FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Environmental Assessment and Restoration, Bureau of Watershed Restoration

NORTHWEST DISTRICT • PENSACOLA BAY BASIN

FINAL TMDL Report

Fecal Coliform TMDL for Turkey Creek (WBID 117)

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Acknowledgments

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Contents

List of Tables

List of Figures

Websites

Florida Department of Environmental Protection, Bureau of Watershed Restoration

TMDL Program

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

Identification of Impaired Surface Waters Rule

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

Florida STORET Program

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

2012 Integrated Report

http://www.dep.state.fl.us/water/docs/2012_integrated_report.pdf

Criteria for Surface Water Quality Classifications

http://www.dep.state.fl.us/water/wqssp/classes.htm

Water Quality Status Report : Pensacola Bay

http://www.dep.state.fl.us/water/basin411/pensacola/status.htm

Water Quality Assessment Report: Pensacola Bay

http://www.dep.state.fl.us/water/basin411/pensacola/assessment.htm

U.S. Environmental Protection Agency

Region 4: TMDLs 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 Turkey Creek, located in the Pensacola Bay Basin. This waterbody was verified as impaired for fecal coliform, and therefore was included on the Verified List of impaired waters for the Pensacola Bay Basin that was adopted by Secretarial Order in November 2010. The TMDL establishes the allowable fecal coliform loading to Turkey Creek that would restore the waterbody so that it meets its applicable water quality criterion for fecal coliform.

1.2 Identification of Waterbody

For assessment purposes, the Florida Department of Environmental Protection (Department) has divided the Pensacola Bay Basin into water assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or stream reach. Turkey Creek is WBID 117.

Turkey Creek is located in Walton County, in northwest Florida, between Interstate 10 and the Florida–Alabama boundary (**Figure 1.1**). The creek, which is approximately 11 miles long, flows from north to south and empties into the Shoal River (**Figure 1.2**). The watershed is rural, mainly covered by upland forest, wetlands, and pasture. Additional information about the hydrology and geology of this area is available in the Water Quality Status Report for the Pensacola Bay Basin (Department 2004).

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.

A TMDL report is followed by the development and implementation of a restoration plan designed to reduce the amount of fecal coliform that caused the verified impairment of a waterbody. These activities depend heavily on the active participation of local governments, businesses, citizens, and other stakeholders. The Department will work with these organizations and individuals to undertake or continue reductions of fecal coliform and achieve the established TMDLs for impaired waterbodies.

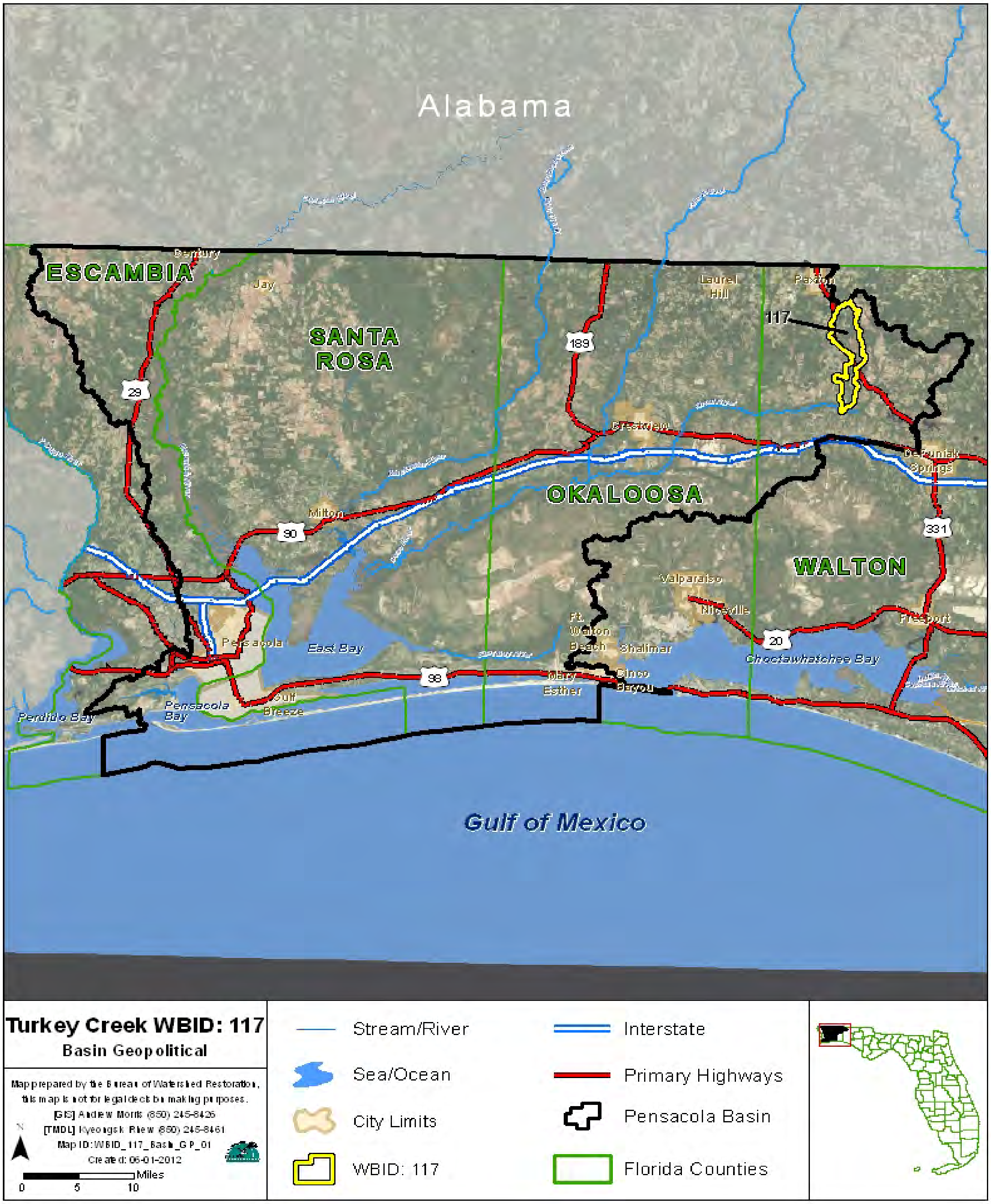


Figure 1.1. Location of the Turkey Creek (WBID 117) Watershed in the Pensacola Bay Basin and Major Geopolitical and Hydrologic Features in the Area

