FINAL

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Environmental Assessment and Restoration,

Bureau of Watershed Restoration

SOUTH DISTRICT • CHARLOTTE HARBOR BASIN

TMDL Report

Fecal Coliform TMDL for Gottfried Creek, WBID 2049

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Florida Department of Environmental Protection, Bureau of Watershed Restoration

TMDL Program

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http://www.dep.state.fl.us/legal/Rules/shared/62-303/62-303.pdf

STORET Program

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

2008 Integrated Report

http://www.dep.state.fl.us/water/docs/2008_Integrated_Report.pdf

Surface Water Quality Standards

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Basin Status Report for the Charlotte Harbor Basin
http://www.dep.state.fl.us/water/basin411/charlotte/status.htm

U.S. Environmental Protection Agency

Region 4: Total Maximum Daily Loads in Florida
http://www.epa.gov/region4/water/tmdl/florida/

National STORET Program

http://www.epa.gov/storet/

Chapter 1: INTRODUCTION

1.1 Purpose of Report

This report presents the Total Maximum Daily Load (TMDL) for fecal coliform bacteria for Gottfried Creek located in the Charlotte Harbor Basin. The creek was verified as impaired for fecal coliform and, therefore, was included on the Verified List of impaired waters for the Charlotte Harbor Basin that was adopted by Secretarial Order on May 19, 2009. The TMDL establishes the allowable fecal coliform loading to Gottfried Creek that would restore the waterbody so that it meets its applicable water quality criterion for fecal coliforms.

1.2 Identification of Waterbody

For assessment purposes, the Florida Department of Environmental Protection (Department) has divided the Charlotte Harbor Basin into water assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or stream reach. This TMDL addresses WBID 2049, Gottfried Creek, for fecal coliforms.

The topography of the Gottfried Creek WBID 2049 watershed encompasses 7,229 acres. The predominant landuses are approximately 1,690 acres of urban areas and 2,087 acres of rangeland. Gottfried Creek is located in Sarasota County. Refer to **Figure 1.1 and 1.2.** The climate in Sarasota County, specifically areas surrounding the Gottfried Creek watershed, is sub-tropical with annual rainfall averaging approximately 49 inches, although rainfall amounts can vary greatly from year to year (SERCC, 2010). Based on data from a 30-year period (1971 – 2000), the average summer temperature is 91.0^{o}F, and the average winter temperature is 72.1^{o}F (SERCC, 2010). The physiography of the Gottfried Creek watershed reflects its location within the Southwestern Florida Flatwoods or Southern Coastal Plains ecoregion. Elevations in the watershed range from around 0 – 10 feet above sea level (FDEP, 2010). The predominant soil type is shelly sand and clay (FDEP, 2008). A major human population center exists within the watershed, which is the City of Englewood.

1.3 Background

This report was developed as part of the Department's watershed management approach for restoring and protecting state waters and addressing TMDL Program requirements. The watershed approach, which is implemented using a cyclical management process that rotates through the state's 52 river basins over a 5-year cycle, provides a framework for implementing the TMDL Program–related requirements of the 1972 federal Clean Water Act and the 1999 Florida Watershed Restoration Act (FWRA) (Chapter 99-223, Laws of Florida).

A TMDL represents the maximum amount of a given pollutant that a waterbody can assimilate and still meet water quality standards, including its applicable water quality criteria and its designated uses. TMDLs are developed for waterbodies that are verified as not meeting their water quality standards. They provide important water quality restoration goals that will guide restoration activities.

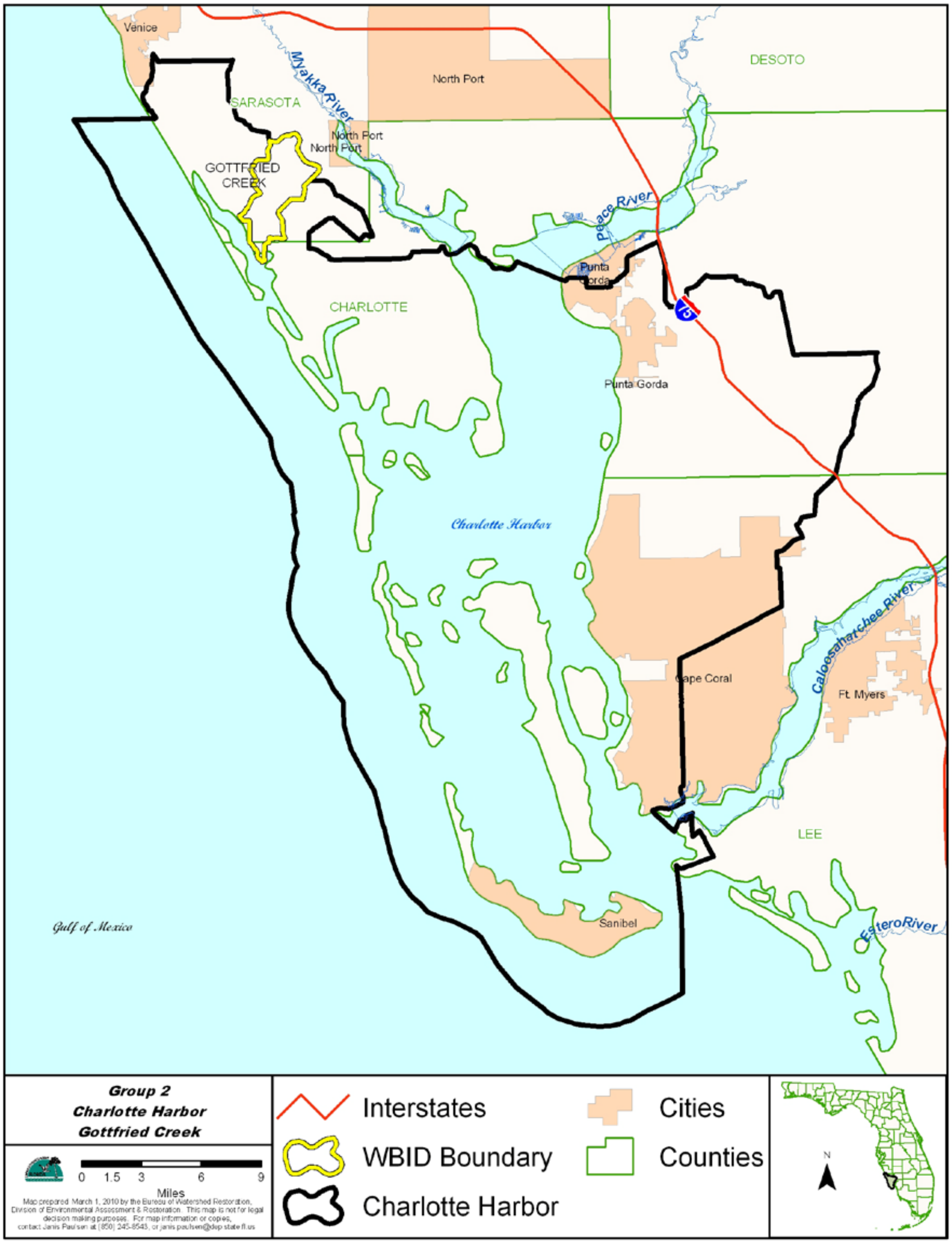


Figure 1.1. Location of Gottfried Creek (WBID 2049) in Sarasota County and Major Hydrological Features in the Area

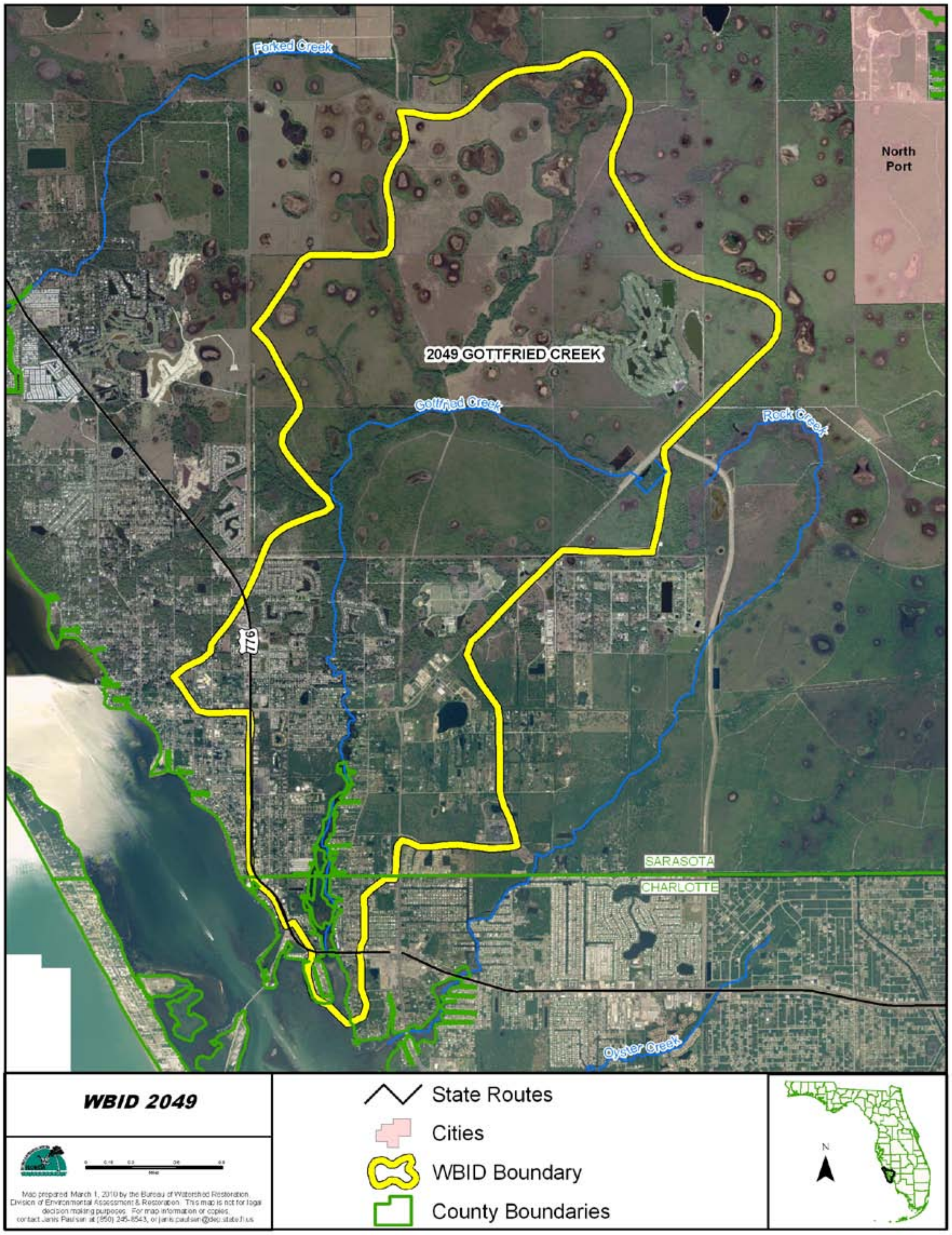


Figure 1.2. Location of Gottfried Creek (WBID 2049)

This TMDL Report will be followed by the development and implementation of a restoration plan designed to reduce the amount of fecal coliform that caused the verified impairment of Gottfried Creek (WBID 2049). These activities will depend heavily on the active participation of the Southwest Florida Water Management District (SWFWMD), local governments, businesses, and other stakeholders. The Department will work with these organizations and individuals to undertake or continue reductions in the discharge of pollutants and achieve the established TMDLs for impaired waterbodies.

