FINAL

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Environmental Assessment and Restoration,

Bureau of Watershed Restoration

SOUTH DISTRICT • CALOOSAHATCHEE RIVER BASIN

TMDL Report

Fecal Coliform TMDL for Trout Creek, WBID 3240G

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Basin Status Report for the Caloosahatchee River Basin
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Chapter 1: INTRODUCTION

1.1 Purpose of Report

This report presents the Total Maximum Daily Load (TMDL) for fecal coliform bacteria for Trout Creek located in the Caloosahatchee River Basin. The creek was verified as impaired for fecal coliform and, therefore, was included on the Verified List of impaired waters for the Caloosahatchee River Basin that was adopted by Secretarial Order on June 20, 2005. The TMDL establishes the allowable fecal coliform loading to Trout 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 Caloosahatchee River 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 3240G, Trout Creek, for fecal coliforms.

The topography of The Trout Creek WBID 3240G watershed encompasses 16,273 acres. The predominant landuses are approximately 6,729 acres of agriculture and 4,567 acres of upland forested areas. Trout Creek is located partially in Lee and Charlotte Counties. Refer to **Figure 1.1 and 1.2.** The climate in Lee and Charlotte Counties, specifically areas surrounding the Trout Creek watershed, is sub-tropical with annual rainfall averaging approximately 55 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 76.8^{o}F (SERCC, 2010). The physiography of the Trout Creek watershed reflects its location within the Southwestern Florida Flatwoods or Southern Coastal Plains ecoregion. Elevations in the watershed range from around 10 – 30 feet above sea level (FDEP, 2010). The predominant soil type is shelly sand and clay (FDEP, 2008). No major human population centers exist within the watershed.

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.

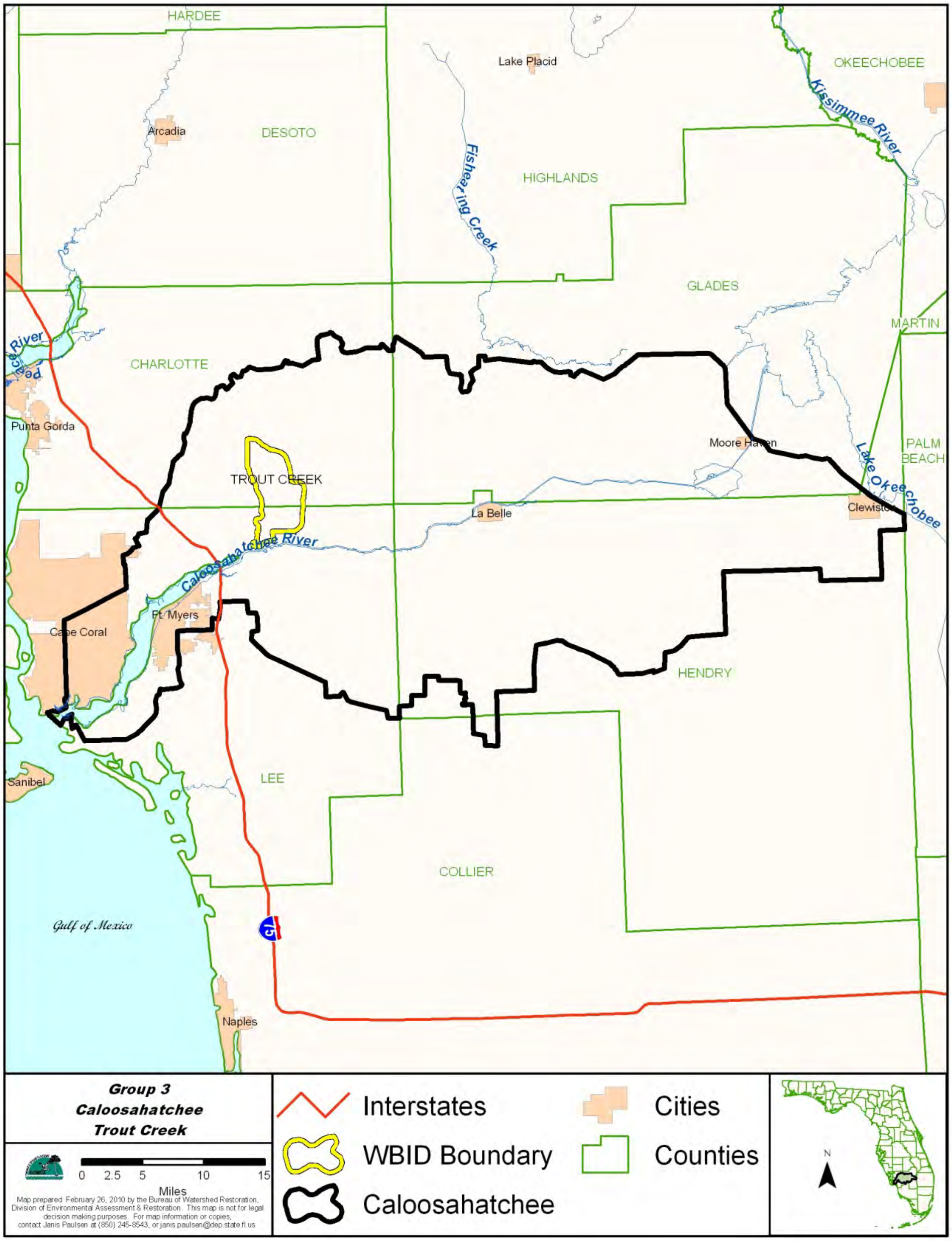


Figure 1.1. Location of Trout Creek (WBID 3240G) in Lee and Charlotte Counties and Major Hydrological Features in the Area

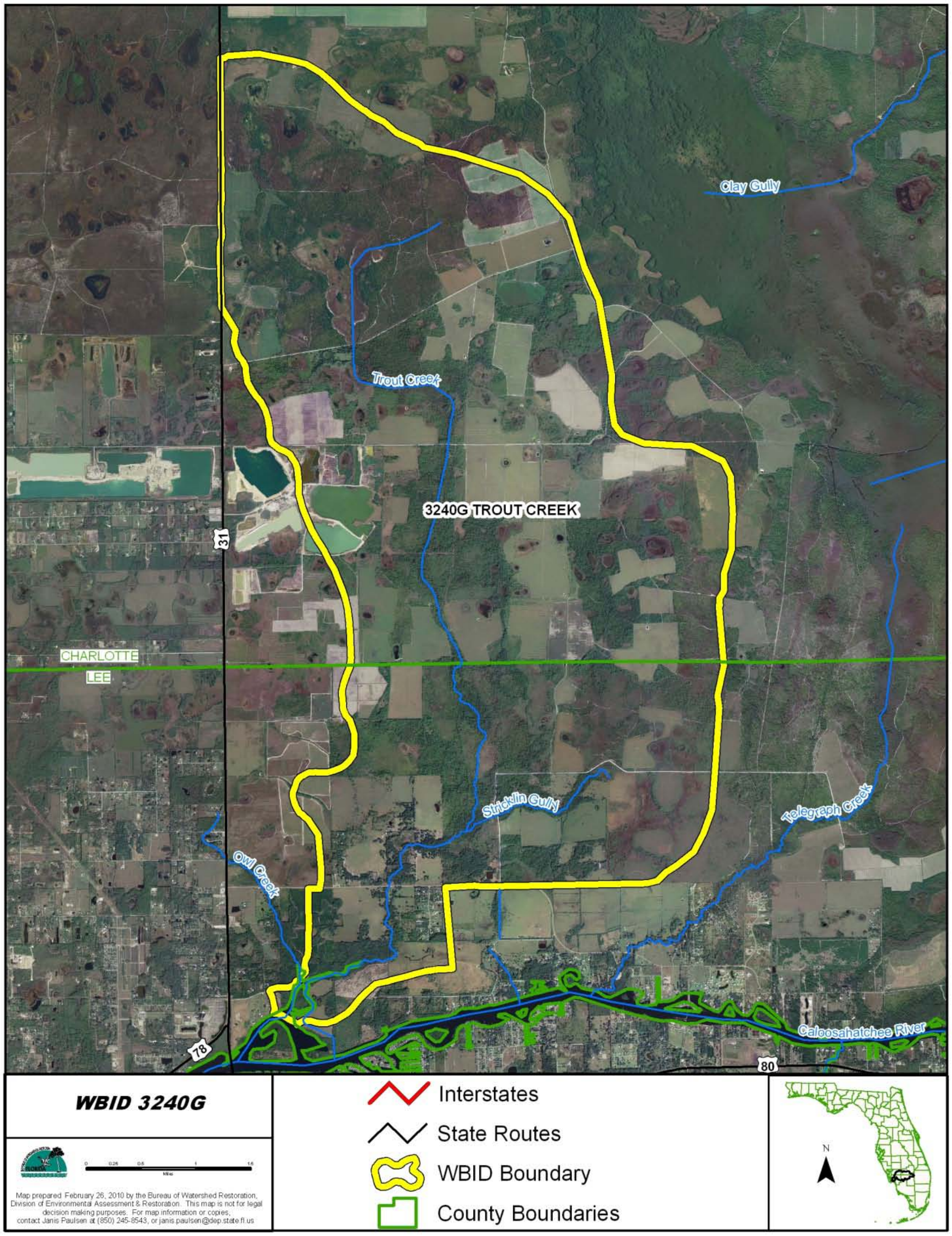


Figure 1.2. Location of Trout Creek (WBID 3240G)

