities is a potential source of coliform bacteria loading to surrounding surface waters. There is one residual land application site in the area of the Peace River above Bowlegs Creek **(Figure 4.3).** The site, Averett Site 1, covers approximately 36 acres and its source WWTP is Averett RMF.

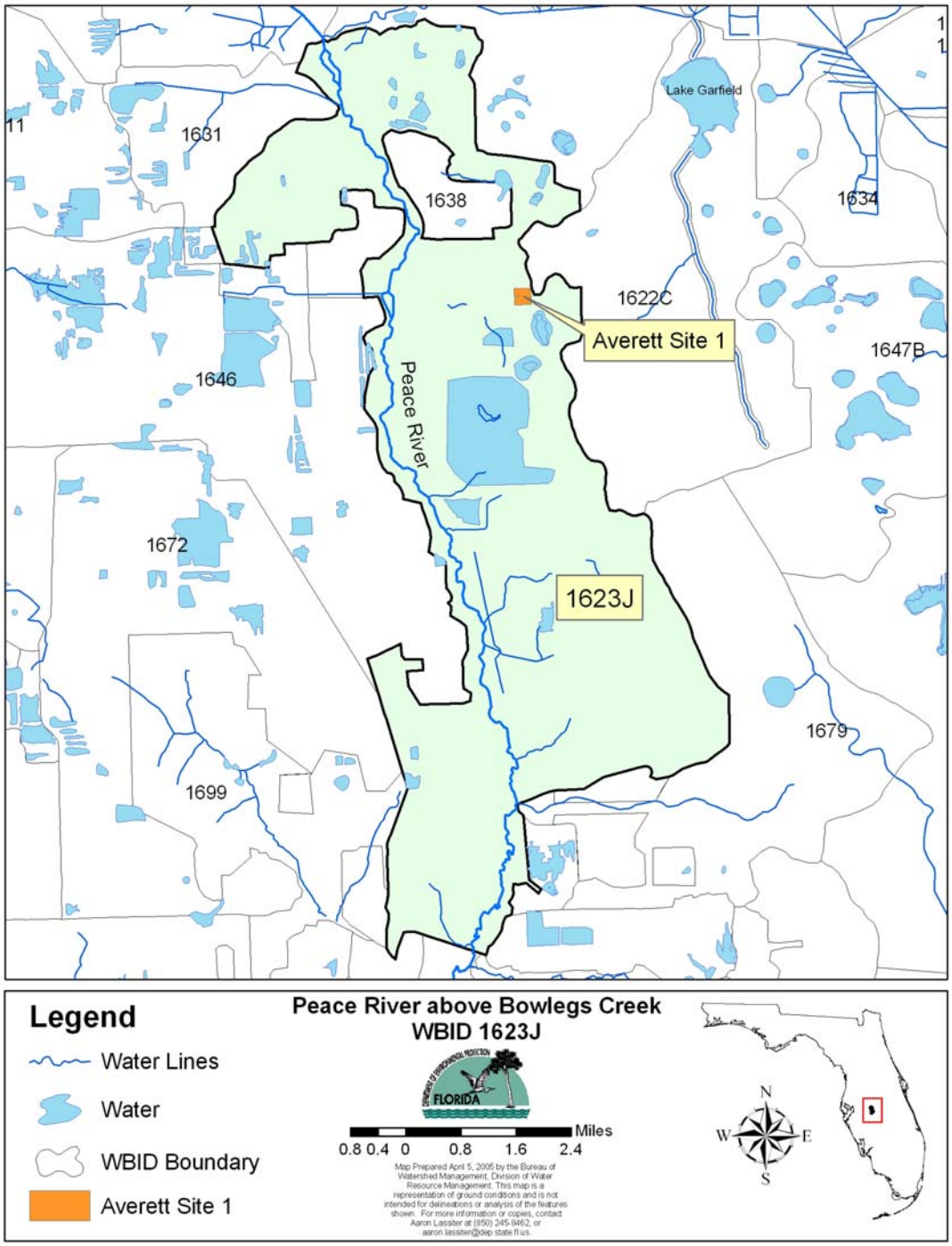

Figure 4.3. Domestic Sludge Application Sites in the Peace River above Bowlegs Creek, WBID 1623J

