

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Water Resource Management, Bureau of Watershed Management

CENTRAL DISTRICT • INDIAN RIVER LAGOON BASIN

TMDL Report
Fecal Coliform TMDL for
Eau Gallie River,
WBID 3082

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Web sites

Florida Department of Environmental Protection, Bureau of Watershed Management

TMDL Program

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

Identification of Impaired Surface Waters Rule

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

STORET Program

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

2006 Integrated Report

http://www.dep.state.fl.us/water/tmdl/docs/2006_Integrated_Report.pdf

Criteria for Surface Water Quality Classifications

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

Basin Status Report for the Indian River Lagoon Basin

<http://www.dep.state.fl.us/water/basin411/indianriver/status.htm>

U.S. Environmental Protection Agency

Region 4: Total Maximum Daily Loads in Florida

<http://www.epa.gov/region4/water/tmdl/florida/>

National STORET Program

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

Chapter 1: INTRODUCTION

1.1 Purpose of Report

This report presents the Total Maximum Daily Load (TMDL) for fecal coliform bacteria for the Eau Gallie River in the Indian River Lagoon Basin. The estuary was verified as impaired for fecal coliform and therefore was included on the Verified List of impaired waters for the Indian River Lagoon Basin that was adopted by Secretarial Order on December 12, 2007. The TMDL establishes the allowable fecal coliform loadings to the Eau Gallie River that would restore the waterbody so that it meets its applicable water quality criterion for fecal coliform.

1.2 Identification of Waterbody

The Eau Gallie River is located in the southeast part of Brevard County (**Figure 1.1**). It flows primarily in an easterly direction (roughly 4.5 miles) into the Indian River Lagoon and drains an area of about 7.2 square miles. The Eau Gallie River watershed, which is located in the northern portion of the city of Melbourne, has a population of approximately 77,000 people. Additional information about the river's hydrology and geology are available in the Basin Status Report for the Indian River Lagoon Basin (Florida Department of Environmental Protection [Department], 2006).

For assessment purposes, the Department has divided the Indian River Lagoon Basin into water assessment polygons with a unique **waterbody identification** (WBID) number for each watershed or stream reach. The Eau Gallie River is WBID 3082 (**Figure 5.1**).

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.

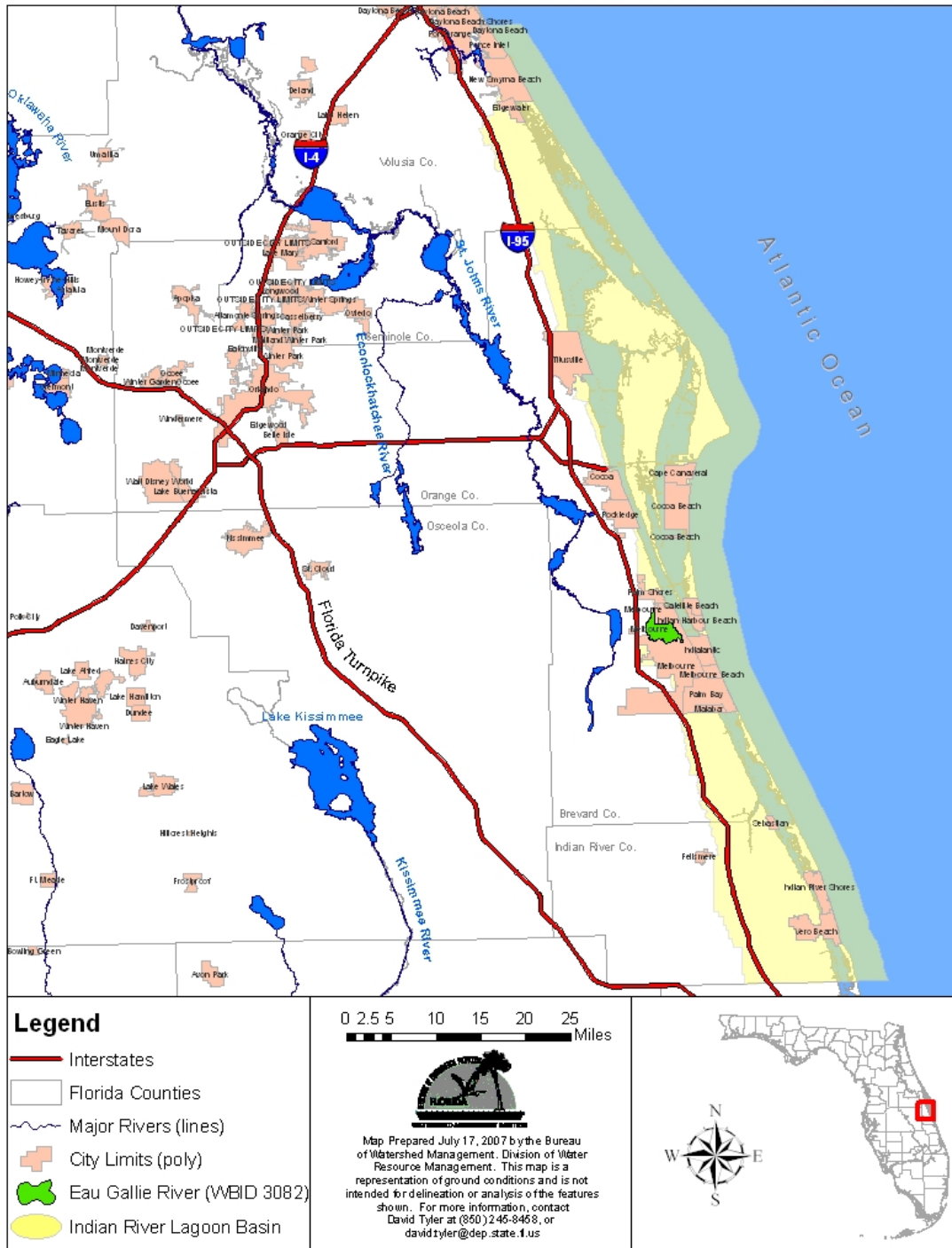


Figure 1.1. Location of the Eau Gallie River in Brevard County and Major Geopolitical Features in the Area

This TMDL Report will be followed by the development and implementation of a Basin Management Action Plan, or BMAP, designed to reduce the amount of fecal coliform that caused the verified impairment of the Eau Gallie River. These activities will depend heavily on the active participation of the St. Johns River Water Management District (SJRWMD), 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 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 26 waterbodies in the Indian River Lagoon 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 2004 and 2007.