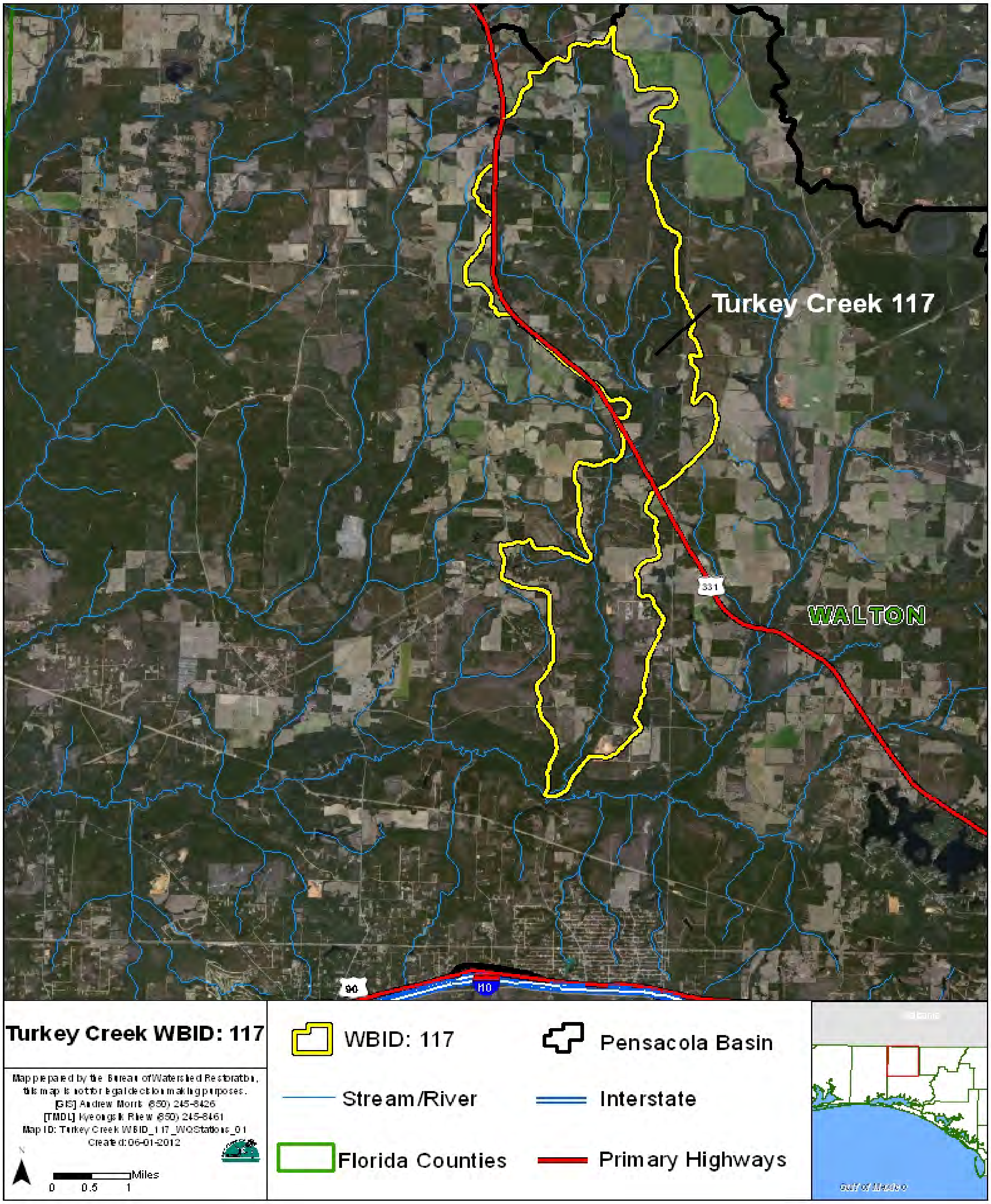


Figure 1.2. Detailed View of the Turkey Creek (WBID 117) Watershed and Major Geopolitical and Hydrologic Features in the Area

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) list included 43 waterbodies in the Pensacola Bay Basin. However the FWRA (Section 403.067, F.S.) stated that all previous Florida 303(d) lists were for planning purposes only and directed the Department to develop, and adopt by rule, a new science-based methodology to identify impaired waters. After a long rulemaking process, the Environmental Regulation Commission adopted the new methodology as Rule 62-303, Florida Administrative Code (F.A.C.) (Identification of Impaired Surface Waters Rule, or IWR), in April 2001; 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 the Turkey Creek watershed and has verified that this waterbody segment is impaired for fecal coliform bacteria. The verified impairment was based on the observation that 5 out of 25 fecal coliform samples collected during the verified period (January 1, 2003, through June 30, 2010) exceeded the applicable fecal water quality criterion (Rule 62-302, F.A.C). **Table 2.1** summarizes the fecal coliform monitoring results for the Cycle 2 verified period for Turkey Creek.

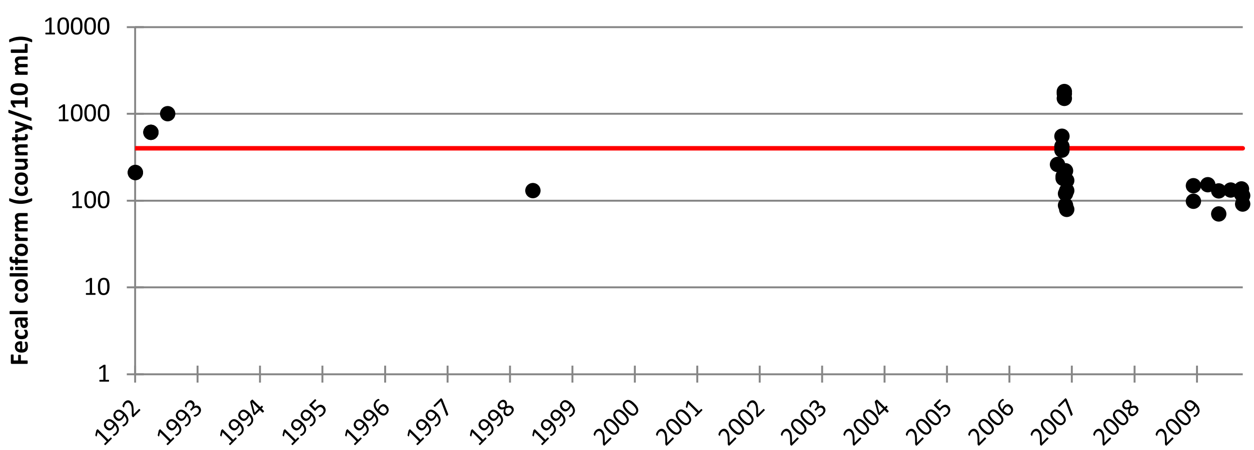
Table 2.1. Summary of Fecal Coliform Monitoring Data for Turkey Creek During the Cycle 2 Verified Period (January 1, 2003–June 30, 2010)

This is a two-column table. Column 1 lists the parameter, and Column 2 lists the corresponding Cycle 2 results

Parameter	Fecal Coliform
Total number of samples	25
IWR-required number of exceedances for the Verified List	5
Number of observed exceedances	5
Number of observed nonexceedances	20
Number of seasons during which samples were collected	4
Highest observation (counts/100mL)	1,800
Lowest observation (counts/100mL)	70
Median observation (counts/100mL)	148
Mean observation (counts/100mL)	359
FINAL ASSESSMENT	**Impaired**

2.3 Period of Record Trend

Historical fecal coliform data collection began in 1992 and continued until 2009 in Turkey Creek. Fecal coliform concentrations ranged from 70 to 1,800 counts per 100 milliliters (counts/100mL) and averaged 379 counts/100mL. Plotting the period of record (historical) fecal coliform data by time for Turkey Creek (Prob> F = 0.3475) revealed no significant increasing or decreasing trend (**Figure 2.1**).



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

Figure 2.1. Fecal Coliform Concentration Trends in Turkey Creek for the Period of Record (1992–2009)

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)**

Turkey Creek is a Class III waterbody, with a designated use of recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife. The 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 TMDL was not to exceed 400 counts/100mL in any sampling event for fecal coliform. The 10% exceedance allowed by the water quality criterion for fecal coliform bacteria was not used directly in estimating the target load, but was included in the TMDL margin of safety (as described in subsequent chapters).

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 discernible, 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, such as 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 Turkey Creek WBID Boundary

4.2.1 Point Sources

Wastewater Point Sources

There are no NPDES-permitted facilities located or that discharge within the Turkey Creek WBID boundary.

Municipal Separate Storm Sewer System Permittees

There are no NPDES municipal separate storm sewer systems (MS4s) covering the Turkey Creek watershed. Therefore, all the load reduction goes to the load allocation for nonpoint sources.

4.2.2 Land Uses and Nonpoint Sources

Accurately quantifying the fecal coliform loadings from nonpoint sources requires identifying nonpoint source categories, locating 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 by agricultural land uses, fecal coliform loadings can come from the runoff from areas with animal feeding operations or direct animal access to receiving waters.

In addition to the sources associated with anthropogenic activities, birds and other wildlife can also act as fecal coliform contributors to 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 the potential sources of observed fecal coliform impairment.

Land Uses

The spatial distribution and acreage of different land use categories were identified using the Northwest Florida Water Management District's (NWFWMD) 2009–10 land use coverage contained in the Department's geographic information system (GIS) library. Land use categories within the Turkey Creek WBID boundary were aggregated using the Florida Land Use Code and Classification System (FLUCCS) expanded Level 1 codes (including low-, medium-, and high-density residential) 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 Turkey Creek WBID boundary is about 10,678 acres. The dominant land use category is upland forest, which accounts for about 51% of the total WBID area. Urban lands—including urban and built-up; low- and medium-density residential; and transportation, communication, and utilities—make up about 3% of the total WBID area. Agricultural land use accounts for about 18%. Low-impact land uses—including rangeland, upland forest, water, wetlands, and barren land—occupy 79% of the watershed.