Chapter 2: DESCRIPTION OF WATER QUALITY PROBLEM

2.1 Statutory Requirements and Rulemaking History

Section 303(d) of the federal Clean Water Act requires states to submit to the U.S. Environmental Protection Agency (EPA) lists of surface waters that do not meet applicable water quality standards (impaired waters) and establish a TMDL for each pollutant causing the impairment of listed waters on a schedule. The Department has developed such lists, commonly referred to as 303(d) lists, since 1992. The list of impaired waters in each basin, referred to as the Verified List, is also required by the FWRA (Subsection 403.067[4], Florida Statutes [F.S.]); the state's 303(d) list is amended annually to include basin updates.

Florida's 1998 303(d) Consent Decree list included two waterbodies in the Charlotte Harbor Basin [Gottfried Creek (WBID 2049) was not one of the waterbodies listed on the 1998 303(d) list]. However, the FWRA (Section 403.067, F.S.) stated that all Florida 303(d) lists created previous to the adoption of the FWRA were for planning purposes only and directed the Department to develop, and adopt by rule, a new science-based methodology to identify impaired waters. After a long rulemaking process, the Environmental Regulation Commission adopted the new methodology as Rule 62-303, Florida Administrative Code (F.A.C.) (Identification of Impaired Surface Waters Rule, or IWR), in April 2001; the rule was modified in 2006 and 2007.

2.2 Information on Verified Impairment

The Department used the IWR to assess water quality impairments in Gottfried Creek (WBID 2049) and has verified that this waterbody segment is impaired for fecal coliform bacteria during the Cycle 2 verified period (January 1, 2001 – June 30, 2008). Using the IWR methodology this waterbody was verified as impaired based on fecal coliform because more than 10 percent of the values exceeded the Class III waterbody criterion of 400 counts per 100 milliliters (counts/100mL) for fecal coliform. In the Cycle 2 verified period, for Gottfried Creek (WBID 2049) 16 exceedances out of 51 samples existed. **Table 2.1** summarizes the fecal coliform monitoring results for the Cycle 2 verified period for Gottfried Creek (WBID 2049) that were used to develop the TMDL. To ensure that the fecal coliform TMDL was developed based on current conditions in the creek and that recent trends in the creek's water quality were adequately captured, monitoring data during the Cycle 2 verified period were used in the TMDL development.

Table 2.1. Summary of Fecal Coliform Monitoring Data for Gottfried Creek (WBID 2049) During the Cycle 2 Verified Period (January 1, 2001 – June 30, 2008)

Waterbody (WBID)	Parameter	Cycle 2 Fecal Coliform
Gottfried Creek (2049)	Total number of samples	51
	IWR-required number of exceedances for the Verified List	9
	Number of observed exceedances	16
	Number of observed nonexceedances	35
	Number of seasons during which samples were collected	4
	Highest observation (counts/100 mL)	2,850
	Lowest observation (counts/100 mL)	1
	Median observation (counts/100 mL)	130
	Mean observation (counts/100 mL)	478
	FINAL ASSESSMENT	**Impaired**

Table 2.1 indicates that elevated fecal coliform concentrations have been observed in Gottfried Creek (WBID 2049). In addition to periodic high fecal coliform concentrations, the mean concentration indicates that the concentration in the creek is often above the 400 counts/100 mL fecal coliform water quality criterion.

Chapter 3. DESCRIPTION OF APPLICABLE WATER QUALITY STANDARDS AND TARGETS

3.1 Classification of the Waterbody and Criterion 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)**

Gottfried Creek (WBID 2049) 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 criterion applicable to this TMDL is the Class III criterion for fecal coliform.

3.2 Applicable Water Quality Standards and Numeric Water Quality Target

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

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

The criterion states that monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30-day period. There were insufficient data (fewer than 10 samples in a given month) available to evaluate the geometric mean criterion for fecal coliform bacteria. Therefore, the criterion selected for the TMDLs was not to exceed 400 counts/100 mL in any sampling event for fecal coliform.

Chapter 4: ASSESSMENT OF SOURCES

4.1 Types of Sources

An important part of the TMDL analysis is the identification of pollutant source categories, source subcategories, or individual sources of pollutants in the impaired waterbody and the amount of pollutant loadings contributed by each of these sources. Sources are broadly classified as either "point sources" or "nonpoint sources." Historically, the term point sources has meant discharges to surface waters that typically have a continuous flow via a discernable, confined, and discrete conveyance, such as a pipe. Domestic and industrial wastewater treatment facilities (WWTFs) are examples of traditional point sources. In contrast, the term "nonpoint sources" was used to describe intermittent, rainfall-driven, diffuse sources of pollution associated with everyday human activities, including runoff from urban land uses, agriculture, silviculture, and mining; discharges from failing septic systems; and atmospheric deposition.

However, the 1987 amendments to the Clean Water Act redefined certain nonpoint sources of pollution as point sources subject to regulation under the EPA's National Pollutant Discharge Elimination System (NPDES) Program. These nonpoint sources included certain urban stormwater discharges, including those from local government master drainage systems, construction sites over five acres, and a wide variety of industries (see **Appendix A** for background information on the federal and state stormwater programs).

To be consistent with Clean Water Act definitions, the term "point source" will be used to describe traditional point sources (such as domestic and industrial wastewater discharges) *and* stormwater systems requiring an NPDES stormwater permit when allocating pollutant load reductions required by a TMDL (see **Section 6.1**). However, the methodologies used to estimate nonpoint source loads do not distinguish between NPDES stormwater discharges and non-NPDES stormwater discharges, and as such, this source assessment section does not make any distinction between the two types of stormwater.

4.2 Potential Sources of Fecal Coliform within the Gottfried Creek WBID Boundary

4.2.1 Point Sources

Wastewater Point Sources

No NPDES permitted facilities exist within the Gottfried Creek WBID boundary; therefore, facilities have no impact on fecal coliform concentrations within the creek.

Municipal Separate Storm Sewer System Permittees

One NPDES municipal separate storm sewer system (MS4) permit covers Gottfried Creek (WBID 2049), which is Sarasota County and Co Permittees (Phase I FLS000004).

4.2.2 Land Uses and Nonpoint Sources

Accurately quantifying the fecal coliform loadings from nonpoint sources requires identifying nonpoint source categories, locating of the sources, determining the intensity and frequency at which these sources create high fecal coliform loadings, and specifying the relative contributions from these sources. Depending on the land use distribution in a given watershed, frequently cited nonpoint sources in urban areas include failed septic tanks, leaking sewer lines, and pet feces. For a watershed dominated also by rangeland land uses, fecal coliform loadings can come from the runoff from areas with animal feeding operation or direct animal access to the receiving waters. In addition to the sources associated with the anthropogenic activities, birds and other wildlife forms can also act as fecal coliform contributors to the receiving waters. While detailed source information is not always available for accurately quantifying the fecal coliform loadings from different sources, land use information, can provide some hints on what can be the potential sources of observed fecal coliform impairment.

Land Uses

The spatial distribution and acreage of different land use categories were identified using the SWFWMD's year 2006 land use coverage contained in the Department's geographic information system (GIS) library. Land use categories within the Gottfried Creek WBID boundary were aggregated using the simplified Level 1 codes and tabulated in **Table 4.1**. **Figure 4.1** shows the spatial distribution of the principal land uses within the WBID boundary.

As shown in **Table 4.1**, the total area within the Gottfried Creek WBID boundary is about 7,229 acres. The dominant land use categories are urban land (urban and built-up; low-, medium-, and high-density residential) and rangeland, which accounts for about 52 percent of the total WBID area. Urban and built-up land use occupies about 1,690 acres or about 23 percent of the total WBID area. Of the 1,690 acres of urban lands, residential land use occupies about 1,156 acres. Rangeland land use occupies about 2,087 acres or about 29 percent of the total WBID area.

Table 4.1. Classification of Land Use Categories within the Gottfried Creek WBID Boundary

Level 1 Code	Land Use	Acreage	% Acreage
1000	Urban and built-up	534	7.4%
1100	Low-density residential	397	5.5%
1200	Medium-density residential	558	7.7%
1300	High-density residential	201	2.8%
2000	Agriculture	1027	14.2%
3000	Rangeland	2088	28.8%
4000	Upland forest	905	12.5%
5000	Water	258	3.6%
6000	Wetland	1150	15.9%
7000	Barren land	0	0.0%
8000	Transportation, communication, and utilities	111	1.5%
	TOTAL	**7,229**	**100%**

Because the dominant land use in the Gottfried Creek WBID boundary is the urban land use and rangeland, the possible sources of the fecal coliform loadings are failed septic tanks, sewer line leakage, pet feces, runoff from areas with animal feeding operation, direct animal access to the receiving waters, and wildlife.

Preliminary quantification of the fecal coliform loadings from these sources was conducted to demonstrate the relative contributions. Detailed load estimation and description of the methods used for the quantification are discussed in **Appendix B**. It should be noted that the information included in the **Appendix B** has been only used to demonstrate the possible relative contributions from different sources. The loading estimates have not been used in establishing the final TMDLs.

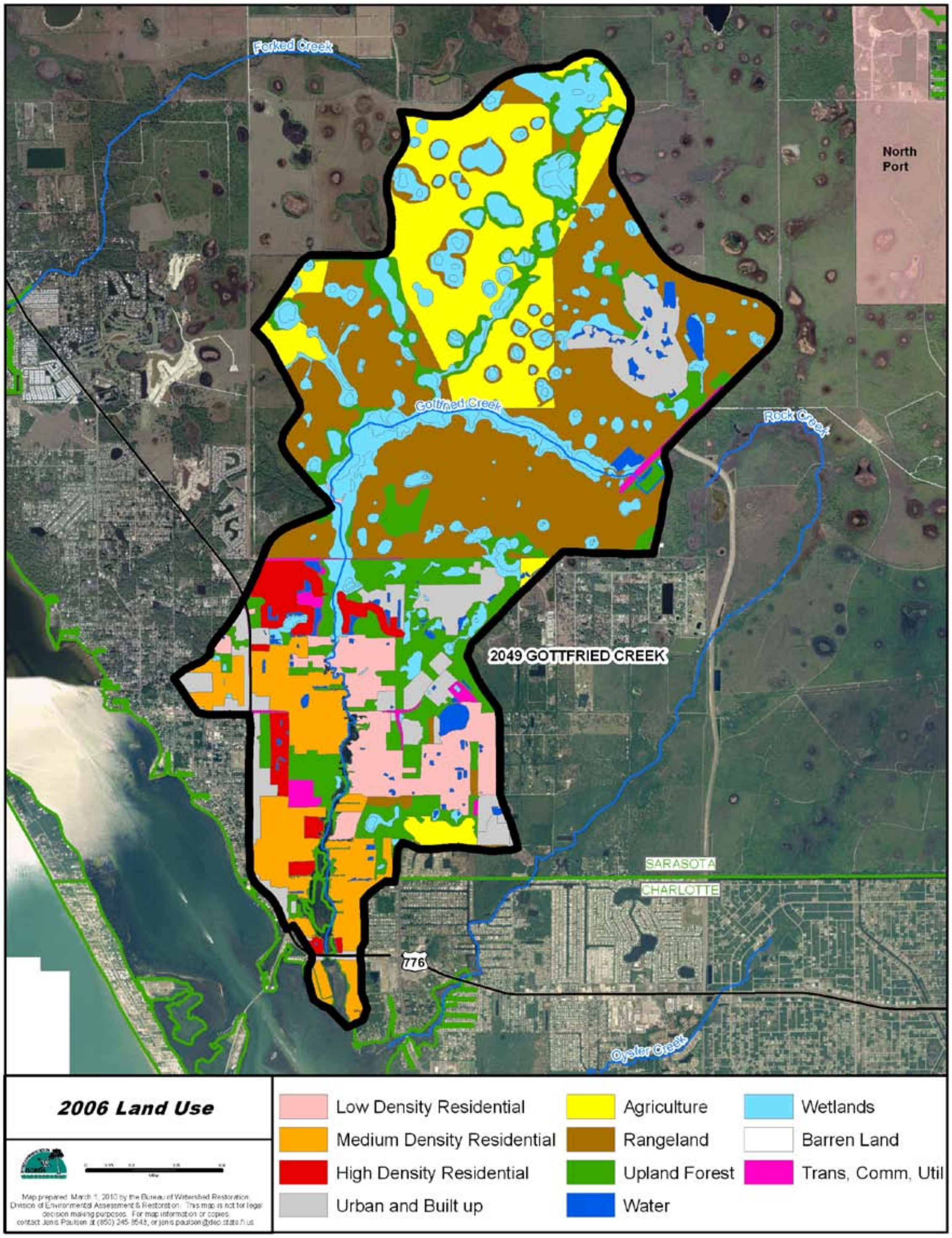


Figure 4.1. Principal Land Uses within the Gottfried Creek WBID Boundary

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Determination of Loading Capacity

