Final

Total Maximum Daily Load

for

Fecal Coliform

in

Pellicer Creek

WBID 2580B

May 2012

Region 4 serving the southeast

In compliance with the provisions of the Federal Clean Water Act, 33 U.S.C §1251 et. seq., as amended by the Water Quality Act of 1987, P.L. 400-4, the U.S. Environmental Protection Agency is hereby establishing the Total Maximum Daily Load (TMDL) for fecal coliform bacteria in Pellicer Creek in Upper East Coast Basin (WBID 2580B). Subsequent actions must be consistent with this TMDL.

/s/ 5/30/2012

James D. Giattina, Director Date

Water Protection Division

Table of Contents

Table of Figures

Table of Tables

LIST OF ABBREVIATIONS

BMAP	Basin Management Action Plan
BMP	Best Management Practices
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FLUCCS	Florida Land Use Classification Code System
FS	Florida Statutes
HUC	Hydrologic Unit Code
IWR	Impaired Waters Rule
LA	Load Allocation
MGD	Million Gallons Per Day
ML/L	Milliliters Per Liter
MOS	Margin of Safety
MPN	Most Probable Number
MS4	Municipal Separate Storm Sewer Systems
N/A	Not Applicable
NASS	National Agriculture Statistics Service
NPDES	National Pollutant Discharge Elimination System
OSTD	Onsite Sewer Treatment and Disposal Systems
SEC/DAY	Seconds Per Day
SQ MI	Square Miles
SJRWMD	St. Johns River Water Management District
STORET	STORage RETrieval database
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WBID	Water Body Identification
WLA	Waste Load Allocation
WMD	Water Management District
WQS	Water Quality Standard
WWTP	Wastewater Treatment Plant

SUMMARY SHEET

Total Maximum Daily Load (TMDL)

1. 303(d) Listed Segment:

WBID	Segment Name	Class and Waterbody Type	Major River Basin	HUC	County	State
2580B	Pellicer Creek	Class II	Upper East Coast	03080201	St. Johns and Flagler	Florida

2. TMDL Endpoints/Targets: Fecal Coliform

3. TMDL Technical Approach: Statistical approach using available water quality data.

4. TMDL Waste Load and Load Allocation:

Waterbody	WBID	WLA	LA (% Reduction)*	TMDL (% Reduction)*
Pellicer Creek	2580B	N/A	94%	94%

Note:
Overall percent reduction required to achieve the 43 counts/100 mL fecal coliform criterion. The MOS is implicit and does not take away from the TMDL value.

5. Endangered Species (yes or blank):

6. USEPA Lead TMDL or Other: USEPA

7. TMDL Considers Point Sources/Non Point Sources: Non Point Sources

8. NPDES Discharge to surface water addressed in TMDL: No

1. Introduction

Section 303(d) of the Clean Water Act requires each state to list those waters within its boundaries for which technology based effluent limitations are not stringent enough to protect any water quality standard applicable to such waters. Listed waters are prioritized with respect to designated use classifications and the severity of pollution. In accordance with this prioritization, states are required to develop Total Maximum Daily Loads (TMDLs) for those water bodies that are not meeting Water Quality Standards (WQS). The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a waterbody based on the relationship between pollution sources and in-stream water quality conditions, so that states can establish water quality based controls to reduce pollution from both point and nonpoint sources and restore and maintain the quality of their water resources (USEPA, 1991).

The Florida Department of Environmental Protection (FDEP) developed a statewide, watershed-based approach to water resource management. Under the watershed management approach, water resources are managed on the basis of natural boundaries, such as river basins, rather than political boundaries. The watershed management approach is the framework FDEP uses for implementing TMDLs. The state's 52 basins are divided into 5 groups. Water quality is assessed in each group on a rotating five-year cycle. FDEP also established five water management districts (WMD) responsible for managing ground and surface water supplies in the counties encompassing the districts. Pellicer Creek is located in the Upper East Coast Basin and is a Group 5 waterbody managed by the St. Johns River Water Management District (SJRWMD).

For the purpose of planning and management, the WMD divided the districts into planning units defined as either an individual primary tributary basin or a group of adjacent primary tributary basins with similar characteristics. Pellicer Creek is located within the Pellicer Creek Planning Unit. These planning units contain smaller, hydrological based units called drainage basins, which are further divided by FDEP into "water segments." A water segment usually contains only one unique waterbody type (stream, lake, canal, etc.) and is about five square miles. Unique numbers or waterbody identification (WBIDs) numbers are assigned to each water segment. This TMDL report addresses WBID 2580B (Pellicer Creek).

2. Problem Definition

To determine the status of surface water quality in Florida, three categories of data – chemistry data, biological data, and fish consumption advisories – were evaluated to determine potential impairments. The level of impairment is defined in the Identification of Impaired Surface Waters Rule (IWR), Section 62-303 of the Florida Administrative Code (FAC). Potential impairments are identified by FDEP using IWR methodology to assess whether a waterbody meets the criteria for inclusion on the planning list. Once a waterbody is on the planning list, additional data and information are collected and examined to determine if the water should be included on the verified list of impaired waters.

The TMDL addressed in this document is being established pursuant to commitments made by the United States Environmental Protection Agency (USEPA) in the 1998 Consent Decree in the Florida TMDL lawsuit (Florida Wildlife Federation, et al. v. Carol Browner, et al., Civil Action No. 4: 98CV356-WS, 1998). That Consent Decree established a schedule for TMDL development for waters listed on Florida's USEPA approved 1998 Section 303(d) list. The 1998 Section 303(d) list identified numerous WBIDs in the Upper East Coast Basin as not meeting WQS. After assessing all readily available water quality data, the USEPA is responsible for developing a TMDL for WBID 2580B (Pellicer Creek). The geographic location of this WBID is shown in Figure 1. The parameter addressed in this TMDL is fecal coliform bacteria.

