TMDL Report

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

U.S. Environmental Protection Agency
Region 4

March 2006

Under the authority of Section 303(d) of the Clean Water Act, 33 U.S. Code §1251 et.seq., as amended by the Water Quality Act of 1987 (PL 100-4), the U.S Environmental Protection Agency is hereby establishing Total Maximum Daily Loads (TMDLs) for fecal coliform bacteria in Peace River above Bowlegs (WBID 1623J), Peace River Basin. Subsequent actions must be consistent with this TMDL.

/s/ March 31, 2006

James D. Giattina, Director
Water Management Division

Date

Acknowledgments

EPA would like to acknowledge that the contents of this report and the total maximum daily load (TMDL) contained herein were developed by the Florida Department of Environmental Protection (FDEP). Many of the text and figures may not read as though EPA is the primary author for this reason, but EPA is officially establishing the TMDL for fecal coliform for Peace River above Bowlegs Creek. EPA is establishing this TMDL in order to meet consent decree requirements pursuant to the Consent Decree entered in the case of Florida Wildlife Federation, et al. v. Carol Browner, et al., Case No. 98-356-CIV-Stafford.

This study could not have been accomplished without significant contributions from staff in the Florida Department of Environmental Protection's Watershed Assessment Section.

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Florida Department of Environmental Protection, Bureau of Watershed Management

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

STORET Program

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

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http://www.dep.state.fl.us/water/docs/2002_305b.pdf

Criteria for Surface Water Quality Classifications

http://www.dep.state.fl.us/legal/rules/shared/62-302t.pdf

Basin Status Report for the Sarasota Bay, Peace River, and Myakka River Basin

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National STORET Program

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Chapter 1: INTRODUCTION

1.1 Purpose of Report

This report presents the Total Maximum Daily Load (TMDL) for fecal coliform bacteria for the Peace River above Bowlegs Creek, which is located in the Upper Peace River Planning Unit, and part of the larger Sarasota Bay, Peace River, and Myakka River Basin Group. 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 River, and Myakka River Basin Group 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 water segment is located within the Upper Peace River Basin, in central Polk County, Florida, at the headwaters of Lake Hancock. This river segment receives drainage from the Saddle Creek and Peace Creek Canal sub-basins located upstream of the reach. 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) and discharges 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 in the watershed 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 River, and Myakka River Basin (Florida Department of Environmental Protection, 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. Peace River above Bowlegs Creek is WBID 1623J **(Figure 1.2).**

1.3 Background

This report was developed as part of the Florida Department of Environmental Protection's (Department) 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. TMDLs 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. Location of the Peace River above Bowlegs Creek Water Segment, WBID 1623J, and Major Geopolitical Features in the Sarasota Bay, Peace River, and Myakka River Basin Group

