Final

Total Maximum Daily Load

for

Fecal Coliform

in

Guana River

WBID 2320

May 2012

In compliance with the provisions of the Federal Clean Water Act, 33 U.S.C §1251 et. seq., as amended by the Water Quality Act of 1987, P.L. 400-4, the U.S. Environmental Protection Agency is hereby establishing the Total Maximum Daily Load (TMDL) for fecal coliform bacteria in Guana River in Upper East Coast Basin (WBID 2320). Subsequent actions must be consistent with this TMDL.

/s/ 5/30/2012

James D. Giattina, Director Date

Water Protection Division

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LIST OF ABBREVIATIONS

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

SUMMARY SHEET

Total Maximum Daily Load (TMDL)

1. 303(d) Listed Segment:

WBID	Segment Name	Class and Waterbody Type	Major River Basin	HUC	County	State
2320	Guana River	Class II	Upper East Coast	03080201	St. Johns	Florida

2. TMDL Endpoints/Targets: Fecal Coliform

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

4. TMDL Waste Load and Load Allocation:

Waterbody	WBID	WLA[1]		LA	TMDL
		Facility (MPN/day)	Stormwater/MS4 (% Reduction)[2]	(% Reduction)[2]	(% Reduction)[2]
Guana River	2320	N/A	N/A	16%	16%

Notes:

1. The WLA is typically separated into the components originating from continuous wastewater NPDES facilities (e.g. WWTPs) and from stormwater NPDES permitted facilities/public bodies (e.g. MS4s).
2. Overall percent reduction required to achieve the 43 counts/100 mL fecal coliform criterion. The MOS is implicit and does not take away from the TMDL value.

5. Endangered Species (yes or blank):

6. USEPA Lead TMDL or Other: USEPA

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

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

1. Introduction

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

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

For the purpose of planning and management, the WMDs divided the districts into planning units defined as either an individual primary tributary basin or a group of adjacent primary tributary basins with similar characteristics. Guana River is located within the Tolomato River Planning Unit. These planning units contain smaller, hydrological based units called drainage basins, which are further divided by FDEP into "water segments." A water segment usually contains only one unique waterbody type (stream, lake, canal, etc.) and is about five square miles. Unique numbers or waterbody identification (WBIDs) numbers are assigned to each water segment. This TMDL report addresses WBID 2320 (Guana River).

2. Problem Definition

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

The TMDL addressed in this document is being established pursuant to commitments made by the United States Environmental Protection Agency (USEPA) in the 1998 Consent Decree in the Florida TMDL lawsuit (Florida Wildlife Federation, et al. v. Carol Browner, et al., Civil Action No. 4: 98CV356-WS, 1998). That Consent Decree established a schedule for TMDL development for waters listed on Florida's USEPA approved 1998 Section 303(d) list. The 1998 Section 303(d) list identified numerous WBIDs in the Upper East Coast Basin as not meeting WQS. After assessing all readily available water quality data, the USEPA is responsible for developing a TMDL for WBID 2320 (Guana River). The geographic location of this WBID is shown in Figure 1. The parameter addressed in this TMDL is fecal coliform bacteria.