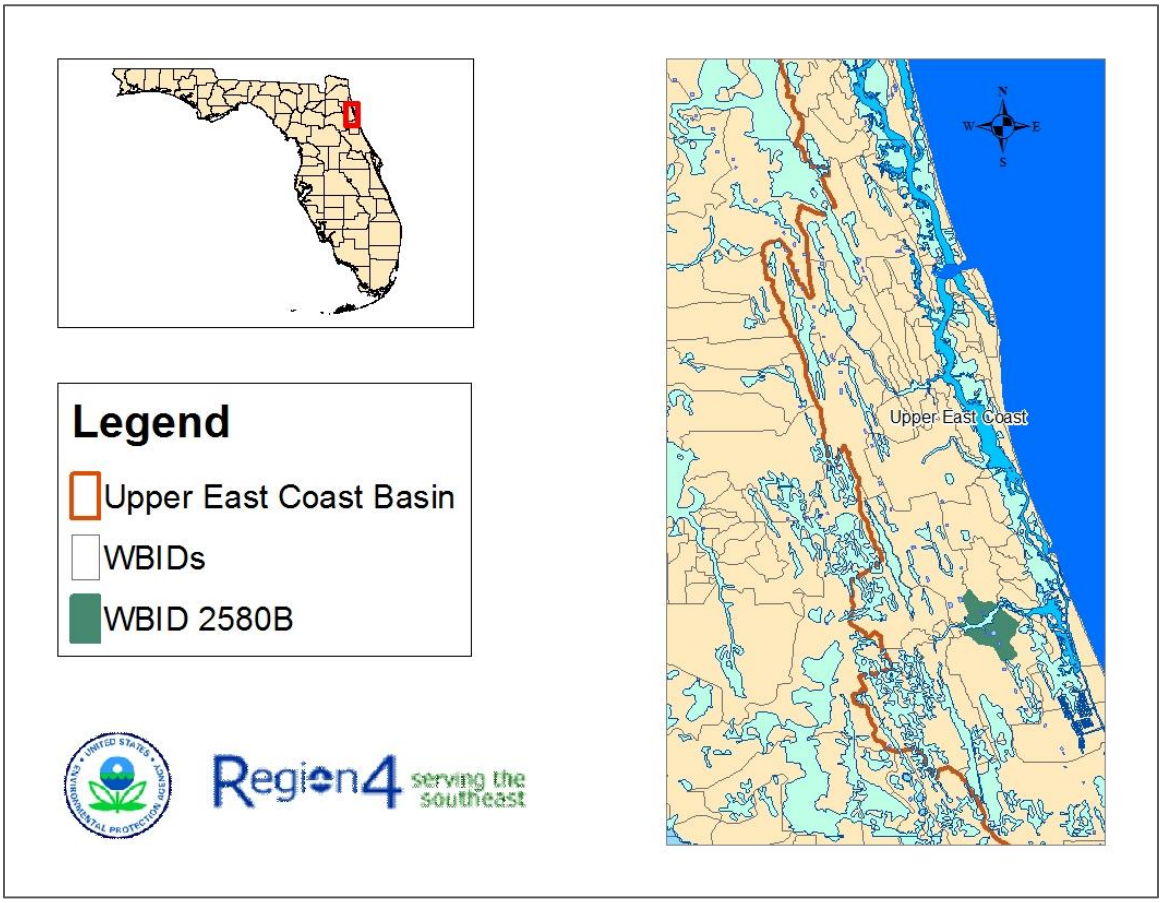

Figure 1. Location of WBID 2580B – Pellicer Creek

3. Watershed Description

Pellicer Creek, specifically WBID 2580B, is located at the border of St. Johns County and Flagler County. Pellicer Creek is designated as an Outstanding Florida Water and an Aquatic Preserve by the state of Florida. It is also the only natural watershed drainage feature located in the Pellicer Creek Planning Unit (FDEP, 2008). Faver-Dykes State Park is located immediately downstream of WBID 2580B (Figure 2). Along with typical park amenities, this park offers canoe trails and more than 100 species of birds can be spotted along Pellicer Creek

and in Faver-Dykes State Park. (SJRWMD, 2009). Pellicer Creek flows from WBID 2580B, through Faver-Dykes State Park and into the Matanzas River, which is part of the Atlantic Intracoastal Waterway. The Matanzas River can be described as a coastal lagoon with access to the Atlantic Ocean by way of the Matanzas Inlet. The Matanzas Inlet, which is located approximately 2.5 miles north of the Pellicer Creek, is the only natural, uncontrolled inlet in Florida and one of the few uncontrolled inlets on the east coast of the United States.

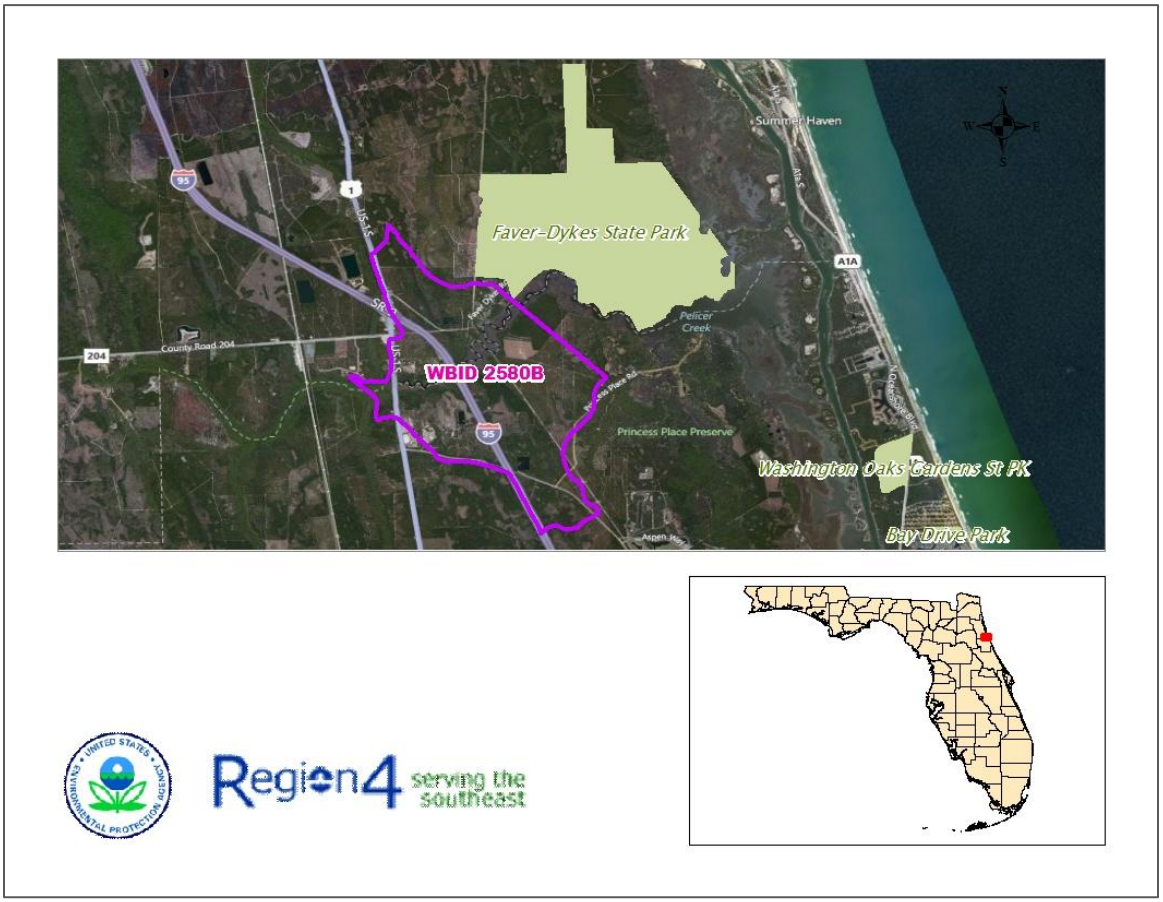

Figure 2. Location of Faver-Dykes State Park

The watershed of WBID 2580B drains approximately 2500 acres (3.9 mi^2) and consists primarily of forested lands (Figure 3). A breakdown of land use by acreage and percentage is provided below in Table 1. The latest land use coverages were obtained from the FDEP FTP site. The data is based on 2004 land cover features and is classified using Level 1 Florida Land Use Classification Codes (FLUCCs).