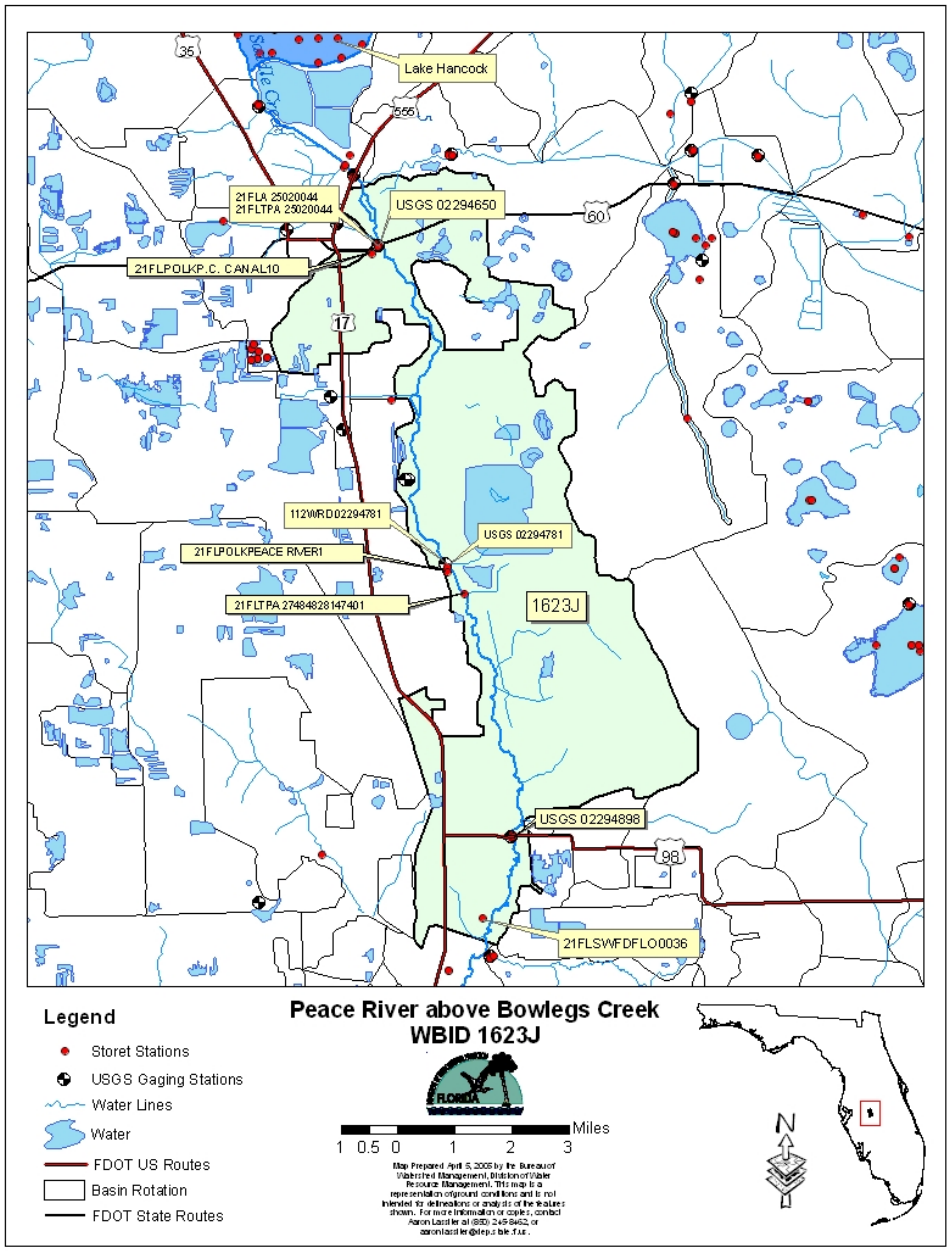

Figure 1.2. Peace River above Bowlegs Creek Water Segment, and Monitoring Locations

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 River, and Myakka River Basin Group. 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 Chapter 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 coliforms **(Table 2.1). Table 2.2** summarizes the data collected during the verification period (January 1997 to June 2004). The River segment was verified as impaired for fecal coliforms because more than 10 percent of the values exceeded the Class III freshwater criteria of 400 counts per 100 milliliters (mL) for fecal coliforms (7 out of 32 samples in the verified period exceeded the criteria of 400 counts per 100 milliliters).

The verified impairments were based on data collected mainly by the Polk County Natural Resources Division and the Florida Department of Environmental Protection. Polk County STORET stations include 21FLPOLKP.C. CANAL10 and 21FLPOLKPEACE RIVER1. Florida Department of Environmental Protection stations include STORET stations 21FLA 25020044, and 21FLTPA 27484828147401. Additional data were from the Southwest Florida Water Management District (SWFWMD) at 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 B** tabulates all available fecal coliform data for the water segment. Fecal coliform values exceeding the criteria of 400 counts per 100 milliliters 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 Water Segment, WBID 1623J

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

*These TMDLs were scheduled to be completed by December 31, 2004, based on a Consent Decree between the EPA and EarthJustice, but the Consent Decree allows a 9-month extension for completing the TMDLs.

Table 2.2. Summary of Fecal Coliform Data for Peace River above Bowlegs Creek, WBID 1623J, January 1997 to 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

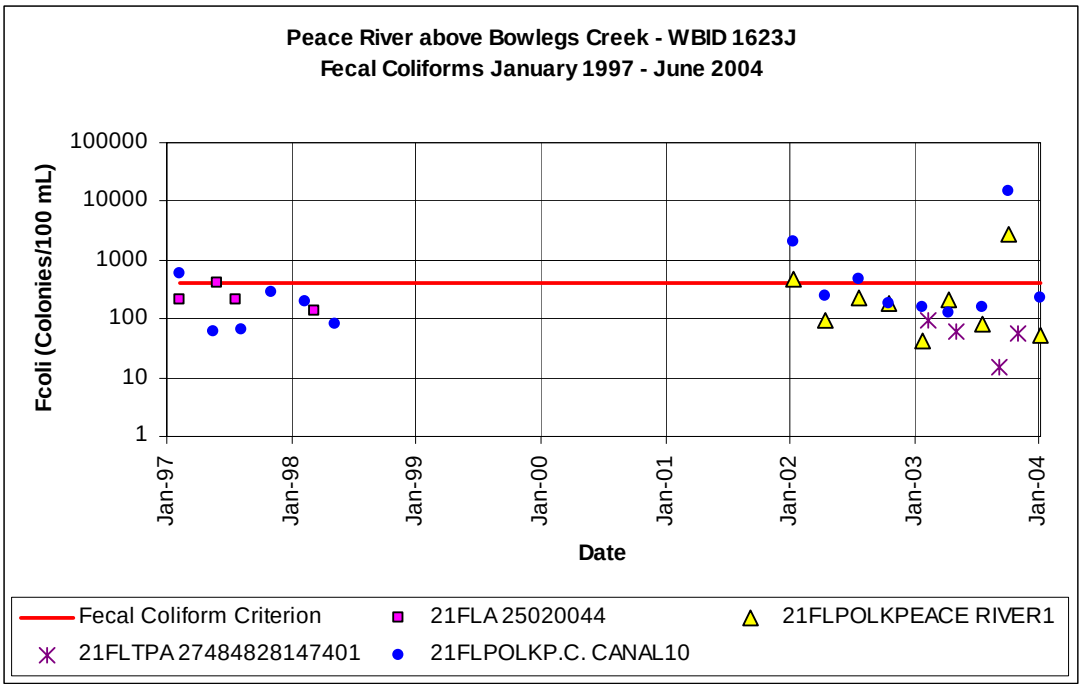

Figure 2.1. Fecal Coliform Measurements for Peace River above Bowlegs Creek (January 1992 to December 2003)

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 criteria applicable to the impairment addressed by this TMDL are the Class III criteria 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 criteria for protection of Class III waters, as established by Chapter 62-302, F.A.C., states the following:

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

For fecal coliforms, the criteria state 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 stream (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/100 mL 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 (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 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 Bacteria in the Peace River above Bowlegs Creek Water Segment

4.2.1 Point Sources

There are no permitted domestic wastewater treatment facilities that discharge fecal coliform loads directly into the Peace River above Bowlegs Creek segment. There is one facility, the City of Winter Haven, WWTP # 3 (Wahneta Plant) (NPDES No. FL0036048) that discharges indirectly to the river. The facility, a 5.0 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, a Class III freshwater body, and ultimately into the Peace River. The potential impacts from this discharge will be 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 are defined in Section 62-624.800, F.A.C., and typically cover urbanized areas serving jurisdictions with a population of at least 10,000 or discharging into Class I or Class II waters, or into Outstanding Florida Waters.