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Method Used To Determine Loading Capacity

The methodology used for this TMDL is the "load duration curve." Also known as the "Kansas Approach" because it was developed by the state of Kansas (Stiles, 2002), this method has been well documented in the literature, with improved modifications used by the EPA Region 4 (Davis, 2004). Basically, the method relates the pollutant concentration to the flow of the stream to establish the existing loading capacity and the allowable pollutant load (TMDL) under a spectrum of flow conditions. It then determines the maximum allowable pollutant load and load reduction requirement based on the analysis of the critical flow conditions. Using this method, it takes five steps to develop the TMDL and establish the required load reduction:

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

5.2 Data Used in the Determination of Loading Capacity

Fecal coliform bacteria concentrations and flow measurements were used to estimate both the allowable coliform loads and existing coliform loads. The primary collectors of water quality data in the watershed are the Polk County Natural Resources Division and the Department. Polk County STORET stations include 21FLPOLKP.C. CANAL10 and 21FLPOLKPEACE RIVER1. The Department's stations include STORET Stations 21FLA 25020044, and 21FLTPA 27484828147401. Additional data were collected at SWFWMD Station 21FLSWFDFLO0036. **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 used in this analysis, and **Appendix A** lists the water quality monitoring results for fecal coliform.

Flow measurements for TMDL development were obtained from a U.S. Geological Survey (USGS) gaging station located on the Peace River (USGS 02294650, Peace River at Bartow, Florida, Latitude 27°54'07", Longitude 81°49'03") **(Figure 1.2)**. The flow data from this gage were selected for this analysis because most of the fecal coliform data were collected at or near the gage site.

5.3 TMDL Development Process

The range of flows from the USGS flow gage was divided into "flow zones." The concept of zones is adopted from Dr. Bruce Cleland (Cleland, August 15, 2002). The purpose of the zones is to demarcate hydrologic conditions between drought and peak flood into flow ranges such as low, dry, average, moist, and high.

Expressing the flows in terms of frequency of recurrence (duration) allows exceedances of the criterion to be linked to specific flow intervals and durations. For example, if all of the exceedances occurred during low-flow conditions, point sources of the pollutant would be suspected. Conversely, if all the exceedances took place during higher-flow periods, then nonpoint sources of the pollutant would be suspected. Following Cleland's approach (Cleland, September 2003), the Department selected the following flow zones: "High" (0–10), "Moist" (11–40), "Mid-range" (41–60), "Dry" (61–90), and "Low" (91–100). **Figure 5.1** shows the flow duration curve for USGS Gage 02294650.

Using the flows from the flow duration curve, load duration curves for fecal coliform bacteria **(Figure 5.2)** were calculated using the following equation:

(1) (observed flow) x (conversion factor) x (state criteria) = ([parameter quantity]/day or daily load)

The equation above yields the load duration curve or allowable load curve, shown as the fecal coliform target line in **Figure 5.2.** Using Equation 1 (above), a table of fecal coliform loads **(Table 5.1)** was calculated, substituting the observed coliform exceedances for the state criterion value. All the fecal coliform observations were then plotted, and it was noted where the samples were in relation to the allowable load curve (above or below the curve). Those above the curve **(Figure 5.2)** are noted as exceedances to the state criterion and are indicated by a red square.