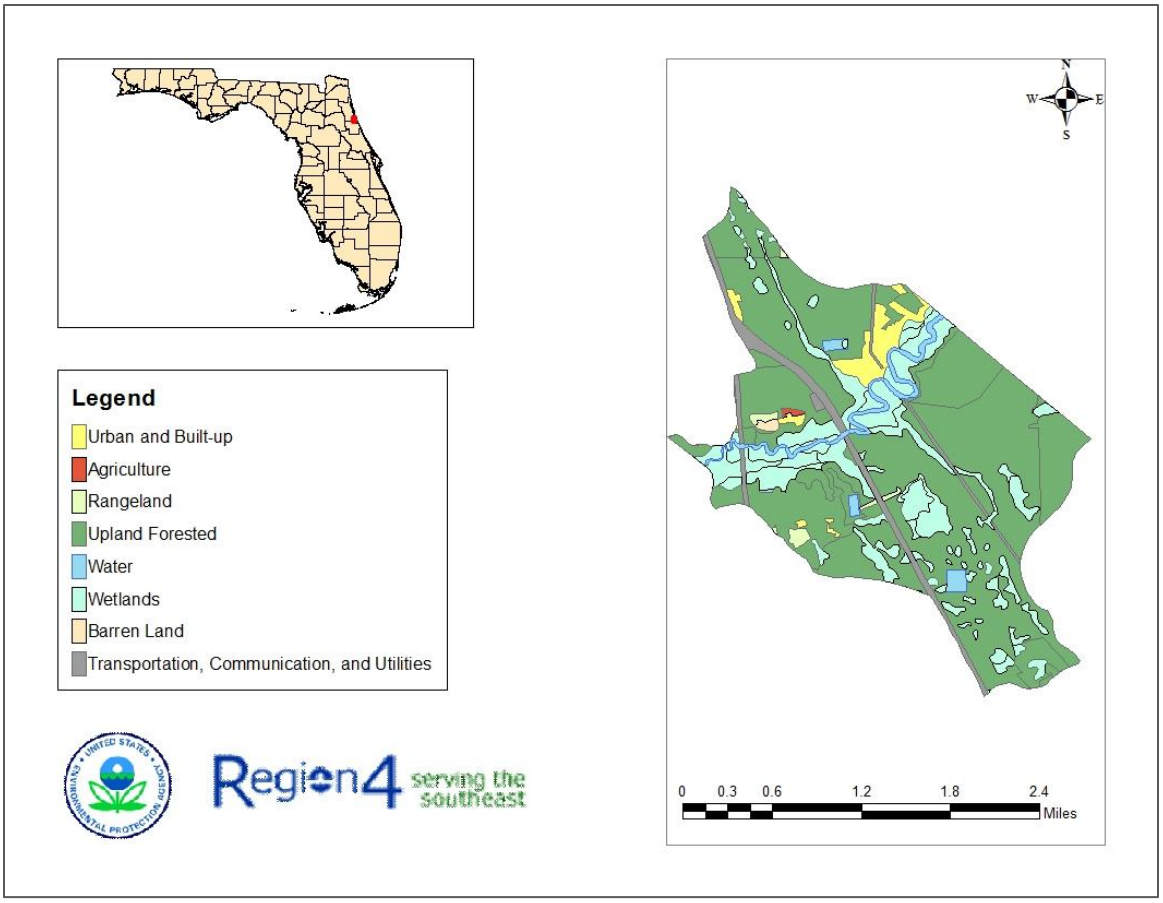

Figure 3. Pellicer Creek – WBID 2580B Land Use Distribution

Table 1. Land Use Distribution in WBID 2580B: Pellicer Creek

Impaired Waterbody	WBID(s)	Unit	Urban Residential & Built-Up[2]	Agriculture	Rangeland	Forest	Water	Wetlands	Barren Land	Transportation & Utilities	Total
Pellicer Creek	2580B	Acres[1]	85.0	3.4	19.3	1699.9	68.1	495.5	5.5	121.9	2498.6
		percent	3.4	0.1	0.8	68.0	2.7	19.8	0.2	4.9	100

Notes:

1. Areas in the table represent the watershed within WBID 2580B.
2. The urban/residential and built-up category includes commercial, industrial and extractive uses.

There are no known wastewater National Pollutant Discharge Elimination System (NPDES) permitted surface water discharges or Municipal Separate Storm Sewer Systems (MS4s) within the watershed.

4. Water Quality Standards/TMDL Targets

Pellicer Creek, specifically WBID 2580B, is a Class II Marine waterbody with a designated use of Shellfish Propagation and Harvesting. Originally, FDEP mistakenly classified this waterbody as a Class III Freshwater. In 2010-2011, FDEP performed a thorough review and determined that WBID 2580B is predominantly saltwater and the classification was corrected (Julie Espy, FDEP, personal communication, January 3, 2012).

Designated use classifications are described in FAC Section 62-302.400(1), and water quality criteria for protection of all classes of waters are established in FAC Section 62-302.530. Individual criteria should be considered in conjunction with other provisions in water quality standards, including Section 62-302.500 FAC. [Surface Waters: Minimum Criteria, General Criteria] that apply to all waters unless alternative criteria are specified in FAC Section 62-302.530.

4.1. Fecal Coliform Bacteria (Class II)

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

The median value criteria reflect chronic or long-term water quality conditions, whereas the 43 and 800 values reflect acute or short-term conditions. The reduction needed to meet the chronic criteria was calculated by comparing the median value with the 14 counts/100 mL criterion. The reduction needed to meet the acute criteria of 43 counts/100 mL was calculated by using the 90^{th} percentile, and the reduction needed to meet the acute criteria of 800 counts/100 mL was calculated using the highest detection. Table 2 provides a comparison of the calculated reductions. The 43 count/100 mL criterion was selected as the TMDL endpoint, since this resulted in the most stringent reduction and satisfied all three parts of the criteria. More information regarding the percent reduction calculation is provided in Section 7 – Analytical Approach.

Table 2. Comparison of Calculated Percent Reductions

14 counts/100mL criterion	43 counts/100mL criterion	800 counts/100mL criterion
Median value = 168	90^{th} percentile = 670	Highest detection = 1580
Percent Reduction = 92%	Percent Reduction = 94%	Percent Reduction = 49%

EPA believes implementation of the percent reduction required in this TMDL will achieve restoration of the waterbody. EPA assumes that the best management practices used to achieve the prescribed reductions will ensure that all three parts of the standard will be met. Florida's continued monitoring and assessment of this waterbody will provide the data and information necessary to demonstrate whether the waterbody is fully restored.

5. Water Quality Assessment

WBID 2580B (Pellicer Creek) was listed as not attaining its designated uses on Florida's 1998 303(d) list due to elevated fecal coliform bacteria. To confirm whether WBID 2580B is impaired due to bacteria, an assessment of available data was conducted. The source for current ambient monitoring data in WBID 2580B, Pellicer Creek, was version 44 of the IWR database. The IWR database contains data from various sources within the state of Florida, including the WMDs and counties.

5.1. Water Quality Data

The table and figures presented in this section provide the station locations and time series data for fecal coliform bacteria collected in Pellicer Creek, WBID 2580B. Table 3 provides a list of the water quality monitoring stations in WBID 2580B, including the date range and number of observations. Figure 4 illustrates where the IWR stations are located within the WBID.

Table 3. Water Quality Monitoring Stations for WBID 2580B: Pellicer Creek

Station	Station Name	First Date	Last Date	No. Obs
21FLA 27010016	PELLICER CR AT US 1	4/26/2004	10/7/2009	26
21FLA 27010073	PELLICER CR @ NE IS BEND	1/15/2009	10/7/2009	4
21FLA 27010074	PELLICER CR E OF I95	1/15/2009	10/7/2009	4

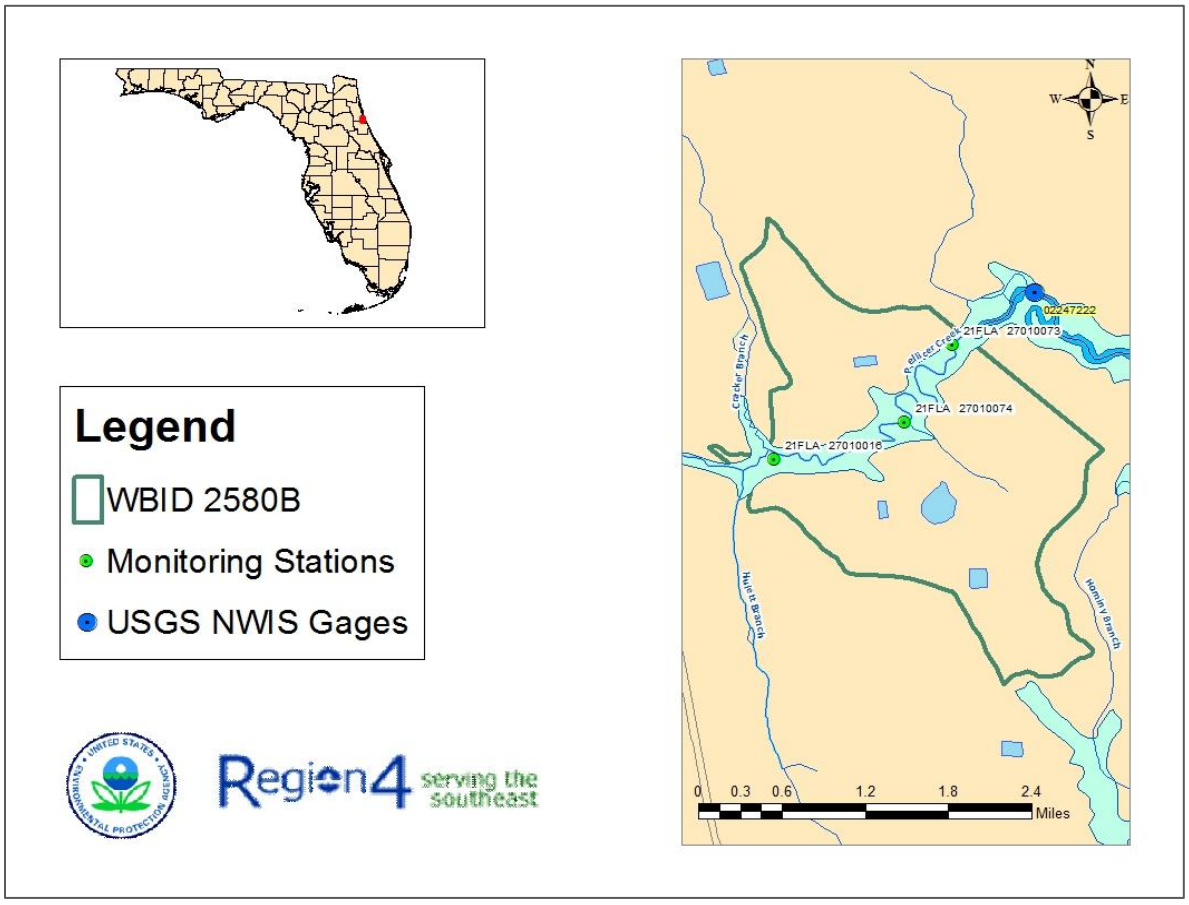

Figure 4. Station Locations for WBID 2580B: Pellicer Creek

Fecal Coliform

Figure 5 provides a time series plot of fecal coliform data in Pellicer Creek. There were 3 monitoring stations used in the assessment that included a total of 34 observations, of which 33 (97 percent) are above the water quality standard of 43 counts/100 mL fecal coliform. The median value for the sample set equals 168 counts/100 mL fecal coliform, exceeding the water quality standard of 14 counts/100 mL fecal coliform. Several samples were flagged with laboratory remark codes. The complete list of data results used in this TMDL analysis is provided in Section 8.2 - Existing Conditions, along with any associated laboratory remark codes. Summary statistics for the fecal coliform data are provided in Table 4.