The stormwater collection systems in the Peace River above Bowlegs Creek water segment, which are owned and operated by Polk County in conjunction with the Florida Department of Transportation, are covered by a Phase I MS4 permit. Currently, no local governments in the watershed have applied for coverage under the Phase II NPDES MS4 permit.

The Peace River above Bowlegs Creek water segment falls under the Polk County Phase I MS4 Permit (Number FLS000015). The City of Fort Meade, City of Bartow, and the Florida Department of Transportation District 1, are co-permittees with portions of their jurisdictions located within the segment.

4.2.2 Land Uses and Nonpoint Sources

Nonpoint source (NPS) pollution, unlike pollution from industrial and sewage treatment plants, comes from many diffuse sources. NPS 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 our underground sources of drinking water (U.S. Environmental Protection Agency, 1994). Potential nonpoint sources of coliforms 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. Livestock data from the 1997 *Agricultural Census Report* for Polk County are listed in **Table 4.1** (U.S. Department of Agriculture, 1997).

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 water segment were aggregated using the simplified Level 1 codes **(Table 4.2). Figure 4.1** shows the acreage of the principal land uses in the water segment. Land use in the basin is predominately urban and built-up land, which covers 60.1 percent of the area in the water segment. Seventy-six percent of the urban and built-up land is mined areas associated with the phosphate mining industry. The other significant land uses in the basin is agriculture (18%), while natural land uses (water and wetlands) represent approximately 19.2 percent of the basin.

Table 4.1. Livestock Distribution for Polk County

Livestock Distribution	Polk County (number of livestock)
Cattle/Calves	49,759
Milk cows	2,116
Hogs/Pigs	1,482
Poultry layers >13 weeks	(D)
Poultry broilers	(D)
Sheep/Lambs	203
Horses	1,505

(D) – Data withheld to avoid disclosing data for individual farms.
Source: U.S. Department of Agriculture. 1997. *Agricultural Census Report*.

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

Code	Land Use	Acreage	Percent of Total
1000	Urban Open	12,514	49.95
1100	Residential Low Density < 2 Dwelling Units/Acre	274	1.09
1200	Residential Med 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
Totals		**25,052**	**100.00**