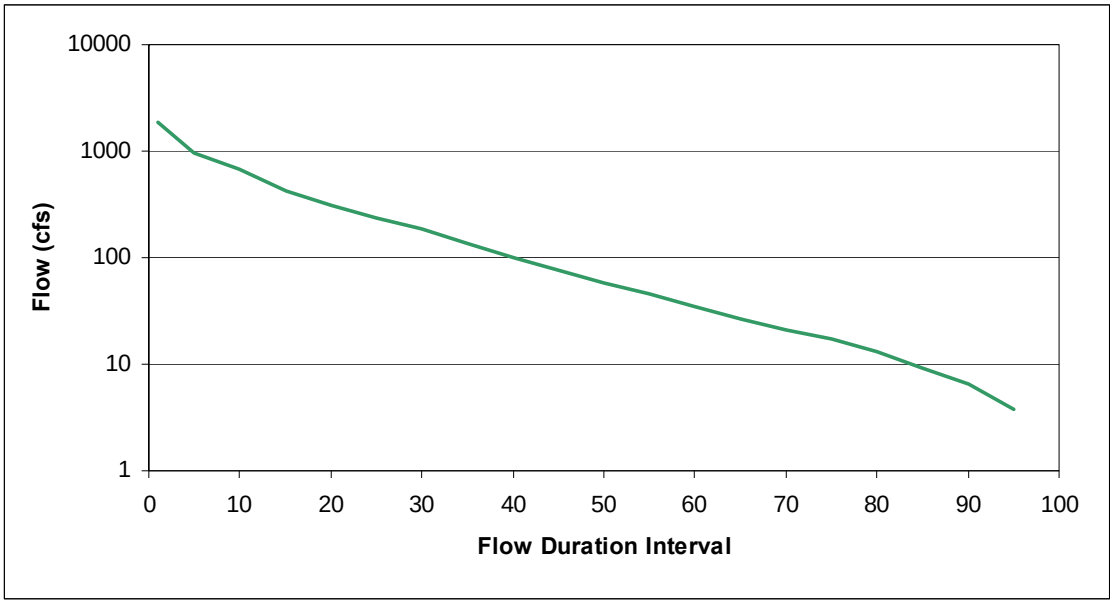

Figure 5.1. Flow Duration Curve for USGS Gage 02294650, 1990–2004

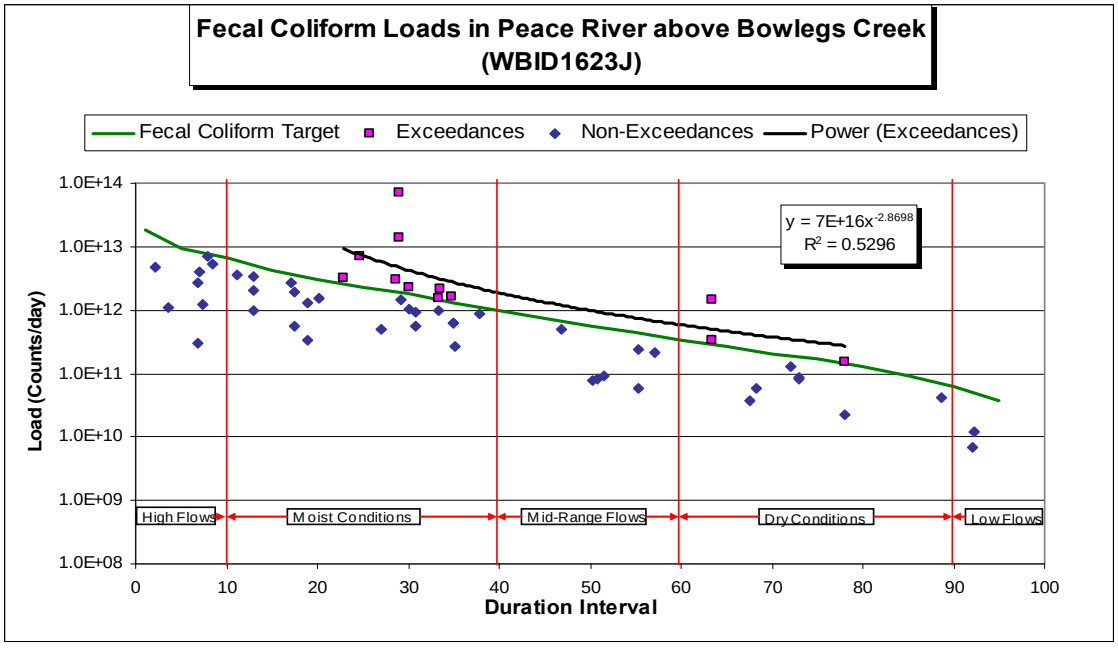

Figure 5.2. Load Duration Curves for Fecal Coliform in the Peace River above Bowlegs Creek, WBID 1623J