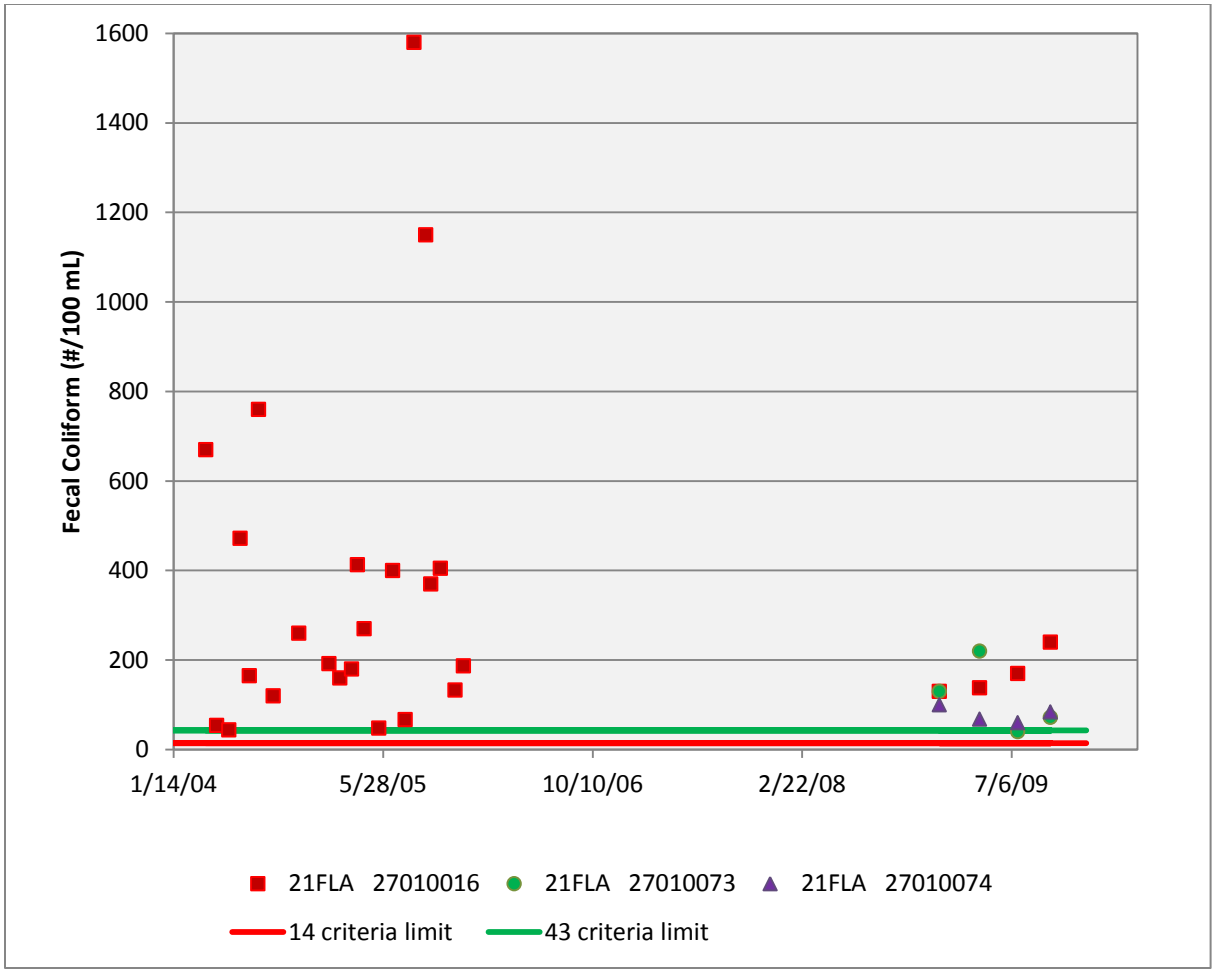

Figure 5. WBID 2580B: Pellicer Creek Measured Fecal Coliform

Table 4. Water Quality Statistics for Fecal Coliforms

Monitoring Station	Minimum Concentration (#/100ml)	Maximum Concentration (#/100ml)	Mean Concentration (#/100ml)	Standard Deviation (#/100ml)	# Samples >43 (#/100ml)
21FLA 27010016	44	1580	338	358	26
21FLA 27010073	40	220	116	79	3
21FLA 27010074	60	100	78	18	4

Stream flow is an important factor affecting water quality, especially insofar as it can be correlated with observed exceedances and used to determine the available loading capacity for pollutants. Flow data is available for Pellicer Creek, downstream of WBID 2580B at USGS Gage 02247222 (see Figure 4 for gage location). However, Pellicer Creek is tidally influenced, resulting in both positive and negative flow rates recorded by the gage. Without more data, such as additional gages along Pellicer Creek, it is difficult to determine to what

extent low flow rates are due to low flow conditions, (i.e. dry conditions) or tidal influences reducing the downstream flow. In order to evaluate the relationship between flow rate and bacteria concentrations, a time series graph is provided. For illustration purposes, the information is divided into two separate figures (Figure 6 and 7). Table 5 also provided a tabular summary of the flow rates and bacteria concentrations during sampling events.

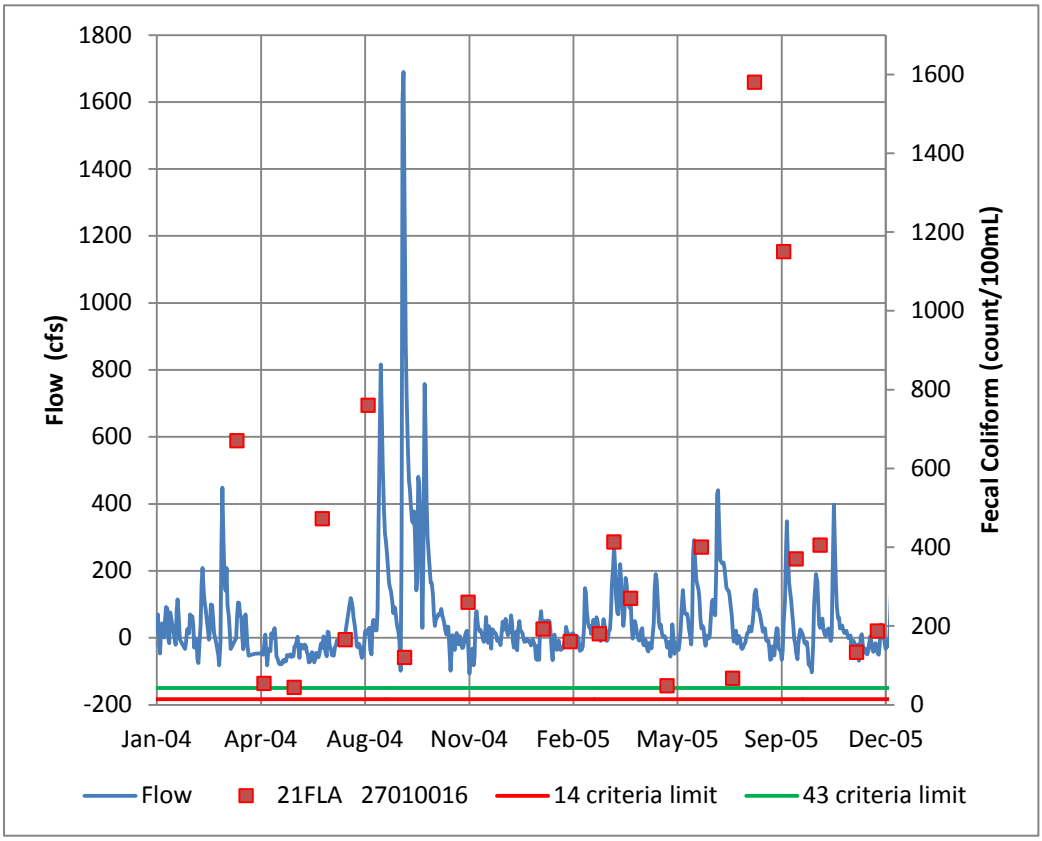

Figure 6. Comparison of Fecal Coliform Concentrations in WBID 2580B and flow data collected at USGS Gage 02247222