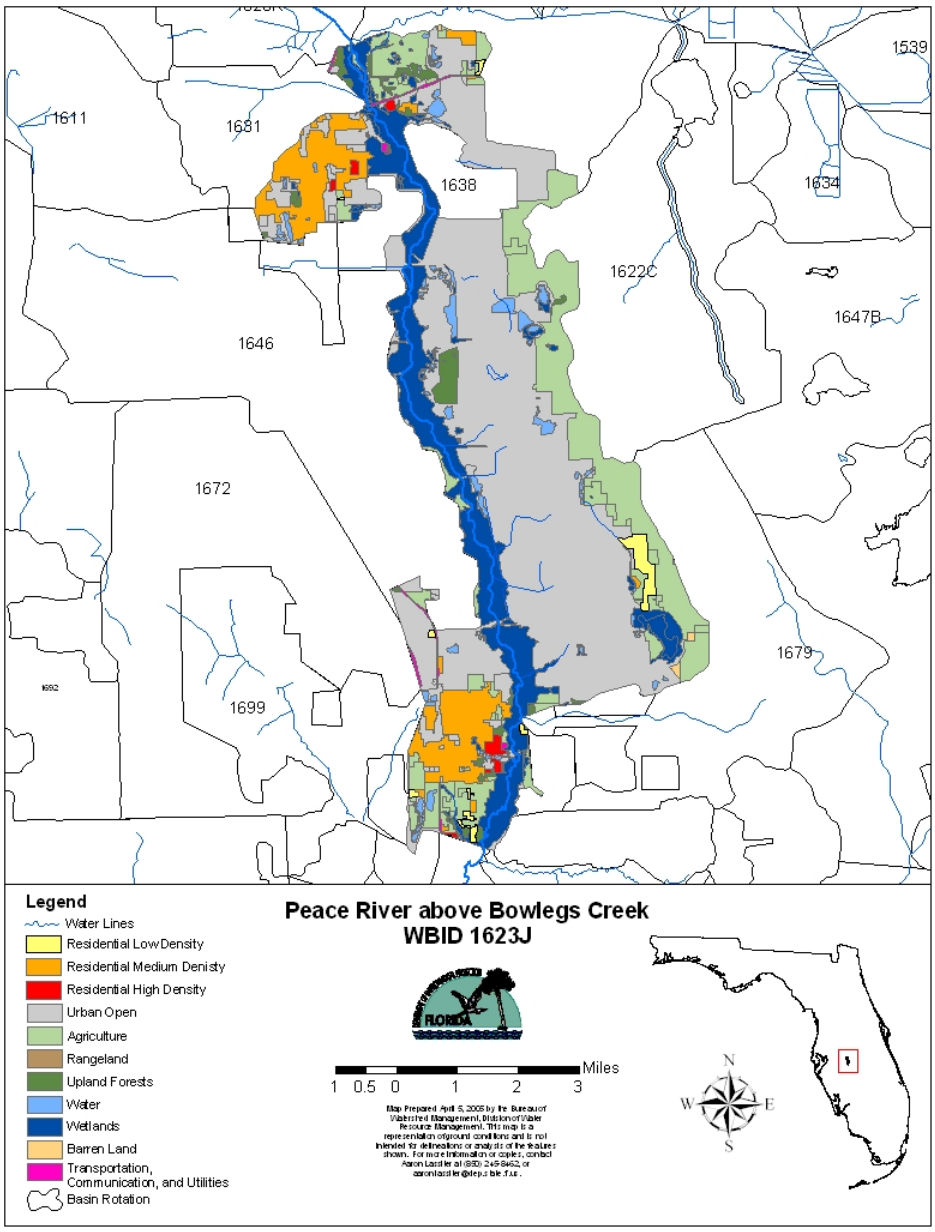

Figure 4.1. Principal Land Uses in the Peace River above Bowlegs Creek Water Segment, WBID 1623J, in 1999

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 ten percent of the land area is residential, it is possible that pets, especially dogs, are having an impact on the waterbody. 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 x 10^{11} organisms/day. This is an estimate, as the actual loading from dogs is not known.

Table 4.3. Estimated Loading from Dogs in the Peace River above Bowlegs Creek Water Segment

Pet	Estimated No. of Households in 1580	Estimated Household: Pet Ratio[1]	Estimated Total Dog Population in Watershed	Estimated Loading of Total	Estimated No. 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 American Veterinary Medical Association website, which states the original source to be the "U.S Pet Ownership and Demographics Sourcebook," 2002.
[2] From EPA document, "Protocol for Developing Pathogen TMDLs," 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 average (U.S. Census Bureau Web site, 2004). In the Peace River above Bowlegs Creek water segment, the population density is between 235 - 427 people per square mile **(Figure 4.2)**.

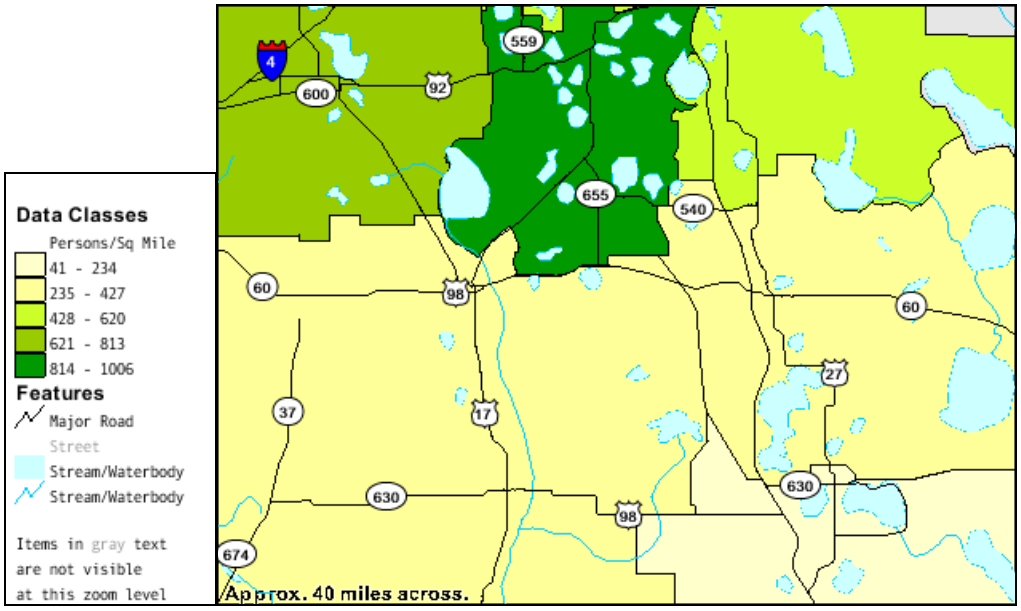

Figure 4.2. Population Density in the area of the Peace River above Bowlegs Creek Water Segment in 2000.

Table 4.4. Population Density in Polk County, Florida

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.

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) utilizing septic tanks. (Florida Department of Health Web site, 2005).

Based on 2000 U.S. Census Bureau data there is an estimated 354 persons/mi^2 in the WBID, or **11,175** for the water segment area. The average household in the Peace River above Bowlegs Creek water segment has 2.7 persons (see **Table 4.5**). According to the DoH, there is an

annual average of 1,256 repairs (fiscal years 1993 – 2004) in Polk County. Based on this, and assuming the failures are spread evenly throughout the county, there are approximately 21 failures in the Peace River above Bowlegs Creek water segment annually. Using 70 gallons/day/person (U.S. Environmental Protection Agency [USEPA], 2001), a loading of 1.5 x 10^{11} colonies/day is derived. This estimation is shown in **Table 4.6.**

Table 4.5. Estimation of Average Household Size in the Peace River above Bowlegs Creek Water Segment

Household Size	No. of Households	Percentage of Total	Number of People
1-person household	979	23.46%	979
2-person household	1356	32.49%	2,712
3-person household	736	17.63%	2,207
4-person household	569	13.62%	2,274
5-person household	302	7.24%	1,511
6-person household	133	3.20%	800
7-or-more-person household	99	2.36%	691
TOTAL:	**4,174**	**100.00%**	**11,175**
		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 Water Segment

Estimated Population Density and Area	WBID Area (mi^2)	Estimated Population in Water Segment	Estimated Number of Tank Failures[1]	Estimated Load From Failed Tank[2]	Gallons/ Person/ Day[2]	Estimated Number Persons Per Household[3]	Estimated Load From Failing Tanks (Counts/Day)
354 persons/mi^2 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 water segment from March 1990 – April 2004 (Fl. DoH) – see text

[2] From EPA document "Protocol for Developing Pathogen TMDLs."