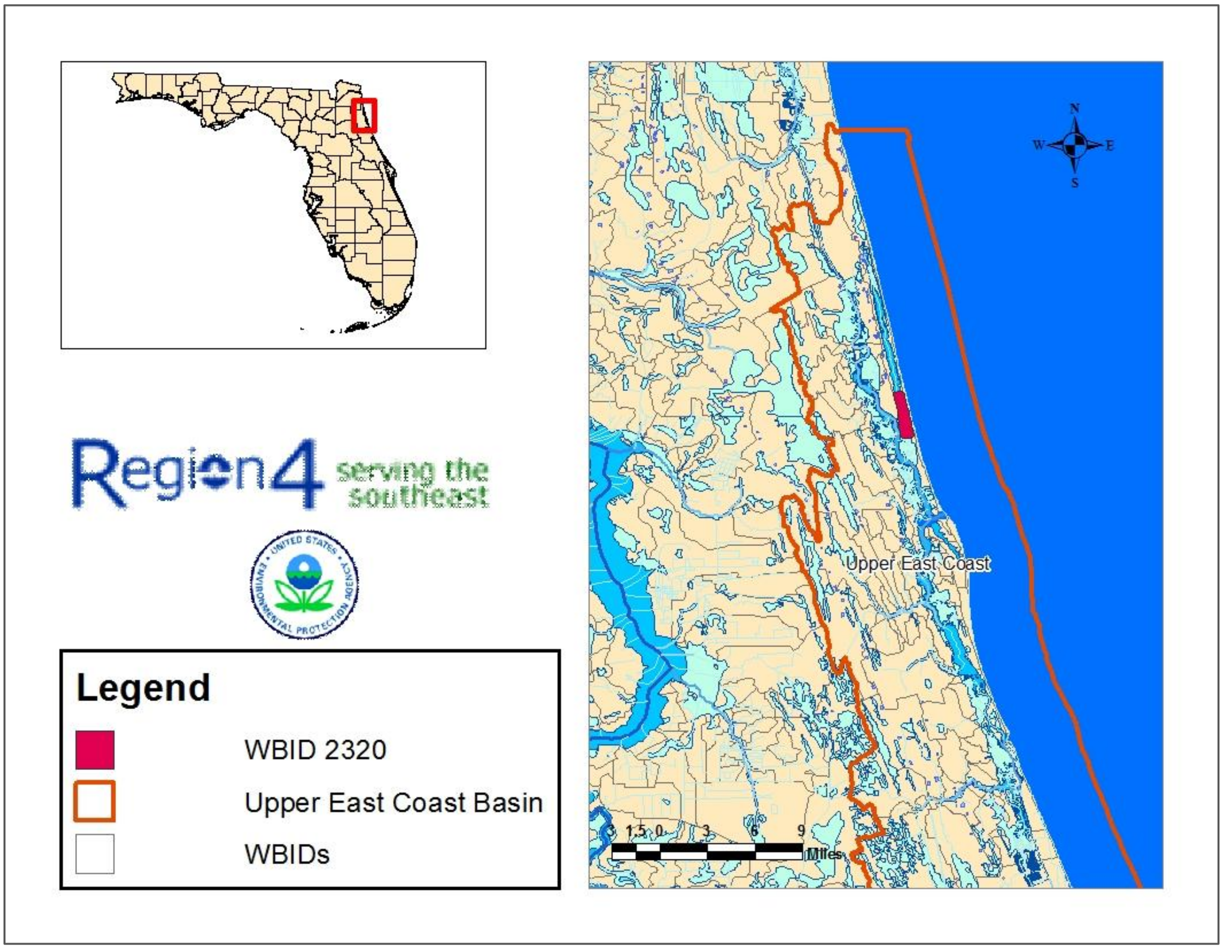

Figure 1. Location of WBID 2320 – Guana River

3. Watershed Description

The Guana River is located within St. Johns County and flows from north to south parallel to the northeastern coastline of Florida. It empties into the Tolomato River which then converges with the Matanzas River and Salt Run before flowing into the Atlantic Ocean at the St. Augustine Inlet (FDEP, 2008). Additionally, the Guana River is protected under the Guana Tolomato Matanzas National Estuarine Research Reserve, specifically addressed under the northern component, Guana River Marsh Aquatic Preserve (Figure 2). WBID 2320 is located in the southern portion of the Guana River immediately south of the Guana Dam. The habitat within the preserve includes salt marshes, a large artificial freshwater-to-brackish water lagoon, open ocean and a complete cross-section of a relatively undisturbed barrier island. The following activities are offered at Guana River: fishing, boating, shrimping and crabbing, along with hiking, biking, and horseback riding in the upland areas. An Environmental Education Center is located in the northeast corner of WBID 2320 near the Guana Dam.