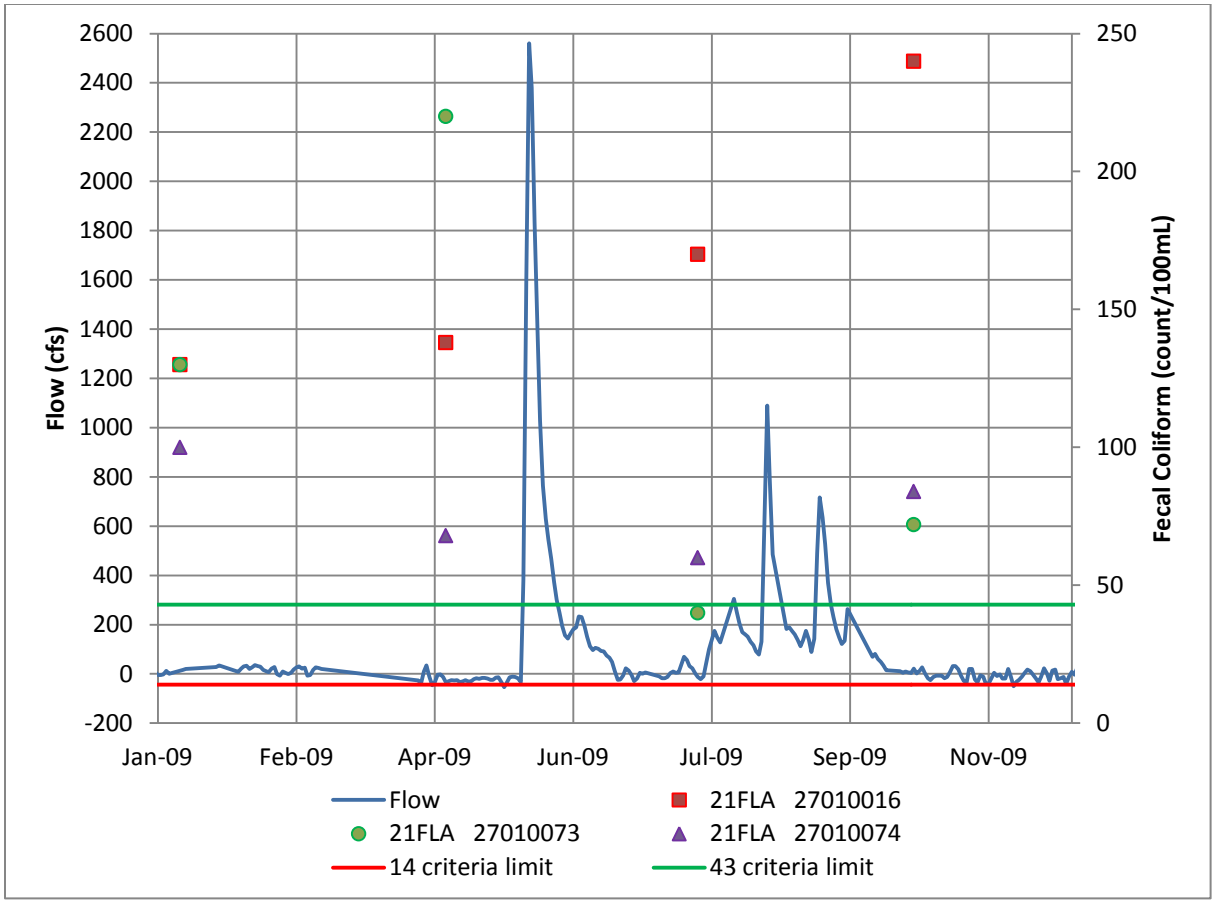

Figure 7. Comparison of Fecal Coliform Concentrations in WBID 2580B and flow data collected at USGS Gage 02247222

Table 5. Comparison of Fecal Coliform Concentrations in WBID 2580B and flow data collected at USGS Gage 02247222

Date	Monitoring Station	Fecal Coliform (#/100 mL)	Flow ft^3/s
3/31/2004	21FLA 27010016	670	65
4/26/2004	21FLA 27010016	54	-28
5/25/2004	21FLA 27010016	44	-27
6/21/2004	21FLA 27010016	472	-30
7/13/2004	21FLA 27010016	165	-5.7
8/4/2004	21FLA 27010016	760	26
9/8/2004	21FLA 27010016	120	1210
11/8/2004	21FLA 27010016	260	-22
1/19/2005	21FLA 27010016	192	48
2/14/2005	21FLA 27010016	160	-9.1
3/14/2005	21FLA 27010016	180	15
3/28/2005	21FLA 27010016	413	275
4/13/2005	21FLA 27010016	270	106
5/18/2005	21FLA 27010016	48	-29
6/20/2005	21FLA 27010016	400	28
7/20/2005	21FLA 27010016	67	20
8/10/2005	21FLA 27010016	1580	129
9/7/2005	21FLA 27010016	1150	47
9/19/2005	21FLA 27010016	370	-45
10/12/2005	21FLA 27010016	405	30
11/16/2005	21FLA 27010016	133	-29
12/6/2005	21FLA 27010016	187	-45
1/15/2009	21FLA 27010016	130	1.2
4/21/2009	21FLA 27010016	138	-34
7/21/2009	21FLA 27010016	170	-13
10/7/2009	21FLA 27010016	240	22
1/15/2009	21FLA 27010073	130	1.2
4/21/2009	21FLA 27010073	220	-34
7/21/2009	21FLA 27010073	40	-13
10/7/2009	21FLA 27010073	72	22
1/15/2009	21FLA 27010074	100	1.2
4/21/2009	21FLA 27010074	68	-34
7/21/2009	21FLA 27010074	60	-13
10/7/2009	21FLA 27010074	84	22

Based on the information presented above, exceedances were detected during high and low flow conditions. The low flow conditions include negative flows which are presumably tidally-influenced. Implementation of this TMDL should address control of all sources during both wet and dry weather conditions.

6. Source and Load Assessment

An important part of the TMDL analysis is the identification of source categories, source subcategories, or individual sources of pollutants in the watershed and the amount of loading contributed by each of these sources. Sources are broadly classified as either point or

nonpoint sources. Coliform bacteria can enter surface waters from both point and nonpoint sources. Since Pellicer Creek is a tidal water, bacteria could potentially be introduced from both upstream and downstream sources.

6.1. Point Sources

A point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Point source discharges of industrial wastewater and treated sanitary wastewater must be authorized by NPDES permits. NPDES permitted discharges include continuous discharges such as wastewater treatment facilities as well as some stormwater driven sources such as MS4s, certain industrial facilities, and construction sites over one acre.

6.1.1. Wastewater/Industrial Permitted Facilities

There are no wastewater or industrial NPDES permitted facilities that discharge to Pellicer Creek.

6.1.2. Stormwater Permitted Facilities/MS4s

The 1987 amendments to the Clean Water Act designated certain stormwater discharges as point sources requiring NPDES stormwater permits. The regulated activities involve MS4s, construction sites over one acre, and specific industrial operations. Although these types of stormwater discharges are now considered point sources with respect to permitting and TMDLs, they behave similarly to nonpoint sources in that they are driven by rainfall-runoff processes leading to the intermittent discharge of pollutants from land use activities in response to storms.

According to 40 CFR 122.26(b)(8), an MS4 is "a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains):

> (i) Owned or operated by a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law)...including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the Clean Water Act that discharges into waters of the United States;
>
> (ii) Designed or used for collecting or conveying storm water;
>
> (iii) Which is not a combined sewer; and
>
> (iv) Which is not part of a Publicly Owned Treatment Works."