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 Trout Creek (WBID 3240G). These activities will depend heavily on the active participation of the South Florida Water Management District (SFWMD), 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 eight waterbodies in the Caloosahatchee River Basin [Trout Creek (WBID 3240G) was 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 Trout Creek (WBID 3240G) and has verified that this waterbody segment is impaired for fecal coliform bacteria during the following data period January 1, 2002 – June 30, 2010, which includes the Cycle 2 Verified Period (January 1, 2002 – June 30, 2009). 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. For Trout Creek (WBID 3240G) 45 exceedances out of 127 samples existed. **Table 2.1** summarizes the fecal coliform monitoring results for the following data period January 1, 2002 – June 30, 2010, which includes the Cycle 2 Verified Period (January 1, 2002 – June 30, 2009), for Trout Creek (WBID 3240G). 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 collected during the following data period January 1, 2002 – June 30, 2010, which includes the Cycle 2 Verified Period (January 1, 2002 – June 30, 2009), were used to develop the TMDL. **Table 2.1** indicates that elevated fecal coliform concentrations have been observed in Trout Creek (WBID 3240G).

Table 2.1. Summary of Fecal Coliform Monitoring Data for Trout Creek (WBID 3240G) During the Following Data Period January 1, 2002 – June 30, 2010, which includes the Cycle 2 Verified Period (January 1, 2002 – June 30, 2009)

Waterbody (WBID)	Parameter	Fecal Coliform
Trout Creek (3240G)	Total number of samples	127
	IWR-required number of exceedances for the Verified List	18
	Number of observed exceedances	45
	Number of observed nonexceedances	82
	Number of seasons during which samples were collected	4
	Highest observation (counts/100 mL)	5900
	Lowest observation (counts/100 mL)	10
	Median observation (counts/100 mL)	220
	Mean observation (counts/100 mL)	480
	FINAL ASSESSMENT	**Impaired**

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)**

Trout Creek (WBID 3240G) 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 Trout Creek WBID Boundary

4.2.1 Point Sources

Wastewater Point Sources

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

Municipal Separate Storm Sewer System Permittees

Two NPDES municipal separate storm sewer system (MS4) permits cover Trout Creek (WBID 3240G), which are held by Lee County and Co Permittees (Phase I – FLS000035) and Charlotte County (Phase II – FLR04E043).

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 sewerlines, 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 SFWMD's year 2004 - 2005 land use coverage contained in the Department's geographic information system (GIS) library. Land use categories within the Trout 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 Trout Creek WBID boundary is about 16,273 acres. The dominant land use categories are agriculture and upland forested areas. Agriculture land use areas occupy about 6,729 acres or about 41 percent of the total WBID area. Upland forested land use areas occupy 4,567 acres or about 28 percent of the total WBID area.

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

Level 1 Code	Land Use	Acreage	% Acreage
1000	Urban and built-up	361	2.2%
1100	Low-density residential	130	0.8%
1200	Medium-density residential	0	0.0%
1300	High-density residential	0	0.0%
2000	Agriculture	6729	41.4%
3000	Rangeland	1851.5	11.4%
4000	Upland forest	4567	28.0%
5000	Water	31	0.2%
6000	Wetland	2602	16%
7000	Barren land	0	0.0%
8000	Transportation, communication, and utilities	0	0.0%
	TOTAL	**16,273**	**100%**

Because the dominant landuse in the Trout Creek WBID boundary is the agriculture, the most likely source of fecal coliform is the animal feeding operation or direct animal access to the receiving waters. Failed septic tanks and pet feces from urban areas may also contribute fecal coliform loading to Trout Creek. Wildlife is another possible source of fecal coliform bacteria within the Trout Creek WBID boundary; however, the bacterial load from naturally occurring wildlife is assumed to be background.

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.

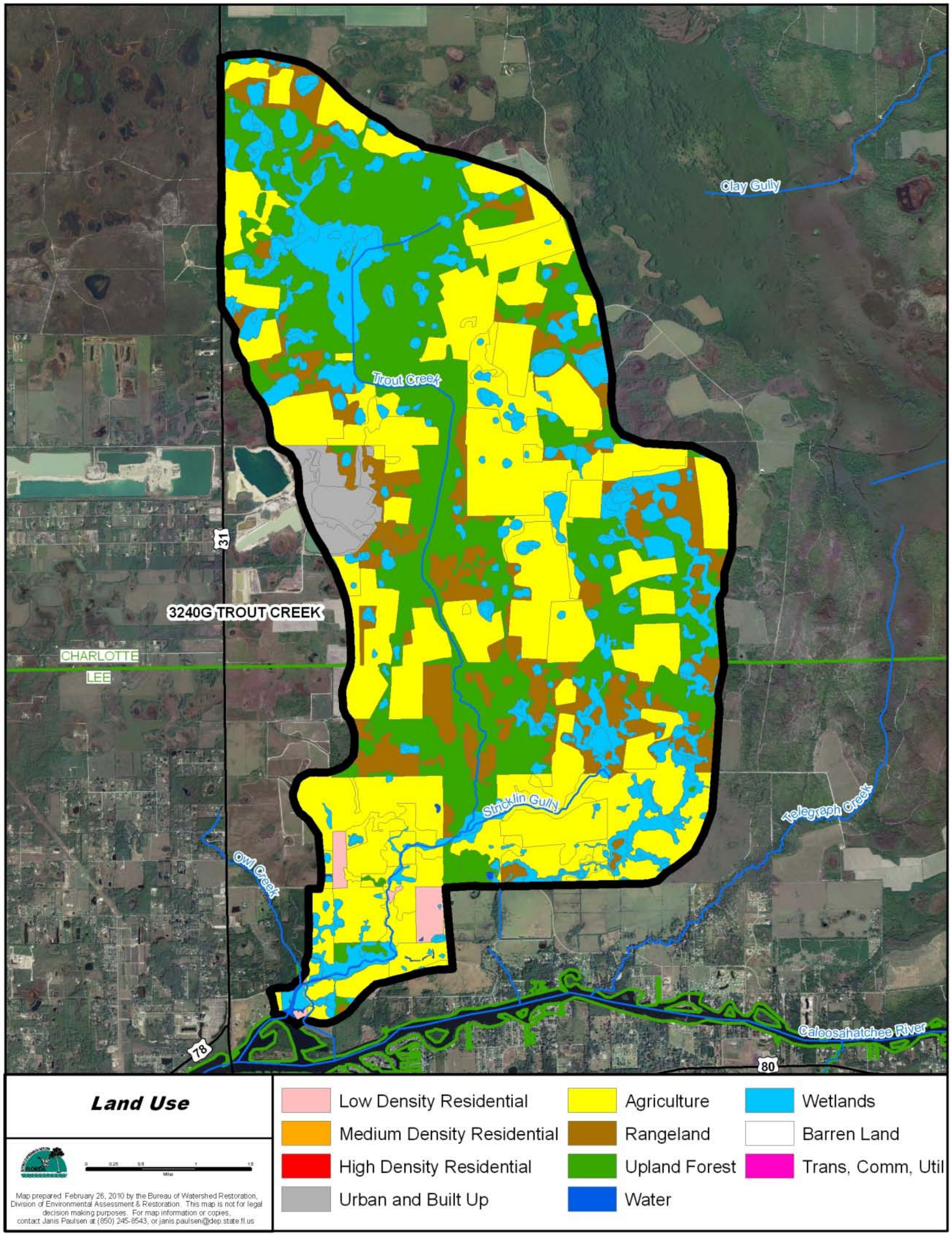


Figure 4.1. Principal Land Uses within the Trout Creek WBID Boundary

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 Trout Creek (WBID 3240G); 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 90th percentile of all measured concentrations collected during the following data period January 1, 2002 – June 30, 2010, which includes the Cycle 2 Verified Period (January 1 2002 – June 30, 2009). 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 Lee County (Station: 21FLEECO27-6GR) and Babcock Ranch – Johnson Engineering (Stations: 21FLBABR27-GR_Coline, 21FLBABR27-GR_Hercules, 21FLBABR27-GR_Outflow, and 21FLBABR27-WB_Outflow. Refer to **Figure 5.1** for the locations of the water quality stations from which fecal coliform data were collected for Trout Creek. The majority of fecal coliform data for the Trout Creek WBID was collected in 2002 – 2010; therefore, this analysis focuses on fecal coliform data collected during the following data period January 1, 2002 – June 30, 2010. During this period 127 fecal coliform samples were collected from five sampling stations in WBID 3240G.