Table 5.1. Observed Fecal Coliform Data for Calculating Exceedances to the State Criterion for the Peace River above Bowlegs Creek, WBID 1623J

Station	Sample Date	Sample Time	Flow (cfs*)	Flow Rank	Flow Rank (%)	Fecal Coliform (counts/ 100mL)	Fecal Coliform Load (counts/day)	Remark Code**
21FLPOLKP.C. CANAL10	11/21/1995	940	153	33.3	33.30%	410	1.53E+12	
21FLA 25020044	6/2/1997	1245	15	78	78.00%	420	1.54E+11	
21FLPOLKPEACE RIVER1	1/15/2002	1050	30	63.5	63.50%	470	3.45E+11	
21FLA 25020044	2/16/1993	1200	267	22.8	22.80%	480	3.14E+12	
21FLA 25020044	11/3/1993	1300	139	34.7	34.70%	490	1.67E+12	
21FLPOLKP.C. CANAL10	7/24/2002	800	188	30	30.00%	490	2.25E+12	
21FLPOLKP.C. CANAL10	2/12/1997	910	151	33.5	33.50%	590	2.18E+12	
21FLA 25020044	7/13/1994	1214	203	28.6	28.60%	600	2.98E+12	L
21FLA 25020044	7/12/1995	1310	238	24.6	24.60%	1,200	6.99E+12	
21FLPOLKP.C. CANAL10	1/15/2002	1015	30	63.5	63.50%	2,000	1.47E+12	
21FLPOLKPEACE RIVER1	10/8/2003	855	199	29	29.00%	2,800	1.36E+13	
21FLPOLKP.C. CANAL10	10/8/2003	920	199	29	29.00%	15,000	7.30E+13	

Note: Flow and concentration data analyzed for the TMDL were from April 1992 through December 2003. The Group 3 verification period is from January 1, 1997, through June 30, 2004. Flow data were from USGS Gage 02294650, located in WBID 1623J.

* cfs – cubic feet per second.
** Remark Code: L – Actual value is known to be greater than value given.

As noted previously, values on the load duration curve can generally be grouped by hydrologic conditions to identify the most likely potential sources. Exceedances falling into the 10th through 40th percentile flows are typically associated with moist conditions when stormwater loads are the most likely source, and exceedances falling into the 60th through 90th percentiles are typically associated with dry conditions when point sources are likely the dominant source. As shown in **Figure 5.1**, the majority of fecal coliform exceedances in the Peace River above Bowlegs Creek are concentrated within the 20th to 40th percentile of flow, with a few exceedances within the 60th to 90th percentiles.

Table 5.2 depicts the allowable coliform bacteria load for peak flow, low flow, and 5-percentile increments in flow. The table was created by taking the Nth-percentile flow (flow rank in the table) from the measured flow data and multiplying each percentile flow by the fecal coliform criterion of 400 counts/100mL and converting into bacteria counts/day. This conversion was accomplished by multiplying the criterion by [(28317/100)*60*60*24]. The factor 28317/100 converts counts/100mL into counts per cubic foot.

Table 5.2. Coliform Target Loads for Flow

Flow Rank	Flow Rank (%)	Cfs	Allowable Loads	
			Fecal Coliform Load (counts/day)	Flow Conditions
0.018%		4690.0	4.59E+13	Peak
0.100%		4202.0	4.11E+13	
0.274%		3587.9	3.51E+13	1-day
1%	1%	1900.0	1.86E+13	
5%	5%	980.0	9.59E+12	
10%	10%	665.0	6.51E+12	
15%	15%	428.0	4.19E+12	
20%	20%	311.6	3.05E+12	
25%	25%	234.0	2.29E+12	
30%	30%	187.7	1.84E+12	
35%	35%	135.0	1.32E+12	
40%	40%	99.0	9.69E+11	
45%	45%	75.0	7.34E+11	
50%	50%	58.0	5.68E+11	
55%	55%	45.0	4.40E+11	
60%	60%	35.0	3.43E+11	
65%	65%	27.0	2.64E+11	
70%	70%	21.0	2.06E+11	
75%	75%	17.0	1.66E+11	
80%	80%	13.0	1.27E+11	
85%	85%	9.4	9.20E+10	
90%	90%	6.4	6.26E+10	
95%	95%	3.8	3.72E+10	
99%	99%	0.0	9.79E+07	
100%	100%	0.0	0.00E+00	Low