MS4s may discharge coliform bacteria and other pollutants to waterbodies in response to storm events. In 1990, USEPA developed rules establishing Phase I of the NPDES

stormwater program, designed to prevent harmful pollutants from being washed by stormwater runoff into MS4s (or from being dumped directly into the MS4) and then discharged from the MS4 into local waterbodies. Phase I of the program required operators of "medium" and "large" MS4s (those generally serving populations of 100,000 or greater) to implement a stormwater management program as a means to control polluted discharges from MS4s. Approved stormwater management programs for medium and large MS4s are required to address a variety of water quality related issues including roadway runoff management, municipal owned operations, hazardous waste treatment, etc.

Phase II of the rule extends coverage of the NPDES stormwater program to certain "small" MS4s. Small MS4s are defined as any MS4 that is not a medium or large MS4 covered by Phase I of the NPDES stormwater program. Only a select subset of small MS4s, referred to as "regulated small MS4s," requires an NPDES stormwater permit. Regulated small MS4s are defined as all small MS4s located in "urbanized areas" as defined by the Bureau of the Census, and those small MS4s located outside of "urbanized areas" that are designated by NPDES permitting authorities.

In October 2000, USEPA authorized FDEP to implement the NPDES stormwater program in all areas of Florida except Indian tribal lands. FDEP's authority to administer the NPDES program is set forth in Section 403.0885, Florida Statutes (FS). The three major components of NPDES stormwater regulations are:

- MS4 permits that are issued to entities that own and operate master stormwater systems, primarily local governments. Permittees are required to implement comprehensive stormwater management programs designed to reduce the discharge of pollutants from the MS4 to the maximum extent practicable.

- Stormwater associated with industrial activities, which is regulated primarily by a multisector general permit that covers various types of industrial facilities. Regulated industrial facilities must obtain NPDES stormwater permit coverage and implement appropriate pollution prevention techniques to reduce contamination of stormwater.

- Construction activity general permits for projects that ultimately disturb one or more acres of land and which require the implementation of stormwater pollution prevention plans to provide for erosion and sediment control during construction.

St. Johns County is covered by a Phase II MS4 permit (Permit No. FLR04E025). Additionally, FDOT District 2 has a Phase II MS4 permit (Permit No. FLR04E019) within St. Johns County. However, the Pellicer Creek watershed is not located within an urbanized area and therefore, not within the service area of the above-mentioned MS4 permits. There are no other MS4s located within the vicinity of Pellicer Creek.

Two facilities with minor Construction Stormwater Generic Permits are located within WBID 2580B; however, stormwater run-off from construction/industrial sites is not typically considered a significant source for coliform bacteria.

6.2. Non Point Sources

Nonpoint sources of coliform are diffuse sources that cannot be identified as entering a waterbody through a discrete conveyance at a single location. These sources generally, but not always, involve accumulation of bacteria on land surfaces and wash off as a result of storm events. Typical nonpoint sources of coliform bacteria include:

- Wildlife
- Agricultural animals
- Onsite Sewer Treatment and Disposal Systems (septic tanks)
- Urban development (outside of Phase I or II MS4 permitted areas)

6.2.1. Wildlife

Wildlife contribute coliform bacteria by depositing feces onto land surfaces where it can be transported to nearby streams during storm events and by direct deposition to the waterbody by birds and other warm blooded animals. Bacteria originating from local wildlife are generally considered to represent natural background concentrations. In most impaired watersheds, the contribution from wildlife is small relative to the load from urban and agricultural areas. Approximately 68 percent of the land area within WBID 2580B is designated as forested and 21 percent of the land area is designated as either water or wetlands. Additionally, due to the tidal influence, land use downstream of the WBID, which consists primarily of a state park, could also be contributing to the coliform bacteria concentrations. With such a high percentage of natural land use in and surrounding WBID 2580B, wildlife could be a potential source of bacteria to Pellicer Creek.

6.2.2. Agriculture

Agriculture is a potential source of coliform delivery to streams, including runoff of manure from pastureland and cropland, and direct animal access to streams. Approximately 0.1 percent of the total land area within WBID 2580B is designated as agricultural. Although agriculture represents only a small portion of the land use within the WBID, it could still be a potential source of pathogen loading to Pellicer Creek.

6.2.3. Onsite Sewerage Treatment and Disposal Systems (Septic Tanks)

Onsite sewage treatment and disposal systems (OSTDs), including septic tanks, are commonly used where providing sewer systems access is not cost effective or practical. When properly sited, designed, constructed, maintained, and operated, OSTDs are a safe means of disposing of domestic waste. The effluent from a well-functioning OSTD is comparable to secondarily treated wastewater from a sewage treatment plant. When not functioning properly, OSTDs

can be a source of nutrients, pathogens, and other pollutants to both ground water and surface water.

The Florida Department of Health publishes data on new septic tank installations and the number of septic tank repair permits issued for each county in Florida. Table 6 summarizes the cumulative number of septic systems installed since the 1970 census and the total number of repair permits issued for years between 1991-92 and 2009-10. The data does not reflect septic tanks removed from service. Because this data is summarized at the county level, the extent to which these values pertain to the impaired watershed is not known. The majority of the urban, residential and built-up land use located in WBID 2580B is within St. Johns County; therefore, the information presented below is a summary of data collected from the SJRWMD.

Table 6. County Estimates of Septic Tanks and Repair Permits

County	Number of Septic Tanks (1970- 2010)	Number of Repair Permits Issued (1991 – 2010)
St. Johns	29,023	4,101

Note: Source: http://www.doh.state.fl.us/environment/ostds/statistics/ostdsstatistics.htm

The Florida Department of Health also maintains a list of OSTDs that have been inspected by the Florida Department of Health. The purpose for the inspections range from new installations to requested repair work. Figure 8 depicts the OSTD inspections conducted in or adjacent to WBID 2580B, Pellicer Creek. Without additional information, an explicit source cannot be determined. However, the presence of OSTDs in close proximity to Pellicer Creek suggests that OSTDs could be relevant sources of pathogen loading to Pellicer Creek.