Because no conventional point sources were identified in the Turkey Creek watershed, the primary loadings of fecal coliform to the creek are generated by nonpoint sources in the watershed. Runoff from agriculture could be another source, in addition to failed septic tanks and pet feces, because this watershed is in a rural area. A preliminary quantification of the fecal coliform loadings from these sources was conducted to demonstrate the relative contributions. **Appendix B** provides detailed load estimates and describes the methods used for the quantification. It should be noted that the information included in **Appendix B** was only used to demonstrate the possible relative contributions from different sources. These loading estimates were not used in establishing the final TMDL.

Wildlife and Sediments

Wildlife and sediments could also contribute to fecal coliform exceedances in each watershed. Wildlife such as deer, raccoons, muskrat, beavers, and birds have direct access to the waterbody and can deposit their feces directly into the water. Wildlife also deposit coliform bacteria with their feces onto land surfaces, where they can be transported during storm events to nearby streams. Studies have shown that fecal coliform bacteria can survive and reproduce in streambed sediments and can be resuspended in surface water when conditions are right (Jamieson *et al.* 2005; Solo-Gabriele *et al.* 2002).

Current source identification methodologies cannot quantify the exact amount of fecal coliform loading from wildlife and/or sediment sources.

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

This is a four-column table. Column 1 lists the Level 1 land use code, Column 2 lists the land use, Column 3 lists the acreage, and Column 4 lists the percent acreage.

- = Empty cell/no data

Level 1 Code	Land Use	Acreage	% Acreage
1000	Urban and built-up	58	0.5%
-	Low-density residential	199	1.9%
-	Medium-density residential	20	0.2%
-	High-density residential	-	-
2000	Agriculture	1,931	18.1%
3000	Rangeland	642	6.0%
4000	Upland forest	5,476	51.3%
5000	Water	153	1.4%
6000	Wetland	2,159	20.2%
7000	Barren land	6	0.1%
8000	Transportation, communication, and utilities	34	0.3%
-	**TOTAL**	**10,678**	**100.0%**

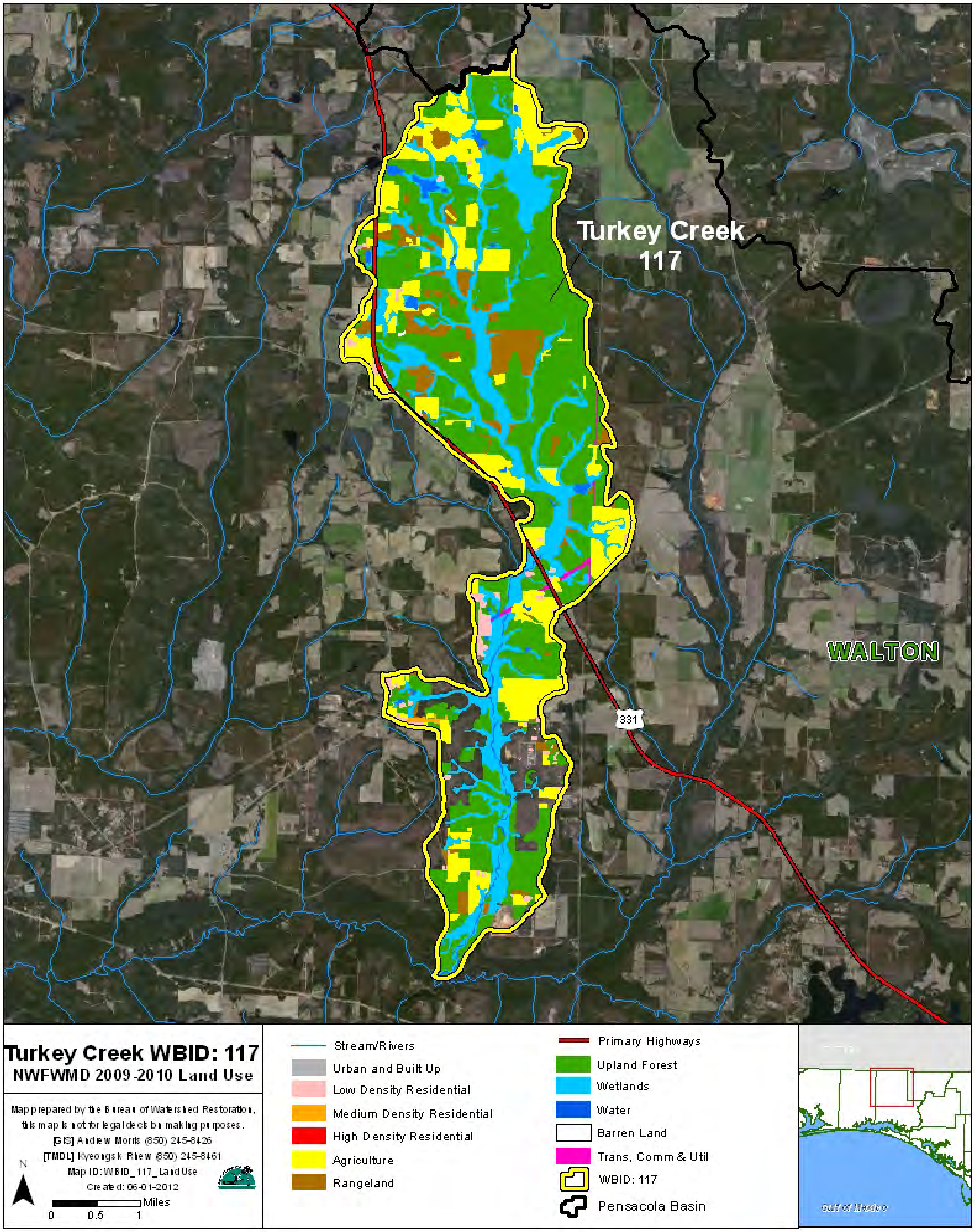


Figure 4.1. Principal Land Uses within the Turkey Creek WBID Boundary in 2009–10

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Determination of Loading Capacity

The fecal coliform TMDL was developed using the Hazen method, which is a percent reduction approach. Using this method, the percent reduction needed to meet the applicable criterion is calculated based on the 90th percentile of all measured concentrations collected during the Cycle 2 verified period (January 1, 2003, through June 30, 2010). 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 90th percentile value. 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

All data used for this TMDL report were provided by the Department's Northwest District office and Biological Research Associates. The data were included in Run_44 of the Department's IWR database. **Figure 5.1** shows the locations of the water quality sites where fecal coliform data were collected. This analysis used fecal coliform data collected during the Cycle 2 verified period (January 1, 2003, through June 30, 2010) to represent better the current conditions. During this period, a total of 25 fecal coliform samples were collected from 6 water quality stations in the WBID.

Figure 5.2 shows the fecal coliform concentrations observed in Turkey Creek. These ranged from 70 to 1,800 counts/100mL and averaged 359 counts/100mL during the Cycle 2 verified period. Plotting fecal coliform data by time for Turkey Creek during the Cycle 2 verified period revealed no significant increasing or decreasing trend (Prob> F = 0.0530).