Finally, the percentage reduction in loading needed for compliance with the state criterion was calculated. For the purposes of this TMDL, critical periods occurred for both “Dry” (60–90) and “Moist” (11–40) flow zones. The critical periods are the flow intervals where the majority of the criteria exceedances occurred, as shown in **Figure 5.2.** Therefore, separate TMDL components were calculated to reflect the critical flow zones **(Table 5.3).** This calculation involved both the median of allowable loads, which previously were calculated using percentile increments of 5, 25, 50, 75, and 95 as the median of the zones, and the median of the existing load based on measured exceedances computed for each critical zone. The needed reduction of daily load was completed using the formula:

$$\textbf{(2)} \qquad \frac{\textbf{(existing load) – (allowable load)}}{\textbf{(existing load)}} \times 100$$

Table 5.3. Fecal Coliform Percentage Reductions Required for Different Flow Zones

TMDL Details	High (0–10)	Moist (10–40)	Mid-range (40–60)	Dry (60–90)	Low (90–100)
TMDL - allowed load (colonies/day)	9.59E+12	2.29E+12	5.68E+11	1.66E+11	3.72E+10
Existing Load (colonies/day)	N/A	2.98E+12	N/A	3.45E+11	N/A
Percent Reduction	N/A	23.2	N/A	51.8	N/A

N/A – Not available.

5.4 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.

For the Peace River above Bowlegs Creek, the fecal coliform bacteria exceedances occurred during “Moist” (11–40) and “Dry” (60–90) flow conditions **(Figure 5.2)**.

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 (waste load allocations, or WLAs), nonpoint source loads (load allocations, or LAs), and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

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

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

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

It should be noted that the various components of the revised TMDL equation may not sum up to the value of the TMDL because (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 percentage reduction, and the WLA for wastewater is typically expressed as mass per day).

WLAs for stormwater discharges are typically expressed as percentage 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 bacteria TMDL for the Peace River above Bowlegs Creek is expressed in terms of colonies per day for the overall TMDL and as a percent reduction for MS4 areas and other nonpoint sources to meet the applicable criterion. The TMDL represents the maximum daily fecal coliform load the river can assimilate and maintain the applicable fecal coliform bacteria criterion **(Table 6.1).**

Table 6.1. TMDL Components for the Peace River above Bowlegs Creek, WBID 1623J

Parameter	Zone	TMDL (colonies/day)	WLA		LA (percent reduction)	MOS
			Wastewater (colonies/day)	NPDES Stormwater (percent reduction)		
Fecal Coliform	Moist[1]	2.29E +12	N/A	23	23	Implicit
Fecal Coliform	Dry[2]	1.66E + 11	N/A	52	52	Implicit

[1] Moist flow zone represents flows between 99 and 665 cfs.
[2] Dry flow zone represents flows between 6.4 and 35 cfs.
N/A – Not applicable

6.2 Load Allocation

Based on a load duration curve approach similar to that developed by the state of Kansas (Stiles, 2002), the load allocation for nonpoint sources is a 23 percent reduction of instream coliform concentrations needed during the "Moist" period, and a 52 percent reduction of instream fecal coliform concentrations during the "Dry" period. It should be noted that the LA includes loading from stormwater discharges that are not part of the NPDES stormwater program (see **Appendix B**).

6.3 Wasteload Allocation

6.3.1 NPDES Wastewater Discharges

As previously mentioned, there are no permitted domestic wastewater treatment facilities that discharge fecal coliform loads directly into the Peace River above Bowlegs Creek. However, all existing indirect discharges, including the city of Winter Haven WWTP #3 (Wahneta Plant, NPDES No. FL0036048), and any future facilities permitted to discharge to the Peace River will be required to meet the state's Class III criterion for fecal coliform.