[3] From U.S Census Bureau, see Table 4.5 for more information on this estimate.

Domestic Sludge

When domestic wastewater is treated, a solid material accumulates in the wastewater treatment plant and 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. 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 water segment (**Figure 4.3)**. The site, Averett Site 1, covers an area of approximately 36 acres and its source WWTP is Averett RMF.

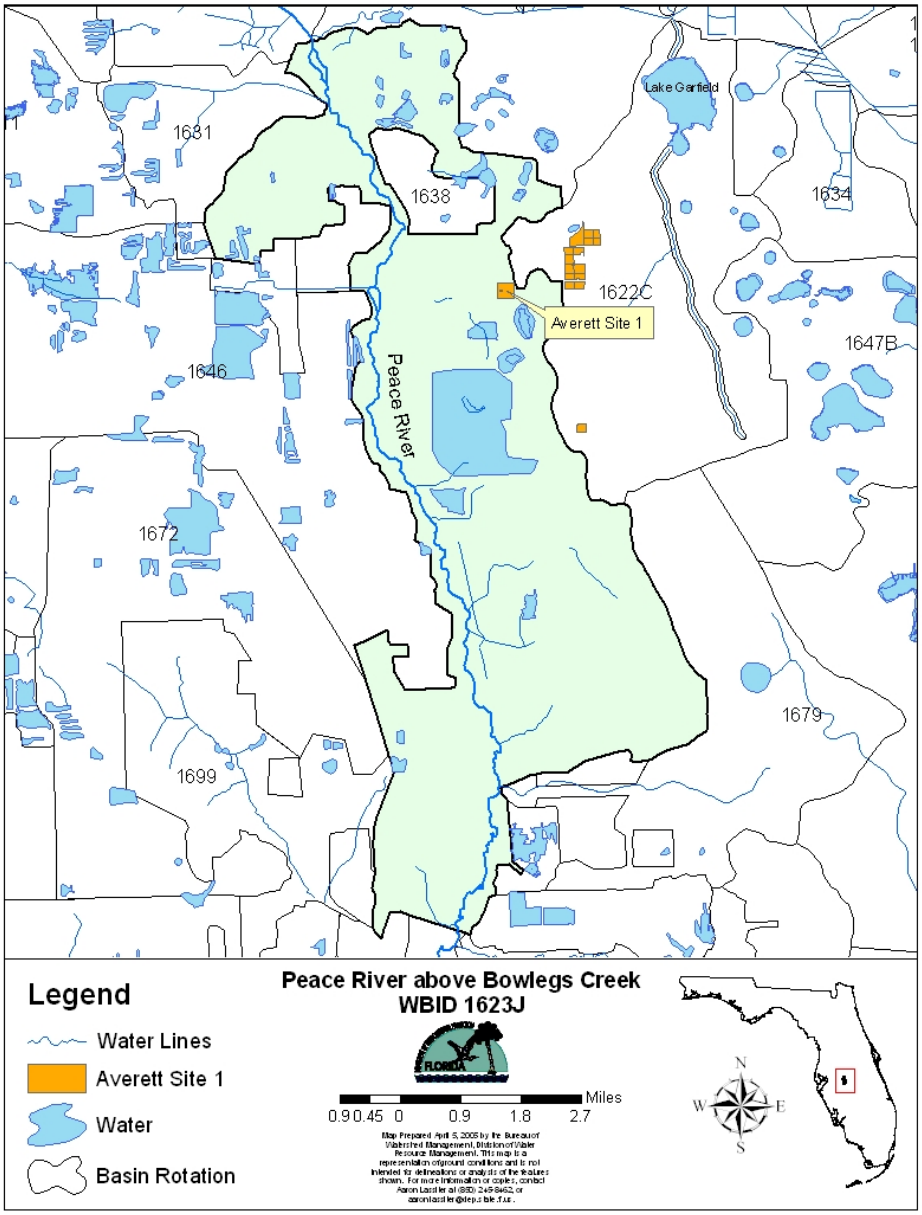

Figure 4.3. Domestic Sludge Application Sites in the Peace River above Bowlegs Creek Water Segment

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, 2003), this method has been well documented in the literature, with improved modifications used by EPA Region IV (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
5. Establish the needed load reduction by comparing the existing loading to the allowable load under critical conditions.

5.2 Data Used in the Determination of the 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 are the Polk County Natural Resources Division and the Florida Department of Environmental Protection. Polk County Storet stations include 21FLPOLKP.C. CANAL10 and 21FLPOLKPEACE RIVER1. Florida Department of Environmental Protection stations include Storet stations 21FLA 25020044, and 21FLTPA 27484828147401. Additional data were collected at the Southwest Florida Water Management District (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 coliforms used in this analysis, and **Appendix B** lists the water quality monitoring results for fecal coliforms.