2.2 Information on Verified Impairment

The Department used the IWR to assess water quality impairments in the Eau Gallie River watershed and verified the impairments for fecal coliform (**Table 2.1**). **Table 2.2** summarizes the data collected during the verification period (January 1, 1999, through June 30, 2006). The estuary was verified as impaired based on fecal coliform because, using the IWR methodology, more than 10 percent of the values exceeded the Class III marine criterion of 400 counts per 100 milliliters (counts/100mL) for fecal coliform (11 out of 62 samples in the verified period exceeded the criterion of 400 counts/100mL).

The verified impairments were based on data collected at STORET station sites 21FLBRA 3082-A, B, C, D, E; 21FLSEAS75SEAS010; and 21FLA 75010SEAS. **Figure 5.1** shows the locations of the sampling sites in the estuary. **Figure 2.1** displays the fecal coliform data collected from 1999 through 2006.

Table 2.1. Verified Impairment in the Eau Gallie River, WBID 3082

Parameter Causing Impairment	Priority for TMDL Development	Projected Year for TMDL Development*
Fecal Coliform	High	2006

*The TMDL was scheduled to be completed by December 31, 2006, based on a Consent Decree between the EPA and Earthjustice, but the Consent Decree allows a nine-month extension for completing the TMDL.

Table 2.2. Summary of Fecal Coliform Data for the Eau Gallie River, WBID 3082 (January 1, 1999–June 30, 2006)

Waterbody (WBID)	Parameter	Fecal Coliform
Eau Gallie River (3082)	Total number of samples	62
	IWR-required number of exceedances for the Verified List	10
	Number of observed exceedances	11
	Number of observed nonexceedances	51
	Number of seasons during which samples were collected	4
	Highest observation (MPN/100mL*)	37,000
	Lowest observation (MPN/100mL)	1
	Median observation (MPN/100mL)	76
	Mean observation (MPN/100mL)	2,367
	FINAL ASSESSMENT	Impaired

* Most probable number per 100 milliliters.

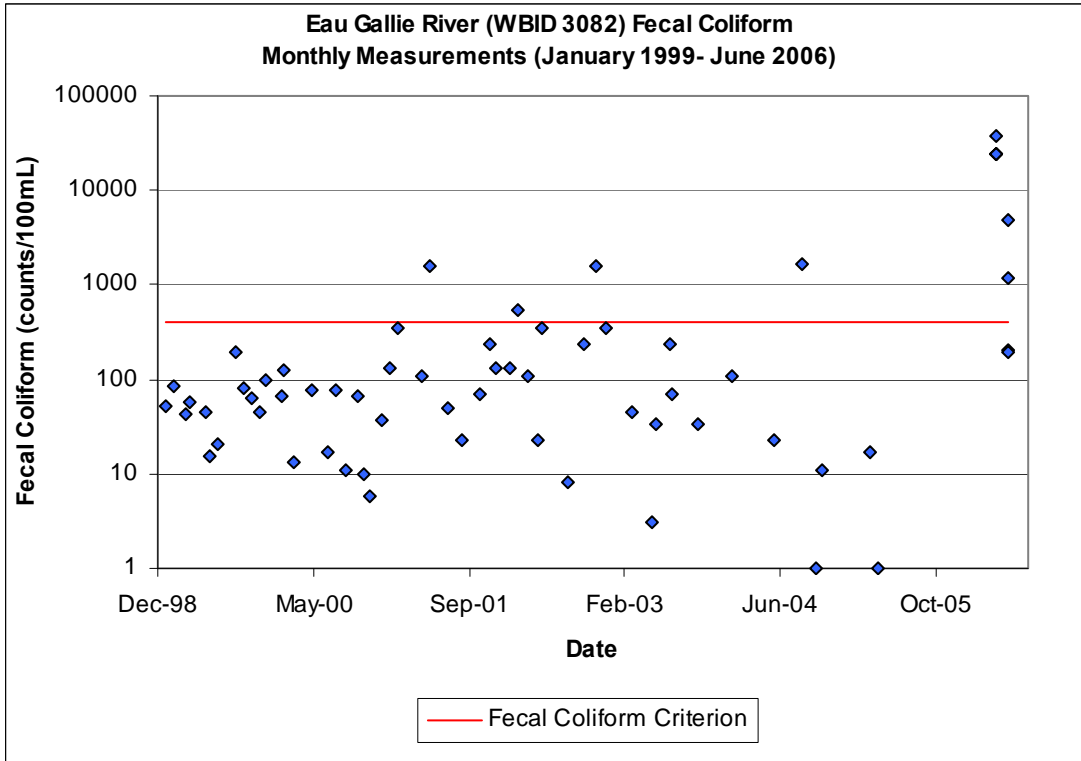


Figure 2.1. Fecal Coliform Measurements for the Eau Gallie River, WBID 3082 (January 1999–June 2006)

Chapter 3. DESCRIPTION OF APPLICABLE WATER QUALITY STANDARDS AND TARGETS

3.1 Classification of the Waterbody and Criteria Applicable to the TMDL

Florida's surface waters are protected for five designated use classifications, as follows:

Class I	Potable water supplies
Class II	Shellfish propagation or harvesting
Class III	Recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife
Class IV	Agricultural water supplies
Class V	Navigation, utility, and industrial use (there are no state waters currently in this class)

The Eau Gallie River is a Class III waterbody, with a designated use of recreation, propagation, and the 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. During the development of load duration curves for the impaired stream (as described in subsequent chapters), there were insufficient data (fewer than 10 samples in a given month) available to evaluate the geometric mean criterion for fecal coliform bacteria. Therefore, the criterion selected for the TMDL was not to exceed 400 MPN/100mL in any sampling event for fecal coliform. The 10 percent 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 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 in the Eau Gallie River Watershed

4.2.1 Point Sources

There is one NPDES permitted facility (Joe Mullins Reverse Osmosis Water Treatment Plant, Permit No. FL0043443) in the Eau Gallie River (**Figure 4.2**). However, the facility does not contribute fecal coliform bacteria to surface water.

Municipal Separate Storm Sewer System Permittees

The stormwater collection systems owned and operated by the city of Melbourne in the Eau Gallie River watershed are covered by a Phase II NPDES municipal separate storm sewer system (MS4) permit (FLR04E027). The city of Melbourne is the lead permittee for the permit. There are no Phase I MS4 permits identified in the Eau Gallie River watershed.

4.2.2 Land Uses and Nonpoint Sources

Nonpoint source pollution, unlike pollution from industrial and sewage treatment plants, comes from many diffuse sources. Nonpoint pollution is caused by rainfall moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and even underground sources of drinking water (EPA, 1994). Potential nonpoint sources of coliform include loadings from surface runoff, wildlife, livestock, pets, leaking sewer lines, and leaking septic tanks.

Wildlife

Wildlife deposit coliform bacteria with their feces onto land surfaces, where they can be transported during storm events to nearby streams. Some wildlife (such as otters, beavers, raccoons, and birds) deposit their feces directly into the water. The bacterial load from naturally occurring wildlife is assumed to be background. In addition, any strategy employed to control this source would probably have a negligible impact on attaining water quality standards.