Concentrations ranged from 10 to 5900 counts/100 mL and averaged 480 counts/100 mL during the period of observation. **Table 5.1** summarizes the descriptive statistics for the 2002 – 2010 fecal coliform results. **Figure 5.2** shows the fecal coliform concentration trends by stations observed in Trout Creek (WBID 3240G).

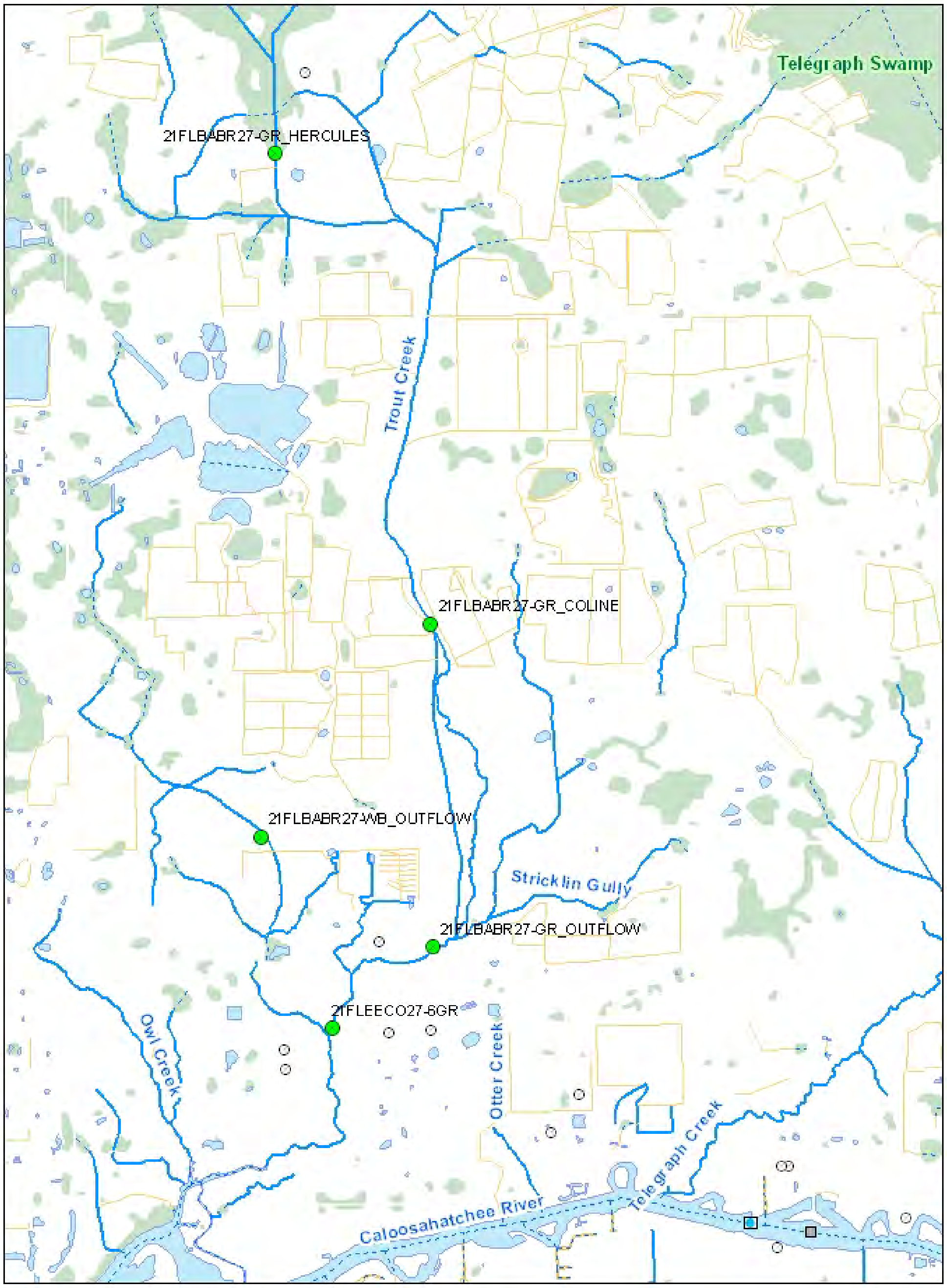
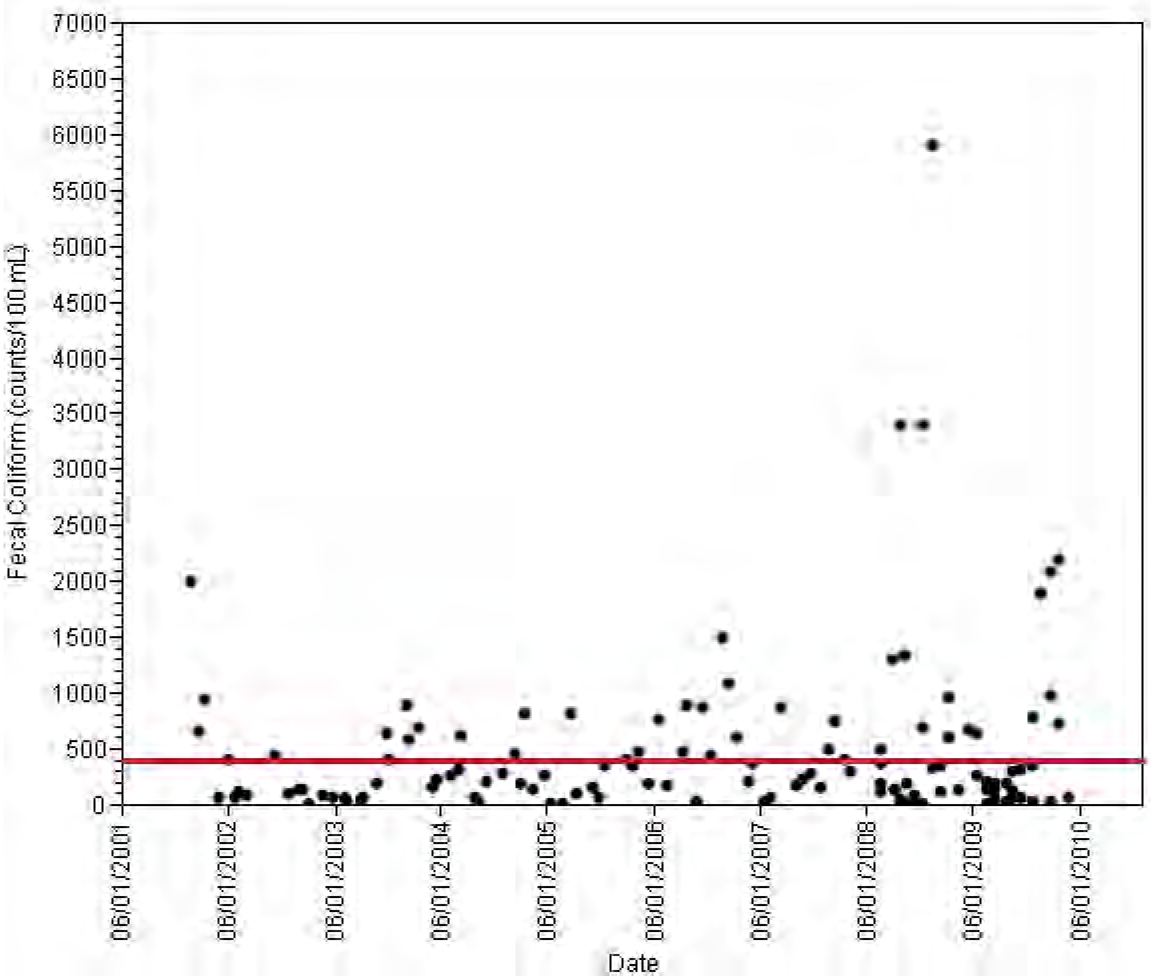


Figure 5.1. Location of Water Quality Stations with Fecal Coliform data in Trout Creek (WBID 3240G)

Table 5.1. Descriptive Statistics of Fecal Coliform Data for Trout Creek (WBID 3240G) for 2002 – 2010

Descriptive Statistic	Result
Mean observation (counts/100 mL)	480
Median observation (counts/100 mL)	220
Highest observation (counts/100 mL)	5900
Lowest observation (counts/100 mL)	10
25% Quartile	90
75% Quartile	600
Number of samples	127



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

Figure 5.2. Fecal Coliform Concentration Trends in Trout Creek (WBID 3240G) for 2002 - 2010