When continuous flow measurements in a watershed are available, a bacteria TMDL can be developed using the load duration curve method, which was developed by the Kansas Department of Health and Environment and provides daily bacteria load. However, flow data were not available for Gottfried Creek (WBID 2049); therefore, the fecal coliform TMDL was developed using the "percent reduction" approach. Using the "percent reduction" method, the percent reduction needed to meet the applicable criterion is calculated based on the 90^{th} percentile of all measured concentrations collected during the Cycle 2 Verified Period (January 1, 2001 – June 30, 2008). Because bacteriological counts in water are not normally distributed, a nonparametric method is more appropriate for the analysis of fecal coliform data (Hunter, 2002). The Hazen method, which uses a nonparametric formula, was used to determine the 90^{th} percentile. EPA Region IV utilizes this method in the development process of fecal coliform TMDLs. The percent reduction of fecal coliform needed to meet the applicable criterion was calculated, as described in **Section 5.1.3**.

5.1.1 Data Used in the Determination of the TMDL

Data used to develop this TMDL were provided by the Florida Department of Environmental Protection – South District (Stations: 21FLFTMSARABY0021FTM, 21FLFTMSARABY0022FTM, 21FLFTMSARABY0023FTM, and 21FLFTMSARABY0024FTM) and the Charlotte Harbor Aquatic/Buffer Preserves (21FLCHARLBGOT2). Refer to **Figure 5.1** for the locations of the water quality stations from which fecal coliform data were collected for Gottfried Creek. The Cycle 2 Verified Period includes data collected from January 1, 2001 through June 30, 2008. For the Cycle 2 Verified Period all the fecal coliform data for the Gottfried Creek WBID were collected in 2005 – 2008; therefore, this analysis focuses on fecal coliform data collected in the mid to latter part of the Cycle 2 Verified Period. During this period 51 fecal coliform samples were collected from five sampling stations in WBID 2049.

Concentrations ranged from 1 to 2850 counts/100 mL and averaged 478 counts/100 mL during the period of observation. **Table 5.1** summarizes the descriptive statistics for the 2005 – 2008 fecal coliform results. **Figure 5.2** shows the fecal coliform concentration trends observed in Gottfried Creek (WBID 2049).

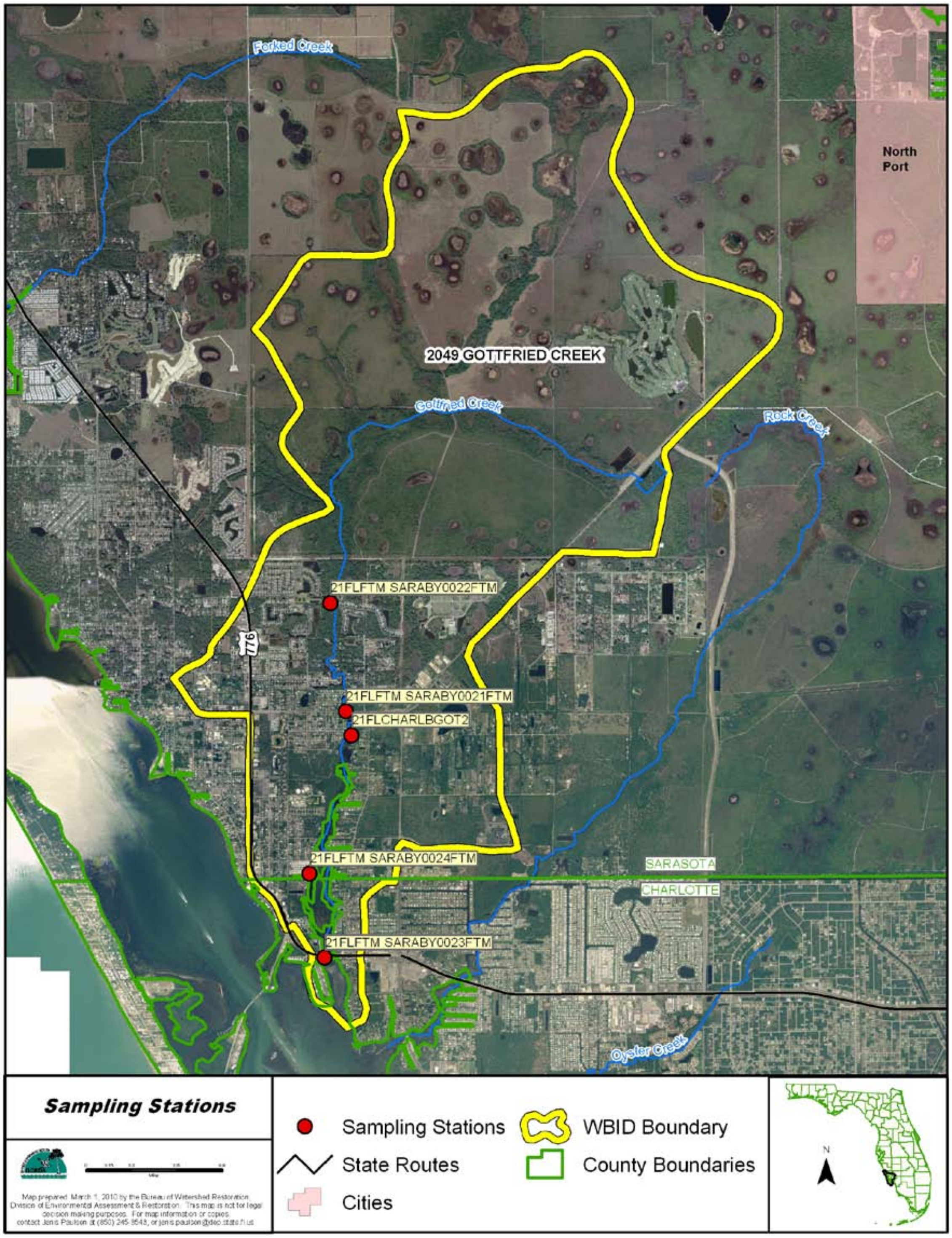
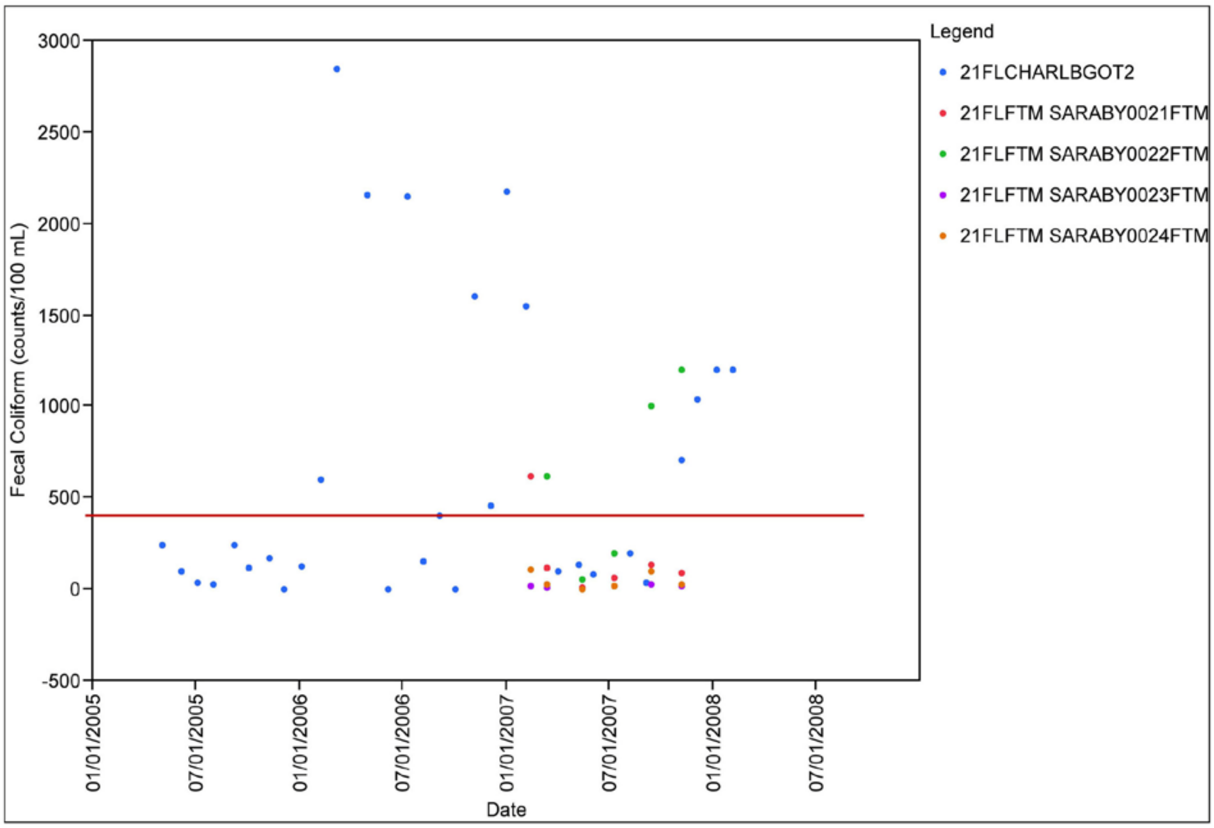


Figure 5.1. Location of Water Quality Stations with Fecal Coliform Data in Gottfried Creek (WBID 2049)

Table 5.1. Descriptive Statistics of Fecal Coliform Data for Gottfried Creek (WBID 2049) for 2005 – 2008

Descriptive Statistic	Result
Mean observation (counts/100 mL)	478
Median observation (counts/100 mL)	130
Highest observation (counts/100 mL)	2850
Lowest observation (counts/100 mL)	1
25% Quartile	32
75% Quartile	620
Number of samples	51



The red line indicates the target concentration (400 counts/100 mL).

Figure 5.2. Fecal Coliform Concentration Trends in Gottfried Creek (WBID 2049) for 2005 - 2008 of the Cycle 2 Verified Period by Station

Spatial Patterns

Fecal coliform data from 2005 - 2008 for water quality sampling stations were analyzed to detect spatial trends in the data (**Figure 5.2**). High fecal coliform concentrations were observed in two of the five stations (21FLCHARLBGOT2 and 21FLFTM SARABY0022FTM). Refer to **Table 5.2**. The landuse surrounding these stations are primarily medium and high density residential.

Table 5.2. Station Summary Statistics of the Fecal Coliform Data for Gottfried Creek (WBID 2049) in 2005 - 2008

Station	Period of Observation	# of Samples	Min.	Max.	Mean	Median	# of Exceedances	Percent Exceedance
21FLCHARLBGOT2	2005 - 2008	30	1	2850	662	220	12	40%
21FLFTM SARABY0021FTM	2007	6	12	620	174	105	1	17%
21FLFTM SARABY0022FTM	2007	5	56	1200	615	620	3	60%
21FLFTM SARABY0023FTM	2007	4	10	32	20	18	0	0%
21FLFTM SARABY0024FTM	2007	6	2	110	48	27	0	0%

Coliform counts are #/100 mL.
Exceedances represent values above 400 counts/100 mL.