6.3.2 NPDES Stormwater Discharges

The WLA for the Polk County and FDOT municipal separate storm sewer system (MS4) permit is a 23 percent reduction in current anthropogenic fecal coliform loading during the "Moist" period and a 52 percent reduction of current anthropogenic fecal coliform loading during the "Dry" period. It should be noted that any MS4 permittee will only be 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.

While the LA and WLA for fecal coliform have been expressed as the percent reduction needed to attain the applicable Class III criterion, 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. An MOS was included in the TMDL by not allowing any exceedances of the state criterion, even though intermittent natural exceedances of the criterion 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 the stream during a rain event.

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 in the Peace River above Bowlegs Creek, WBID 1623J

Station	Sample Date	Sample Time	Flow (cfs)	Flow Rank	Flow Rank (%)	Fecal Coliform (counts/100mL)	Fecal Coliform Load (counts/day)	Remark Code
21FLSWFDFLO0036	4/6/1992	1330	5.6	92	92.00%	50	6.85E+09	
21FLSWFDFLO0036	7/8/1992	1045	309	20.2	20.20%	200	1.51E+12	
21FLSWFDFLO0036	9/29/1992	945	198	29.1	29.10%	300	1.45E+12	Q
21FLSWFDFLO0036	12/9/1992	1430	69	46.9	46.90%	300	5.06E+11	Q
21FLA 25020044	2/16/1993	1200	267	22.8	22.80%	480	3.14E+12	
21FLA 25020044	6/2/1993	1255	20	72.1	72.10%	260	1.27E+11	J
21FLA 25020044	8/3/1993	1330	115	37.8	37.80%	320	9.00E+11	J
21FLA 25020044	11/3/1993	1300	139	34.7	34.70%	490	1.67E+12	
21FLA 25020044	1/25/1994	1351	54	51.6	51.60%	68	8.98E+10	J
21FLA 25020044	5/4/1994	1300	19	73	73.00%	172	8.00E+10	
21FLA 25020044	7/13/1994	1214	203	28.6	28.60%	600	2.98E+12	L
21FLA 25020044	10/5/1994	1355	1,110	3.6	3.60%	40	1.09E+12	J
21FLA 25020044	1/25/1995	1230	153	33.3	33.30%	260	9.73E+11	J
21FLA 25020044	5/3/1995	1215	24	68.2	68.20%	100	5.87E+10	J
21FLA 25020044	7/12/1995	1310	238	24.6	24.60%	1,200	6.99E+12	
21FLA 25020044	10/4/1995	1130	606	11.1	11.10%	240	3.56E+12	J
21FLPOLKP.C. CANAL10	11/21/1995	940	153	33.3	33.30%	410	1.53E+12	
21FLA 25020044	1/9/1996	1020	739	8.5	8.50%	300	5.42E+12	J
21FLPOLKP.C. CANAL10	2/7/1996	958	760	8	8.00%	390	7.25E+12	
21FLA 25020044	4/3/1996	1240	809	6.9	6.90%	140	2.77E+12	J
21FLPOLKP.C. CANAL10	5/21/1996	1000	19	73	73.00%	190	8.83E+10	
21FLA 25020044	7/9/1996	1345	373	17.4	17.40%	60	5.48E+11	J
21FLPOLKP.C. CANAL10	8/14/1996	920	525	12.9	12.90%	270	3.47E+12	
21FLPOLKP.C. CANAL10	11/20/1996	955	25	67.5	67.50%	60	3.67E+10	
21FLA 25020044	2/11/1997	1200	41	57.2	57.20%	210	2.11E+11	
21FLPOLKP.C. CANAL10	2/12/1997	910	151	33.5	33.50%	590	2.18E+12	
21FLPOLKP.C. CANAL10	5/20/1997	905	15	78	78.00%	60	2.20E+10	
21FLA 25020044	6/2/1997	1245	15	78	78.00%	420	1.54E+11	
21FLA 25020044	7/28/1997	1100	373	17.4	17.40%	212	1.93E+12	
21FLPOLKP.C. CANAL10	8/12/1997	1030	790	7.3	7.30%	65	1.26E+12	
21FLPOLKP.C. CANAL10	11/6/1997	915	377	17.2	17.20%	290	2.67E+12	
21FLPOLKP.C. CANAL10	2/11/1998	850	800	7	7.00%	200	3.91E+12	
21FLTPA 25020044	3/10/1998	215	1,410	2.2	2.20%	140	4.83E+12	
21FLPOLKP.C. CANAL10	5/14/1998	850	134	35.2	35.20%	81	2.66E+11	
21FLPOLKP.C. CANAL10	1/15/2002	1015	30	63.5	63.50%	2,000	1.47E+12	
21FLPOLKPEACE RIVER1	1/15/2002	1050	30	63.5	63.50%	470	3.45E+11	