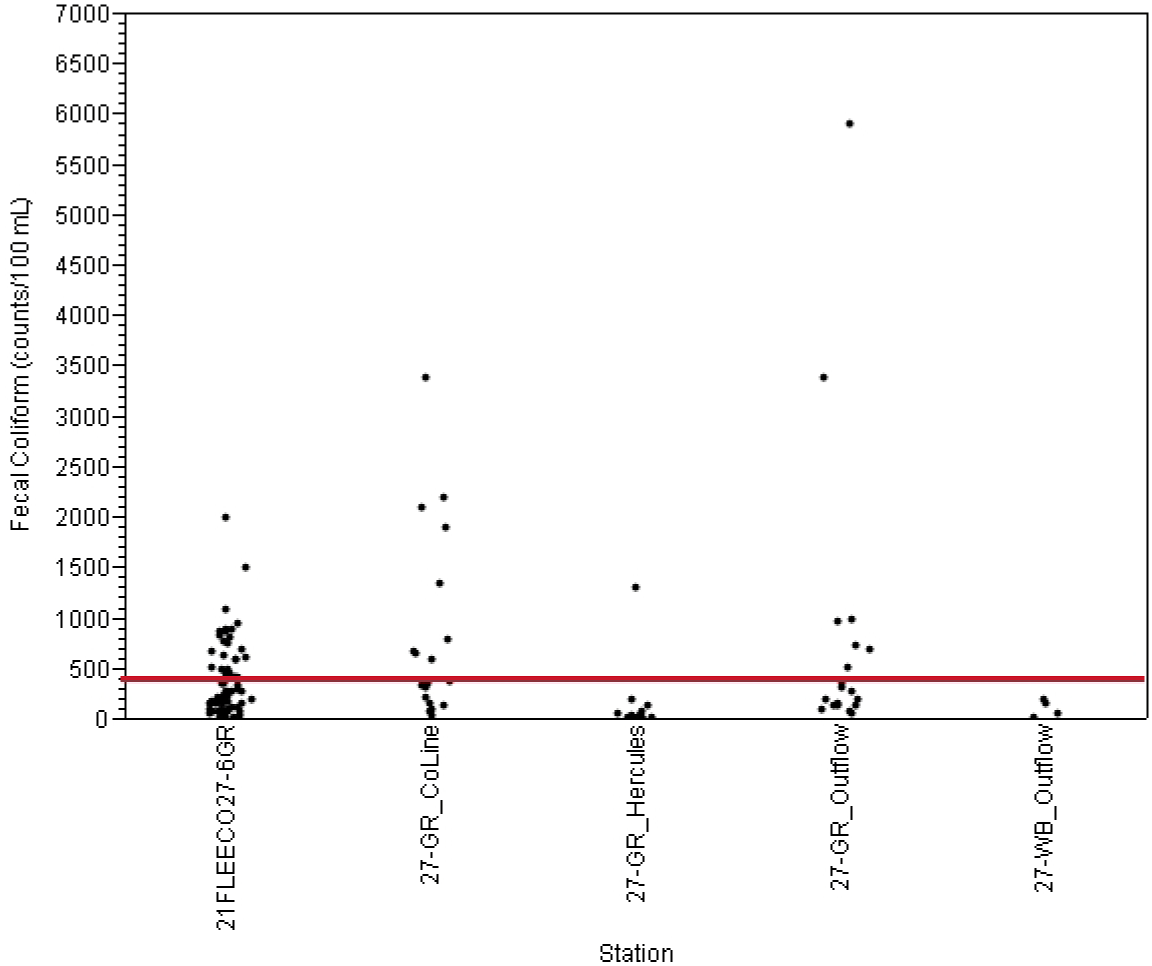
Spatial Patterns

Fecal coliform data from water quality sampling stations for the 2002 – 2010 data period were analyzed to detect spatial trends in the data (**Figure 5.2 and Table 5.2**). The period of observation for station 21FLEECO27-6GR was 2002 – 2008. The period of observation for stations 21FLBABR27-GRColine, 21FLBABR27-GR_Hercules, and 21FLBABR27-GR_Outflow were 2008 – 2010. However, stations 21FLBABR27-GR_Coline and 21FLBABR27-GR_Outflow had the highest fecal coliform concentrations (**Figure 5.3**). In addition, the stations 21FLBABR27-GRColine (47%), 21FLEECO27-6GR (38%), and 21FLBABR27-GR_Outflow (32%) had the highest fecal coliform exceedance rate. The landuse surrounding these stations are primarily agriculture**.**

Table 5.2. Station Summary Statistics of the Fecal Coliform Data for Trout Creek (WBID 3240G) from 2002 – 2010

Station	Period of Obs	# of Samples	Min	Max	Mean	Median	# of Exceed	Percent Exceed
21FLEECO27-6GR	2002-2008	73	10	2001	377	270	28	38%
21FLBABR 27-GR_CoLine	2008-2010	19	40	3400	829	380	9	47%
21FLBABR 27-GR_Hercules	2008-2010	12	10	1300	156	35	1	8%
21FLBABR 27-GR_Outflow	2008-2010	19	50	5900	805	270	6	32%
21FLBABR 27-WB_Outflow	2008	4	20	190	105	105	0	0%

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



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

Figure 5.3. Fecal Coliform Concentration Trends in Trout Creek (WBID 3240G) for 2002 - 2010 by Station

Temporal Patterns

Monthly and Seasonal Trends

Using rainfall data collected at the FL CLIMOD station – Fort Myers FAA/AP (083186), (http://climod.meas.ncsu.edu/) it was possible to compare monthly rainfall in 2002 – 2010 with monthly fecal coliform exceedance rates for the same period, as well as average quarterly rainfall with average quarterly fecal coliform exceedance rates (**Figures 5.4** and **5.5**).

High fecal coliform concentrations were observed during each month and each season. However, the highest fecal coliform concentrations and the highest exceedance rate (72%) were observed during the 1st quarter (January, February, and March). Monthly and seasonal fecal coliform averages and percent exceedances for the data collected in 2002 - 2010 are summarized in **Table 5.3.**

Table 5.3. Summary Statistics of Fecal Coliform Data for Station 21FLEECO27-6GR in Trout Creek (WBID 3240G) by Month and Season during 2002 – 2010

Month	Number of Cases	Min	Max	Median	Mean	Number of Exceedances	% Fecal Exceedances	Rainfall Mean
1	8	150	5900	1195	1649	6	75	2.32
2	13	30	2100	460	612	8	62	2.05
3	11	20	2200	700	760	9	82	2.49
4	9	70	490	150	189	1	11	1.93
5	7	70	680	270	317	2	29	3.8
6	8	20	770	175	270	2	25	8.97
7	13	10	510	150	180	1	8	9.32
8	12	50	1300	170	411	5	42	9.9
9	11	10	3400	80	458	2	18	7.69
10	12	10	1340	145	228	1	8	2.87
11	11	60	870	220	289	3	27	1.59
12	12	10	3400	355	589	5	42	1.59
Season	**Number of Cases**	**Min**	**Max**	**Median**	**Mean**	**Number of Exceedances**	**% Fecal Exceedances**	**Rainfall Mean**
1	32	20	5900	700	1007	23	72	6.86
2	24	20	770	175	259	5	21	14.7
3	36	10	3400	150	350	8	22	26.91
4	35	10	3400	220	369	9	26	6.05

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

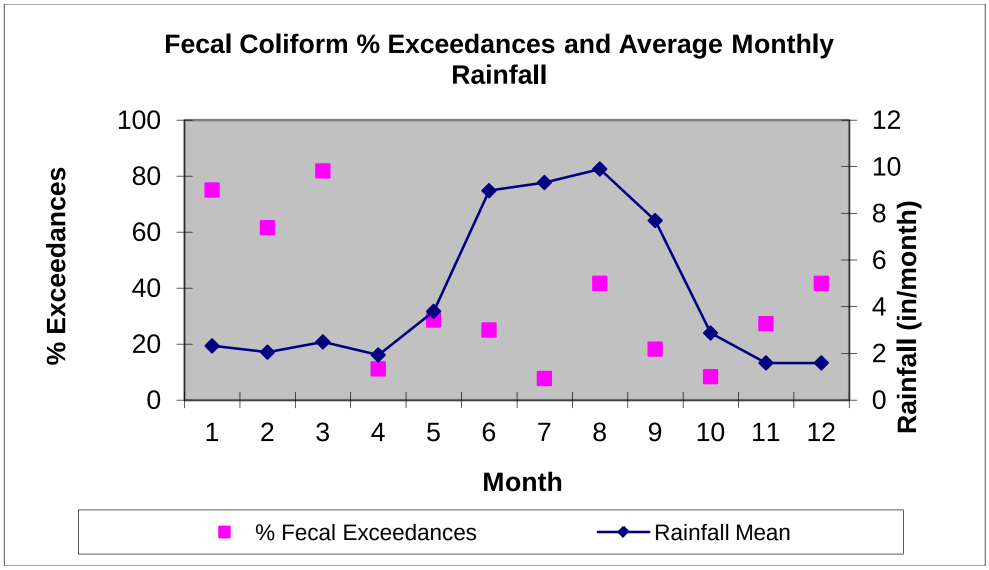


Figure 5.4. Fecal Coliform Exceedances and Rainfall at Station 21FLEECO27-6GR in Trout Creek (WBID 3240G) by Month during 2002 – 2010