Temporal Patterns

Monthly and Seasonal Trends

Using rainfall data collected at the Venice, FL CLIMOD station (http://climod.meas.ncsu.edu/) it was possible to compare monthly rainfall in 2005 – 2008 with monthly fecal coliform exceedance rates for the same period, as well as average quarterly rainfall with average quarterly fecal coliform exceedance rates at all stations (**Figures 5.3** and **5.4**).

High monthly mean fecal coliform concentrations were observed in November, December, January, February, and March. The highest monthly mean fecal coliform concentration and the highest exceedance rate (57%) were observed during the 1st quarter (January, February, and March). The lowest monthly mean fecal coliform concentration and the lowest exceedance rate (10%) were observed during the 2nd quarter (April, May, and June). Monthly and seasonal fecal coliform averages and percent exceedances for the data collected in 2005 - 2008 are summarized in **Table 5.3**

Table 5.3. Summary Statistics of Fecal Coliform Data for All Stations in Gottfried Creek (WBID 2049) by Month and Season during 2005 – 2008 of the Cycle2 Verified Period

Month	Number of Samples	Minimum	Maximum	Median	Mean	Number of Exceedances	Percent Exceedance
January	3	130	2180	1200	1170	2	67
February	6	20	1550	610	683	4	67
March	5	10	2850	120	726	2	40
April	1	100	100	100	100	0	0
May	6	2	2160	98	435	1	17
June	3	1	100	80	60	0	0
July	5	20	2150	60	493	1	20
August	3	24	200	150	125	0	0
September	7	32	1000	140	279	1	14
October	2	1	120	61	61	0	0
November	7	16	1600	170	544	3	43
December	3	1	1040	460	500	2	67
Season	**Number of Samples**	**Minimum**	**Maximum**	**Median**	**Mean**	**Number of Exceedances**	**Percent Exceedance**
Quarter 1	14	10	2850	610	803	8	57
Quarter 2	10	1	2160	90	289	1	10
Quarter 3	15	20	2150	140	319	2	13
Quarter 4	12	1	1600	145	453	5	42

Coliform counts are #/100 mL.
Exceedances represent values above 400 counts/100 mL.

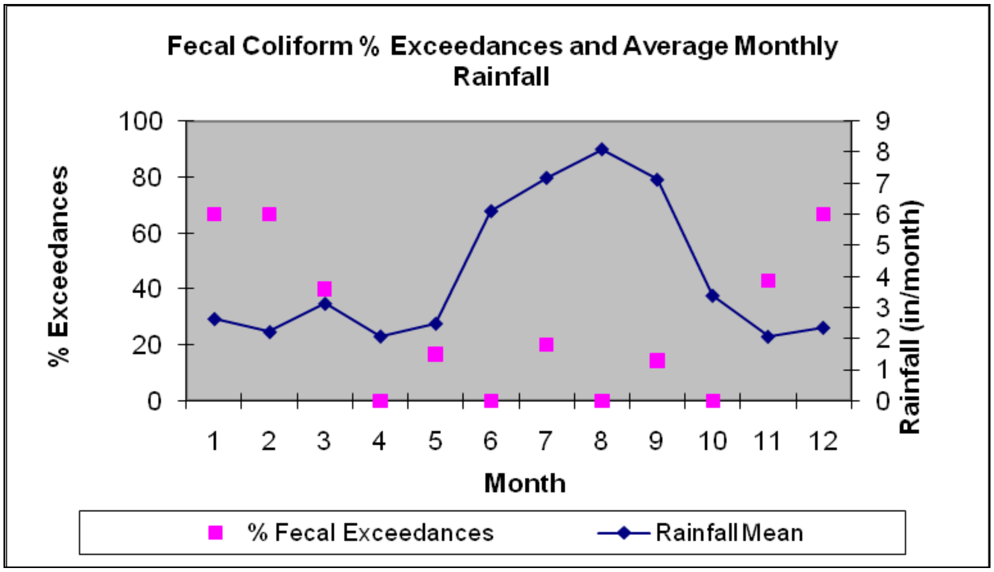


Figure 5.3. Fecal Coliform Exceedances and Rainfall at All Stations in Gottfried Creek (WBID 2049) by Month during 2005 – 2008 of the Cycle 2 Verified Period

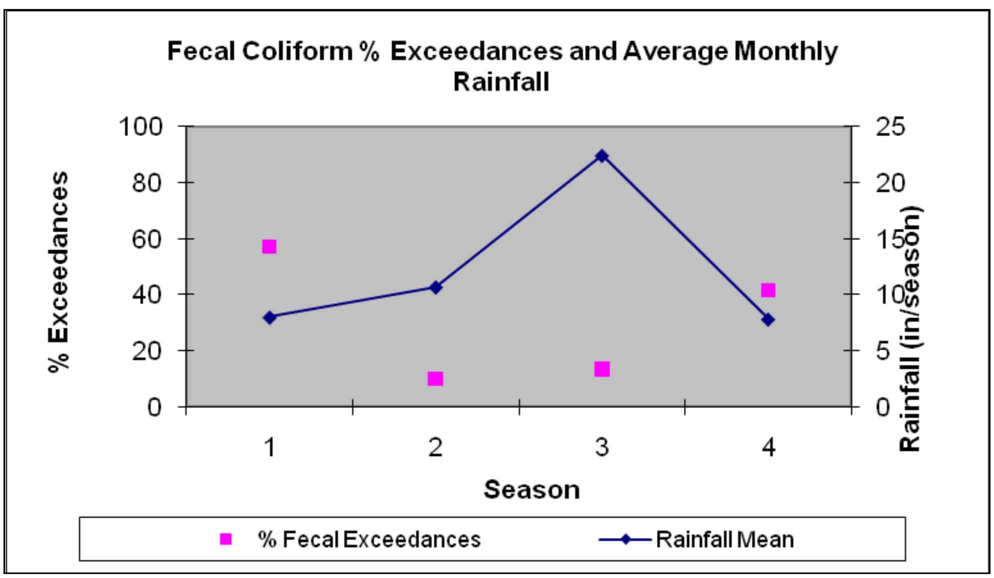
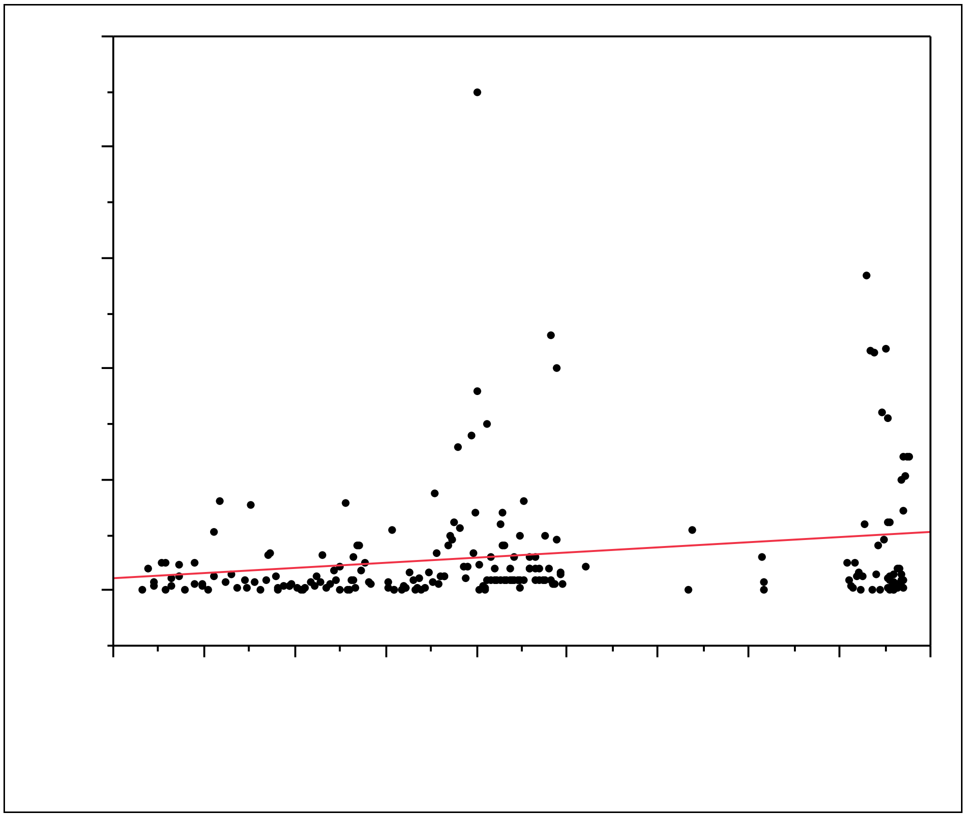


Figure 5.4. Fecal Coliform Exceedances and Rainfall at All Stations in Gottfried Creek (WBID 2049) by Season during 2005 – 2008 of the Cycle 2 Verified Period

Period of Record trend

Plotting the historical fecal coliform data by time revealed a significant (Prob > F = 0.002) increasing trend for the entire period of record (1974 – 2008) in Gottfried Creek (**Figure 5.5**).



Linear Equation: Fecal Coliform (counts/100 mL) = -698.2458 + 3.7086e-7*date

Figure 5.5. Fecal Coliform Concentration Trends in Gottfried Creek (WBID 2049) for Entire Period of Record (1974 – 2008)

Fecal Coliform Data by Hydrologic Condition

As no current flow data were available, hydrologic conditions were analyzed using rainfall. A loading curve type chart, that would normally be applied to flow events, was created using precipitation data from the Venice, FL CLIMOD station (089176). The chart was divided in the same manner as if flow was being analyzed, where extreme precipitation events represent the upper percentiles (0-5th percentile), followed by large precipitation events (5th – 10th percentile), medium precipitation events (10th – 40th percentile), small precipitation events (40th – 60th percentile), and no recordable precipitation events (60th – 100th percentile). Three day (day of and two days prior to sampling) precipitation accumulations were used in the analysis (**Table 5.4** and **Figure 5.6**). Because all the fecal coliform data for the data period (2005 – 2008) were collected during dry weather events (no recordable precipitation event) a connection between fecal coliform data and hydrologic condition could not be determined.