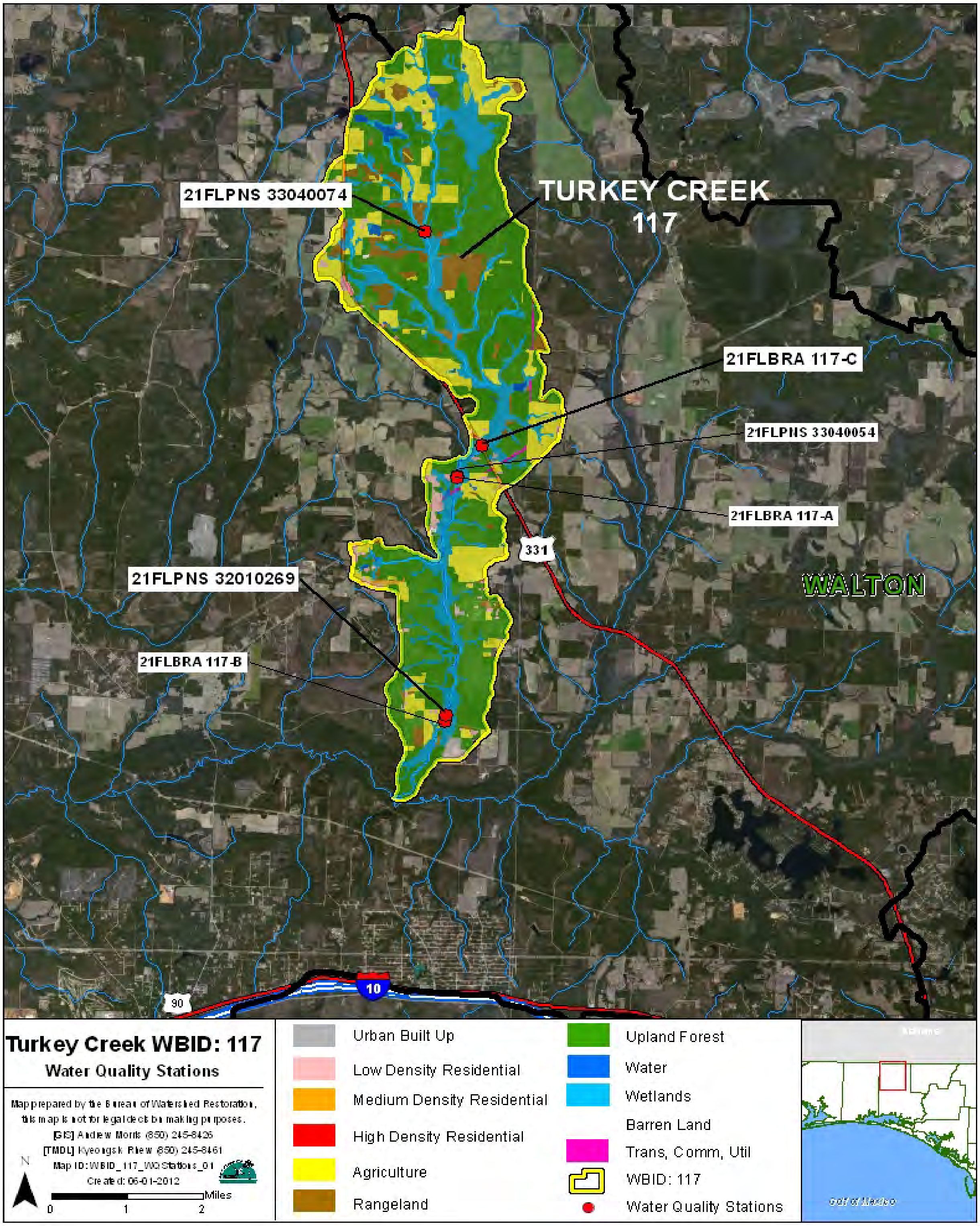
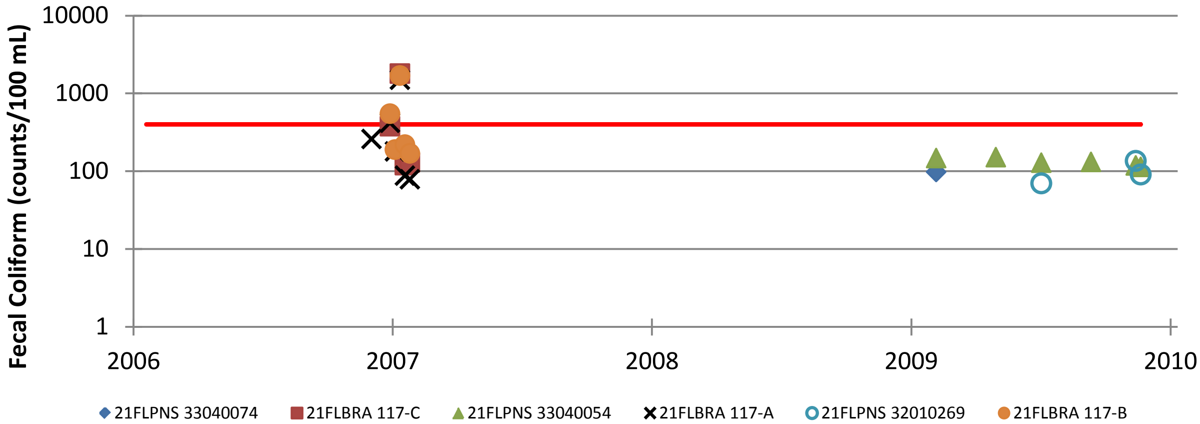


Figure 5.1. Location of Water Quality Stations in Turkey Creek



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

Figure 5.2. Trends in Fecal Coliform Concentrations in Turkey Creek During the Cycle 2 Verified Period (January 1, 2003–June 30, 2010)

Temporal Patterns

Monthly and Seasonal Trends

Seasonally, a peak in fecal coliform concentrations and exceedance rates is commonly observed during the third quarter (summer, July–September), when conditions are rainy and warm, and lower concentrations and exceedance rates are observed in the first quarter (winter, January–March), when conditions are drier and colder. Such a relationship was not found in Turkey Creek. Mean fecal coliform concentrations and exceedance rates were highest in the first quarter (**Table 5.1b** and **Figure 5.3b**).

Using rainfall data collected at Crestview Bob Sikes Airport (Climate Information for Management and Operational Decisions [CLIMOD] website 2008), it was possible to compare average quarterly total rainfall with long-term (2003–11) with average monthly and quarterly fecal coliform exceedance rates at all stations (**Figures 5.3a** and **5.3b**). Rainfall differences among months were relatively small, but the months from July to August were wetter than the other months. Seasonal differences in rainfall were also small and the third quarter was wettest.

Fecal coliform exceedances (31%) were observed only in the first quarter, and the highest quarterly concentration (486 counts/100mL) was also observed during the same quarter. The lowest average fecal coliform concentration (110 counts/100mL) was observed during the third quarter. On a monthly basis, January was the only month showing fecal coliform exceedances (45%). The highest monthly average fecal coliform concentration (650 counts/100mL) was also observed in January. No samples were available in March, April, June, August, and October during the Cycle 2 verified period for this WBID. **Tables 5.1a** and **5.1b** summarize the monthly and seasonal fecal coliform average and percent exceedances, respectively, during the Cycle 2 verified period.

The influence of rainfall on monthly and quarterly exceedances in the WBID is inconclusive, as during the Cycle 2 verified period, monthly exceedance rates do not appear to be correlated with monthly rainfall. However, three-day rainfall accumulations had an effect on fecal coliform concentrations (see **Figure 5.5**).

Table 5.1a. Summary Statistics of Fecal Coliform Data for All Stations in Turkey Creek by Month During the Cycle 2 Verified Period (January 1, 2003–June 30, 2010)

This is an eight-column table. Column 1 lists the month, Column 2 lists the number of samples, Column 3 lists the minimum coliform count/100mL, Column 4 lists the maximum count, Column 5 lists the median count, Column 6 lists the mean count, Column 7 lists the number of exceedances, and Column 8 lists the percent exceedances.

[1] Coliform counts are #/100mL.
[2] Exceedances represent values above 400 counts/100mL
- = Empty cell/no data

Month	Number of Samples	Minimum[1]	Maximum[1]	Median[1]	Mean[1]	Number of Exceedances[2]	% Exceedances
January	11	88	1,800	380	650	5	45%
February	5	79	170	130	125	0	0%
March	0	-	-	-	-	-	-
April	0	-	-	-	-	-	-
May	1	152	152	152	152	0	0%
June	0	-	-	-	-	-	-
July	2	70	129	100	100	0	0%
August	0	-	-	-	-	-	-
September	1	132	132	132	132	0	0%
October	0	-	-	-	-	-	-
November	2	119	136	128	128	0	0%
December	3	91	260	114	155	0	0%

Table 5.1b. Summary Statistics of Fecal Coliform Data for All Stations in Turkey Creek by Season during the Cycle 2 Verified Period (January 1, 2003–June 30, 2010)

This is an eight-column table. Column 1 lists the season, Column 2 lists the number of samples, Column 3 lists the minimum coliform count/100mL, Column 4 lists the maximum count, Column 5 lists the median count, Column 6 lists the mean count, Column 7 lists the number of exceedances, and Column 8 lists the percent exceedances.