Agricultural Animals

Agricultural animals are the source of several types of coliform loading to streams. Agricultural activities, including runoff from pastureland and cattle in streams, can affect water quality. Agricultural land occupies less than 1 percent of the total land area in the Eau Gallie River watershed; therefore, it is unlikely that agricultural activities play a major role in coliform loading in the watershed.

Land Uses

The spatial distribution and acreage of different land use categories were identified using the SJRWMD's 2004 land use coverage (scale 1:40,000) contained in the Department's geographic information system (GIS) library. Land use categories in the watershed were aggregated using the simplified Level 1 codes and tabulated in **Table 4.1**. **Figure 4.1** shows the acreage of the principal land uses in the watershed.

As shown in **Table 4.1**, the Eau Gallie River watershed drains about 4,618 acres of land. The dominant land use category is urban land (urban and built-up; low-, medium-, and high-density residential; and transportation, communication, and utilities), which accounts for about 78 percent of the total watershed area. Of the 3,673 acres of urban land, residential areas occupy about 2,675 acres, or about 57.9 percent of the total watershed area. Natural land use areas, which include water/wetlands, upland forest, and barren land, occupy about 688 acres, accounting for about 14.4 percent of the total watershed area.

Table 4.1. Classification of Land Use Categories for the Eau Gallie River Watershed, WBID 3082

Level 1 Code	Land Use	Acreage	% Acreage
1000	Urban and built-up	880	19.06
1100	Low-density residential	180	3.90
1200	Medium-density residential	1,606	34.78
1300	High-density residential	889	19.25
2000	Agriculture	33	0.71
3000	Rangeland	224	4.85
4000	Forest/rural open	324	7.02
5000	Water	159	3.44
6000	Wetland	194	4.20
7000	Barren land	11	0.24
8000	Transportation, communication, and utilities	118	2.56
	TOTAL	4,618	100

Urban Development

Pets (especially dogs) could be a significant source of coliform pollution through surface runoff in the Eau Gallie River watershed. In addition to pets, other animal fecal coliform contributors commonly seen in urban areas include rats, pigeons, and sometimes raccoons.

Studies report that up to 95 percent of the fecal coliform found in urban stormwater can come from 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 for fecal coliform and fecal streptococcus bacteria. Trial et al. (1993) also reported that cats and dogs were the primary source of fecal coliform in urban watersheds. Using bacteria source tracking techniques, Watson (2002) found that the amount of fecal coliform bacteria contributed by dogs in Stevenson Creek in Clearwater, Florida, was as important as that from septic tanks.

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 23 million 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.

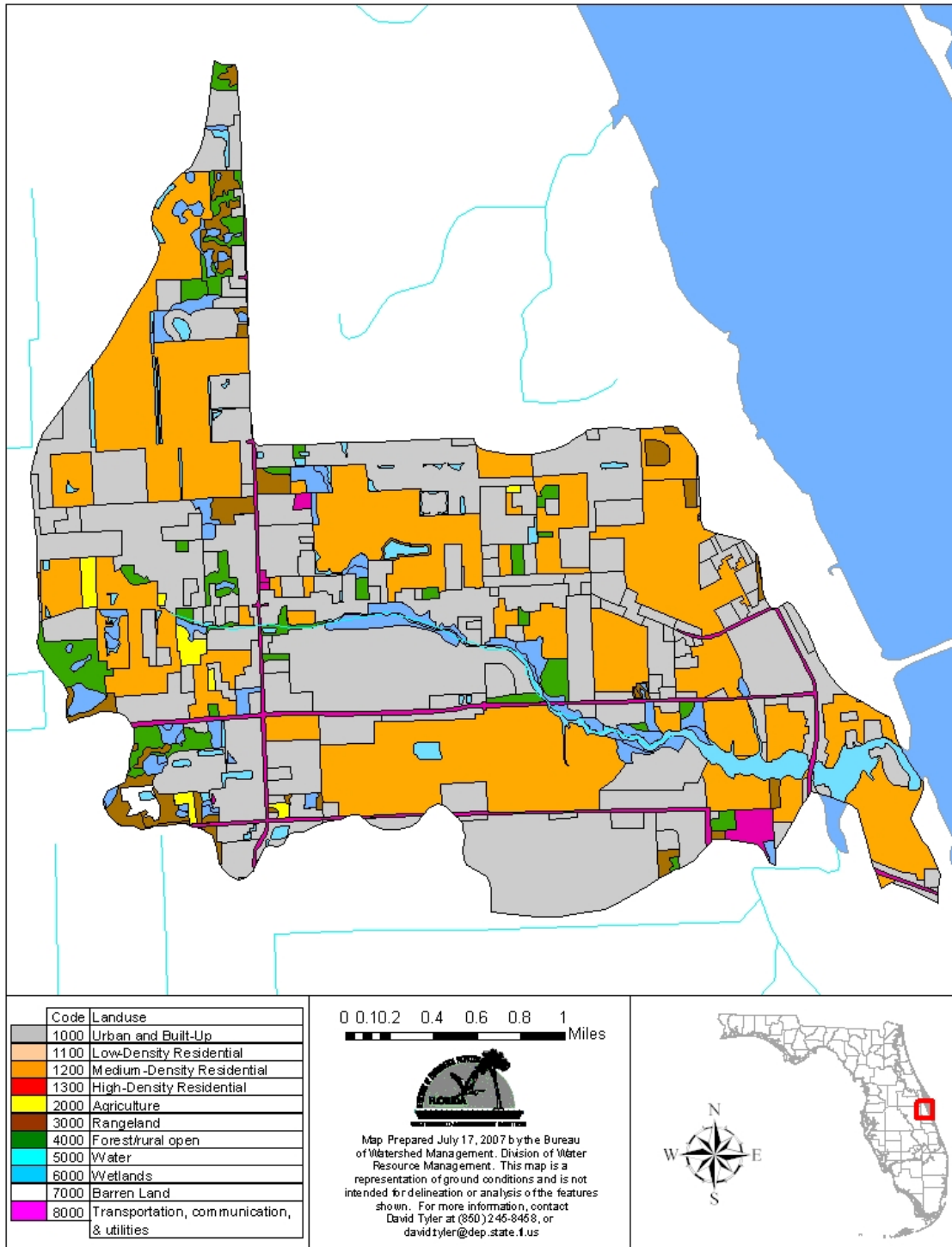


Figure 4.1. Principal Land Uses in the Eau Gallie River Watershed, WBID 3082, in 2004

Table 4.2 shows the fecal coliform concentrations of surface runoff measured in two urban areas (Bannerman et al., 1993; Steuer et al., 1997). While bacteria levels were widely different in the two studies, both indicated that residential lawns, driveways, and streets were the major source areas for bacteria.