Table 5.4. Summary of Fecal Coliform Data by Hydrological Condition Based on Three Day Precipitation

Precipitation Event	Event Range (Percentile)	Total Samples	Number of Exceedances	Percent Exceedance	Number of Non-Exceedances	Percent Non-Exceedance
None/Not Measurable	60 - 100	51	16	31%	35	69%
Small	40 - 60	0	0	0	0	0
Medium	10 - 40	0	0	0	0	0
Large	5 - 10	0	0	0	0	0
Extreme	0 - 5	0	0	0	0	0

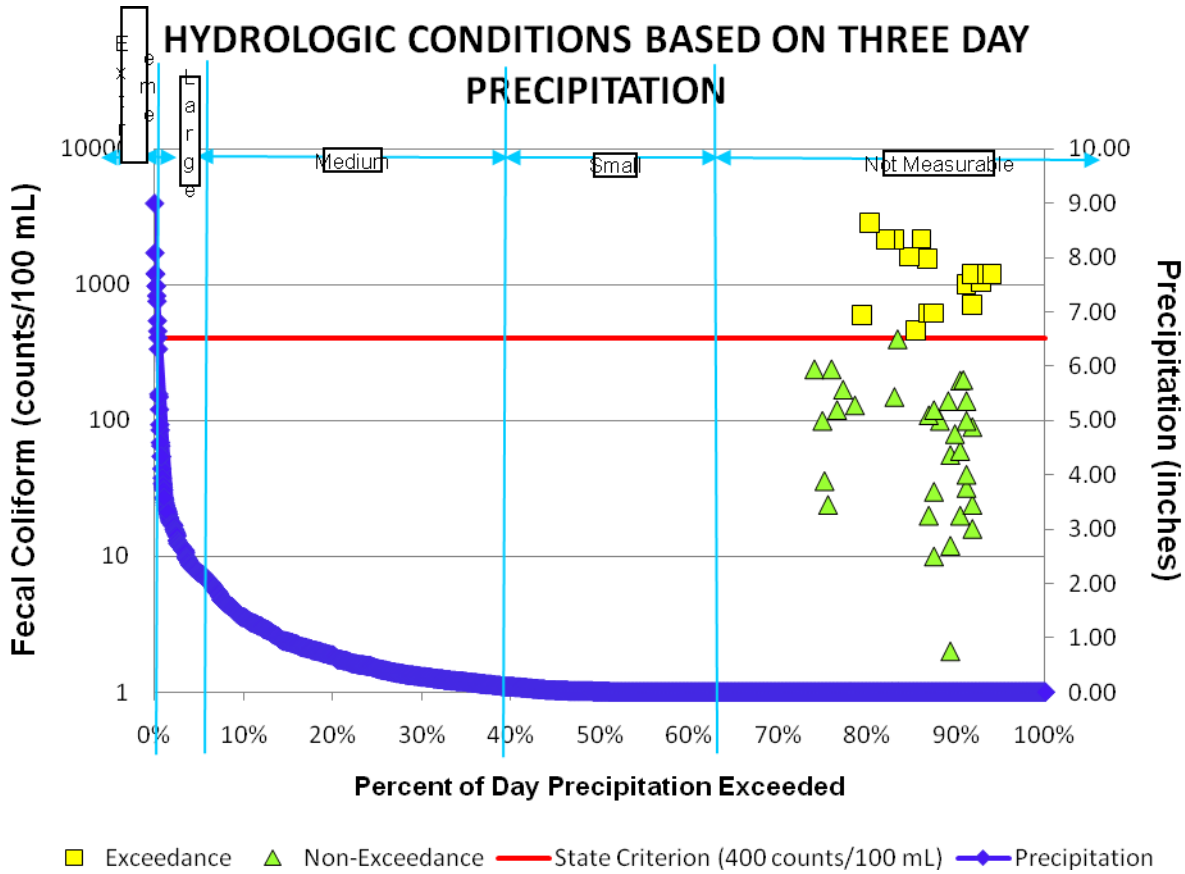


Figure 5.6. Fecal Coliform Data by Hydrological Condition Based on Three Day Precipitation

5.1.2 Critical Conditions

The critical condition for coliform loadings in a given watershed depends on many factors, including the presence of point sources and the land use pattern in the watershed. Typically, the critical condition for nonpoint sources is an extended dry period followed by a rainfall runoff event. During the wet weather period, rainfall washes off coliform bacteria that have built up on the land surface under dry conditions, resulting in the wet weather exceedances. However, significant nonpoint source contributions can also appear under dry conditions without any major surface runoff event. This usually happens when nonpoint sources contaminate the surficial aquifer, and fecal coliform bacteria are brought into the receiving waters through baseflow. In addition, the fecal coliform contribution of wildlife and livestock with direct access to the receiving water can be more noticeable during dry weather. The critical condition for point source loading typically occurs during periods of low stream flow, when dilution is minimized.

Based on 52% of the total WBID area being composed of urban and rangeland land use areas, the temporal patterns, and spatial patterns of the fecal coliform data, it is likely that many of the exceedances are from nonpoint sources and MS4s entering the surface waters through surface runoff. Since all the data was collected under relatively dry conditions (small and none/not measurable precipitation events) it is impossible to exclude the possibility of exceedances under the wet condition. Therefore, the fecal coliform target established for this TMDL applies to all the rainfall conditions.

5.1.3 TMDL Development Process

Due to the lack of supporting information, mainly flow data, a simple reduction calculation was performed to determine the reduction in fecal coliform concentration necessary to achieve the concentration target (400 counts/100 ml). The percent reduction needed to reduce pollutant load was calculated by comparing the existing concentrations and target concentration using the **Formula 1**:

$$\text{Needed \% Reduction} = \frac{\text{Existing } 90^{\text{th}} \text{ Percentile Concentration-Allowable Concentration}}{\text{Existing } 90^{\text{th}} \text{ Percentile Concentration}} \times 100 \qquad \textbf{Formula 1}$$

Using the Hazen method for estimating percentiles as described in Hunter (2002), the existing condition concentration was defined as the 90^{th} percentile of all the fecal coliform data collected during the Cycle 2 Verified Period (January 1, 2002 – June 30, 2009). The 90^{th} percentile is also called the 10 percent exceedance event. This will result in a target condition that is consistent with the state bacteriological water quality assessment threshold for Class III waters.

In applying this method, all of the available data are ranked (ordered) from the lowest to the highest (**Table 5.5**) and **Formula 2** is used to determine the percentile value of each data point.

$$\text{Percentile} = \frac{\text{Rank} - 0.5}{\text{Total Number of Samples Collected}} \qquad \textbf{Formula 2}$$

If none of the ranked values are shown to be the 90^{th} percentile value, then the 90^{th} percentile number (used to represent the existing condition concentration) is calculated by interpolating between the two data points adjacent (above and below) to the desired 90^{th} percentile rank using **Formula 3,** as described below.

$$90^{\text{th}} \text{ Percentile Concentration} = C_{\text{lower}} + (P_{90\text{th}} * R) \qquad \textbf{Formula 3}$$

Where,

C_{lower} is the fecal coliform concentration corresponding to the percentile lower than the *90^{th}* percentile,

P_{90th} is the percentile difference between the 90^{th} percentile and the percentile number immediately lower than the 90^{th} percentile (in this case, 89%), which is 90% - 89% = 1%

R is a ratio defined as R= (fecal coliform concentration $_{upper}$ – fecal coliform concentration $_{lower}$)/(percentile $_{upper}$ – percentile $_{lower}$)

To calculate R, the percentile values below and above the 90^{th} percentile were identified, in this case, 89% and 91%, respectively. Refer to **Table 5.5**. Next, the corresponding fecal coliform concentration for 89% is 1,550 counts/100mL, and the corresponding fecal coliform concentration for 91% is 1,600 counts/100mL (**Table 5.5**). The fecal coliform concentration difference between the lower and higher percentiles was then calculated and divided by the unit percentile. The unit percentile difference is the difference between the lower and upper percentiles (e.g. 91% – 89% = 1 percentile unit difference). R was then calculated as (1,600 – 1,550)/(91% - 89%) = R = 25.

The C_{lower}, P_{90th}, and R were substituted into **Formula 3** to calculate the 90^{th} percentile fecal coliform concentration (i.e. 90^{th} Percentile Concentration = 1,550 + 1 * 25 = 1,575 counts/mL).

Using **Formula 1**, the percent reduction for the period of observation (January 1, 2001 – June 30, 2008) was calculated as 74% for Gottfried Creek WBID 2049 (i.e. % reduction needed = [(1,575-400)/1,575]*100 = 74%).

Table 5.5 shows the individual fecal coliform data, the ranks, the percentiles for each individual data, the existing 90^{th} percentile concentration, the allowable concentration (400 counts/100 ml), and the percent reduction needed to meet the applicable water quality criterion for fecal coliform.

Table 5.5. Calculation of Fecal Coliform Reductions for the Gottfried Creek (WBID 2049) TMDL Based on the Hazen Method

Station	Date	Fecal Coliform Conc (MPN/100 mL)	Rank	Percentile by Hazen Method
21FLCHARLBGOT2	12/5/2005	1	1	1%
21FLCHARLBGOT2	6/5/2006	1	2	3%
21FLCHARLBGOT2	10/2/2006	1	3	5%
21FLFTM SARABY0024FTM	5/14/2007	2	4	7%
21FLFTM SARABY0023FTM	3/13/2007	10	5	9%
21FLFTM SARABY0021FTM	5/14/2007	12	6	11%
21FLFTM SARABY0023FTM	11/5/2007	16	7	13%
21FLFTM SARABY0023FTM	2/12/2007	20	8	15%
21FLFTM SARABY0024FTM	7/10/2007	20	9	17%
21FLCHARLBGOT2	8/1/2005	24	10	19%
21FLFTM SARABY0024FTM	11/5/2007	24	11	21%
21FLFTM SARABY0024FTM	3/13/2007	30	12	23%
21FLFTM SARABY0023FTM	9/12/2007	32	13	25%
21FLCHARLBGOT2	7/5/2005	36	14	26%
21FLCHARLBGOT2	9/4/2007	40	15	28%
21FLFTM SARABY0022FTM	5/14/2007	56	16	30%
21FLFTM SARABY0021FTM	7/10/2007	60	17	32%
21FLCHARLBGOT2	6/4/2007	80	18	34%
21FLFTM SARABY0021FTM	11/5/2007	90	19	36%

21FLCHARLBGOT2	6/6/2005	100	20	38%
21FLCHARLBGOT2	4/2/2007	100	21	40%
21FLFTM SARABY0024FTM	9/12/2007	100	22	42%
21FLFTM SARABY0024FTM	2/12/2007	110	23	44%
21FLCHARLBGOT2	10/3/2005	120	24	46%
21FLFTM SARABY0021FTM	3/13/2007	120	25	48%
21FLCHARLBGOT2	1/3/2006	130	26	50%
21FLCHARLBGOT2	5/7/2007	140	27	52%
21FLFTM SARABY0021FTM	9/12/2007	140	28	54%
21FLCHARLBGOT2	8/7/2006	150	29	56%
21FLCHARLBGOT2	11/7/2005	170	30	58%
21FLFTM SARABY0022FTM	7/10/2007	198	31	60%
21FLCHARLBGOT2	8/6/2007	200	32	62%
21FLCHARLBGOT2	5/2/2005	240	33	64%
21FLCHARLBGOT2	9/6/2005	240	34	66%
21FLCHARLBGOT2	9/5/2006	400	35	68%
21FLCHARLBGOT2	12/4/2006	460	36	70%
21FLCHARLBGOT2	2/6/2006	600	37	72%
21FLFTM SARABY0021FTM	2/12/2007	620	38	74%
21FLFTM SARABY0022FTM	3/13/2007	620	39	75%
21FLCHARLBGOT2	11/5/2007	710	40	77%
21FLFTM SARABY0022FTM	9/12/2007	1000	41	79%
21FLCHARLBGOT2	12/3/2007	1040	42	81%
21FLFTM SARABY0022FTM	11/5/2007	1200	43	83%
21FLCHARLBGOT2	1/7/2008	1200	44	85%
21FLCHARLBGOT2	2/4/2008	1200	45	87%
21FLCHARLBGOT2	2/5/2007	1550	46	89%
21FLCHARLBGOT2	11/6/2006	1600	47	91%
21FLCHARLBGOT2	7/10/2006	2150	48	93%
21FLCHARLBGOT2	5/1/2006	2160	49	95%
21FLCHARLBGOT2	1/2/2007	2180	50	97%
21FLCHARLBGOT2	3/6/2006	2850	51	99%
Existing condition concentration – 90th percentile (counts/100mL)				**1575**
Allowable concentration (counts/100mL)				**400**
Final percent reduction				**74%**

Chapter 6: DETERMINATION OF THE TMDL

6.1 Expression and Allocation of the TMDL

The objective of a TMDL is to provide a basis for allocating acceptable loads among all of the known pollutant sources in a watershed so that appropriate control measures can be implemented and water quality standards achieved. A TMDL is expressed as the sum of all point source loads (Wasteload Allocations, or WLAs), nonpoint source loads (Load Allocations, or LAs), and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

TMDL = ∑ WLAs + ∑ LAs + MOS

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

$$\textbf{TMDL} \cong \sum \textbf{WLAs}_{\textbf{wastewater}} + \sum \textbf{WLAs}_{\textbf{NPDES Stormwater}} + \sum \textbf{LAs} + \textbf{MOS}$$

It should be noted that the various components of the revised TMDL equation may not sum up to the value of the TMDL because (a) the WLA for NPDES stormwater is typically based on the percent reduction needed for nonpoint sources and is also accounted for within the LA, and (b) TMDL components can be expressed in different terms (for example, the WLA for stormwater is typically expressed as a percent reduction, and the WLA for wastewater is typically expressed as mass per day).