[1] Coliform counts are #/100mL.
[2] Exceedances represent values above 400 counts/100mL

Season	Number of Samples	Minimum[1]	Maximum[1]	Median[1]	Mean[1]	Number of Exceedances[2]	% Exceedances
Quarter 1	16	79	1,800	185	486	5	31%
Quarter 2	1	152	152	152	152	0	0%
Quarter 3	3	70	132	129	110	0	0%
Quarter 4	5	91	260	119	144	0	0%

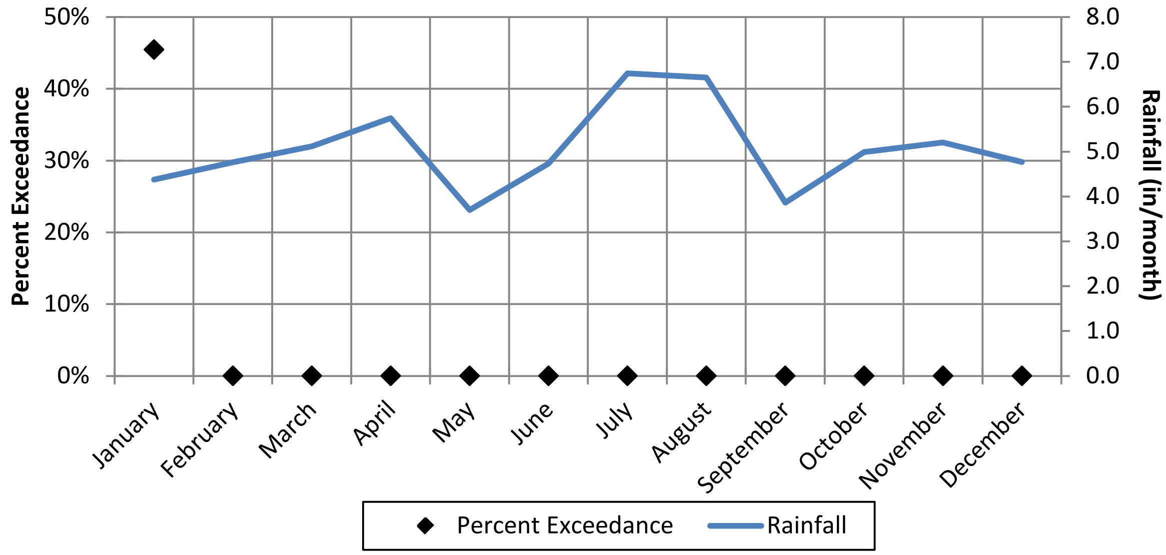


Figure 5.3a. Fecal Coliform Exceedances and Rainfall at All Stations in Turkey Creek by Month During the Cycle 2 Verified Period (January 1, 2003–June 30, 2010)

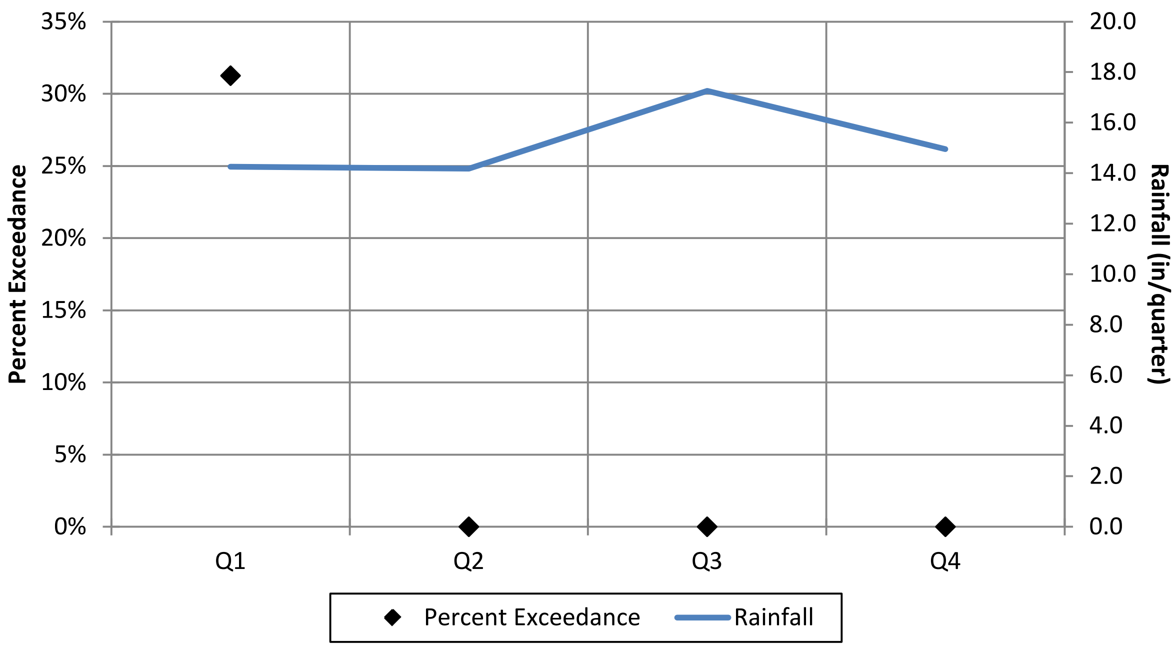


Figure 5.3b. Fecal Coliform Exceedances and Rainfall at All Stations in Turkey Creek by Season During the Cycle 2 Verified Period (January 1, 2003–June 30, 2010)

Spatial Patterns

Fecal coliform data for the WBID from the Cycle 2 verified period (January 1, 2003, through June 30, 2010) were analyzed to detect spatial trends in the data (**Table 5.2** and **Figure 5.4**). Stations are displayed from upstream to downstream (from left to right) (**Figure 5.4**).

Fecal coliform concentrations that exceeded the state criterion were observed in 3 of the 6 sampling stations within Turkey Creek (**Table 5.2** and **Figure 5.4**). Station 21FLBRA 117-B, which is located downstream in the waterbody, had an exceedance rate of 40%. Stations 21FLBRA 117-A and 21FLBRA 117-C, located in the middle portion of the creek, showed 33% and 25% exceedance rates, respectively. Near the sampling stations where fecal coliform exceedances were observed, there are improved pasturelands.

Table 5.2. Station Summary Statistics of Fecal Coliform Data for Turkey Creek During the Cycle 2 Verified Period (January 1, 2003–June 30, 2010)

This is a nine-column table. Column 1 lists the station, Column 2 lists the period of observation, Column 3 lists the number of samples, Column 4 lists the minimum count/100mL, Column 5 lists the maximum count, Column 6 lists the median count, Column 7 lists the mean count, Column 8 lists the number of exceedances, and Column 9 lists the percent exceedances.

[1] Coliform counts are #/100mL.
[2] Exceedances represent values above 400 counts/100mL.