Station	Sample Date	Sample Time	Flow (cfs)	Flow Rank	Flow Rank (%)	Fecal Coliform (counts/100mL)	Fecal Coliform Load (counts/day)	Remark Code
21FLPOLKP.C. CANAL10	4/16/2002	1025	7	88.7	88.70%	240	4.11E+10	
21FLPOLKPEACE RIVER1	4/17/2002	925	5.5	92.2	92.20%	92	1.24E+10	
21FLPOLKP.C. CANAL10	7/24/2002	800	188	30	30.00%	490	2.25E+12	
21FLPOLKPEACE RIVER1	7/24/2002	840	188	30	30.00%	220	1.01E+12	
21FLPOLKP.C. CANAL10	10/23/2002	815	136	35	35.00%	189	6.29E+11	
21FLPOLKPEACE RIVER1	10/23/2002	855	136	35	35.00%	183	6.09E+11	
21FLPOLKP.C. CANAL10	1/28/2003	940	334	19	19.00%	156	1.27E+12	
21FLPOLKPEACE RIVER1	1/28/2003	910	334	19	19.00%	42	3.43E+11	
21FLTPA 27484828147401	2/12/2003	1315	217	27.1	27.10%	95	5.04E+11	
21FLPOLKP.C. CANAL10	4/16/2003	900	178	30.9	30.90%	130	5.66E+11	
21FLPOLKPEACE RIVER1	4/16/2003	835	178	30.9	30.90%	210	9.15E+11	
21FLTPA 27484828147401	5/7/2003	1010	56	50.8	50.80%	60	8.22E+10	
21FLPOLKP.C. CANAL10	7/23/2003	850	513	13	13.00%	160	2.01E+12	
21FLPOLKPEACE RIVER1	7/23/2003	830	513	13	13.00%	80	1.00E+12	
21FLTPA 27484828147401	9/8/2003	210	811	6.8	6.80%	15	2.98E+11	
21FLPOLKP.C. CANAL10	10/8/2003	920	199	29	29.00%	15,000	7.30E+13	
21FLPOLKPEACE RIVER1	10/8/2003	855	199	29	29.00%	2,800	1.36E+13	
21FLTPA 27484828147401	11/4/2003	1010	58	50.3	50.30%	55	7.80E+10	
21FLPOLKP.C. CANAL10	1/7/2004	915	45	55.3	55.30%	220	2.42E+11	
21FLPOLKPEACE RIVER1	1/7/2004	850	45	55.3	55.30%	54	5.95E+10	

Note: Flow and concentration data analyzed for the TMDL were from December 1992 through April 2004. The Group 3 verification period is from January 1, 1997, through June 30, 2004. Flow data were from USGS Gage 02294650, located in WBID 1623J.
*Remark Code: *J – Estimated value.*
Q – Sample held beyond normal holding time.
L – Actual value is known to be greater than value given.

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 (WMDs) 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 implementation of 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 NPDES and other state stormwater permitting programs is that the NPDES program covers both new and existing discharges, while the other state programs focus on new discharges. 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.

Florida Department of Environmental Protection
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