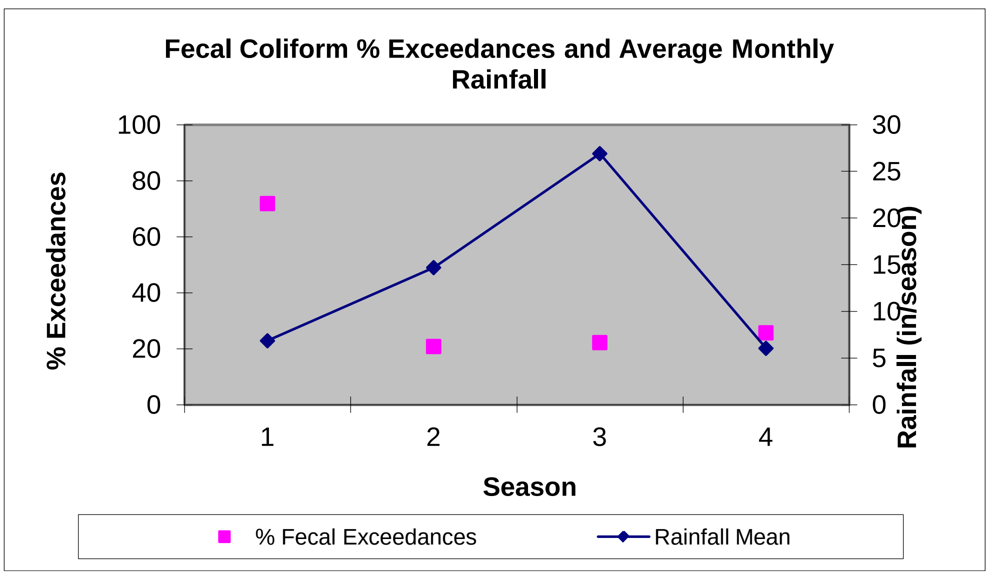
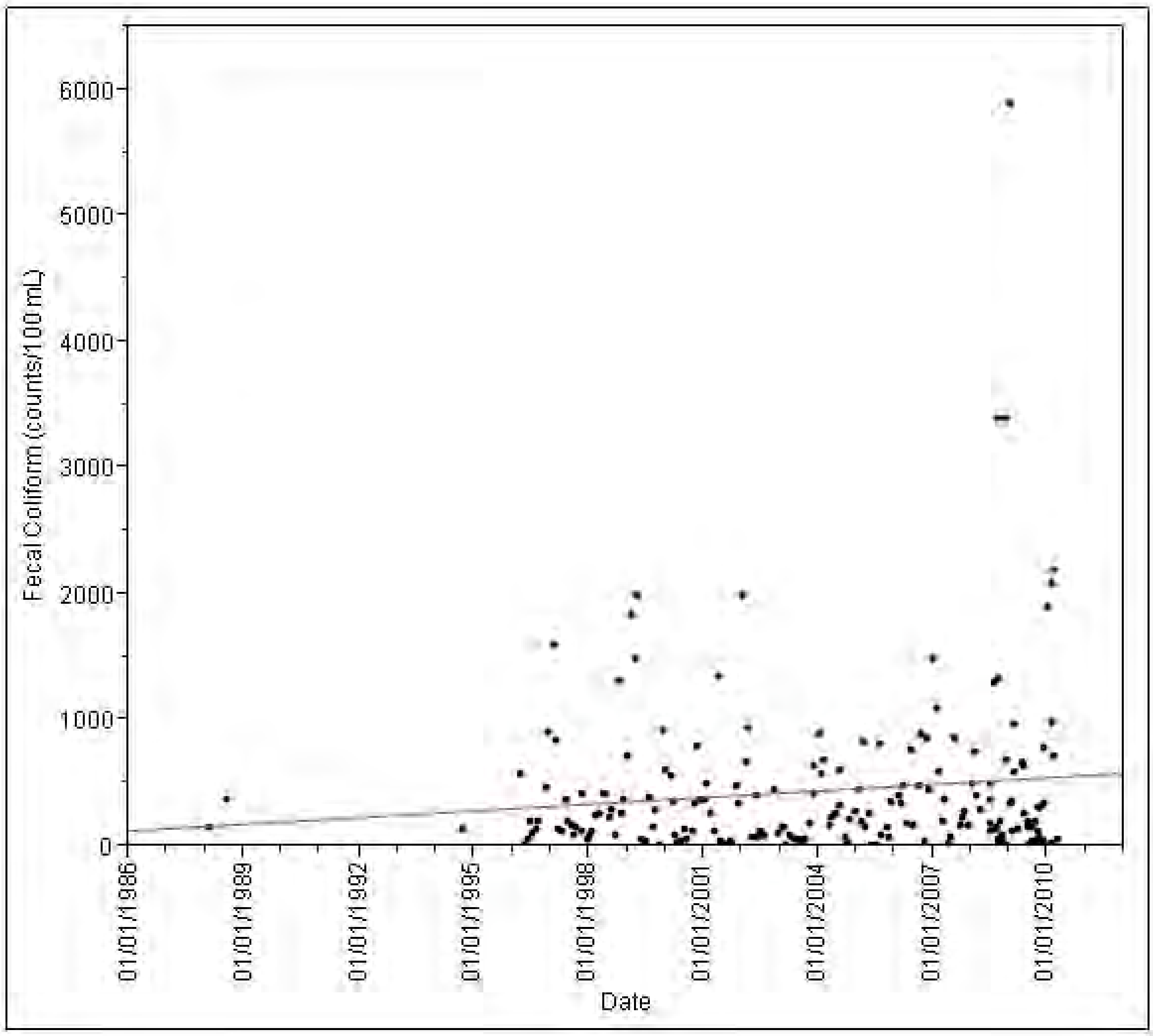


Figure 5.5. Fecal Coliform Exceedances and Rainfall at Station 21FLEECO27-6GR in Trout Creek (WBID 3240G) by Season during 2002 – 2010

Period of Record trend

The period of record for Trout Creek (WBID 3240G) is from 1988 – 2010. Plotting the historical fecal coliform data by time revealed a slight increasing trend; however, the trend was not significant (R^2 = 0.01 and Prob > F = 0.08). Refer to **Figure 5.6**. The fecal coliform concentration data range has not significantly differed from 1988 – 2010.



Linear Equation: Fecal Coliform (counts/100 mL) = 105.99926 + 8.7339e-8*date

Figure 5.6. Fecal Coliform Concentration Trends in Trout Creek (WBID 3240G) for the Entire Period of Record (1988 – 2008)

Fecal Coliform Data by Hydrologic Condition

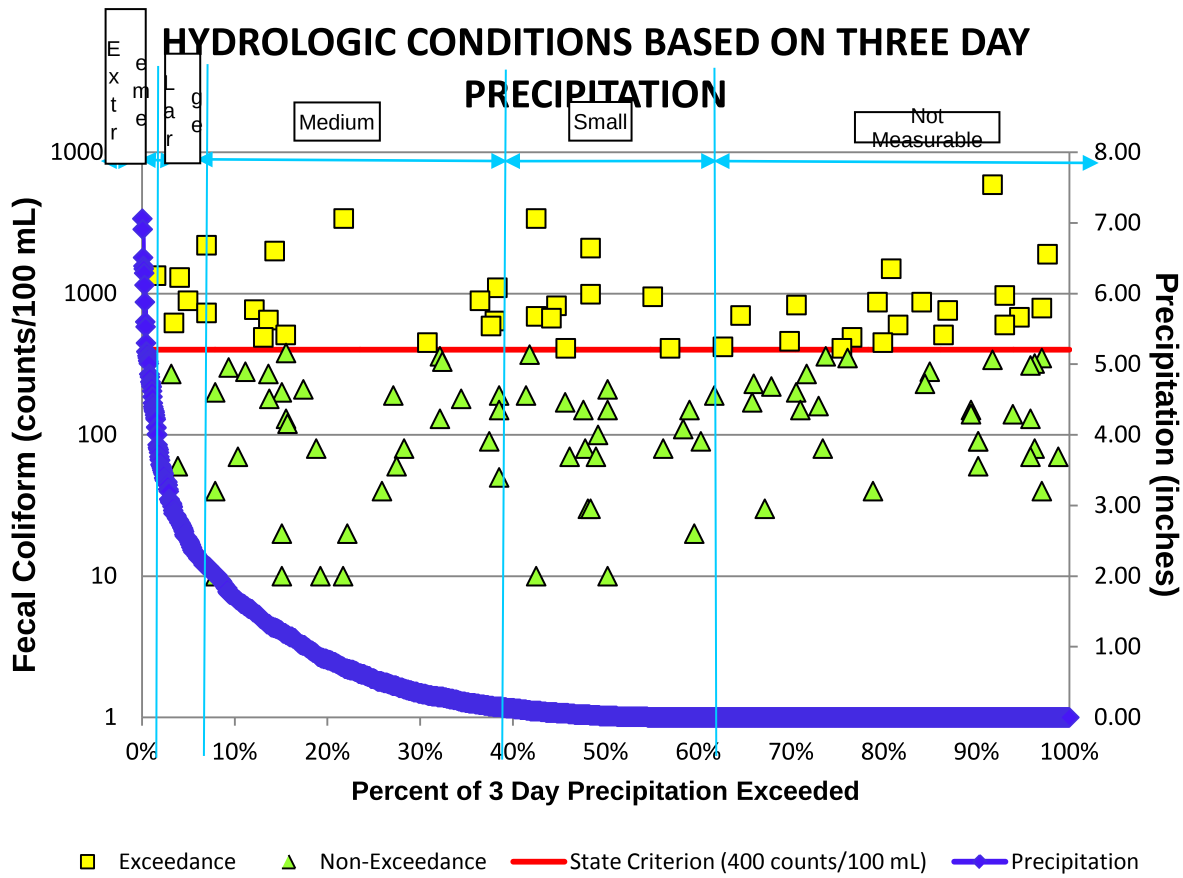
As no current flow data were available, hydrologic conditions were analyzed using rainfall. A loading curve type chart, that would normally be applied to flow events, was created using precipitation data from the Fort Myers FAA/AP, FL CLIMOD station (083186). The chart was divided in the same manner 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 5.7**).