Station	Period of Observation	Number of Samples	Minimum[1]	Maximum[1]	Median[1]	Mean[1]	Number of Exceedances[2]	% Exceedances
21FLPNS 33040074	2009	1	98	98	98	98	0	0%
21FLBRA 117-C	2007	4	120	1,800	255	608	1	25%
21FLPNS 33040054	2009	6	114	152	130.5	132	0	0%
21FLBRA 117-A	2007	6	79	1,500	220	421	2	33%
21FLPNS 32010269	2009	3	70	136	91	99	0	0%
21FLBRA 117-B	2007	5	170	1,700	220	566	2	40%

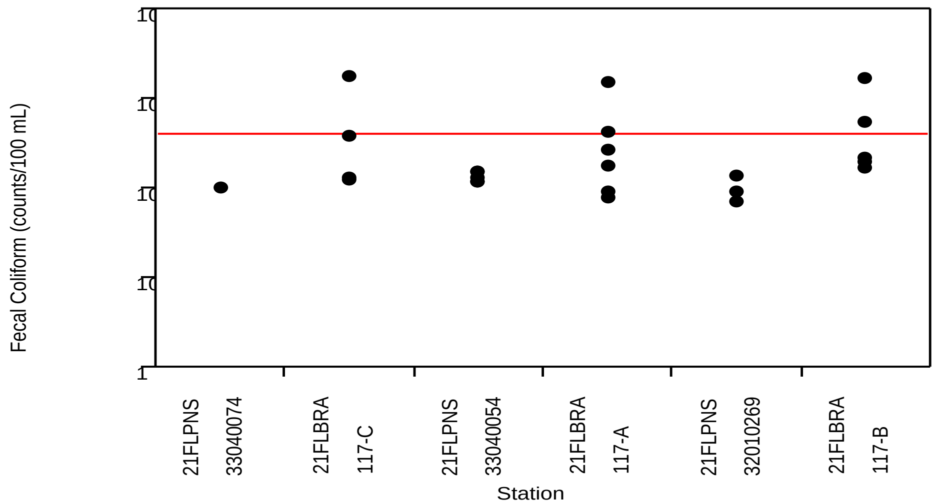


Figure 5.4. Spatial Fecal Coliform Concentration Trends in Turkey Creek by Station During the Cycle 2 Verified Period (January 1, 2003–June 30, 2010)

5.1.2 Critical Condition

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 with direct access to the receiving water can be more noticeable during dry weather, by contributing to exceedances. The critical condition for point source loading typically occurs during periods of low stream flow, when dilution is minimized.

Hydrologic conditions were analyzed using rainfall in the Turkey Creek watershed. A loading curve–type chart that would normally be applied to flow events was created using precipitation data from Crestview Bob Sikes Airport (Climate Information for Management and Operational Decisions [CLIMOD] website 2008). The chart was divided in the same manner as if flow were 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 (the day of and 2 days prior to sampling) precipitation accumulations were used in the analysis (**Table 5.3** and **Figure 5.5**).

Data collected during the Cycle 2 verified period show that fecal coliform exceedances occurred only in medium precipitation events (42%). There were no fecal coliform data available for extreme and large precipitation events. Considering the data availability and high exceedance rate in medium precipitation events, nonpoint sources are probably a major contributing factor. **Table 5.3** and **Figure 5.5** show fecal coliform data by hydrologic condition.

Table 5.3. Summary of Fecal Coliform Data by Hydrologic Condition for Turkey Creek During the Cycle 2 Verified Period (January 1, 2003–June 30, 2010)

This is a seven-column table. Column 1 lists the type of precipitation event, Column 2 lists the event range (in inches), Colum 3 lists the total number of samples, Column 4 lists the number of exceedances, Column 5 lists the percent exceedances, Column 6 lists the number of nonexceedances, and Column 7 lists the percent nonexceedances.

- = Empty cell/no data

Precipitation Event	Event Range (inches)	Total Samples	Number of Exceedances	% Exceedances	Number of Non-exceedances	% Non-exceedances
Extreme	> 2.36"	-	-	-	-	-
Large	1.55" - 2.36"	-	-	-	-	-
Medium	0.20" - 1.55"	12	5	42%	7	58%
Small	0.01" - 0.20"	10	0	0%	10	100%
None/ Not Measurable	< 0.01"	3	0	0%	3	100%

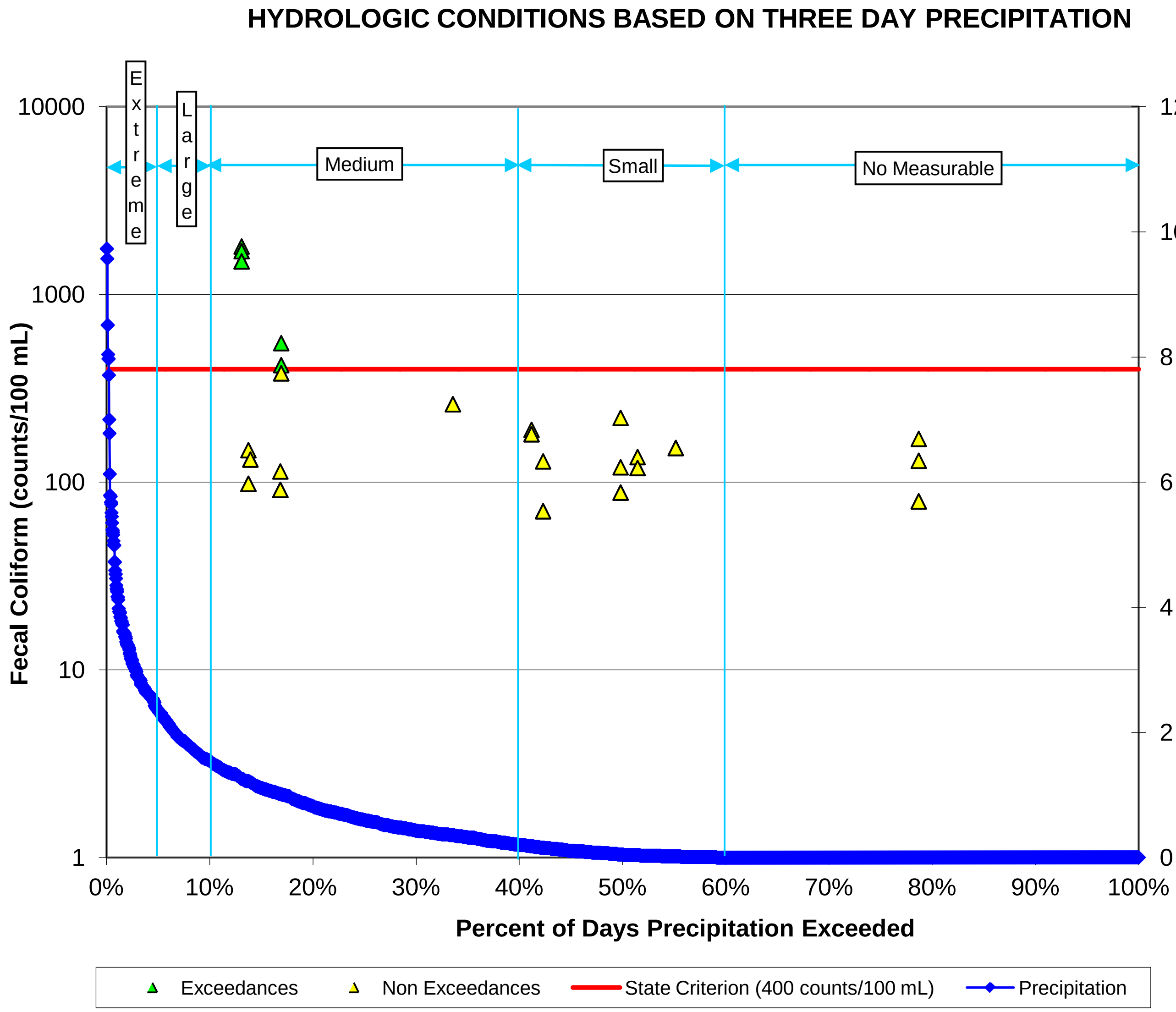


Figure 5.5. Fecal Coliform Data by Hydrologic Condition for Turkey Creek During the Cycle 2 Verified Period (January 1, 2003–June 30, 2010)

5.1.3 TMDL Development Process

A simple reduction calculation was performed to determine the reduction in fecal coliform concentration necessary to achieve the concentration target (400 counts/100mL). The percent reduction needed to reduce the pollutant load was calculated by comparing the existing concentrations and target concentration using **Formula 1**:

$$\textbf{Needed \% reduction} = \frac{\textbf{Existing 90th percentile concentration} - \textbf{Allowable concentration}}{\textbf{Existing 90th percentile concentration}} \times \textbf{100\%} \qquad \textbf{Formula 1}$$