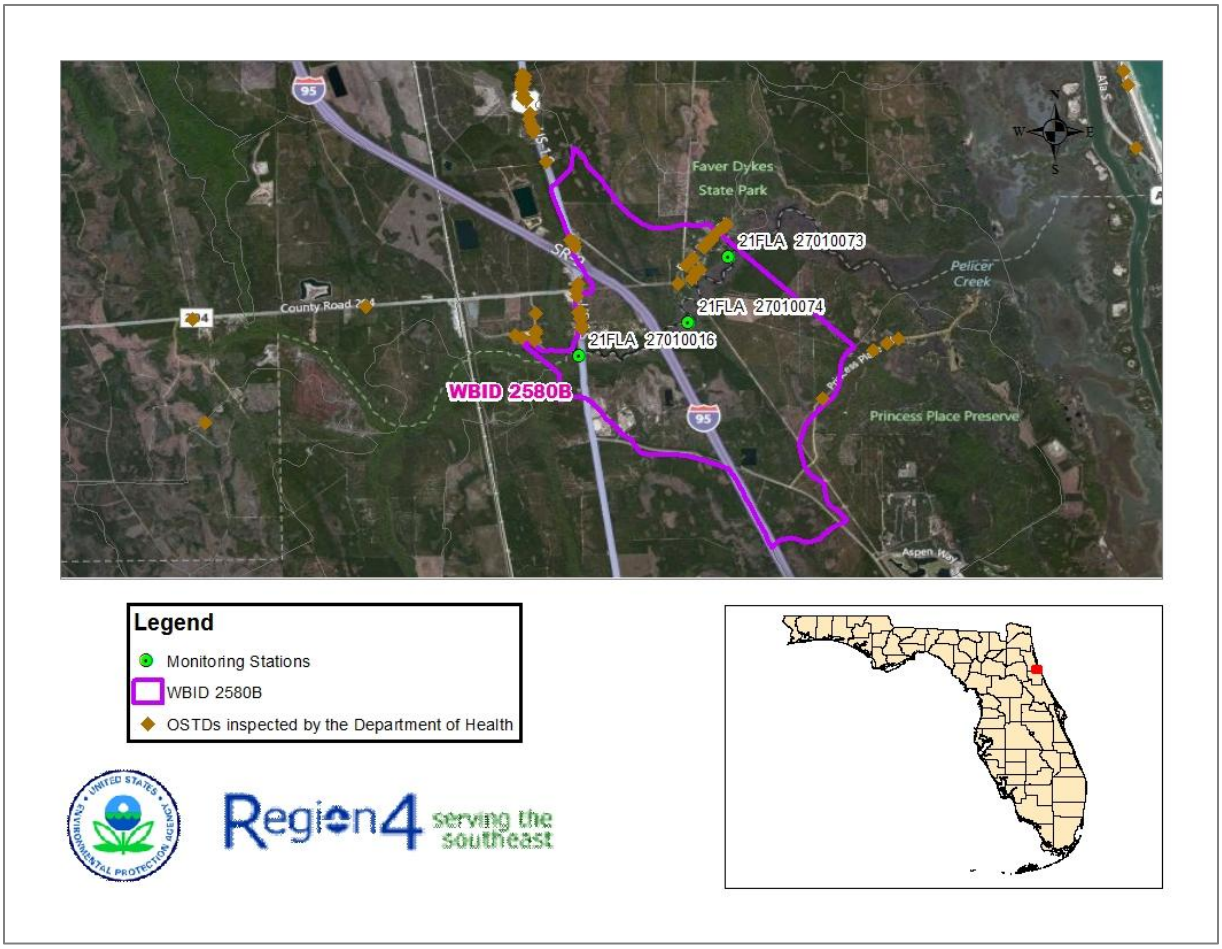

Figure 8. OSTDs inspected in the vicinity of Pellicer Creek, WBID 2580B

6.2.4. Urban Areas/Pervious

Urban areas include land uses such as residential, industrial, utility swaths, extractive and commercial. Fecal coliform loading from urban areas (whether within an MS4 jurisdiction or not) is attributable to multiple sources including storm water 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.

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 outlined in Chapter 403 FS, was established as a technology-based program that relies upon 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, FAC.

Florida's stormwater program is unique in having a performance standard for older stormwater systems that were built before the implementation of the Stormwater Rule in 1982. This rule states: "the pollutant loading from older stormwater management systems

shall be reduced as needed to restore or maintain the beneficial uses of water" (Section 62-4-.432 (5)(c), FAC).

Nonstructural and structural BMPs are an integral part of the State's stormwater programs. Nonstructural BMPs, often referred to as "source controls," are those that can be used to prevent the generation of nonpoint source pollutants or to limit their transport off-site. Typical nonstructural BMPs include public education, land use management, preservation of wetlands and floodplains, and minimization of impervious surfaces. Technology-based structural BMPs are used to mitigate the increased stormwater peak discharge rate, volume, and pollutant loadings that accompany urbanization.

Approximately three percent of the total land area within WBID 2580B is designated as urban. Although developed land use represents only a small percentage of the total land use, it is located immediately adjacent to Pellicer Creek. Additionally, transportation and utilities land use consists of almost five percent of the total land use within the WBID. Two major highways cross Pellicer Creek along the western portion of WBID 2580B. As such, urban and transportation land uses combined represent over eight percent of the total land use in the WBID and could be a relevant source of pathogen loading to Pellicer Creek.

7. Analytical Approach

The approach for calculating fecal coliform TMDLs depends on the number of water quality samples and the availability of flow data. When long-term records of water quality and flow data are not available, the TMDL is expressed as a percent reduction. Load duration curves are used to develop TMDLs when significant data is available to develop a relationship between flow and concentration. Due to the tidal influence on the Pellicer Creek, a load duration curve was not developed with the flow data collected at USGS Gage 02247222. Therefore, this TMDL is expressed as a percent reduction.

7.1. Percent Reduction Approach for TMDL Development

Under this "percent reduction" method, the percent reduction needed to meet the applicable criterion is calculated based on a percentile of all measured concentrations. The (p X 100) percentile is the value with the cumulative probability of p. For example, the 90^{th} percentile has a cumulative probability of 0.90. The 90^{th} percentile is also called the 10 percent exceedance event because it will be exceeded with the probability of 0.10. Therefore, considering a set of water quality data, 90 percent of the measured values are lower than the 90^{th} percentile concentration and 10 percent are higher. There are many formulas for determining the percentile and these can be found in many text books on statistics. The Hazen formula was used in this TMDL since it is recommended in Hunter's Applied Microbiology (2002) article concerning bacteria in water. Application of the Hazen formula to data collected in WBID 2580B is provided in Appendix A.

$$\%\text{Reduction} = \left(\frac{[existing] - [criterion]}{[existing]} \right) \times 100$$

Where:
% Reduction = percent reduction
[*existing*] = existing concentration
[*criterion*] = criterion concentration (i.e., target)

8. TMDL Determination

Pellicer Creek is designated as an Outstanding Florida Water and an Aquatic Preserve by the state of Florida. Additionally, almost 90 percent of the land area within WBID 2580B is designated as natural land use (i.e., forest, water or wetland). With such a high percentage of natural land use in and surrounding WBID 2580B, wildlife (i.e., natural background conditions) is a potential source of bacteria to Pellicer Creek. However, due to the presence of OSTDs and urban development within the watershed, anthropogenic sources cannot be ruled out. Furthermore, WBID 2580B is a Class II Marine waterbody with a designated use of Shellfish Propagation and Harvesting. The Faver-Dykes State Park is located immediately downstream of WBID 2580B. Along with typical park amenities, this park has canoe trails located in Pellicer Creek. Due to the risk to human health from harvesting shellfish with elevated levels of bacteria, and due to the potential anthropogenic sources located within the watershed, a TMDL is being established to bring Pellicer Creek back into compliance with the Class II fecal coliform WQS.

A TMDL for a given pollutant and waterbody is comprised of the sum of individual waste load allocations (WLAs) for point sources, and load allocations (LAs) for both nonpoint sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. Conceptually, this definition is represented by the equation:

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

The TMDL is the total amount of pollutant that can be assimilated by the receiving waterbody and still achieve water quality standards and the waterbody's designated use. In TMDL development, allowable loadings from all pollutant sources that cumulatively amount to no more than the TMDL must be set and thereby provide the basis to establish water quality-based controls.

The percent reduction that meets the acute criteria for Class II waters was calculated by comparing the 90th percentile value with the 43 counts/100 mL criterion. The calculated TMDL reduction for Pellicer Creek (WBID 2580B) is summarized in Table 7.

Table 7. Summary of TMDL Components

Waterbody	WBID	WLA	LA (% Reduction)*	TMDL (% Reduction)*
Pellicer Creek	2580B	N/A	94%	94%

Note:
Overall percent reduction required to achieve the 43 counts/100 mL fecal coliform criterion. The MOS is implicit and does not take away from the TMDL value.

The TMDL is expressed as a daily load by multiplying the water quality target by an estimate of flow in the WBID. The maximum load the stream can transport on any one day and maintain water quality standards is calculated by multiplying 800 counts/100 mL by the flow (in cubic feet per second), along with a conversion factor to obtain units of fecal coliform counts per day.

8.1. Critical Conditions and Seasonal Variation

The critical conditions can be defined as the environmental conditions requiring the largest reduction to meet standards. By achieving the reduction for critical conditions, water quality standards should be achieved during all other times. Seasonal variation must also be considered in TMDL development to ensure that water quality standards will be met during all seasons of the year.

The critical condition for nonpoint source coliform loading is typically an extended dry period followed by a rainfall-runoff event. During dry weather periods, coliform bacteria build up on the land surface, and are washed off by subsequent rainfall. The critical condition for point source loading usually occurs during periods of low streamflow when dilution is minimized.

Flow data is available for Pellicer Creek, downstream of WBID 2580B at USGS Gage 02247222. However, Pellicer Creek is tidally influenced resulting in both positive and negative flow rates recorded by the gage. Therefore, the flow data and bacteria concentrations were evaluated using a time series graph instead of a load duration curve. Based on the information presented in the graphs, exceedances were detected during all flow conditions. Therefore, critical conditions and seasonal variation are accounted for in the TMDL analysis for Pellicer Creek by selecting the largest percent reduction from the entire period of measured water quality data, and using it to represent the pollutant reduction required year-round, for the entire watershed.

8.2. Existing Conditions

Existing conditions represent the current water quality conditions of a waterbody. Existing conditions for WBID 2580B are being represented using the 90^{th} percentile of measured concentrations. The 90^{th} percentile and percent reduction required to meet the TMDL target are shown below in Table 8.