Because fecal coliform exceedances for the data period (2002 – 2010) were observed during all types of weather events (extreme, large, medium, small, and none/not measurable precipitation events), a connection linking fecal coliform data and hydrologic condition was determined to be non-existent.

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	50	19	38%	31	62%
Small	40 - 60	27	9	33%	18	67%
Medium	10 - 40	38	11	29%	27	71%
Large	5 - 10	6	2	33.3%	4	67%
Extreme	0 - 5	6	4	66.7%	2	33.3%

Figure 5.7. 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 41% of the total WBID area being composed of agriculture land use areas and the temporal patterns of the fecal coliform data, it is likely that many of the exceedances are from nonpoint sources entering the surface waters through surface runoff during wet weather conditions and baseflow during dry weather conditions. For Trout Creek, based on monthly and seasonal fecal coliform and precipitation data (Section 5.1.1.Temporal Patterns), fecal coliform exceedances are not precipitation dependent because exceedances occur throughout all precipitation events. 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**:

Formula 1

Using the Hazen method for estimating percentiles as described in Hunter (2002), the existing condition concentration was defined as the 90th percentile of all the fecal coliform data collected from January 1, 2002 – June 30, 2010, which includes the Cycle 2 Verified Period (January 1, 2002 – June 30, 2009). The 90th 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.

Formula 2

If none of the ranked values are shown to be the 90th percentile value, then the 90th 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 90th percentile rank using **Formula 3,** as described below.

$$90^{th}\ \text{Percentile Concentration} = C_{lower} + (P_{90th} * R)$$ **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 90th percentile and the percentile number immediately lower than the 90th percentile (90% - percentile $_{lower}$ = P_{90th})

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 90th percentile were identified. Next, the fecal coliform concentrations corresponding to the lower and upper percentile values were identified. Then, the fecal coliform concentration difference between the lower and upper percentiles was then calculated and divided by the unit percentile. The unit percentile difference is the difference between the lower and upper percentiles. R was then calculated as (fecal coliform concentration $_{upper}$ – fecal coliform concentration $_{lower}$)/(percentile $_{upper}$ – percentile $_{lower}$) = R.

Then C_{lower}, P_{90th}, and R are substituted into **Formula 3** to calculate the 90th percentile fecal coliform concentration (counts/mL).

Using **Formula 1**, the percent reduction for the period of observation 2002 – 2008 was calculated as 58% for Trout Creek (WBID 3240G) (i.e. % reduction needed = [(970-400)/970]*100 = 58%)

Table 5.5 shows the individual fecal coliform data, the ranks, the percentiles for each individual data, the existing 90th 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 Trout Creek (WBID 3240G) TMDL Based on the Hazen Method

Station	Date	Fecal Coliform Conc (MPN/100 mL)	Rank	Percentile by Hazen Method
21FLEECO27-6GR	7/19/2005	10	1	0%
27-GR_Hercules	9/17/2008	10	2	1%
27-GR_Hercules	10/9/2008	10	3	2%
27-GR_Hercules	12/4/2008	10	4	3%
27-GR_Hercules	7/8/2009	10	5	4%
27-GR_Hercules	9/14/2009	10	6	4%
21FLEECO27-6GR	3/3/2003	20	7	5%
21FLEECO27-6GR	6/7/2005	20	8	6%
27-WB_Outflow	10/9/2008	20	9	7%
21FLEECO27-6GR	10/5/2004	30	10	7%
21FLEECO27-6GR	6/7/2007	30	11	8%
27-GR_Hercules	2/10/2010	30	12	9%
21FLEECO27-6GR	7/10/2003	40	13	10%
21FLEECO27-6GR	10/18/2006	40	14	11%
27-GR_CoLine	9/14/2009	40	15	11%

27-GR_Hercules	12/10/2009	40	16	12%
27-GR_Outflow	8/6/2009	50	17	13%
21FLEECO27-6GR	8/27/2003	60	18	14%
27-WB_Outflow	9/19/2008	60	19	15%
27-GR_Hercules	11/7/2008	60	20	15%
21FLEECO27-6GR	5/19/2003	70	21	16%
21FLEECO27-6GR	6/30/2003	70	22	17%
21FLEECO27-6GR	9/4/2003	70	23	18%
27-GR_Hercules	10/8/2009	70	24	19%
27-GR_Outflow	4/15/2010	70	25	19%
21FLEECO27-6GR	4/25/2002	80	26	20%
21FLEECO27-6GR	6/18/2002	80	27	21%
21FLEECO27-6GR	9/20/2004	80	28	22%
21FLEECO27-6GR	11/17/2005	80	29	22%
21FLEECO27-6GR	7/2/2007	80	30	23%
27-GR_CoLine	11/5/2009	80	31	24%
21FLEECO27-6GR	8/1/2002	90	32	25%
21FLEECO27-6GR	4/16/2003	90	33	26%
27-GR_CoLine	11/7/2008	90	34	26%
27-GR_Outflow	11/7/2008	90	35	27%
21FLEECO27-6GR	9/6/2005	100	36	28%
21FLEECO27-6GR	12/19/2002	110	37	29%
21FLEECO27-6GR	7/3/2002	120	38	30%
27-GR_Hercules	7/9/2008	130	39	30%
27-GR_Outflow	2/4/2009	130	40	31%
27-GR_Outflow	10/8/2009	130	41	32%
27-GR_CoLine	4/7/2009	140	42	33%
27-GR_Outflow	8/29/2008	140	43	33%
21FLEECO27-6GR	1/28/2003	150	44	34%
21FLEECO27-6GR	2/10/2003	150	45	35%
21FLEECO27-6GR	4/6/2005	150	46	36%
27-WB_Outflow	8/29/2008	150	47	37%
27-GR_CoLine	8/6/2009	150	48	37%
27-GR_Outflow	7/8/2009	150	49	38%
21FLEECO27-6GR	10/31/2005	160	50	39%
21FLEECO27-6GR	4/28/2004	170	51	40%
21FLEECO27-6GR	12/17/2007	170	52	41%
21FLEECO27-6GR	7/10/2006	180	53	41%
21FLEECO27-6GR	9/27/2007	180	54	42%
21FLEECO27-6GR	10/21/2003	190	55	43%
21FLEECO27-6GR	5/10/2006	190	56	44%
27-WB_Outflow	7/10/2008	190	57	44%
27-GR_Hercules	8/6/2009	190	58	45%
21FLEECO27-6GR	2/24/2005	200	59	46%
27-GR_Outflow	10/9/2008	200	60	47%
27-GR_Outflow	9/14/2009	200	61	48%
21FLEECO27-6GR	4/16/2007	210	62	48%