Using the Hazen method for estimating percentiles, as described in Hunter (2002), the existing condition concentration was defined as the 90th percentile of all the fecal coliform data collected during the Cycle 2 verified period (January 1, 2003, to June 30, 2010). 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 5.4**), and **Formula 2** is used to determine the percentile value of each data point:

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

If none of the ranked values ix 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:

90th Percentile Concentration = Clower + (P90th * R) **Formula 3**

Where:

C_{lower} is the fecal coliform concentration corresponding to the percentile lower than the 90th percentile;

P_{90th} is the percentile difference between the 90th percentile and the percentile number immediately lower than the 90th percentile; and

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

Table 5.4 presents the individual fecal coliform data, the ranks, the percentiles for each individual data, the existing 90th percentile concentration (1,500 counts/100mL), the allowable concentration (400 counts/100mL), and the percent reduction needed to meet the applicable water quality criterion for fecal coliform. The needed reduction was calculated as 73%:

$$\textbf{Needed \% reduction} = \frac{\textbf{1500} - \textbf{400}}{\textbf{1000}} \times \textbf{100\%}$$

Table 5.4. Calculation of Fecal Coliform Reductions for the Turkey Creek TMDL Based on the Hazen Method

This is a five-column table. Column 1 lists the station, Column 2 lists the sample collection date, Column 3 lists the fecal coliform existing concentration (counts/100mL), Column 4 lists the concentration rank, and Column 5 lists the concentration percentile.

Note: The row with boldface type and yellow highlighting indicates the 90th percentile.
- = Empty cell/no data

Station	Date	Fecal Coliform Concentration (MPN/100mL)	Rank	Percentile by Hazen Method
21FLPNS 32010269	7/14/2009	70	1	2%
21FLBRA 117-A	2/6/2007	79	2	6%
21FLBRA 117-A	1/30/2007	88	3	10%
21FLPNS 32010269	12/1/2009	91	4	14%
21FLPNS 33040074	2/16/2009	98	5	18%
21FLPNS 33040054	12/1/2009	114	6	22%
21FLPNS 33040054	11/24/2009	119	7	26%
21FLBRA 117-C	1/30/2007	120	8	30%
21FLPNS 33040054	7/14/2009	129	9	34%
21FLBRA 117-C	2/6/2007	130	10	38%
21FLPNS 33040054	9/22/2009	132	11	42%
21FLPNS 32010269	11/24/2009	136	12	46%
21FLPNS 33040054	2/16/2009	148	13	50%
21FLPNS 33040054	5/11/2009	152	14	54%
21FLBRA 117-B	2/6/2007	170	15	58%
21FLBRA 117-A	1/16/2007	180	16	62%
21FLBRA 117-B	1/16/2007	190	17	66%
21FLBRA 117-B	1/30/2007	220	18	70%
21FLBRA 117-A	12/14/2006	260	19	74%
21FLBRA 117-C	1/9/2007	380	20	78%
21FLBRA 117-A	1/9/2007	420	21	82%
21FLBRA 117-B	1/9/2007	550	22	86%
21FLBRA 117-A	**1/23/2007**	**1,500**	**23**	**90%**
21FLBRA 117-B	1/23/2007	1,700	24	94%
21FLBRA 117-C	1/23/2007	1,800	25	98%
-	-	-	**Existing condition concentration-90th percentile (counts/100mL)**	**1500**
-	-	-	**Allowable concentration (counts/100mL)**	**400**
-	-	-	**Final % reduction**	**73%**

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

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

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

It should be noted that the various components of the revised TMDL equation may not sum up to the value of the TMDL because (1) 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 (2) 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 Turkey Creek is expressed in terms of counts/100mL and percent reduction, and represents 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 Turkey Creek

This is a six-column table. Column 1 lists the parameter, Column 2 lists the TMDL (counts/100mL), Column 3 lists the WLA for wastewater (counts/100mL), Column 4 lists the WLA for NPDES stormwater (percent reduction), Column 5 lists the LA (percent reduction), and Column 6 lists the MOS.

N/A – Not applicable

Parameter	TMDL (counts/100mL)	WLA for Wastewater (counts/100mL)	WLA for NPDES Stormwater (% reduction)	LA (% reduction)	MOS
Fecal coliform	400	N/A	N/A	73%	Implicit

6.2 Load Allocation

A fecal coliform reduction of 73% is needed from nonpoint sources in the Turkey Creek watershed. 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 are permitted to discharge within the Turkey 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. Any point sources that may discharge in the WBID in the future will also be required to meet end-of-pipe standards for coliform bacteria.

6.3.2 NPDES Stormwater Discharges

There are no NPDES MS4s covering the Turkey Creek watershed. Therefore, all the load reduction goes to the load allocation for nonpoint sources.

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

7.1 Basin Management Action Plan

Following the adoption of this TMDL by rule, the Department will determine the best course of action regarding its implementation. Depending on 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. BMAPs 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 that 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 the following:

- *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 the obligations of wastewater point source, MS4, and non-MS4 stakeholders in TMDL implementation; enhanced transparency in the Department's decision making; and built strong relationships between the Department and local stakeholders that have benefited other program areas.

7.2 Other TMDL Implementation Tools

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. This is 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.

A multitude of assessment tools is 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 Basins, 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 road map for restoration activities, while still meeting the requirements of Subsection 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 (ERP) regulations.

Rule 62-40, F.A.C., 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, they 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 the 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 Florida Department of Transportation (FDOT) throughout the 15 counties meeting the population criteria. The Department received authorization to implement the NPDES Stormwater Program in 2000.

An important difference between the federal NPDES and the state's Stormwater/ERP 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 has provided these estimations for informational purposes only and did not use them to calculate the TMDL. They 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 when the calculation was made. The numbers provided do not represent actual loadings from the sources.

Agriculture

In the Level 3 land use category, 10 agricultural codes were identified in the Turkey Creek watershed. Hay field, the largest agricultural category, represented 701 acres. Row crop, the second largest, represented approximately 530 acres. Improved pasture, the third largest, represented approximately 482 acres. Assuming that the improved pasture is primarily used to raise cattle, there is 1 beef cow per 3 acres, and beef cattle produce 1×10^{11} fecal coliform counts/cow/day, this could represent potential fecal coliform loadings of 1.61×10^{13} counts/day (**Table B.1**).

Table B.1. Estimated Agricultural Loading in the Turkey Creek Watershed

This is a five-column table. Column 1 lists the improved pasture acreage, Column 2 lists the number of beef cattle per three acres, Column 3 lists the estimated number of cattle, Column 4 lists the estimated fecal coliform density per cow, and Column 5 lists the fecal coliform load.

Improved Pasture Acreage	Number of Beef Cattle per Three Acres	Estimated Number of Cattle	Estimated Fecal Coliform Counts/Cow/Day	Estimated Fecal Coliform Load Counts/day
482	1	161	$1 \text{ X } 10^{11}$	1.61×10^{13}

Pets

Pets (especially dogs) could be a significant source of coliform pollution through surface runoff within the Turkey Creek WBID boundary. Studies report that up to 95% 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 1 dog. A single gram of dog feces contains about 2.2 million fecal coliform bacteria (Weiskel *et al.* 1996). Unfortunately, statistics show that about 40% of American dog owners do not pick up their dogs' feces. The number of dogs within the Turkey 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 information from the Florida Department of Revenue's (DOR) 2009 Cadastral tax parcel and ownership coverage contained in the Department's GIS library, residential parcels were identified using DOR's residential land use codes. The final number of households within the WBID boundary was calculated by adding the number of residential units on the parcels for all improved residential land use codes. There are about 75 households within the WBID boundary (**Table B.2**).

Table B.3 shows the waste production rate for a dog (450 grams/animal/day) and the fecal coliform counts per gram of dog waste (2,200,000 counts/gram). **Table B.2** also shows the estimated number of dogs within the WBID boundary, assuming that 40% of the households in these areas have 1 dog; the total waste produced (grams/day) by dogs and left on the land surface in residential areas in the WBID, assuming that 40% of dog owners do not pick up their dogs' feces; and the total load of fecal coliform produced by dogs (counts/day) within the WBID boundary.