Table 4.2. Concentrations (Geometric Mean Colonies per 100 mL) of Fecal Coliform from Urban Source Areas (Steuer et al., 1997; Bannerman et al., 1993)

Geographic Location	Marquette, MI	Madison, WI
Number of storms sampled	12	9
Commercial parking lot	4,200	1,758
High-traffic street	1,900	9,627
Medium-traffic street	2,400	56,554
Low-traffic street	280	92,061
Commercial rooftop	30	1,117
Residential rooftop	2,200	294
Residential driveway	1,900	34,294
Residential lawns	4,700	42,093
Basin outlet	10,200	175,106

The number of dogs in the Eau Gallie River watershed is not known. Therefore, this analysis used the statistics produced by APPMA to estimate the possible fecal coliform loads contributed by dogs. The human population in the Eau Gallie River watershed calculated from the census track using Tiger Track 2000 data (the Department's GIS library) was approximately 18,835. According to the U.S. Census Bureau, there were 2.35 persons per household in Brevard County in 2000. This adds up to about 8,015 households in the entire watershed. Assuming that 40 percent of the households in this area have 1 dog, the total number of dogs in the watershed is about 3,206.

According to the waste production rate for dogs and the fecal coliform counts per gram of dog wastes listed in **Table 4.3**, and assuming that 40 percent of dog owners do not pick up dog feces, the total waste produced by dogs and left on the land surface of residential areas would be 577,080 grams/day. The total fecal coliform produced by dogs would be 1.27×10^{12} /day fecal coliform.

It should be noted that this load only represents the fecal coliform load created in the watershed 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 4.3. Dog Population Density, Wasteload, and Fecal Coliform Density

Type	Population density (an/household)	Waste load (g/an-day)	Fecal coliform density (fecal coliform/g)
Dog	0.4*	450	2,200,000

* Number from APPMA.

Source: Weiskel et al., 1996.

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, in areas with a relatively high ground water table, the drainage field can be flooded during the rainy season, and coliform bacteria can pollute the surface water through storm runoff. 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 go into the well and once the polluted water is used to irrigate lawns, coliform bacteria may reach the land surface and wash into surface waters during the rainy season.

A rough estimate of fecal coliform loads from failed septic tanks in the Eau Gallie River watershed can be made using **Equation 4.1**:

$$L = 37.85 * N * Q * C * F \quad \text{Equation 4.1}$$

Where,

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

N is the total number of septic tanks in the watershed (septic tanks);

Q is the discharge rate for each septic tank;

C is the fecal coliform concentration for the septic tank discharge, and

F is the septic tank failure rate.

Based on 2007 Florida Department of Health (FDOH) onsite sewage GIS coverage (<http://www.doh.state.fl.us/environment/programs/EhGis/EhGisDownload.htm>), about 111 housing units (*N*) were identified as being on septic tanks in the Eau Gallie River watershed (**Figure 4.2**). 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 U.S. Census Bureau, the average household size for Brevard County is about 2.35 people/household. The same population density was assumed for the Eau Gallie River watershed. 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/100mL for fecal coliform (EPA, 2001).

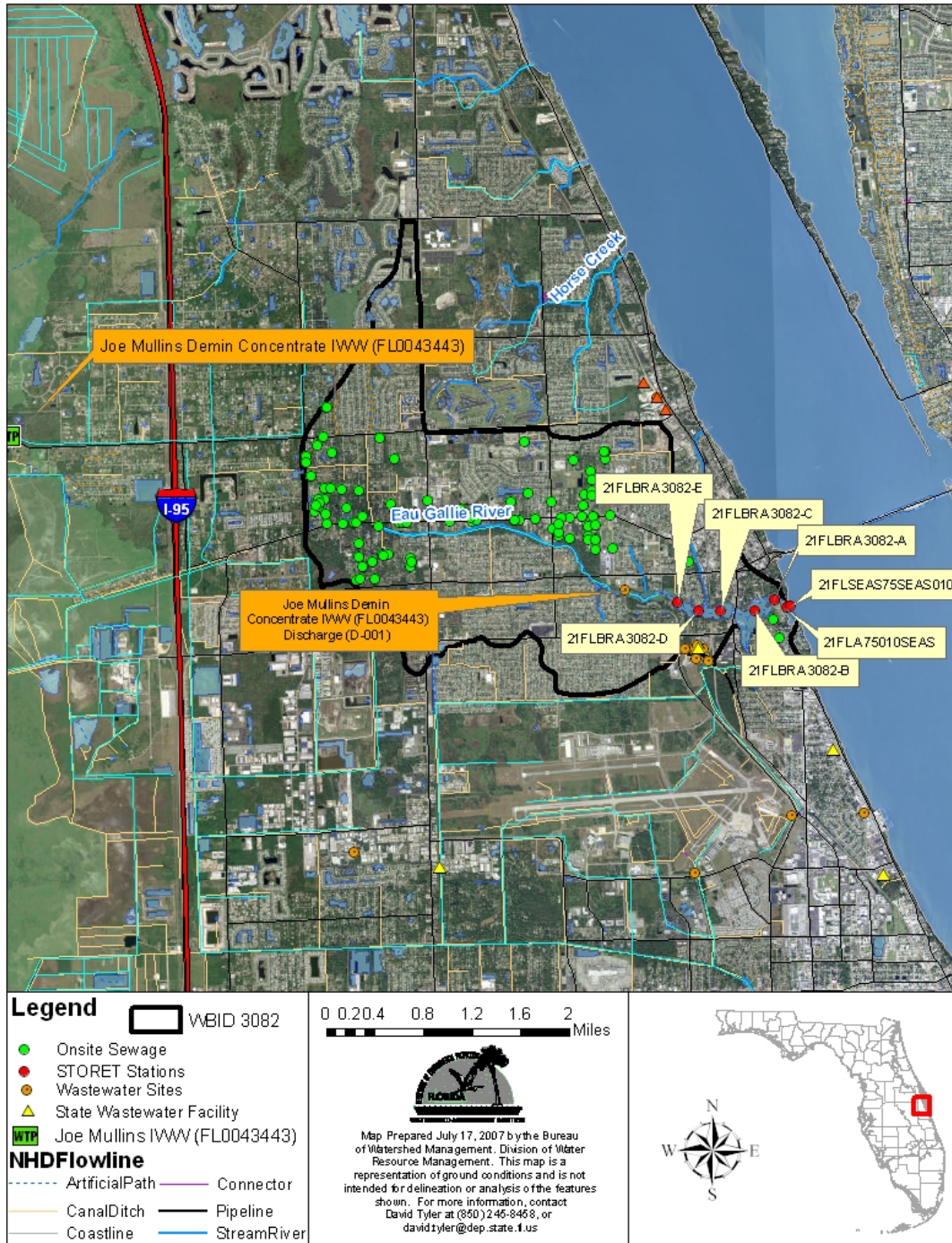


Figure 4.2. Distribution of Onsite Sewage Systems (Septic Tanks) in the Eau Gallie River Watershed

No measured septic tank failure rate data were available for the watershed at the time this TMDL analysis was conducted. Therefore the failure rate was derived from the number of septic tank and septic tank repair permits for the county published by FDOH (<http://www.doh.state.fl.us/environment/OSTDS/statistics/ostdsstatistics.htm>). The number of septic tanks in the county was calculated assuming that none of the installed septic tanks will be removed after being installed (**Table 4.4**). The reported number of septic tank repair permits was also obtained from the FDOH website (**Table 4.4**).