Flow measurements for the 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 a linkage of exceedances of the criterion to specific flow intervals and durations. For example, if all of the exceedances occurred during low-flow conditions, point sources of the pollutant should be suspected. Conversely, if all the exceedances came during higher flow periods, then nonpoint sources of pollution should be suspected. Following Dr. 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 above equation yields the load duration curve or allowable load curve, shown as the fecal coliform target line in **Figures 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 criteria 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 purple square.

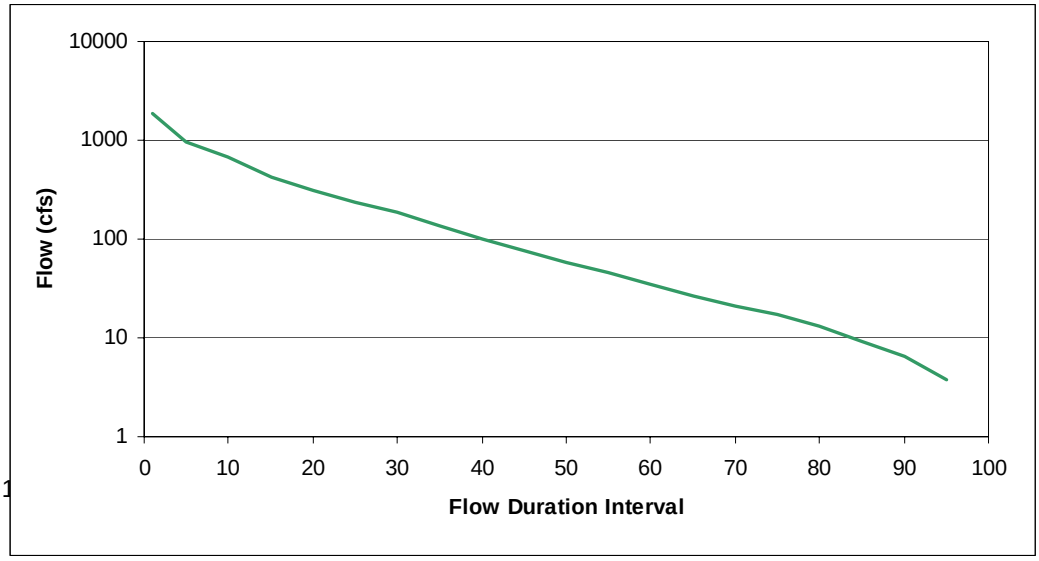

Figure 5.1. Flow Duration Curve for USGS Gage 02294650 (1990 – 2004)

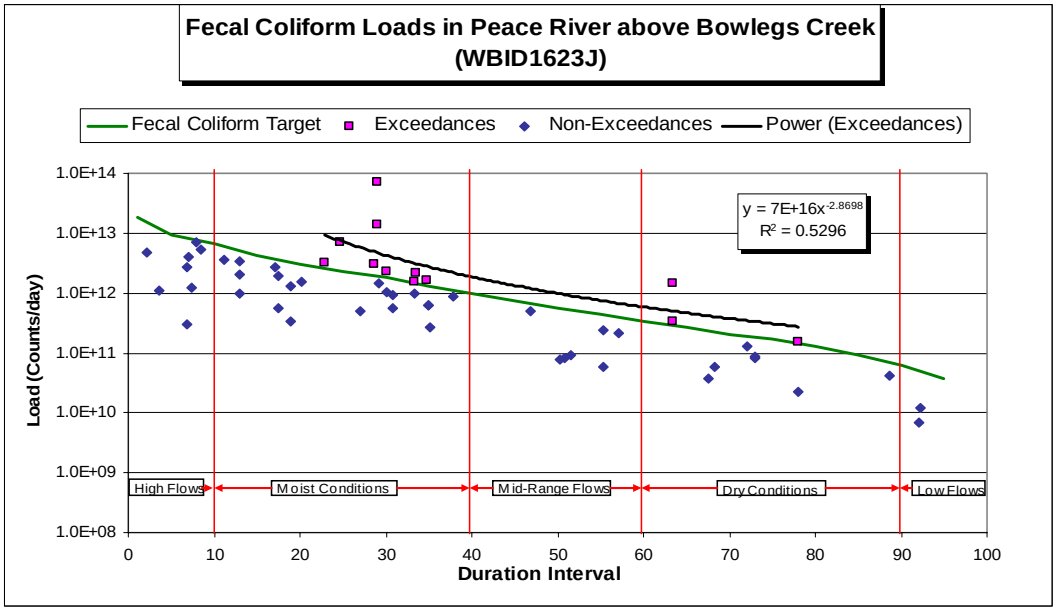

Figure 5.2. Load Duration Curve for Fecal Coliform in Peace River above Bowlegs Creek

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

Station	Sample Date	Sample Time	Flow (cfs)	Flow Rank	Flow Rank (percent)	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%	1200	6.99E+12	
21FLPOLKP.C. CANAL10	1/15/2002	1015	30	63.5	63.50%	2000	1.47E+12	
21FLPOLKPEACE RIVER1	10/8/2003	855	199	29	29.00%	2800	1.36E+13	
21FLPOLKP.C. CANAL10	10/8/2003	920	199	29	29.00%	15000	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 1997 through June 2004. Flow data were from USGS Gage 02294650, located in WBID 1623J.
*Remark Codes: *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. **Table 5.2** 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	

Flow Rank	Flow Rank (%)	Cfs	Allowable Loads	
			Fecal coliform Load (counts/day)	**Flow Conditions**
95%	95	3.8	3.72E+10	
99%	99	0.0	9.79E+07	
100%	100	0.0	0.00E+00	**Low**

Finally, the percent reduction in loading needed for compliance with the state criterion was calculated. For 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:

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

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

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

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 water segment, 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 percent reduction, and the WLA for wastewater is typically expressed as mass per day).