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

This approach is consistent with federal regulations (40 CFR § 130.2[I]), which state that TMDLs can be expressed in terms of mass per time (e.g., pounds per day), toxicity, or other appropriate measure. The TMDL for Gottfried Creek (WBID 2049) are expressed in terms of counts/day and percent reduction, and represent the maximum daily fecal coliform load the stream can assimilate without exceeding the fecal coliform criterion (**Table 6.1**).

Table 6.1. TMDL Components for Fecal Coliform in Gottfried Creek (WBID 2049)

Parameter	TMDL (counts/100mL)	WLA		LA (% reduction)	MOS
		Wastewater (counts/100mL)	NPDES Stormwater (% reduction)		
Fecal coliform	400	NA	74%	74%	Implicit

6.2 Load Allocation

Based on a percent reduction approach the load allocation is a 74 percent reduction in fecal coliform from nonpoint sources. It should be noted that the LA includes loading from stormwater discharges regulated by the Department and the water management districts that are not part of the NPDES stormwater program (see **Appendix A**).

6.3 Wasteload Allocation

6.3.1 NPDES Wastewater Discharges

No NPDES-permitted wastewater facilities were permitted to discharge within the Gottfried Creek WBID boundary. The state already requires all NPDES point source dischargers to meet bacteria criteria at the end of the pipe. It is the Department's current practice not to allow mixing zones for bacteria. These requirements will also be applied to any possible future point sources that may discharge in the WBID to meet end-of-pipe standards for coliform bacteria.

6.3.2 NPDES Stormwater Discharges

The WLA for stormwater discharges with an MS4 permit is a 74 percent reduction in current fecal coliform loading for WBID 2049. It should be noted that any MS4 permittee is only responsible for reducing the anthropogenic loads associated with stormwater outfalls that it owns or otherwise has responsible control over, and it is not responsible for reducing other nonpoint source loads in its jurisdiction.

6.4 Margin of Safety

Consistent with the recommendations of the Allocation Technical Advisory Committee (Department, 2001), an implicit MOS was used in the development of this TMDL by not subtracting contributions from natural sources and sediments when the percent reduction was calculated. This makes the estimation of human contribution more stringent and therefore adds to the MOS.

Chapter 7: TMDL IMPLEMENTATION

7 TMDL Implementation

Following the adoption of this TMDL by rule, the Department will determine the best course of action regarding its implementation. Depending upon the pollutant(s) causing the waterbody impairment and the significance of the waterbody, the Department will select the best course of action leading to the development of a plan to restore the waterbody. Often this will be accomplished cooperatively with stakeholders by creating a Basin Management Action Plan, referred to as the BMAP. Basin Management Action Plans are the primary mechanism through which TMDLs are implemented in Florida [see Subsection 403.067(7) F.S.]. A single BMAP may provide the conceptual plan for the restoration of one or many impaired waterbodies.

If the Department determines a BMAP is needed to support the implementation of this TMDL, a BMAP will be developed through a transparent stakeholder-driven process intended to result in a plan that is cost-effective, technically feasible, and meets the restoration needs of the applicable waterbodies. Once adopted by order of the Department Secretary, BMAPs are enforceable through wastewater and municipal stormwater permits for point sources and through BMP implementation for nonpoint sources. Among other components, BMAPs typically include:

- Water quality goals (based directly on the TMDL);
- Refined source identification;
- Load reduction requirements for stakeholders (quantitative detailed allocations, if technically feasible);
- A description of the load reduction activities to be undertaken, including structural projects, nonstructural BMPs, and public education and outreach;
- A description of further research, data collection, or source identification needed in order to achieve the TMDL;
- Timetables for implementation;
- Implementation funding mechanisms;
- An evaluation of future increases in pollutant loading due to population growth;
- Implementation milestones, project tracking, water quality monitoring, and adaptive management procedures; and
- Stakeholder statements of commitment (typically a local government resolution).

BMAPs are updated through annual meetings and may be officially revised every five years. Completed BMAPs in the state have improved communication and cooperation among local stakeholders and state agencies, improved internal communication within local governments, applied high-quality science and local information in managing water resources, clarified obligations of wastewater point source, MS4 and non-MS4 stakeholders in TMDL implementation, enhanced transparency in DEP decision-making, and built strong relationships between DEP and local stakeholders that have benefited other program areas.

However, in some basins, and for some parameters, particularly those with fecal coliform impairments, the development of a BMAP using the process described above will not be the most efficient way to restore a waterbody, such that it meets its designated uses. Why? Because fecal coliform impairments result from the cumulative effects of a multitude of potential sources, both natural and anthropogenic. Addressing these problems requires good old fashioned detective work that is best done by those in the area. There are a multitude of assessment tools that are available to assist local governments and interested stakeholders in this detective work. The tools range from the simple – such as Walk the WBIDs and GIS mapping - to the complex such as Bacteria Source Tracking. Department staff will provide technical assistance, guidance, and oversight of local efforts to identify and minimize fecal coliform sources of pollution. Based on work in the Lower St Johns River tributaries and the Hillsborough River basin, the Department and local stakeholders have developed a logical process and tools to serve as a foundation for this detective work. In the near future, the Department will be releasing these tools to assist local stakeholders with the development of local implementation plans to address fecal coliform impairments. In such cases, the Department will rely on these local initiatives as a more cost-effective and simplified approach to identify the actions needed to put in place a roadmap for restoration activities, while still meeting the requirements of Chapter 403.067(7), F.S.

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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 Rule 62-40, F.A.C. In 1994, the Department's stormwater treatment requirements were integrated with the stormwater flood control requirements of the water management districts, along with wetland protection requirements, into the Environmental Resource Permit regulations.

Rule 62-40 also requires the state's water management districts to establish stormwater pollutant load reduction goals (PLRGs) and adopt them as part of a Surface Water Improvement and Management (SWIM) plan, other watershed plan, or rule. Stormwater PLRGs are a major component of the load allocation part of a TMDL. To date, stormwater PLRGs have been established for Tampa Bay, Lake Thonotosassa, the Winter Haven Chain of Lakes, the Everglades, Lake Okeechobee, and Lake Apopka.

In 1987, the U.S. Congress established Section 402(p) as part of the federal Clean Water Act Reauthorization. This section of the law amended the scope of the federal NPDES permitting program to designate certain stormwater discharges as "point sources" of pollution. The EPA promulgated regulations and began implementing the Phase I NPDES stormwater program in 1990. These stormwater discharges include certain discharges that are associated with industrial activities designated by specific standard industrial classification (SIC) codes, construction sites disturbing 5 or more acres of land, and master drainage systems of local governments with a population above 100,000, which are better known as MS4s. However, because the master drainage systems of most local governments in Florida are interconnected, the EPA implemented Phase I of the MS4 permitting program on a countywide basis, which brought in all cities (incorporated areas), Chapter 298 urban water control districts, and the Florida Department of Transportation throughout the 15 counties meeting the population criteria. The Department received authorization to implement the NPDES stormwater program in 2000.

An important difference between the federal NPDES and the state's stormwater/environmental resource permitting programs is that the NPDES Program covers both new and existing discharges, while the state's program focus on new discharges only. Additionally, Phase II of the NPDES Program, implemented in 2003, expands the need for these permits to construction sites between 1 and 5 acres, and to local governments with as few as 1,000 people. While these urban stormwater discharges are now technically referred to as "point sources" for the purpose of regulation, they are still diffuse sources of pollution that cannot be easily collected and treated by a central treatment facility, as are other point sources of pollution such as domestic and industrial wastewater discharges. It should be noted that all MS4 permits issued in Florida include a reopener clause that allows permit revisions to implement TMDLs when the implementation plan is formally adopted.

Appendix B: Estimates of Fecal Coliform Loadings from Potential Sources

The Department provides these estimations for informational purposes only. The Department did not use these estimates to calculate the TMDL. These estimates are intended to give the public a general idea of the relative importance of each source in the waterbody. The estimates were based on the best information available to the Department at the time the calculation was made. The numbers provided do not represent actual loadings from the sources.

Pets

Pets (especially dogs) could be a significant source of coliform pollution through surface runoff within the Gottfried Creek WBID boundary. Studies report that up to 95 percent of the fecal coliform found in urban stormwater can have nonhuman origins (Alderiso et al., 1996; Trial et al., 1993).

The most important nonhuman fecal coliform contributors appear to be dogs and cats. In a highly urbanized Baltimore catchment, Lim and Olivieri (1982) found that dog feces were the single greatest source of fecal coliform and fecal strep bacteria. Trial et al. (1993) also reported that cats and dogs were the primary source of fecal coliform in urban subwatersheds. Using bacteria source tracking techniques, it was found in Stevenson Creek in Clearwater, Florida, that the amount of fecal coliform bacteria contributed by dogs was as important as that from septic tanks (Watson, 2002).

According to the American Pet Products Manufacturers Association (APPMA), about 4 out of 10 U.S. households include at least one dog. A single gram of dog feces contains about 2,200,000 counts/g fecal coliform bacteria (van der Wel, 1995). Unfortunately, statistics show that about 40 percent of American dog owners do not pick up their dogs' feces. The number of dogs within the Gottfried Creek WBID boundary is not known. Therefore, the statistics produced by APPMA were used in this analysis to estimate the possible fecal coliform loads contributed by dogs.

Using data obtained from the Florida Department of Health (FDOH) to calculate the number of properties in residential land use areas within the Gottfried Creek WBID boundary, the number of households within the WBID boundary was estimated to be 1,414. The data provided by FDOH are described in the next section. Assuming that 40 percent of the households in this area have one dog, the total number of dogs within the WBID is about 566.

Table B.1 shows the waste production rate for a dog (450 g/animal/day) and the fecal coliform counts per gram of dog waste (2,200,000 counts/g). Assuming that 40 percent of dog owners do not pick up their dogs' feces, the total waste produced by dogs and left on the land surface in residential areas would be approximately 101,808 grams/day. The total produced by dogs would be 2.24×10^{11} counts/day of fecal coliform. It should be noted that this load only represents the fecal coliform load created in the WBID and is not intended to be used to represent a part of the existing load that reaches the receiving waterbody. The fecal coliform load that eventually reaches the receiving waterbody could be significantly less than this value due to attenuation in overland transport.

Table B.1. Dog Population Density, Wasteload, and Fecal Coliform Density (Weiskel et al., 1996)

Type	Population density (animal/household)	Wasteload (g/animal-day)	Fecal coliform density (counts/g)
Dog	0.4**	450	2,200,000

** Number from APPMA.

Septic Tanks

Septic tanks are another potentially important source of coliform pollution in urban watersheds. When properly installed, most of the coliform from septic tanks should be removed within 50 meters of the drainage field (Minnesota Pollution Control Agency, 1999). However, the physical properties of an aquifer, such as thickness, sediment type (sand, silt, and clay), and location play a large part in determining whether contaminants from the land surface will reach the groundwater (USGS, 2010). The risk of contamination is greater for unconfined (water-table) aquifers than for confined aquifers because they usually are nearer to land surface and lack an overlying confining layer to impede the movement of contaminants (USGS, 2010).