Based on this information, a discovery rate of failed septic tanks for each year between 2000 and 2005 was calculated and listed in **Table 4.4**. Using the table, the average annual septic tank failure discovery rate for Brevard County is about 0.34 percent. 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 1.7 percent. Based on **Equation 4.1**, the estimated fecal coliform loading from failed septic tanks in the watershed is about 1.2×10^{10} counts/day.

Table 4.4. Estimated Septic Numbers and Septic Failure Rates for Brevard County, 2000–05

	2000	2001	2002	2003	2004	2005	Average
New installation (septic tanks)	1,455	1,774	142	1,515	1,715	3,039	1,607
Accumulated installation (septic tanks)	77,357	78,812	80,586	80,728	82,243	83,958	80,614
Repair permit (septic tanks)	427	407	131	275	234	183	276
Failure discovery rate (%)	0.55	0.52	0.16	0.34	0.28	0.22	0.34
Failure rate (%)*	2.8	2.6	0.8	1.7	1.4	1.1	1.7

* The failure rate is 5 times the failure discovery rate.

Sanitary Sewer Overflows

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

Fecal coliform loading from sewer line leakage can be calculated, based on the number of people in the watershed, typical per household generation rates, and the typical fecal coliform concentration in domestic sewage, assuming a leakage rate of 0.5 percent (Culver et al., 2002). Based on this assumption, a rough estimate of fecal coliform loads from leaks and overflows of sanitary sewer in the Eau Gallie River watershed can be made using **Equation 4.2**:

$$L = 37.85 * N * Q * C * F$$

Equation 4.2

Where,

- L is the fecal coliform daily load (counts/day);
- N is the number of households using sanitary sewer in the watershed;
- Q is the discharge rate for each household;
- C is the fecal coliform concentration for the domestic wastewater discharge, and
- F is the sewer line leakage rate.

The number of households (N) that use the sewer line is 7,904 (total households minus septic tank households) in the Eau Gallie River watershed. The discharge rate through the sewer line from each household (Q) was calculated by multiplying the average household size (2.35 people) by the per capita wastewater production rate per day (70 gallons). The commonly cited concentration (C) for domestic wastewater is 1×10^6 counts/100mL for fecal coliform (EPA, 2001). Of the total number of households using the sewer line, 0.5 percent (F) was assumed as the sewer line leakage rate (Culver et al., 2002). Based on **Equation 4.2**, the estimated fecal coliform loading from sewer line leakage in the watershed is about 2.5×10^{11} counts/day.

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Determination of Loading Capacity

Typically, there are continuous flow measurements in a watershed that can be used to develop a bacteria TMDL. However, since the majority of the Eau Gallie River where the fecal coliform data were collected is influenced by tides, this fecal coliform TMDL was developed using the “percent reduction” approach. For this method, the percent reduction needed to meet the applicable criterion is calculated for each value above the criterion, and then a median percent reduction is calculated.

5.1.1 Data Used in the Determination of the TMDL

The data used to develop this TMDL were mainly provided by the Florida Department of Agriculture and Consumer Services (FDACS) (Stations: 21FLSEAS75SEAS010 and 21FLA 75010SEAS), and the Biological Research Association Stations: (21FLBRA 3082-A, B, C, D, E). **Figure 5.1** shows the locations of the water quality sites from which fecal coliform data were collected. **Figure 2.1** displays the fecal coliform data used in this analysis. An additional 17 samples collected at the end of 2006 were extracted from FLSTORET and used in this analysis, along with all verified period data (January 1, 1999, through June 30, 2006). Also, samples collected in August and December 2007 were used in calculating the TMDL.

5.1.2 TMDL Development Process

As described in **Section 5.1**, the percent reduction needed to meet the fecal coliform criterion was determined for each individual exceedance using the following equation:

$$(2) \frac{[\text{measured exceedance} - \text{criterion}] * 100}{\text{measured exceedance}}$$

The fecal coliform TMDL was calculated as the median of the percent reductions needed over the data range where exceedances occurred (see **Table 5.1** for data). As noted in the next section, all of the exceedances occurred in the summer months, and the median percent reduction for this period was 81 percent.