27-GR_CoLine	7/8/2009	210	63	49%
21FLEECO27-6GR	11/2/2004	220	64	50%
21FLEECO27-6GR	5/10/2004	230	65	51%
21FLEECO27-6GR	10/18/2007	230	66	52%
21FLEECO27-6GR	6/29/2004	270	67	52%
21FLEECO27-6GR	5/19/2005	270	68	53%
27-GR_Outflow	6/4/2009	270	69	54%
21FLEECO27-6GR	12/27/2004	280	70	55%
21FLEECO27-6GR	11/15/2007	280	71	56%
21FLEECO27-6GR	4/2/2008	300	72	56%
27-GR_CoLine	10/8/2009	310	73	57%
27-GR_Outflow	11/5/2009	320	74	58%
21FLEECO27-6GR	7/26/2004	330	75	59%
27-GR_CoLine	1/8/2009	340	76	59%
21FLEECO27-6GR	3/16/2006	350	77	60%
27-GR_Outflow	12/10/2009	350	78	61%
21FLEECO27-6GR	12/7/2005	360	79	62%
27-GR_CoLine	2/4/2009	360	80	63%
21FLEECO27-6GR	5/1/2007	370	81	63%
27-GR_CoLine	7/9/2008	380	82	64%
21FLEECO27-6GR	5/28/2002	410	83	65%
21FLEECO27-6GR	2/22/2006	410	84	66%
21FLEECO27-6GR	3/6/2008	410	85	67%
21FLEECO27-6GR	12/1/2003	420	86	67%
21FLEECO27-6GR	11/6/2002	450	87	68%
21FLEECO27-6GR	12/7/2006	450	88	69%
21FLEECO27-6GR	2/2/2005	460	89	70%
21FLEECO27-6GR	4/3/2006	490	90	70%
21FLEECO27-6GR	8/31/2006	490	91	71%
21FLEECO27-6GR	1/14/2008	510	92	72%
27-GR_Outflow	7/8/2008	510	93	73%
21FLEECO27-6GR	2/3/2004	590	94	74%
21FLEECO27-6GR	3/6/2007	600	95	74%
27-GR_CoLine	3/4/2009	600	96	75%
21FLEECO27-6GR	8/3/2004	620	97	76%
21FLEECO27-6GR	11/19/2003	640	98	77%
27-GR_CoLine	6/4/2009	650	99	78%
21FLEECO27-6GR	2/14/2002	670	100	78%
27-GR_CoLine	5/5/2009	680	101	79%
27-GR_Outflow	12/4/2008	690	102	80%
21FLEECO27-6GR	3/8/2004	700	103	81%
27-GR_Outflow	3/11/2010	730	104	81%
21FLEECO27-6GR	2/5/2008	760	105	82%
21FLEECO27-6GR	6/14/2006	770	106	83%
27-GR_CoLine	12/10/2009	790	107	84%
21FLEECO27-6GR	8/15/2005	820	108	85%
21FLEECO27-6GR	3/7/2005	830	109	85%

21FLEECO27-6GR	11/6/2006	870	110	86%
21FLEECO27-6GR	8/6/2007	870	111	87%
21FLEECO27-6GR	1/27/2004	890	112	88%
21FLEECO27-6GR	9/12/2006	890	113	89%
21FLEECO27-6GR	3/6/2002	950	114	89%
27-GR_Outflow	3/4/2009	970	115	90%
27-GR_Outflow	2/10/2010	990	116	91%
21FLEECO27-6GR	2/5/2007	1100	117	92%
27-GR_Hercules	8/22/2008	1300	118	93%
27-GR_CoLine	10/1/2008	1340	119	93%
21FLEECO27-6GR	1/16/2007	1500	120	94%
27-GR_CoLine	1/7/2010	1900	121	95%
21FLEECO27-6GR	1/17/2002	2001	122	96%
27-GR_CoLine	2/10/2010	2100	123	96%
27-GR_CoLine	3/11/2010	2200	124	97%
27-GR_CoLine	12/4/2008	3400	125	98%
27-GR_Outflow	9/18/2008	3400	126	99%
27-GR_Outflow	1/8/2009	5900	127	100%
Existing condition concentration – 90th percentile (counts/100mL)				**970**
Allowable concentration (counts/100mL)				**400**
Final percent reduction				**58%**

Chapter 6: DETERMINATION OF THE TMDL

6.1 Expression and Allocation of the TMDL

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

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

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

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

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

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

This approach is consistent with federal regulations (40 CFR § 130.2[I]), which state that TMDLs can be expressed in terms of mass per time (e.g., pounds per day), toxicity, or other appropriate measure. The TMDL for Trout Creek (WBID 3240G) 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 Trout Creek (WBID 3240G)

Parameter	TMDL (counts/100mL)	WLA		LA (% reduction)	MOS
		Wastewater (counts/100mL)	NPDES Stormwater (% reduction)		
Fecal coliform	400	N/A	58%	58%	Implicit

N/A Not Applicable

6.2 Load Allocation

Based on a percent reduction approach the load allocation is a 58 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 Trout 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 58 percent reduction in current fecal coliform loading for WBID 3240G. 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 Trout 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 Trout 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 Trout Creek WBID boundary, the number of households within the WBID boundary was estimated to be 41. 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 16.

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 2,952 grams/day. The total produced by dogs would be 6.5 x 10^9 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 Trout Creek WBID boundary can be made using **Equation 1**:

$L = 37.85 * N * Q * C * F$ **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, 41 housing units *(N)* within the Trout 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 Trout Creek WBID boundary, 14 properties are known to use septic tanks and 27 are estimated to use septic systems. Because the probability that these 27 estimated septic tank properties are in fact served by septic tanks ranges from 99 percent to 100 percent, all 41 (Total 41 = 14 known on septic + 27 estimated on septic) properties were assumed to be served by septic tanks for the purposes of this report.

The discharge rate from each septic tank (*Q*) was calculated by multiplying the average household size by the per capita wastewater production rate Because the majority of actual and estimated septic tanks are located in Lee County, an estimate of fecal coliform loads from failed septic tanks was generated using Lee County information. Based on the information published by the Census Bureau, the average household size for Lee County is about 2.35 people/household. The same population densities were assumed within the Trout 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 1×10^6 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 Lee County based on FDOH's septic tank inventory and septic tank repair permits issued in Lee 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 Lee 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 0.27 percent for Lee 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 1.33 percent. Based on **Equation 1**, the estimated fecal coliform loading from failed septic tanks within the Trout Creek WBID boundary is about 3.40 x 10^9 counts/day.

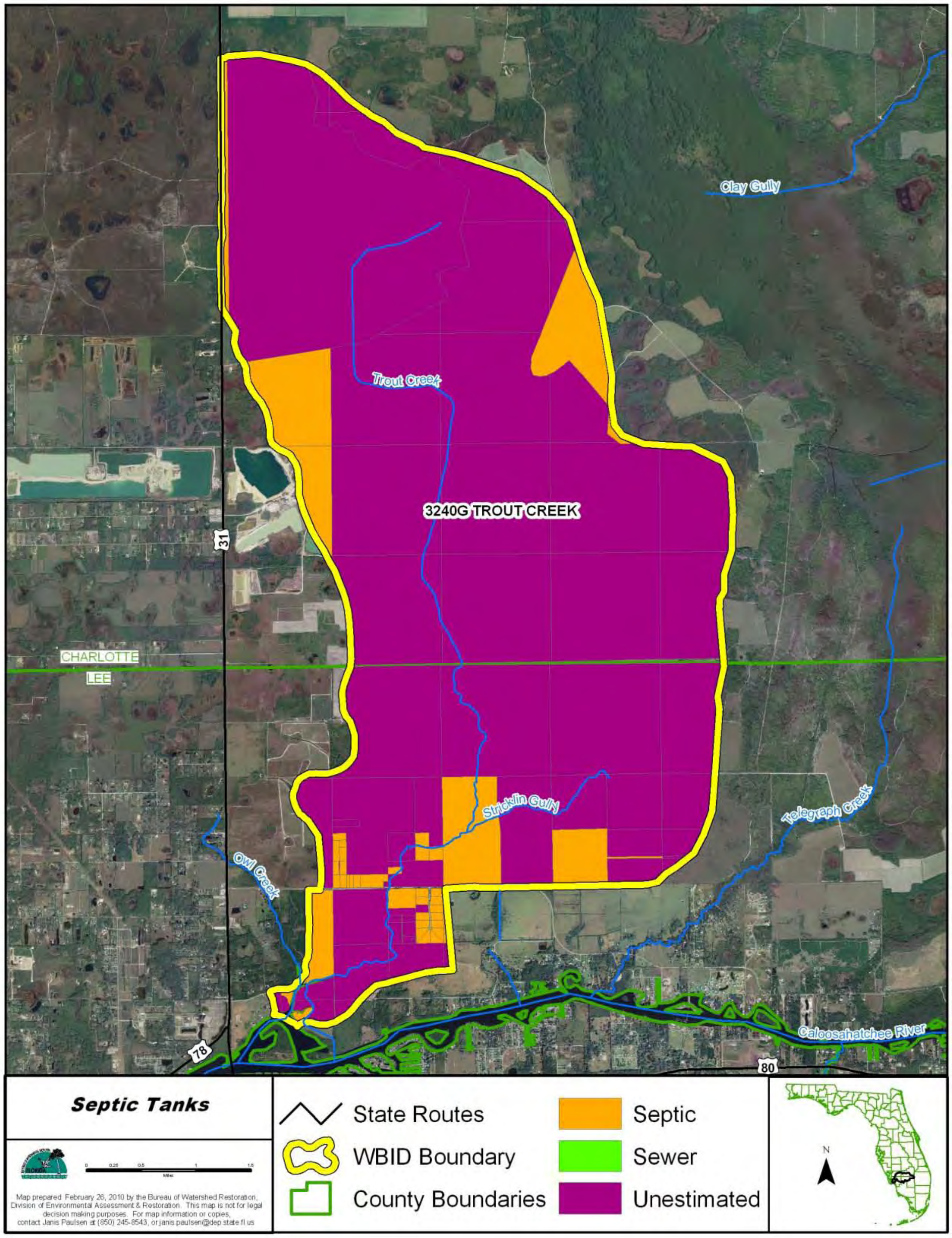

Figure B.1. Distribution of Onsite Sewage Disposal Systems (Septic Tanks) in the Residential Land Use Areas within the Trout Creek WBID Boundary

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

Lee County	2003	2004	2005	2006	2007	2008	Average
New installation (septic tanks)	3149	4180	5883	9672	12588	2494	6328
Accumulated installation (septic tanks)	91609	94758	98938	104821	114493	127081	105283.3
Repair permit (septic tanks)	253	219	122	110	243	818	294
Failure discovery rate (%)	0.28	0.23	0.12	0.10	0.21	0.64	0.27
Failure rate (%)*	1.38	1.16	0.62	0.52	1.06	3.22	1.33

* Failure rate is 5 times the failure discovery rate.