Sediment type (sand, silt, and clay) also determines the risk of contamination in a particular watershed. "Porosity, which is the proportion of a volume of rock or soil that consists of open spaces, tells us how much water rock or soil can retain. Permeability is a measure of how easily water can travel through porous soil or bedrock. Soil and loose sediments, such as sand and gravel, are porous and permeable. They can hold a lot of water, and it flows easily through them. Although clay and shale are porous and can hold a lot of water, the pores in these fine-grained materials are so small that water flows very slowly through them. Clay has a low permeability (USGS, 2010)."

Also, the risk of contamination is increased for areas with a relatively high ground water table. The drain field can be flooded during the rainy season, resulting in ponding and coliform bacteria can pollute the surface water through stormwater runoff. Additionally, in these circumstances, a high water table can result in coliform bacteria pollution reaching the receiving waters through baseflow.

In addition, watersheds located in karst regions are extremely vulnerable to contamination. Karst terrain is characterized by springs, caves, sinkholes, and a unique hydrogeology that results in aquifers that are highly productive (USGS, 2010). In comparsion to non-karst areas, the springs, caves, sinkholes, etc act as direct pathways for pollutants to enter waterbodies.

Septic tanks may also cause coliform pollution when they are built too close to irrigation wells. Any well that is installed in the surficial aquifer system will cause a drawdown. If the septic tank system is built too close to the well (e.g., less than 75 feet), the septic tank discharge will be within the cone of influence of the well. As a result, septic tank effluent may enter the well, and once the polluted water is used to irrigate lawns, coliform bacteria may reach the land surface and wash into surface waters through stormwater runoff.

A rough estimate of fecal coliform loads from failed septic tanks within the Gottfried Creek WBID boundary can be made using **Equation 1**:

$$L = 37.85 * N * Q * C * F \qquad \textbf{Equation 1}$$

Where,

L is the fecal coliform daily load (counts/day);
N is the number of households using septic tanks in the WBID;
Q is the discharge rate for each septic tank (gallons/day);
C is the fecal coliform concentration for the septic tank discharge (counts/ 100 mL);
F is the septic tank failure rate; and
37.85 is a conversion factor (100 mL/gallon).

Based on data obtained from FDOH, which is currently undertaking a project to inventory the use of onsite treatment and disposal systems (i.e., septic tanks) by determining the methods of wastewater disposal for developed property sites statewide, 1,414 housing units *(N)* within the Gottfried Creek WBID boundary are known or believed to be using septic tanks to treat their domestic wastewater (**Figure B.1**). FDOH's parcel data were obtained from the Florida Department of Revenue 2008 tax roll. FDOH's wastewater disposal data were obtained from county Environmental Health Departments, wastewater treatment facilities, FDEP domestic wastewater treatment permits, existing county and city inventories, and other available information. If there was not enough information to determine with certainty whether a property used a septic system, FDOH employed a probability model to analyze the characteristics of the property and estimate the probability that the property was served by a septic tank. Within the Gottfried Creek WBID boundary, 20 properties are known to use septic tanks and 1,394 are estimated to use septic systems. Because the probability that these 1,394 estimated septic tank properties are in fact served by septic tanks ranges from 99 percent to 100 percent, all 1,414 (Total 1,414 = 20 known on septic + 1,394 estimated on septic) properties were assumed to be served by septic tanks for the purposes of this report. Information from the Sarasota County Property Appraiser's Office was used to determine that some of the properties with septic systems within the Gottfried Creek WBID boundary were high density residential with multiple units (multiple households) on a property.

The discharge rate from each septic tank (*Q*) was calculated by multiplying the average household size by the per capita wastewater production rate per day. Based on the information published by the Census Bureau, the average household size for Sarasota County is about 2.19 people/household. The same population densities were assumed within the Gottfried Creek WBID boundary. A commonly cited value for per capita wastewater production rate is 70 gallons/day/person (EPA, 2001). The commonly cited concentration (*C*) for septic tank discharge is $1x10^6$ counts/100 mL for fecal coliform (EPA, 2001).

No measured septic tank failure rate data were available for the WBID at the time this TMDL was developed. Therefore, the failure rate was derived from the number of septic tank in Sarasota County based on FDOH's septic tank inventory and septic tank repair permits issued in Sarasota County as published by FDOH. Refer to the following website for OSTDS statistics (http://www.doh.state.fl.us/environment/OSTDS/statistics/ostdsstatistics.htm). The cumulative number of septic tanks in Sarasota County on an annual basis was calculated by subtracting the number of issued septic tank installation permits for each year from the current number of septic tanks in the county based on FDOH's 2008/2009 inventory, and assuming that none of the installed septic tanks will be removed after being installed (**Table B.2**). The reported number of septic tank repair permits was also obtained from the FDOH Website. Based on this information, annual discovery rates of failed septic tanks were calculated and listed in **Table B.2**.

Based on **Table B.2**, the average annual septic tank failure discovery rate is about 0.49 percent for Sarasota County. Assuming that failed septic tanks are not discovered for about 5 years, the estimated annual septic tank failure rate is about 5 times the discovery rate, or 2.47 percent. Based on **Equation 1**, the estimated fecal coliform loading from failed septic tanks within the Gottfried Creek WBID boundary is about 2.03×10^{11} counts/day.

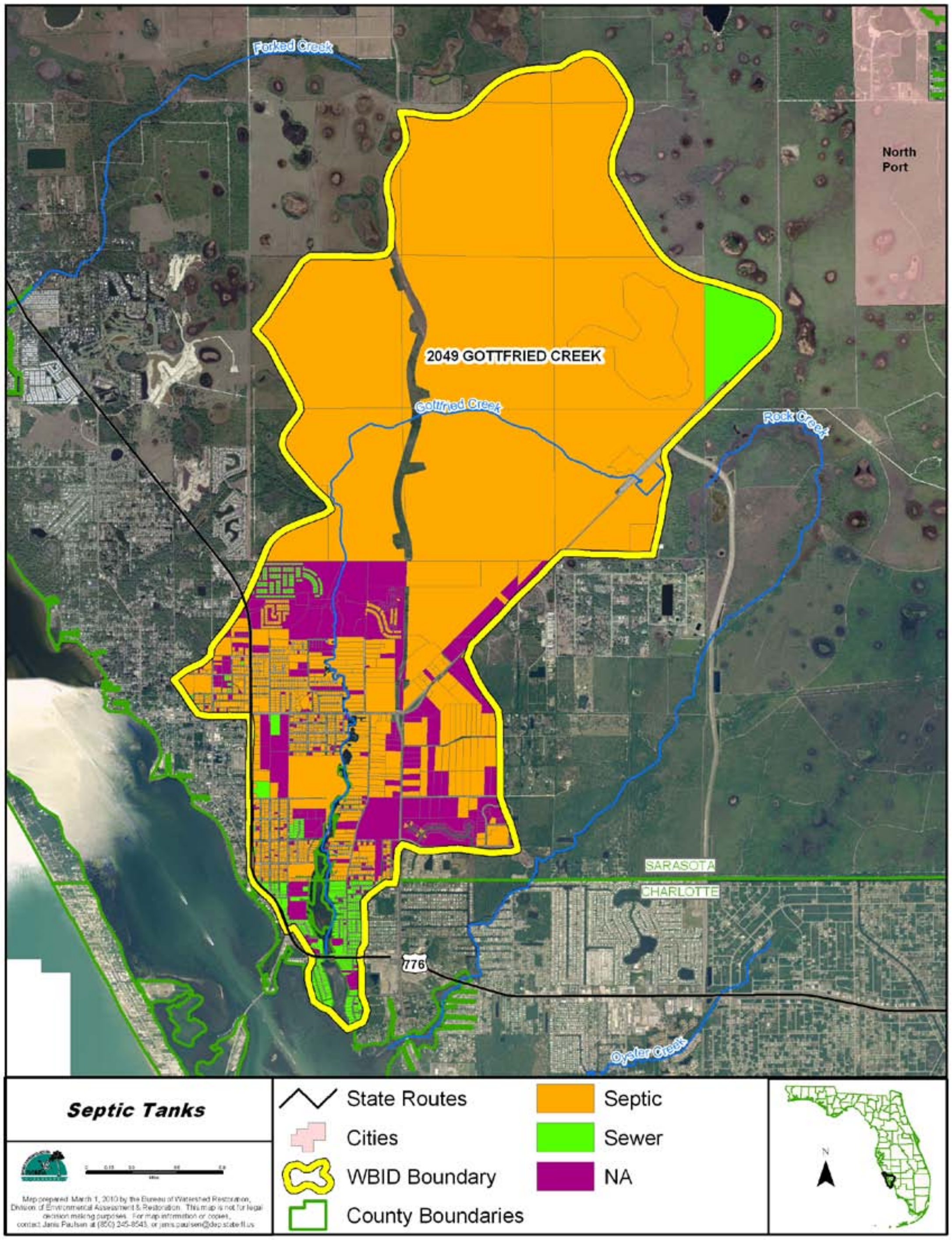

Figure B.1. Distribution of Onsite Sewage Disposal Systems (Septic Tanks) in the Residential Land Use Areas within the Gottfried Creek WBID Boundary

Table B.2. Estimated Number of Septic Tank and Septic Tank Failure Rate for Sarasota County, 2003 – 2008

Sarasota	2003	2004	2005	2006	2007	2008	Average
New installation (septic tanks)	1827	3060	4311	21	668	240	1688
Accumulated installation (septic tanks)	69887	71714	74774	79085	79106	79774	75723.33
Repair permit (septic tanks)	493	556	471	74	250	350	366
Failure discovery rate (%)	0.71	0.78	0.63	0.09	0.32	0.44	0.49
Failure rate (%)*	3.53	3.88	3.15	0.47	1.58	2.19	2.47

* Failure rate is 5 times the failure discovery rate.

Sanitary Sewer Overflows

Sanitary sewer overflows (SSOs) can also be a potential source of fecal bacteria pollution. Human sewage can be introduced into surface waters even when storm and sanitary sewers are separated. Leaks and overflows are common in many older sanitary sewers where capacity is exceeded, high rates of infiltration and inflow occur (i.e., outside water gets into pipes, reducing capacity), frequent blockages occur, or sewers are simply falling apart due to poor joints or pipe materials. Power failures at pumping stations are also a common cause of SSOs. The greatest risk of an SSO occurs during storm events; however, few comprehensive data are available to quantify SSO frequency and bacteria loads in most watersheds.

The number of properties connected to the sewer system was also based on data obtained from FDOH's ongoing inventory of wastewater treatment and disposal method for developed properties. As for septic tanks, if there was not enough information to determine with certainty whether a property was sewered, a probability of whether the property was served by a septic tank was determined. If that probability was low (less than 50 percent), the property was estimated to be served by a sewer system. Within the Gottfried Creek WBID boundary, 412 properties are known to be served by sewer systems and 463 are estimated to be served by sewer systems. Because the probability that these 463 properties are in fact served by septic tanks is low, all 463 properties were assumed to be served by sewer systems for the purposes of this report. Information from the Sarasota County Property Appraiser's Office was used to determine that some of the properties tied to the sewer system within the Gottfried Creek WBID boundary were high density residential with multiple units (multiple households) on a property. The number of households connected to the sewer system within the WBID boundary was calculated to be 875 (Total 875 = 412 known on sewer + 463 estimated on sewer). Fecal coliform loading from sewer line leakage can be calculated based on the number of people in the watershed, typical per household generation rates, and typical fecal coliform concentrations in domestic sewage, assuming a leakage rate of 0.5 percent (Culver et al., 2002). Based on this assumption, a rough estimate of fecal coliform loads from leaks and SSOs within the Gottfried Creek WBID boundary can be made using **Equation 2**.

$$L = 37.85 * N * Q * C * F \qquad \textbf{Equation 2}$$

Where,

L is the fecal coliform daily load (counts/day);

N is the number of households using sanitary sewer in the WBID;

Q is the discharge rate for each household (gallons/day);
C is the fecal coliform concentration for domestic wastewater (counts/100 mL);
F is the sewer line leakage rate; and
37.85 is a conversion factor (100 mL/gallon).