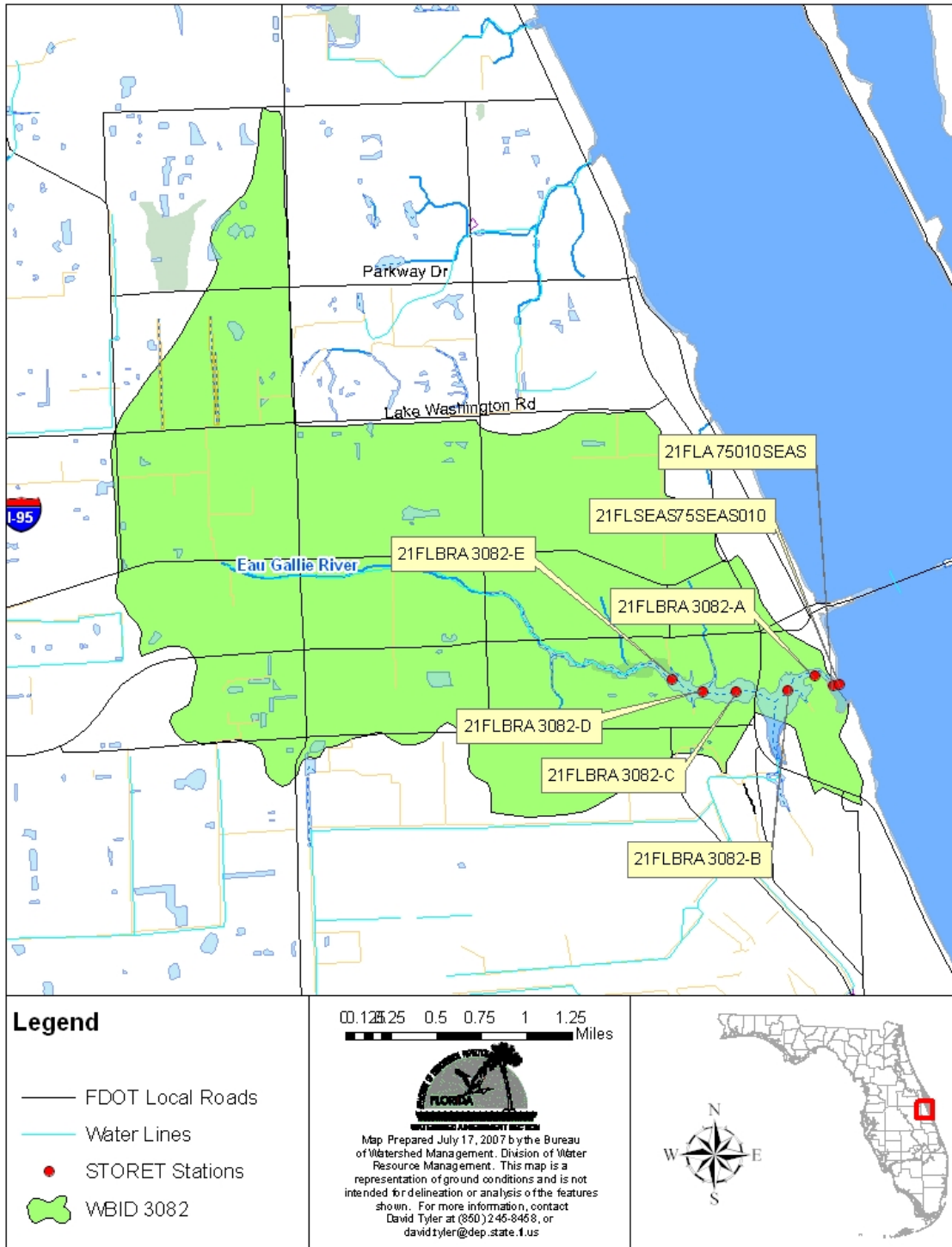


Figure 5.1. Historical Monitoring Sites in the Eau Gallie River, WBID 3082

Table 5.1. Calculation of Percent Reduction in Fecal Coliform Necessary To Meet the Water Quality Standard of 400 Colonies/100mL in the Eau Gallie River, WBID 3082

Date	Station	Fecal Coliform Exceedances	Fecal Coliform Target	% Reduction
08/28/07	EG-3	420	400	5
9/12/2006	21FLBRA 3082-B	505	400	21
2/26/2002	21FLA 75010SEAS	540	400	26
12/27/07	EG-2	640	400	38
08/28/07	EG-1	740	400	46
11/15/2006	21FLBRA 3082-D	980	400	59
08/28/07	EG-2	1,020	400	61
9/12/2006	21FLBRA 3082-E	1,100	400	64
12/12/2006	21FLBRA 3082-A	1,150	400	65
12/27/07	EG-1	1,190	400	66
6/20/2006	21FLBRA 3082-B	1,200	400	67
08/28/07	EG-5	1,440	400	72
10/30/2002	21FLA 75010SEAS	1,600	400	75
5/16/2001	21FLA 75010SEAS	1,600	400	75
8/24/2004	21FLSEAS75SEAS010	1,700	400	76
08/28/07	EG-2	1,960	400	80
11/15/2006	21FLBRA 3082-A	2,000	400	80
9/12/2006	21FLBRA 3082-A	2,100	400	81
6/20/2006	21FLBRA 3082-A	4,900	400	92
8/8/2006	21FLBRA 3082-B	12,000	400	97
8/8/2006	21FLBRA 3082-A	17,000	400	98
5/11/2006	21FLBRA 3082-A	24,000	400	98
5/11/2006	21FLBRA 3082-B	24,000	400	98
5/11/2006	21FLBRA 3082-C	24,000	400	98
5/11/2006	21FLBRA 3082-D	24,000	400	98
5/11/2006	21FLBRA 3082-E	37,000	400	99
Median % Reduction =				81

5.1.3 Critical Conditions/Seasonality

The critical conditions for coliform loadings in a given watershed depend on the existence of point sources and land use patterns in the watershed. Typically, the critical condition for nonpoint sources is an extended dry period, followed by a rainfall runoff event. During wet weather periods, coliform bacteria that have built up on the land surface under dry weather conditions are washed off by rainfall, resulting in wet weather exceedances. However, significant nonpoint source contributions could also occur under dry weather conditions without any major surface runoff event. This usually happens when nonpoint sources contaminate the surficial aquifer, and coliform bacteria are brought into the receiving waters through baseflow. Livestock with direct access to the receiving water could also contribute to the exceedances

during dry weather conditions. The critical condition for point source loading typically occurs during periods of low stream flow, when dilution is minimized.

Measurements were sorted by month and season (the calendar year was divided into quarters) to determine whether there was a temporal pattern of exceedances. Monthly rainfall data from Melbourne International Airport (085612) were also obtained and included in the analysis.

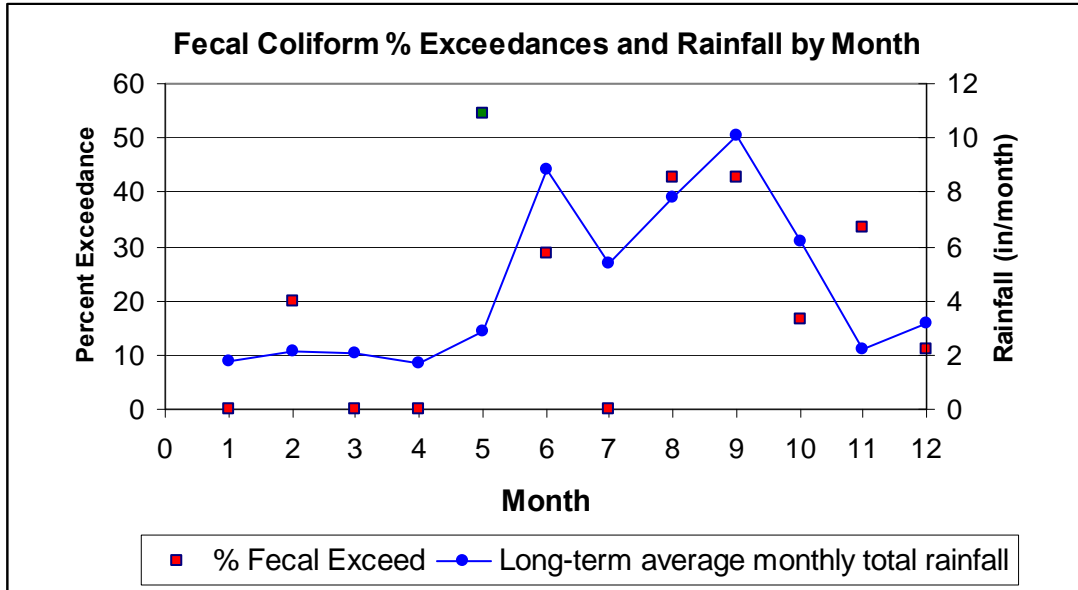
Table 5.2 presents summary statistics by month and season, respectively, for fecal coliform measurements (Winter: January–March; Spring: April–June; Summer: July–September; Fall: October–December). The highest exceedance frequency is observed during the summer, which is consistent with the highest rainfall observed during the summer. This implies that the exceedance may be mainly related to nonpoint source contributions through surface runoff.