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.2. Estimated Number of Households and Dogs, Waste Produced (grams/day) by Dogs Left on the Land Surface, and Total Load of Fecal Coliform (counts/day) Produced by Dogs within the Turkey Creek WBID Boundary

This is a four-column table. Column 1 lists the number of households, Column 2 lists the number of dogs, Column 3 lists the waste produced left on land, and Column 4 lists the fecal coliform loading.

Number of Households	Number of Dogs	Waste Produced Left on Land Surface (grams/day)	Loading (counts/day)
75	30	5,400	1.19×10^{10}

Table B.3. Dog Population Density, Wasteload, and Fecal Coliform Density Based on the Literature (Weiskel *et al.* 1996)

This is a four-column table. Column 1 lists the animal type (dog), Column 2 lists the population density, Column 3 lists the wasteload, and Column 4 lists the fecal coliform density.

* Number from APPMA

Type	Population Density (animals/household)	Wasteload (grams/animal-day)	Fecal Coliform Density (counts/gram)
Dog	0.4*	450	2,200,000

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 ground water (U.S. Geological Survey [USGS] 2010). The risk of contamination is greater for unconfined (water table) aquifers than for confined aquifers because they usually are nearer to the 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. According to the USGS (2010), "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."

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.

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 Turkey Creek WBID boundary can be made using **Equation B.1**:

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

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/100mL);
F is the septic tank failure rate; and
37.85 is a conversion factor (100mL/gallon).

Based on the Florida Department of Health's (FDOH) 2012 onsite sewage GIS coverage contained in the Department's GIS library, about 223 households were identified as being on active septic tanks in the Turkey Creek watershed (**Figure B.1** and **Table B.3**). 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 Walton County is about 2.22 people/household (U.S. Census Bureau website 2006–10). The same population densities were assumed within the 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/100mL for fecal coliform (EPA 2001).

No measured septic tank failure rate data were available for the WBID when this TMDL was developed. Therefore, the failure rate was derived from the number of septic tanks in Walton County based on FDOH's septic tank inventory and the number of septic tank repair permits issued in Walton County, as published by FDOH (FDOH website 2010). The cumulative number of septic tanks in Walton 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 2009–10 inventory, assuming that none of the installed septic tanks will be removed after being installed (**Table B.5**). The reported number of septic tank repair permits was also obtained from the FDOH website.

Based on **Table B.5**, the average annual septic tank failure discovery rate is about 0.45% for Walton 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 2.25%. Based on **Equation B.1**, the estimated fecal coliform loading from failed septic tanks within the Turkey Creek WBID boundary is about 7.3×10^9 counts/day (**Table B.4**).

Wildlife

Wildlife is another possible source of fecal coliform bacteria within the Turkey Creek WBID boundary. However, as these represent natural inputs, no reductions are assigned to these sources by this TMDL.

Table B.4. Estimated Number of Households Using Septic Tanks and Estimated Septic Tank Loading within the Turkey Creek WBID Boundary

This is a two-column table. Column 1 lists the number of households with a septic tank, and Column 2 lists the septic tank loading.

Number of Households Using Septic Tanks	Septic Tanks (counts/day)
55	7.3×10^9

Table B.5. Estimated Number of Septic Tanks and Septic Tank Failure Rates for Walton County, 2003–10

This is a 10-column table. Column 1 lists the parameter, Columns 2 through 9 list the estimate for each year from 2003 to 2010, respectively, and Column 10 lists the average.

- = Empty cell/no data
[1] The failure rate is 5 times the failure discovery rate.

Year	2003	2004	2005	2006	2007	2008	2009	2010	Average
Number of new septic tank installations	411	525	603	521	302	211	147	110	354
Cumulative total number of septic tanks	19,679	20,204	20,807	21,328	21,630	21,841	21,988	22,098	21,197
Number of septic tank repair permits issued	120	108	80	110	75	96	85	85	95
Failure discovery rate (%)	0.61%	0.53%	0.38%	0.52%	0.35%	0.44%	0.39%	0.38%	0.45%
Failure rate (%)[1]	3.05%	2.67%	1.92%	2.58%	1.73%	2.20%	1.93%	1.92%	2.25%

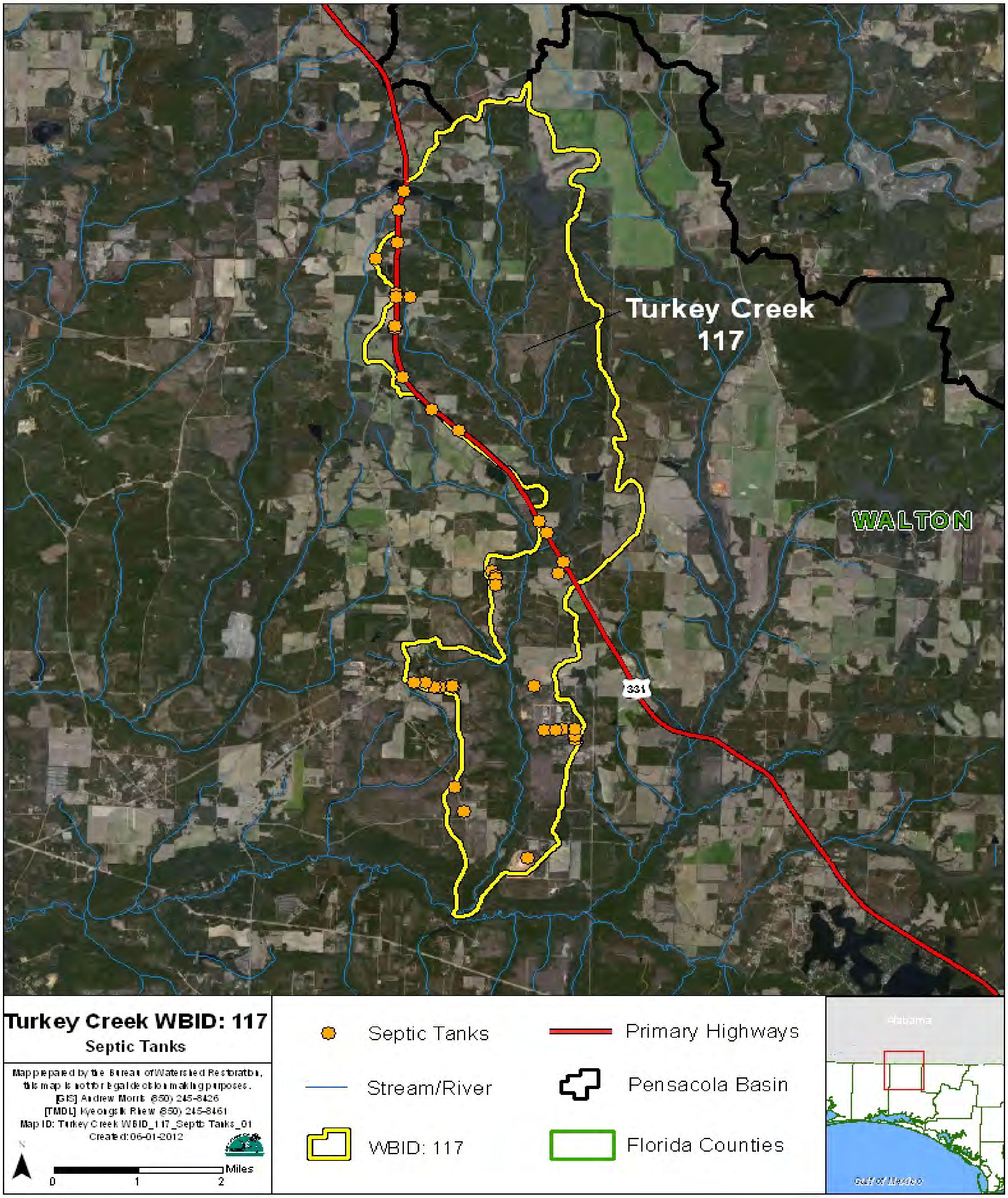

Figure B.1. Distribution of Onsite Sewage Disposal Systems (Septic Tanks) in the Residential Land Use Areas within the Turkey Creek WBID Boundary

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