The number of households *(N)* within the Gottfried Creek WBID boundary that are served by sewer systems is 875. The discharge rate through sewers from each household (*Q*) was calculated by multiplying the average household size (2.19) by the per capita wastewater production rate per day (70 gallons/day/person). The commonly cited concentration (*C*) for domestic wastewater is $1x10^6$ counts/100 mL for fecal coliform (EPA, 2001). The contribution of fecal coliform through sewer line leakage was assumed to be 0.5 percent of the total sewage loading created from the population not on septic tanks (Culver et al., 2002). Based on **Equation 2**, the estimated fecal coliform loading from sewer line leakage in the WBID is approximately 2.6×10^{10} counts/day.

Sediments

Studies have shown that fecal coliform bacteria can survive and reproduce in stream bed sediments and can be resuspended in surface water when conditions are right (Jamieson et al., 2005). Current methodology cannot quantify the exact amount of fecal coliform coming from each source. Therefore, the Department is unable to provide estimates of fecal coliform loading from sediments.

Wildlife

Wildlife is another possible source of fecal coliform bacteria within the Gottfried Creek WBID boundary. As shown in **Figure 4.1**, wetland areas border Gottfried Creek within the WBID boundary. Additionally, upland forest and barren land areas are in close proximity to the creek. These areas likely serve as habitat for wildlife that has the potential to contribute fecal coliform to the creek. 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 birds, otters, alligators, raccoons, and etc) deposits their feces directly into the water. The bacterial load from naturally occurring wildlife is assumed to be background. However, as these represent natural inputs, no reductions are assigned to these sources by this TMDL.

Livestock

Agricultural animal waste is associated with various pathogens in streams; these can include *E. coli, Salmonella, Giardia, Campylobacter, Shigella and Cryptosporidiumparvum* (Landry and Wolfe, 1999). High loading rates of pathogens to soils and waters can result from livestock and other agricultural animals. Livestock with direct access to the receiving water can contribute to the exceedances during wet and dry weather conditions. Problems with grazing animals and pathogen loading rates derive primarily from animal density (Hubbard et al., 2004). At low animal density concerns relate primarily from livestock having free access to waterbodies where they can directly deposit urine and manure (Hubbard et al., 2004). At high animal densities concerns relate to the large amounts of urine and feces that are deposited in relatively small areas increasing the probabilities of nutrients and pathogens being transported to surface waterbodies via surface runoff, or entering groundwater (Hubbard et al., 2004).

Agricultural and Rangeland landuse occupies 43.0% of the total land area in the Gottfried Creek (WBID 2049) watershed. Livestock data from the 2007 *Agricultural Census Report* for Sarasota County is listed in **Table B.3** (U.S. Department of Agriculture, 2007). Since a livestock inventory does not exist for the Gottfried Creek watershed, a possible fecal coliform load from livestock could not be calculated.

Table B.3 Livestock Inventory for Sarasota County

Livestock Inventory	Sarasota County (number of livestock)
Cattle/Calves	16,845
Horses/Ponies	1,183
Colonies of Bees	undisclosed
Sheep/Lambs	623
Poultry Layers	264

Data withheld to avoid disclosing data for individual farms.
Source: U.S. Department of Agriculture. 2007. *Agricultural Census Report*.

Appendix C: TMDL Public Comments for Gottfried Creek (WBID 2049) Fecal Coliform TMDL

June 15, 2010

Ms. Elizabeth Wong (Elaye), P.E.
City of North Port
Stormwater Manager
4970 City Hall Blvd
North Port, FL 34286

Re: City of North Port Comments on Newly Released Draft TMDLs

Dear Ms. Wong:

The Department appreciates the time and effort you and your staff put into reviewing these draft TMDLs. Thank you for your insights and help in improving the quality of our TMDL for Gottfried Creek. To aid you in reviewing our responses, we have included your comments, followed by a response to each (in blue), in the order in which they were presented.

Comment No.1

I will like to schedule with your staff to go see the exact point where samples are withdrawn at your sampling location21FLFTM SARABY0022FTM. In my extensive sampling experience, I have found that high coliforms can sometimes be due to sampling too close to vegetation which encourages fishes which in turn, attracts bird which tends to defecate in the same vicinity. I have moved sampling locations just a few feet upstream and away from vegetation and found coliforms levels to drop by several orders of magnitude. If wildlife and farm animals within our WVID contribute to Fecal coliforms and I will like to trace this source. If needed we can both jointly take a water sample closer to the City of North Port boundary.

The water quality sampling for station 21FLFTM SARABY0022FTM was conducted by FDEP's South District Office personnel, located in Fort Myers, FL. Jennifer Nelson is the Environmental Administrator for the South District Environmental Assessment and Restoration Section, which oversees TMDL activities and can work with you to set up any added investigative studies to help us better understand the sources of high fecal

Ms. Elizabeth Wong (Elaye), P.E.
City of North Port
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June 15, 2010

coliform counts. Ms. Nelson and her staff will be able to assist you with your request. Her telephone number is (239) 332-6975 ext. 129, or you can contact her by e-mail at:Jennifer.Nelson@dep.state.fl.us.

Comment No. 2

Is it possible to send a sample to a lab to do DNA testing to see if the Fecal Coliforms are derived from Human or animals? I understand there is a lab in Miami that can do this. Not sure the cost or name of the lab.

This is a very reasonable question. Previously, to examine the capabilities of modern molecular techniques in quantifying the human fecal coliform and separate them from the non-human fecal bacteria, and the feasibility of using these techniques to assist water quality assessment on the routine basis, we contracted two research labs to examine the bacterial DNA signals in ambient samples using established DNA library, and also tried to use known bacteria DNAs as probes to examine the fecal source profile of ambient samples using the PCR technique. We found that these techniques now mostly provide qualitative results, which tell you whether fecal bacteria from certain source exist in the samples or not, but are not very good at providing quantitative information on the relative importance of the bacteria from different sources. In addition, the inter-laboratory inconsistency on results also exists, suggesting that these techniques, while instrumental for research purposes, may not be completely ready for the regulatory application. Of course, cost is another concern. If you are interested in these techniques and their applications, you can contact Dr. Leslee Williams' phone: (850) 245-8182 and e-mail: Leslee.Williams@dep.state.fl.us or David Whiting's phone: (850) 245-8191 and e-mail: David.D.Whiting@dep.state.fl.us.

We appreciate your offer to aid in future sampling efforts and look forward to working with you on the implementation phase of this TMDL. Please contact me at Jan.Mandrup-Poulsen@dep.state.fl.us, if you have any further questions.

Sincerely,

Jan Mandrup-Poulsen, Administrator
Watershed Evaluation and TMDL Section

ec: John Abendroth
Beth Alvi
Jennifer Nelson
Jennifer Thera

June 15, 2010

Mr. Jack Merriam
Sarasota County Water Resources
Environmental Manager
1001 Sarasota Center Boulevard
Sarasota, FL 34240

Re: Sarasota County Comments on Newly Released Draft TMDLs

Dear Mr. Merriam:

The Department appreciates the time and effort you and your staff put into reviewing these draft TMDLs. Thank you for your insights and help in improving the quality of our TMDL for Gottfried Creek. We have made necessary edits to some draft TMDL reports as a result of your comments. Because of your efforts, the final TMDL will be improved. To aid you in reviewing our responses, we have included your comments, followed by a response to each (in blue), in the order in which they were presented.

Comments

Thank you for the opportunity to comment on the subject proposed TMDL. Thanks also to Dr. Bailey and Ms. Bridger who hosted the meeting on April 22 – it was valuable and informative. At the meeting it was suggested that the stakeholders use a "Walk the WBID" approach to identifying and eliminating man-made sources of fecal pollution. Sarasota County welcomes the opportunity to participate in this effort to reduce the pathogen concentrations in the Gottfried Creek watershed.

The purpose of this letter is to share information and concerns about the TMDL and its implementation. The County has limited control over this watershed. We are very willing to reduce pollutants from areas that we can affect but want to make sure the Department is aware of our limitations. The City of North Port has annexed some areas in the headwaters. The southern end of the WBID is within Charlotte County. Some of the headwaters are within unincorporated Sarasota County but are private, agricultural lands that are not part of the Municipal Separate Storm Sewer System (MS4). The County neither owns nor operated a drainage system there.

Thank you for your insights regarding the County's willingness to reduce pollutants from its jurisdiction areas and the County's limitations. As noted in the TMDL report, MS4 permittees are only responsible for reducing the anthropogenic loads associated with stormwater drainage that it owns or otherwise has responsible control over, and it is not responsible for reducing other nonpoint source loads beyond its jurisdiction. However, while the county will not be held for reducing the fecal coliform load entering Sarasota County's stormwater conveyance system from outside the county's jurisdiction area, it is part of Sarasota County's responsibility to identify these external fecal coliform loads. As a result of your comments, FDEP is currently revising the MS4 language located within the TMDL document.

The County does not provide sanitary sewer service within the WBID area. Sanitary sewer service is provided by a private utility (Englewood Water District). In recent years the EDW has expanded service to customers formerly using septic systems. We do not have an up-to-date estimate of the number of remaining properties served by septic systems. We recommend that the Department work with stakeholders to establish a detailed understanding of septic system location.

We appreciate learning about these changes and will incorporate language in the TMDL report to help facilitate establishing a better understanding of the septic and sanitary sewer service, which will also occur during the TMDL implementation process.

The Department is aware that the fecal coliform (FC) method is an imperfect indicator of human pathogens in surface water. Florida rules require the Department to implement this indicator and employ the codified concentration standard regardless of the innate problems. We encourage the Department to continue to investigate more effective analytical methods to protect Floridians from the serious health threats of fecal pollution.

FDEP and EPA are aware that fecal coliform method is an imperfect indicator of human pathogens in surface water. Currently, EPA is in the process of revising the indicator for human pathogens in surface water. However, regardless of the indicator organism to be used in the future, to address the pathogen impairment in a given watershed, the general approach will be the same, which includes "walking the WBID", identify the possible sources, and addressing them. In this case, using fecal coliform as an indicator species in the TMDL provides the incentive to initiate and carry out these restoration activities, not just a fixed number.

Mr. Jack Merriam
Sarasota County Water Resources
Page 3

June 16, 2010

Our citizens expect their waterways to be healthy and the County will actively participate in improving water quality in Gottfried Creek and downstream in Lemon Bay. We will contact the Department soon about initiating "Walk the WBID" collaboration. Thank you for this opportunity to work with the Department on improving water quality in our community.

We thank you for your interest in water quality issues in your area and look forward to working with you on implementing this and future TMDLs. Beth Alvi is the BMAP Coordinator for the Charlotte Harbor Basin. She will be able to assist you with the "Walk the WBID" approach in order to identify and eliminate fecal pollution within the Gottfried Creek watershed. Her contact information is phone: (850) 245-8559 and e-mail: Elizabeth.Alvi@dep.state.fl.us.

Please contact me at Jan.Mandrup-Poulsen@dep.state.fl.us, if you have any further questions.

Sincerely,

Jan Mandrup-Poulsen, Environmental Administrator
Watershed Evaluation and TMDL Section

ec: John Abendroth
Beth Alvi
Jennifer Nelson
Jennifer Thera

Florida Department of Environmental Protection
Division of Environmental Assessment and Restoration
Bureau of Watershed Restoration
2600 Blair Stone Road
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