Figure 5.2 shows this information graphically.

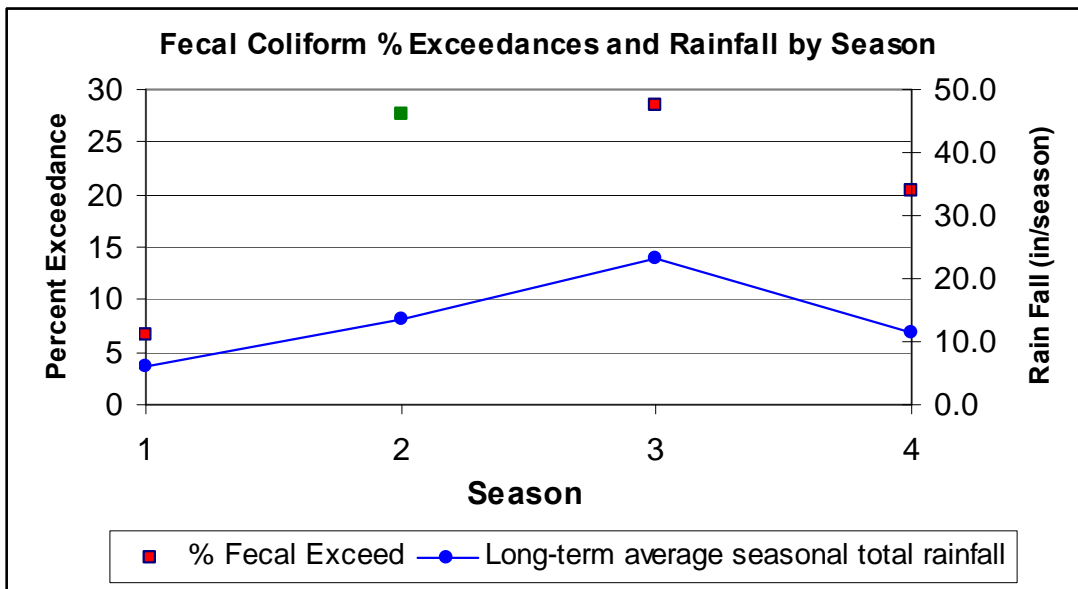
Table 5.2. Summary Statistics of Fecal Coliform Data for the Eau Gallie River, WBID 3082, by Month and Season

Month	Number of Cases	Minimum	Maximum	Median	Mean	Number of Exceedances	% Exceedances of Cases	Rainfall Mean
1	5	53	130	110	98	0	0.00	1.78
2	5	46	540	123	228	1	20.00	2.13
3	3	13	110	43	55	0	0.00	2.08
4	5	1	110	23	39	0	0.00	1.71
5	11	17	37,000	975	11,262	6	54.55	2.86
6	7	16	4,900	200	966	2	28.57	8.86
7	4	21	76	59.5	54	0	0.00	5.41
8	7	8	17,000	193	4,419	3	42.86	7.83
9	7	33	2,100	240	589	3	42.86	10.07
10	6	1	1,600	37	293	1	16.67	6.21
11	6	6	2,000	215	577	2	33.33	2.24
12	9	4	1,150	98	224	1	11.11	3.13
Season	Number of Cases	Minimum	Maximum	Median	Mean	Number of Exceedances	% Exceedances of Cases	Rainfall Mean
Winter	13	13	540	110	127	1	6.67	5.98
Spring	23	1	37,000	200	4,089	8	27.71	13.43
Summer	18	8	17,000	193	1,688	6	28.57	23.31
Fall	21	1	2,000	98	365	4	20.37	11.58

Figure 5.2. Fecal Coliform Exceedances and Rainfall for the Eau Gallie River, WBID 3082, by Month and Season, 1999-2006



Note: The % fecal exceedance calculated for May is a extremely high and may require further investigation.



Note: The % fecal exceedance calculated for the second quarter is extremely high and may require further investigation.

5.1.4 Spatial and Temporal Patterns

As noted in **Section 5.1.1**, an additional 17 samples were used in this analysis outside the verified period, in order to establish spatial and temporal patterns to the data. Data from 1999 thru 2005 were all collected at 2 downstream stations (21FLSEAS75SEAS010 and 21FLA 75010SEAS) located at the mouth of the Eau Gallie River, while all 2006 data were collected at the 5 upstream stations (21FLBRA 3082-A, B, C, D, E) (**Figure 5.1**).

Both of the 2 downstream stations (21FLSEAS75SEAS010 and 21FLA 75010SEAS) at the mouth of the river had low fecal coliform counts, averaging 346 and 161 MPN/100mL, respectively. There seemed to be no temporal trend to these 2 stations, and a buffer effect from the lagoon could easily account for such low values. Furthermore, the 5 upstream stations (21FLBRA 3082-A, B, C, D, E) all had high fecal coliform averages, ranging from 7,300 to 19,050 MPN/100mL. **Figure 5.3** displays the station averages going from downstream to upstream, showing that the fecal coliform counts seem to increase going upstream. This could be explained by a buffer effect on fecal coliform bacteria as water gradually flows downriver into the lagoon. **Figure 5.4** displays the temporal trend of the 5 upstream stations.

As shown in **Figure 5.4** (May 11, 2006) all 5 stations recorded extremely high fecal coliform counts, pointing out the possibility of a point source discharger not yet detected. The Eau Gallie River watershed has a high percentage of urban and residential areas surrounding the river, which seems to indicate that this nonpoint source is contributing a significant amount of fecal coliform loading into the river. However, typical fecal coliform values associated with nonpoint sources are usually less than 5,000 counts/100mL. Therefore, the Department needs to further investigate the possibility of a spill, reassess the quality of data, and look into other possible point sources with local stakeholders in an on-site survey in the near future.