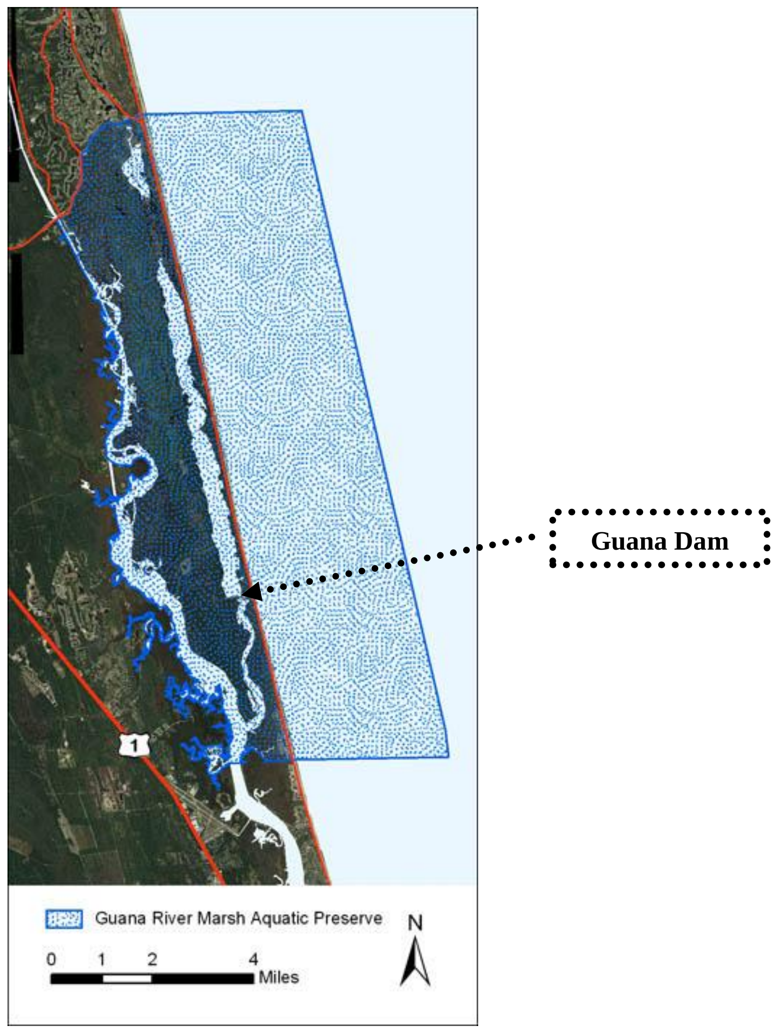

Figure 2. Guana River Marsh Aquatic Preserve
Source: http://www.dep.state.fl.us/coastal/sites/gtm/guana.htm

The Guana River drains approximately 8700 acres (14 mi^2) and consists primarily of water and wetlands with urban development located in the northern portion of the watershed (Figure 3). WBID 2320 drains approximately 1200 acres (1.9 mi^2) and consists primarily of water and wetlands with very little urban development (Figure 4). A breakdown of landuse by acreage and percentage is provided below in Table 1. The latest land use coverages were obtained from the FDEP FTP site. The data is based on 2004 land cover features and is classified using Level 1 Florida Land Use Classification Codes (FLUCCs).