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 Trout Creek WBID boundary. As shown in **Figure 4.1**, wetland areas border Trout Creek within the WBID boundary. Additionally, upland forest 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).

Agriculture land use areas, specifically crop and pastureland, occupy 41.0% of the total land area in the Trout Creek (WBID 3240G) watershed. High loading rates of fecal coliforms 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. Livestock data from the 2007 *Agricultural Census Report* for Lee and Charlotte Counties are listed in **Table B.3** (U.S. Department of Agriculture, 2007). Since a livestock inventory does not exist for the Trout Creek watershed, a possible fecal coliform load from livestock could not be calculated.

Table B.3 Livestock Inventory for Lee and Charlotte Counties

Livestock Inventory	Lee County (number of livestock)	Charlotte County (number of livestock)
Cattle/Calves	12,376	26,937
Horses/Ponies	2,010	472
Colonies of Bees	11,041	5,224
Goats, all	1,893	255
Poultry Layers	4,155	252

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 Trout Creek (WBID 3240G) Fecal Coliform TMDL

June 18, 2010

Ms. Karen Bickford
Lee County Division of Natural Resources
TMDL Coordinator
2295 Victoria Blvd, Fort Myers, FL 33901

Re: Lee County Comments on Newly Released Draft TMDLs

Dear Ms. Bickford:

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 Trout Creek. To aid you in reviewing our responses, we have included your comments, followed by a response to each (in blue).

To recap the teleconference that we had with Kristina and Nathan this afternoon; we are unable to conduct “walk/drive the basin” because most of the land in the Trout Creek basin is in private ownership and public entities are regularly denied access to these areas. We urge the Department to request water quality data collected by Babcock Partners, LLC given that they have previously loaded data to STORET however the last years’ data has not been loaded and this information would be most helpful in pin-pointing sources of fecal coliform pollution. The contact names that we gave today are Tim Dennison and Andy Tilton of Johnson Engineering. They are the lead consultant for water quality data collection for the Babcock development.

Thank you for your insights regarding the County’s willingness to reduce pollutants from its jurisdictional areas and the County’s limitations. As a result of your comments, FDEP is currently revising the MS4 language located within the TMDL document.

In addition, using the contact information Lee County provided for Tim Dennison and Andy Tilton of Johnson Engineering, FDEP has requested the water quality data collected by Babcock Partners, LLC. The STORET Section of FDEP coordinated with Johnson Engineering to upload their data for Babcock into Florida STORET. Once the data were uploaded into Florida STORET, the TMDL Section of FDEP was able to obtain and include the data into the Trout Creek Fecal Coliform TMDL. The new data provided a more comprehensive spatial understanding of the sources of fecal coliform contamination within the Trout Creek watershed. Fecal Coliform data from the water quality sampling stations were analyzed to detect spatial trends in the watershed. The stations with the highest fecal coliform concentrations are 21BABR27-GR_COLINE and 21BABR27-GR_OUTFLOW (**Table 1**). The landuse surrounding these stations is predominantly agriculture.

Table 1. Station Summary Statistics of the Fecal Coliform Data for Trout Creek (WBID 3240G)

Station	N	Mean	Median	Min	Max
21FLA 28020040	2	265	265	150	380
21FLEECO27-6GR	142	379	240	10	2001
21FLSFWMTROUTCRK	1	148	148	148	148
21FLBABR27-GR_CoLine	19	829	380	40	3400
21FLBABR27-GR_Hercules	12	156	35	10	1300
21FLBABR27-GR_Outflow	19	805	270	50	5900
21FLBABR27-WB_Outflow	4	105	105	20	190

The 90th percentile existing concentration was recalculated to include the additional data from Johnson Engineering. The 90th percentile existing concentration is 970 counts/100 mL. The revised percent reduction for the period of 2002 – 2010 was calculated as 58% for Trout Creek (WBID 3240G) and has been added to Table 5.6 of the TMDL report.

% reduction needed = [(970-400)/970]*100 = 58%

We thank you for your insights in water quality issues in your area 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
Florida Department of Environmental Protection

ec: John Abendroth
Beth Alvi
Jennifer Nelson
Jennifer Thera

Enclosure

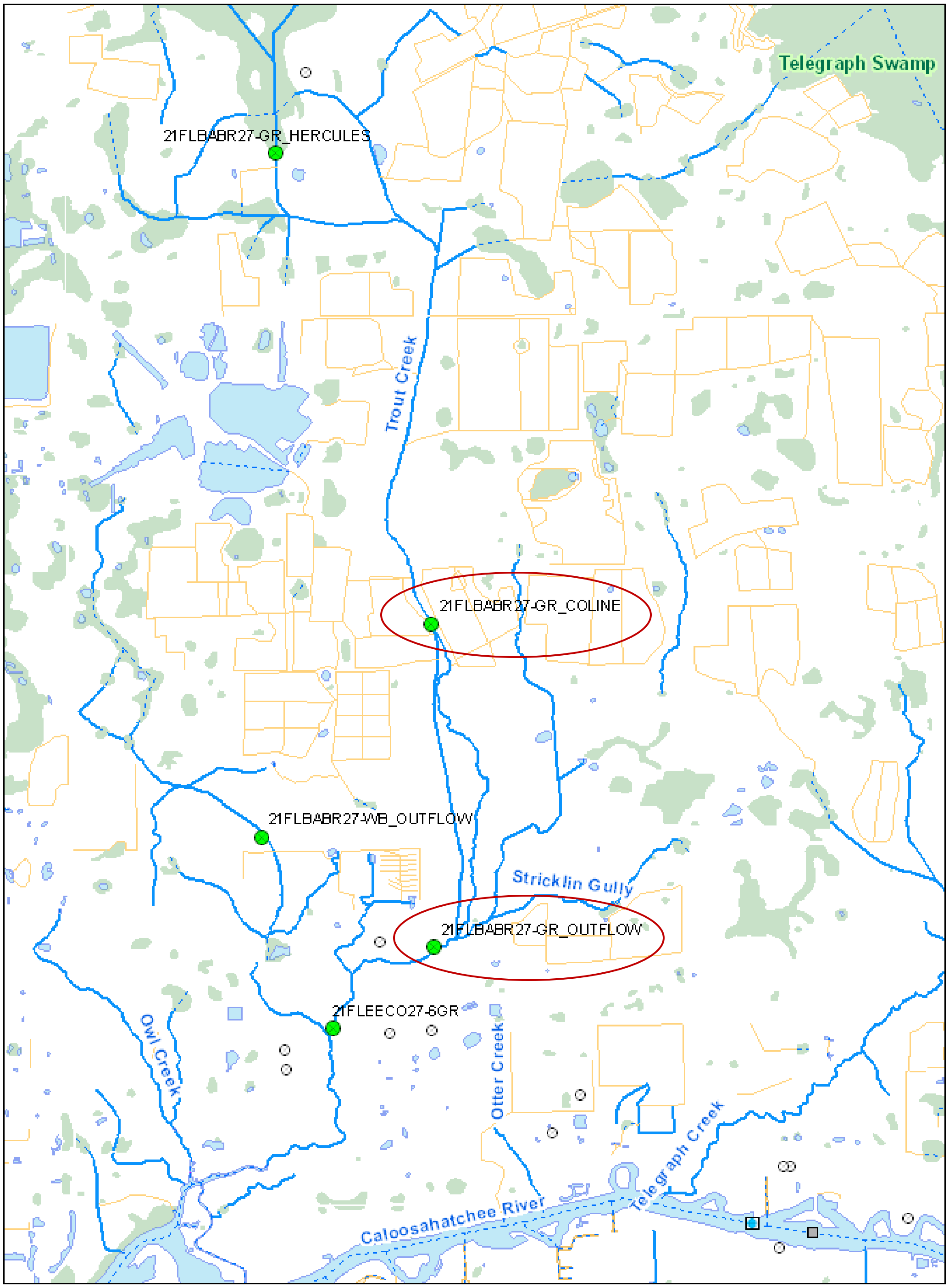

Figure 1. Location of the Water Quality Sampling Stations in the Trout Creek (WBID 3240G) Watershed.

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