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

This approach is consistent with federal regulations (40 CFR § 130.2[I]), which state that TMDLs can be expressed in terms of mass per time (e.g., pounds per day), toxicity, or **other appropriate measure**. The fecal coliform bacteria TMDL for Peace River above Bowlegs Creek is expressed in terms of percent reduction. The TMDL represents the maximum daily fecal coliform load the river can assimilate and maintain the applicable fecal coliform bacteria criteria **(Table 6.1).**

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

Parameter	Zone	TMDL (percent reduction)	WLA		LA (percent reduction)	MOS
			Wastewater (counts/day)	NPDES Stormwater (percent)		
Fecal Coliform	Moist[1]	23	N/A	23	23	Implicit
Fecal Coliform	Dry[2]	52	N/A	52	52	Implicit

[1]Moist flow zone represents flows between 99 to 665 cfs.
[2]Dry flow zone represents flows between 6.4 to 35 cfs.

6.2 Load Allocation

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

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 state Class III criteria for fecal coliforms.

6.3.2 NPDES Stormwater Discharges

The WLA for the Polk County MS4 Permit (Number FLS000015) 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.

6.4 Margin of Safety

Consistent with the recommendations of the Allocation Technical Advisory Committee (Florida Department of Environmental Protection, February 2001), an implicit margin of safety (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. A MOS was included in the TMDL by not allowing any exceedances of the state criteria, even though intermittent natural exceedances of the criteria 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, which will be a component of a Basin Management Action Plan (BMAP). This document will be developed over the next year in cooperation with local stakeholders and will attempt to reach consensus on more detailed allocations and on how load reductions will be accomplished. The BMAP will include the following:

- Appropriate allocations among the affected parties,
- A description of the load reduction activities to be undertaken,
- Timetables for project implementation and completion,
- Funding mechanisms that may be utilized,
- Any applicable signed agreement,
- Local ordinances defining actions to be taken or prohibited,
- Local water quality standards, permits, or load limitation agreements, and
- Monitoring and follow-up measures.

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Appendices

Appendix A: Background Information on Federal and State Stormwater Programs

In 1982, Florida became the first state in the country to implement statewide regulations to address the issue of nonpoint source pollution by requiring new development and redevelopment to treat stormwater before it is discharged. The Stormwater Rule, as authorized in Chapter 403, F.S., was established as a technology-based program that relies on the implementation of BMPs that are designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Chapter 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 SWIM plan, other watershed plan, or rule. Stormwater PLRGs are a major component of the load allocation part of a TMDL. To date, stormwater PLRGs have been established for Tampa Bay, Lake Thonotosassa, the Winter Haven Chain of Lakes, the Everglades, Lake Okeechobee, and Lake Apopka. No PLRG has been developed for Newnans Lake at the time this study was conducted.

In 1987, the U.S. Congress established Section 402(p) as part of the federal Clean Water Act Reauthorization. This section of the law amended the scope of the federal NPDES stormwater permitting program to designate certain stormwater discharges as "point sources" of pollution. These stormwater discharges include certain discharges that are associated with industrial activities designated by specific Standard Industrial Classification (SIC) codes, construction sites disturbing five or more acres of land, and master drainage systems of local governments with a population above 100,000, which are better known as municipal separate storm sewer systems (MS4s). However, because the master drainage systems of most local governments in Florida are interconnected, the EPA has implemented Phase 1 of the MS4 permitting program on a countywide basis, which brings in all cities (incorporated areas), Chapter 298 urban water control districts, and the Florida Department of Transportation throughout the fifteen counties meeting the population criteria.

An important difference between the federal and state stormwater permitting programs is that the federal program covers both new and existing discharges, while the state program focuses on new discharges. Additionally, Phase 2 of the NPDES Program will expand the need for these permits to construction sites between one and five acres, and to local governments with as few as 10,000 people. These revised rules require that these additional activities obtain permits by 2003. While these urban stormwater discharges are now technically referred to as "point sources" for the purpose of regulation, they are still diffuse sources of pollution that cannot be easily collected and treated by a central treatment facility similar to other point sources of pollution, such as domestic and industrial wastewater discharges. The Department recently accepted delegation from the EPA for the stormwater part of the NPDES Program. It should be noted that most MS4 permits issued in Florida include a re-opener clause that allows permit revisions to implement TMDLs once they are formally adopted by rule.