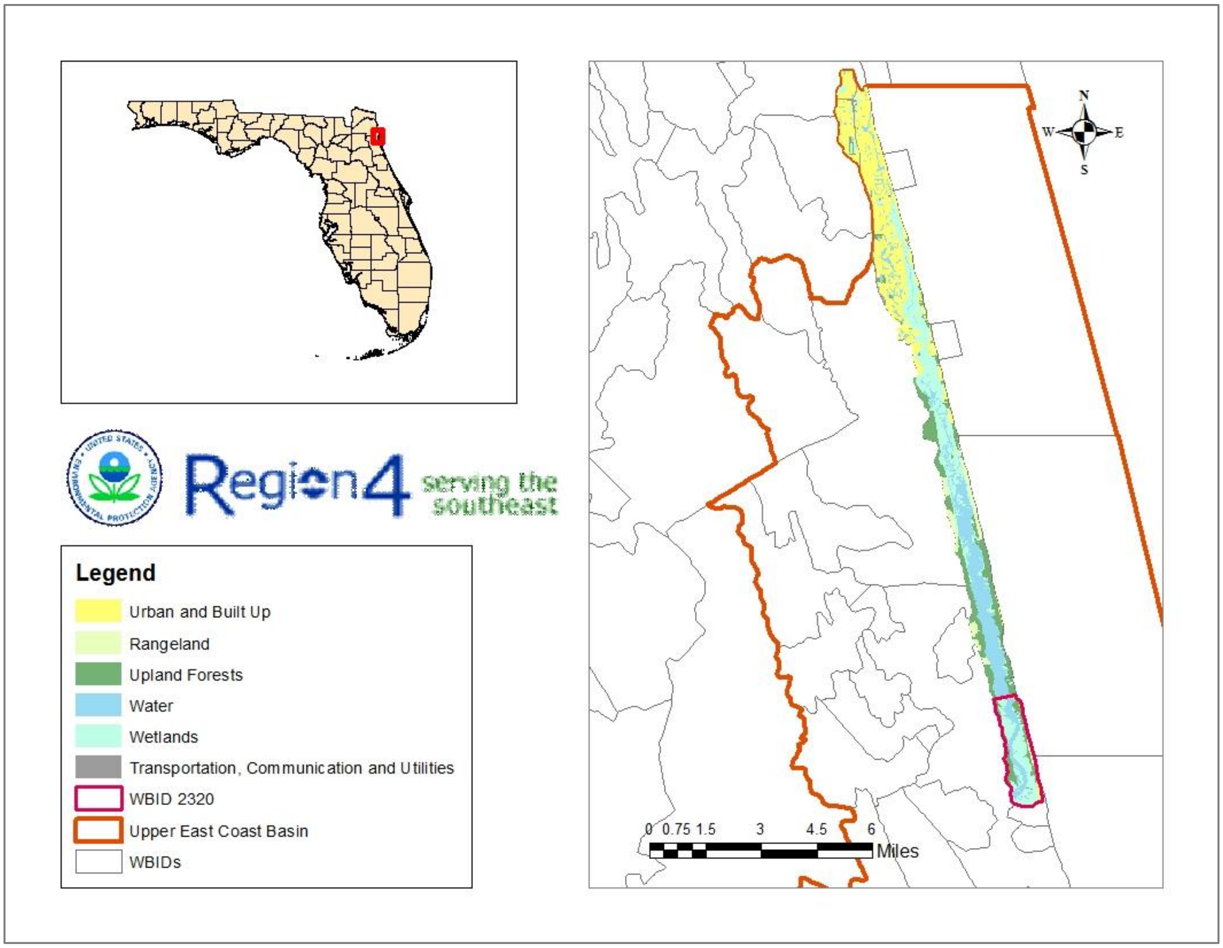

Figure 3. Guana River Watershed Landuse Distribution

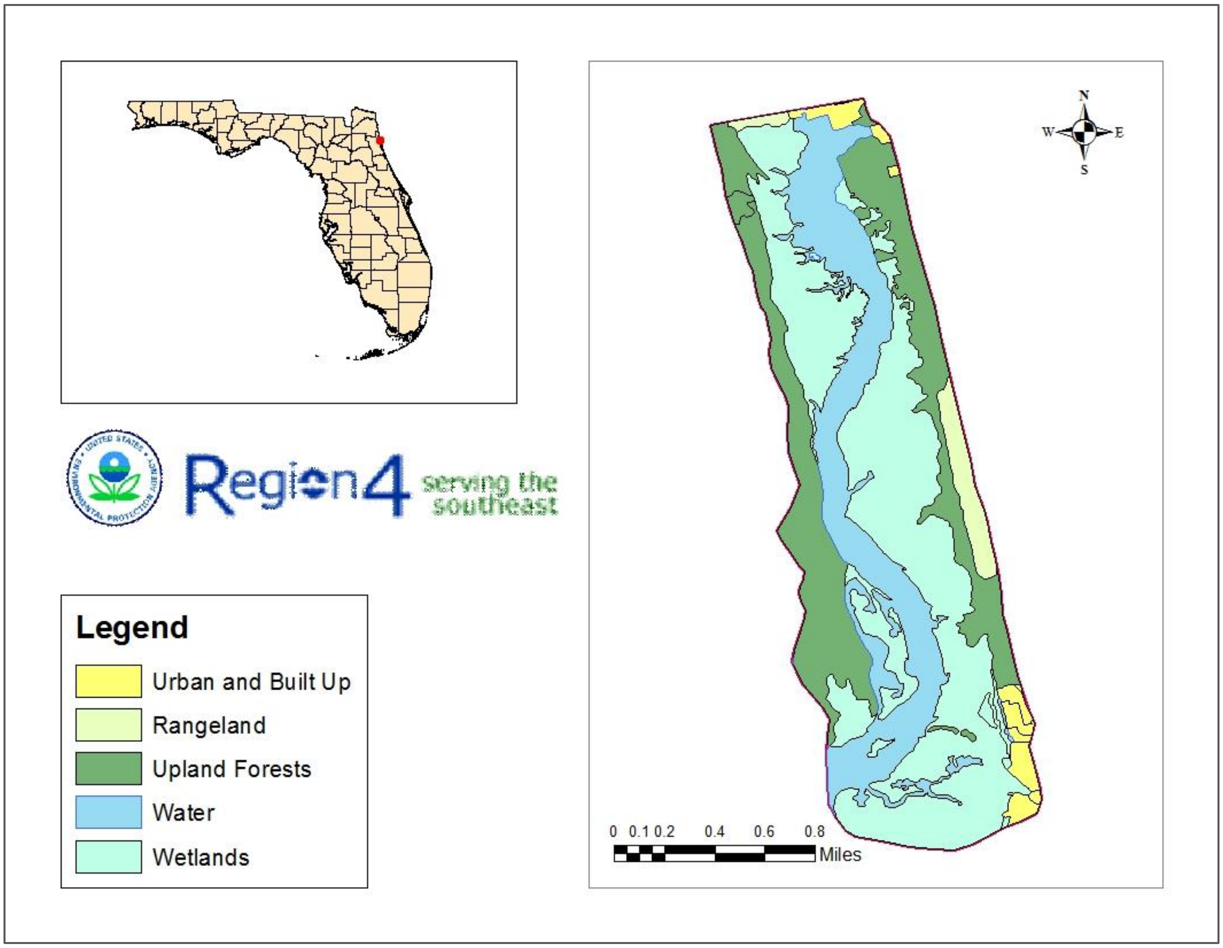

Figure 4. WBID 2320 Land Use Distribution

Table 1. Land Use Distribution in Guana River

Waterbody	WBID(s)	Unit	Urban Residential & Built-Up[2]	Rangeland	Forest	Water	Wetlands	Transportation Communication, and Utilities	Total
Guana River	2320, 2320F	Acres	2,537	407	1,394	2,049	2,147	142	8,676
		percent	29.2	4.7	16.1	23.6	24.8	1.6	100
Guana River[1]	2320	Acres	40.9	39.4	308.0	289.9	532.2	0	1,210
		percent	3.38	3.25	25.4	24.0	44.0	0	100

Notes:

1. Areas and percentages in this row represent the watershed within WBID 2320 only.
2. The urban/residential and built-up category includes commercial, industrial and extractive uses.