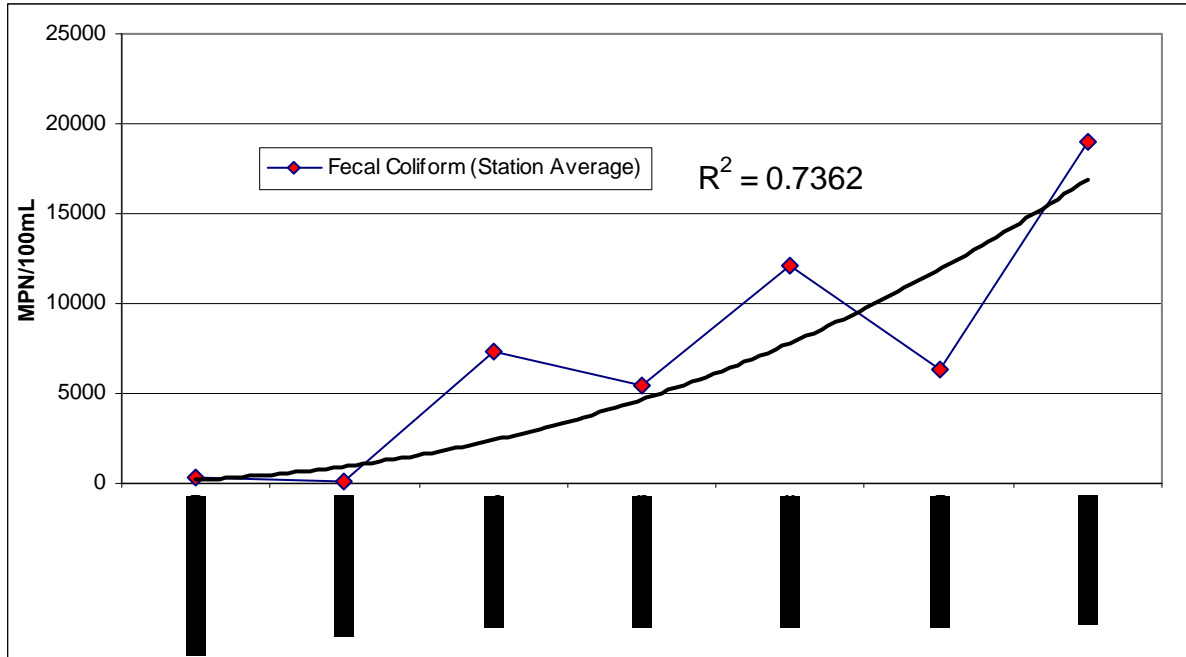


Figure 5.3. Monitoring Station Averages for Fecal Coliform, WBID 3082

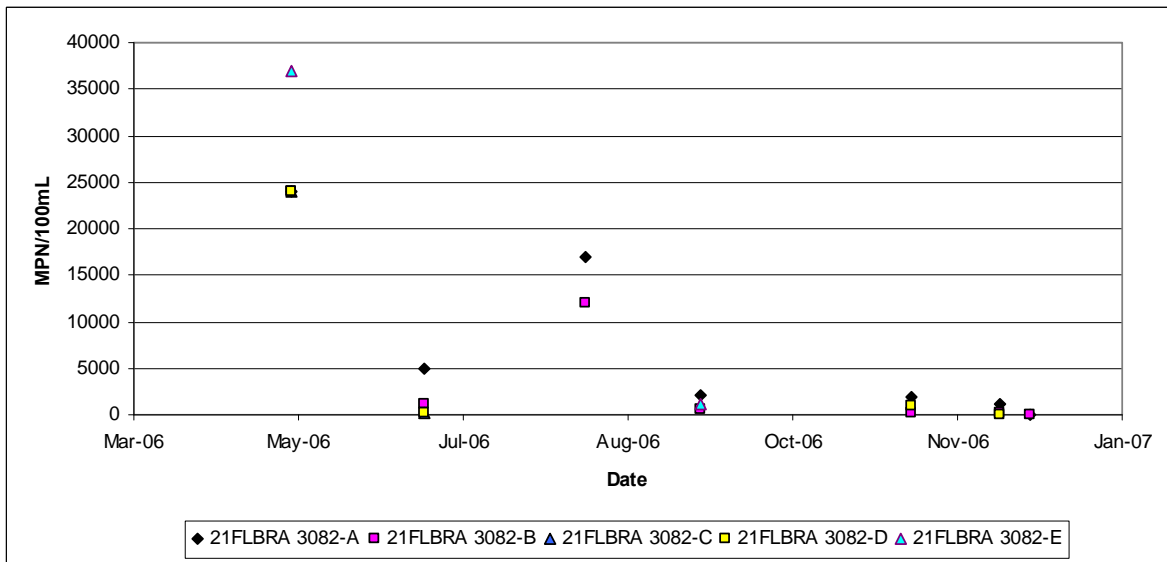


Figure 5.4. Temporal Trend of Fecal Coliform Concentrations at Monitoring Stations in WBID 3082

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:

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

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

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

It should be noted that the various components of the revised TMDL equation may not sum up to the value of the TMDL because (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 TMDLs for the Eau Gallie River are expressed in terms of MPN/day and percent reduction, and represent the maximum daily fecal coliform and total coliform loads the stream can assimilate and maintain the fecal coliform criterion (**Table 6.1**).

Table 6.1. TMDL Components for Fecal Coliform in the Eau Gallie River, WBID 3082

WBID	Parameter	TMDL (counts/day)	WLA		LA (% reduction)	MOS
			Wastewater (counts/day)	NPDES Stormwater (% reduction)		
308s	Fecal Coliform	400 #/100mL	N/A	81	81	Implicit

NA – Not applicable.

6.2 Load Allocation

A fecal coliform reduction of 81 percent is needed 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 with fecal coliform limits were identified in the Eau Gallie River. 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 watershed 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 an 80 percent reduction in current fecal coliform. 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, February 2001), an implicit MOS was used in the development of this TMDL. An MOS was included in the TMDL by meeting the water quality criterion of 400 colonies/100mL, while the actual criterion allows for a 10 percent exceedance over that level.

Chapter 7: NEXT STEPS: IMPLEMENTATION PLAN DEVELOPMENT AND BEYOND

7.1 Basin Management Action Plan

Following the adoption of this TMDL by rule, the next step in the TMDL process is to develop an implementation plan for the TMDL, referred to as the BMAP. This document will be developed over the next year in cooperation with local stakeholders, who will attempt to reach consensus on detailed allocations and on how load reductions will be accomplished. The BMAP will include, among other things:

- Appropriate load reduction allocations among the affected parties,
- 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,
- Confirmed and potential funding mechanisms,
- Any applicable signed agreement(s),
- Local ordinances defining actions to be taken or prohibited,
- Any applicable local water quality standards, permits, or load limitation agreements,
- Milestones for implementation and water quality improvement, and
- Implementation tracking, water quality monitoring, and follow-up measures.

An assessment of progress toward the BMAP milestones will be conducted every five years, and revisions to the plan will be made as appropriate, in cooperation with basin stakeholders.

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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.



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