Table 8. Fecal Coliform Existing Conditions in Pellicer Creek (WBID 2580B)

Date	Time	Station	Fecal Coliform (count/100ml)	Remark Code
3/31/2004	1035	21FLA 27010016	670	B
4/26/2004	940	21FLA 27010016	54	
5/25/2004	1120	21FLA 27010016	44	
6/21/2004	1116	21FLA 27010016	472	
7/13/2004	1020	21FLA 27010016	165	
8/4/2004	1040	21FLA 27010016	760	B
9/8/2004	1226	21FLA 27010016	120	
11/8/2004	1300	21FLA 27010016	260	
1/19/2005	940	21FLA 27010016	192	
2/14/2005	1237	21FLA 27010016	160	
3/14/2005	950	21FLA 27010016	180	Q
3/28/2005	1050	21FLA 27010016	413	B
4/13/2005	1240	21FLA 27010016	270	
5/18/2005	850	21FLA 27010016	48	
6/20/2005	1120	21FLA 27010016	400	
7/20/2005	1130	21FLA 27010016	67	B
8/10/2005	1121	21FLA 27010016	1580	B
9/7/2005	1257	21FLA 27010016	1150	
9/19/2005	1040	21FLA 27010016	370	
10/12/2005	940	21FLA 27010016	405	
11/16/2005	1120	21FLA 27010016	133	
12/6/2005	909	21FLA 27010016	187	
1/15/2009	1125	21FLA 27010016	130	
4/21/2009	1037	21FLA 27010016	138	B
7/21/2009	1042	21FLA 27010016	170	B
10/7/2009	1015	21FLA 27010016	240	
1/15/2009	1225	21FLA 27010073	130	
4/21/2009	1145	21FLA 27010073	220	
7/21/2009	1132	21FLA 27010073	40	
10/7/2009	1055	21FLA 27010073	72	
1/15/2009	1155	21FLA 27010074	100	
4/21/2009	1108	21FLA 27010074	68	
7/21/2009	1111	21FLA 27010074	60	
10/7/2009	1037	21FLA 27010074	84	
		90th Percentile	**670**	
		Percent Reduction to meet TMDL Target	**94 percent**	

Several samples were flagged with laboratory remark codes. The following laboratory remark codes were associated with at least one of the samples analyzed as part of this TMDL.

Remark Code B –The laboratory remark code B indicates that the sample result was based upon colony counts outside of the acceptable range. However, the colony counts were considered to be an accurate count and are acceptable for use in the TMDL analysis.

Remark Code Q – The laboratory remark code Q indicates that the sample was held beyond normal holding time. However, holding samples on ice slows the metabolism of the organisms resulting in no appreciable growth. Actual concentration is expected to be at least as high as the value reported. Therefore, the data was considered acceptable for use in the TMDL analysis.

8.3. Margin of Safety

There are two methods for incorporating an MOS in the analysis: a) implicitly incorporate the MOS using conservative assumptions to develop TMDL allocations; or b) explicitly reserve a portion of the TMDL as the MOS and use the remainder for point and nonpoint source allocations. An implicit MOS was incorporated into the TMDL approach by including natural sources of fecal coliform bacteria in the calculation of existing conditions. This conservatively estimates the anthropogenic contributions and increases the required reduction for the TMDL.

8.4. Waste Load Allocations

Only MS4s and NPDES facilities discharging directly into water segments (or upstream tributaries of those segments) are assigned a WLA. The WLAs, if applicable, are expressed separately for continuous discharge facilities (e.g., WWTPs) and MS4 areas, as the former discharges during all weather conditions, whereas the later discharges in response to storm events.

8.4.1. Wastewater/Industrial Permitted Facilities

There are no wastewater or industrial NPDES permitted facilities that discharge to Pellicer Creek, specifically WBID 2580B.

8.4.2. Stormwater Permitted Facilities/MS4s

There are no MS4 areas located within the Pellicer Creek watershed. All future MS4s permitted in the area are automatically prescribed a WLA equivalent to the percent reduction assigned to the LA. Best management practices should be developed for all future MS4s in order to meet the percent reduction as prescribed in Table 7. Two facilities with minor Construction Stormwater Generic Permits are located within WBID 2580B; however, stormwater run-off from construction/industrial sites is not typically considered a significant source for coliform bacteria and were not included in the WLA.

8.5. Load Allocations

The load allocation for nonpoint sources was assigned a percent reduction from the current loadings coming into Pellicer Creek.

9. Recommendations

The initial step in implementing a pathogen TMDL is to more specifically locate the source(s) of bacteria in the watershed. FDEP employs the Basin Management Action Plan (B-MAP) as the mechanism for developing strategies to accomplish the specified load reductions. Components of a B-MAP are:

- Allocations among stakeholders
- Listing of specific activities to achieve reductions
- Project initiation and completion timeliness
- Identification of funding opportunities
- Agreements
- Local ordinances
- Local water quality standards and permits
- Follow-up monitoring

10. References

FDEP 2008. *Water Quality Assessment Report: Upper East Coast.* Florida Department of Environmental Protection, Division of Environmental Assessment and Restoration, Northeast District, Group 5 Basin. 2008.

Florida Administrative Code. Chapter 62-302, Surface Water Quality Standards.

Florida Administrative Code. Chapter 62-303, Identification of Impaired Surface Waters.

P.R. Hunter. 2002. The Society for Applied Microbiology, Letters in Applied Microbiology. 34. 283–286.

SJRWMD, 2009. *Petition to Designate Certain Waters in the Matanzas River Basin as Outstanding Florida Waters.* St. Johns River Water Management District. February 2009.

USEPA, 1991. *Guidance for Water Quality –based Decisions: The TMDL Process.* U.S. Environmental Protection Agency, Office of Water, Washington, DC. EPA-440/4-91-001, April 1991.

Appendix A

Fecal Coliform Data and Percentiles for WBID 2580B

Date	Station	Result (counts/100mL)	Rank	Percentile by Hazen Method
7/21/2009	21FLA 27010073	40	1	1%
5/25/2004	21FLA 27010016	44	2	4%
5/18/2005	21FLA 27010016	48	3	7%
4/26/2004	21FLA 27010016	54	4	10%
7/21/2009	21FLA 27010074	60	5	13%
7/20/2005	21FLA 27010016	67	6	16%
4/21/2009	21FLA 27010074	68	7	19%
10/7/2009	21FLA 27010073	72	8	22%
10/7/2009	21FLA 27010074	84	9	25%
1/15/2009	21FLA 27010074	100	10	28%
9/8/2004	21FLA 27010016	120	11	31%
1/15/2009	21FLA 27010016	130	12	34%
1/15/2009	21FLA 27010073	130	12	34%
11/16/2005	21FLA 27010016	133	14	40%
4/21/2009	21FLA 27010016	138	15	43%
2/14/2005	21FLA 27010016	160	16	46%
7/13/2004	21FLA 27010016	165	17	49%
7/21/2009	21FLA 27010016	170	18	51%
3/14/2005	21FLA 27010016	180	19	54%
12/6/2005	21FLA 27010016	187	20	57%
1/19/2005	21FLA 27010016	192	21	60%
4/21/2009	21FLA 27010073	220	22	63%
10/7/2009	21FLA 27010016	240	23	66%
11/8/2004	21FLA 27010016	260	24	69%
4/13/2005	21FLA 27010016	270	25	72%
9/19/2005	21FLA 27010016	370	26	75%
6/20/2005	21FLA 27010016	400	27	78%
10/12/2005	21FLA 27010016	405	28	81%
3/28/2005	21FLA 27010016	413	29	84%
6/21/2004	21FLA 27010016	472	30	87%
3/31/2004	21FLA 27010016	670	31	90%
8/4/2004	21FLA 27010016	760	32	93%
9/7/2005	21FLA 27010016	1150	33	96%
8/10/2005	21FLA 27010016	1580	34	99%

In this TMDL the Hazen formula was used to calculate percentiles since it is recommended in Hunter's Applied Microbiology (2002) article concerning bacteria in water. To calculate the percentile associated with the sample concentrations, the data is first sorted by concentration, lowest to highest. A ranking is assigned to each sample, with the lowest concentration having a rank of 1 and the highest concentration having a rank equivalent to the total number of samples collected. The percentile is calculated as follows:

Percentile = (Rank – 0.5)/ (total number of samples collected)

For example, for WBID 2580B on November 16, 2005, a fecal coliform concentration of 133 counts/100 mL was measured at station 21FLA 27010016. This concentration ranks number 14 out of 34 samples collected in WBID 2580B. The associated percentile is calculated as:

Percentile = (14-0.5)/34 = 0.40 = 40%

This implies that 40 percent of the time, the instream concentration is less than 133 counts/100 mL.