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

4. Water Quality Standards/TMDL Targets

Guana River, specifically WBID 2320, is a Class II Marine waterbody with a designated use of Shellfish Propagation and Harvesting. Designated use classifications are described in FAC Section 62-302.400(1), and water quality criteria for protection of all classes of waters are established in FAC Section 62-302.530. Individual criteria should be considered in conjunction with other provisions in water quality standards, including Section 62-302.500 FAC. [Surface Waters: Minimum Criteria, General Criteria] that apply to all waters unless alternative criteria are specified in FAC Section 62-302.530.

4.1. Fecal Coliform Bacteria (Class II)

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

The median value criterion reflects chronic or long-term water quality conditions, whereas the 43 and 800 values reflect acute or short-term conditions. The 43 count/100 mL criterion was the only criterion exceeded; therefore, it was selected as the TMDL endpoint. EPA believes implementation of the percent reduction required in this TMDL will achieve restoration of the waterbody. Florida's continued monitoring and assessment of this waterbody will provide the data and information necessary to demonstrate whether the waterbody is fully restored.

5. Water Quality Assessment

WBID 2320 (Guana River) was listed as not attaining its designated uses on Florida's 1998 303(d) list due to elevated fecal coliform bacteria. To confirm whether WBID 2320 is impaired due to bacteria, an assessment of available data was conducted. The source for current ambient monitoring data in WBID 2320, Guana River, was version 44 of the IWR database. The IWR database contains data from various sources within the state of Florida, including the WMDs and counties.

5.1. Water Quality Data

The table and figures presented in this section provide the station locations and time series data for fecal coliform bacteria collected in Guana River, WBID 2320. Table 2 provides a list of the water quality monitoring stations in WBID 2320, including the date range and number of observations. Figure 5 illustrates where the IWR stations are located within the WBID.

Table 2. Water Quality Monitoring Stations for WBID 2320: Guana River

Station	Station Name	First Date	Last Date	No. Obs
21FLA 27010169	GUANA LAKE APPROX 50 YARDS S OF DAM	1/26/2005	8/18/2005	7
21FLA 92600SEAS	Tip of Guana River at dam	1/15/2002	4/20/2004	17
21FLA 92617SEAS	Smith's lease mid-way up Guana River	1/15/2002	4/20/2004	17
21FLA 92618SEAS	Mouth of Guana River	1/15/2002	4/20/2004	17
21FLSEAS92SEAS600	Tip of Guana River at dam	7/15/2004	3/7/2011	26
21FLSEAS92SEAS617	Smith's lease mid-way up Guana River	7/15/2004	3/7/2011	26
21FLSEAS92SEAS618	Mouth of Guana River	7/15/2004	3/7/2011	26
21FLSJWMGAR	GUANA RIVER 100 meters south of the Dam	1/14/2002	11/18/2010	82