Appendix B: Summary of Monitoring Results for Fecal Coliforms in the Peace River above Bowlegs Creek Water Segment

Station	Sample Date	Sample Time	Flow (cfs)	Flow Rank	Flow Rank (percent)	Fecal Coliform (counts/100mL)	Fecal Coliform Load (cnts/day)	Remark Code
21FLTPA 27484828147401	9/8/2003	210	811	6.8	6.80%	15	2.98E+11	
21FLA 25020044	10/5/1994	1355	1110	3.6	3.60%	40	1.09E+12	J
21FLPOLKPEACE RIVER1	1/28/2003	910	334	19	19.00%	42	3.43E+11	
21FLSWFDFLO0036	4/6/1992	1330	5.6	92	92.00%	50	6.85E+09	
21FLPOLKPEACE RIVER1	1/7/2004	850	45	55.3	55.30%	54	5.95E+10	
21FLTPA 27484828147401	11/4/2003	1010	58	50.3	50.30%	55	7.80E+10	
21FLA 25020044	7/9/1996	1345	373	17.4	17.40%	60	5.48E+11	J
21FLPOLKP.C. CANAL10	11/20/1996	955	25	67.5	67.50%	60	3.67E+10	
21FLPOLKP.C. CANAL10	5/20/1997	905	15	78	78.00%	60	2.20E+10	
21FLTPA 27484828147401	5/7/2003	1010	56	50.8	50.80%	60	8.22E+10	
21FLPOLKP.C. CANAL10	8/12/1997	1030	790	7.3	7.30%	65	1.26E+12	
21FLA 25020044	1/25/1994	1351	54	51.6	51.60%	68	8.98E+10	J
21FLPOLKPEACE RIVER1	7/23/2003	830	513	13	13.00%	80	1.00E+12	
21FLPOLKP.C. CANAL10	5/14/1998	850	134	35.2	35.20%	81	2.66E+11	
21FLPOLKPEACE RIVER1	4/17/2002	925	5.5	92.2	92.20%	92	1.24E+10	
21FLTPA 27484828147401	2/12/2003	1315	217	27.1	27.10%	95	5.04E+11	
21FLA 25020044	5/3/1995	1215	24	68.2	68.20%	100	5.87E+10	J
21FLPOLKP.C. CANAL10	4/16/2003	900	178	30.9	30.90%	130	5.66E+11	
21FLA 25020044	4/3/1996	1240	809	6.9	6.90%	140	2.77E+12	J
21FLTPA 25020044	3/10/1998	215	1410	2.2	2.20%	140	4.83E+12	
21FLPOLKP.C. CANAL10	1/28/2003	940	334	19	19.00%	156	1.27E+12	
21FLPOLKP.C. CANAL10	7/23/2003	850	513	13	13.00%	160	2.01E+12	
21FLA 25020044	5/4/1994	1300	19	73	73.00%	172	8.00E+10	
21FLPOLKPEACE RIVER1	10/23/2002	855	136	35	35.00%	183	6.09E+11	
21FLPOLKP.C. CANAL10	10/23/2002	815	136	35	35.00%	189	6.29E+11	
21FLPOLKP.C. CANAL10	5/21/1996	1000	19	73	73.00%	190	8.83E+10	
21FLSWFDFLO0036	7/8/1992	1045	309	20.2	20.20%	200	1.51E+12	
21FLPOLKP.C. CANAL10	2/11/1998	850	800	7	7.00%	200	3.91E+12	
21FLA 25020044	2/11/1997	1200	41	57.2	57.20%	210	2.11E+11	
21FLPOLKPEACE RIVER1	4/16/2003	835	178	30.9	30.90%	210	9.15E+11	
21FLA 25020044	7/28/1997	1100	373	17.4	17.40%	212	1.93E+12	
21FLPOLKPEACE RIVER1	7/24/2002	840	188	30	30.00%	220	1.01E+12	
21FLPOLKP.C. CANAL10	1/7/2004	915	45	55.3	55.30%	220	2.42E+11	
21FLA 25020044	10/4/1995	1130	606	11.1	11.10%	240	3.56E+12	J
21FLPOLKP.C. CANAL10	4/16/2002	1025	7	88.7	88.70%	240	4.11E+10	
21FLA 25020044	6/2/1993	1255	20	72.1	72.10%	260	1.27E+11	J
21FLA 25020044	1/25/1995	1230	153	33.3	33.30%	260	9.73E+11	J
21FLPOLKP.C. CANAL10	8/14/1996	920	525	12.9	12.90%	270	3.47E+12	

Station	Sample Date	Sample Time	Flow (cfs)	Flow Rank	Flow Rank (percent)	Fecal Coliform (counts/100mL)	Fecal Coliform Load (cnts/day)	Remark Code
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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	1/9/1996	1020	739	8.5	8.50%	300	5.42E+12	J
21FLA 25020044	8/3/1993	1330	115	37.8	37.80%	320	9.00E+11	J
21FLPOLKP.C. CANAL10	2/7/1996	958	760	8	8.00%	390	7.25E+12	
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	
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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%	1200	6.99E+12	
21FLPOLKP.C. CANAL10	1/15/2002	1015	30	63.5	63.50%	2000	1.47E+12	
21FLPOLKPEACE RIVER1	10/8/2003	855	199	29	29.00%	2800	1.36E+13	
21FLPOLKP.C. CANAL10	10/8/2003	920	199	29	29.00%	15000	7.30E+13	

Note: Flow and concentration data analyzed for the TMDL were from December 1992 through April 2004. The Group 3 verification period is from January 1997 through June 2004. Flow data were from USGS Gage 02293987, located in WBID 1539.
*Remark Codes: *J – Estimated Value.*
Q – Sample held beyond normal holding time.
B – Results based on colony counts outside the acceptable range.
E – Extra sample taken in composting process.
K – Actual value not known, but known to be less than value shown.
L – Actual Value is known to be greater than value given.