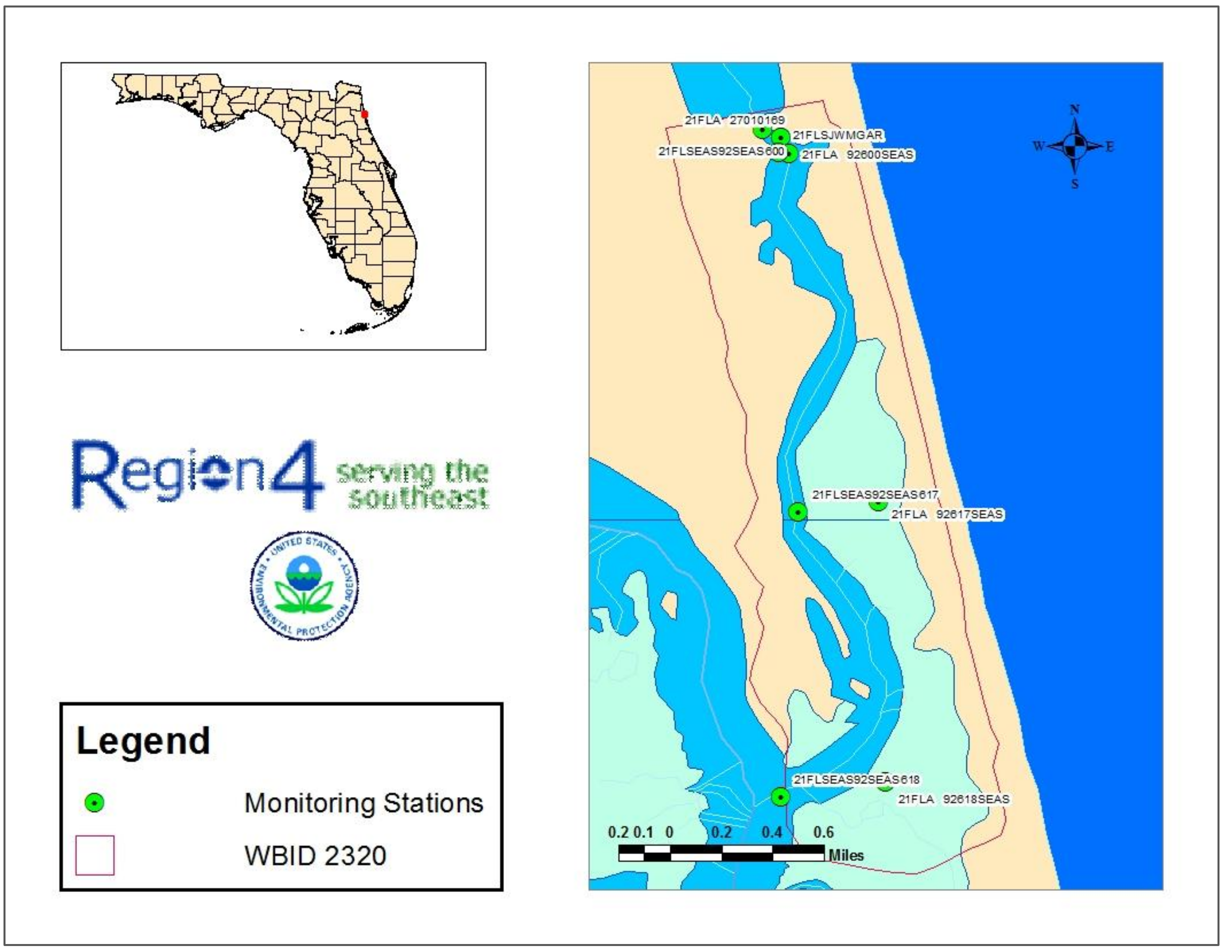

Figure 5. Station Locations for WBID 2320: Guana River

Four monitoring stations (21FLA 27010169, 21FLA 92600SEAS, 21FLSEAS92SEAS600, and 21FLSJWMGAR) are located immediately downstream of the Guana Dam and within close proximity to each other (within 200 meters). Therefore, these monitoring stations are considered to be the same sampling location and referred to as the Guana Dam Group in this TMDL. The locations of the monitoring stations and the Guana Dam are depicted in Figure 6.

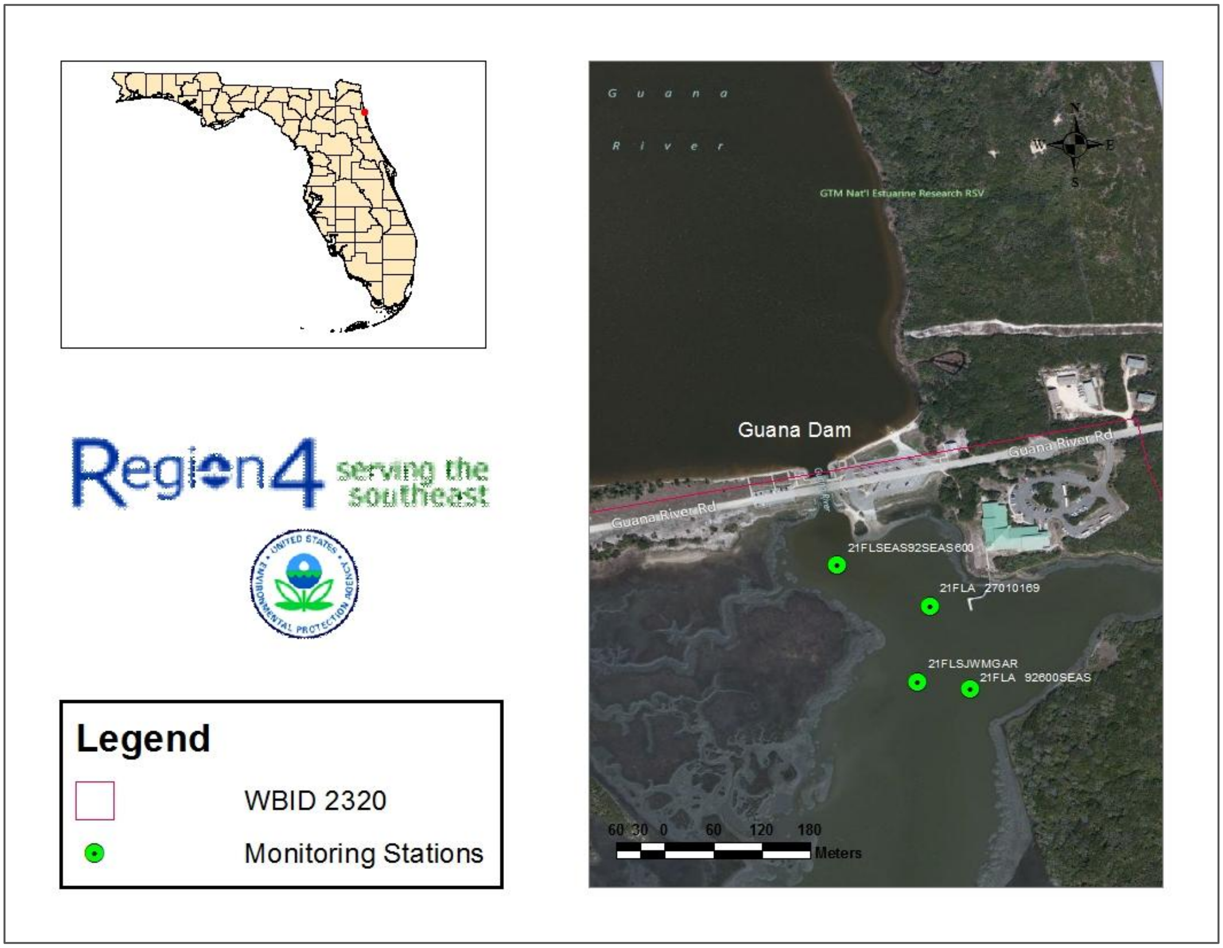

Figure 6. Location of the Monitoring Stations in the immediate vicinity of the Guana Dam

All samples collected from the same location within a 4-day time period must be considered one sample for analytical purposes. Several occurrences of multiple sampling within this short timeframe were present in the Guana Dam Group. The resulting median value for each occurrence was used to represent that sampling period in this TMDL.

Fecal Coliform

Figure 7 provides a time series plot of fecal coliform data in Guana River. There were 5 monitoring locations used in the assessment that included a total of 191 observations, of which 27 (14 percent) are above the water quality standard of 43 counts/100 mL fecal coliform. The median value for the sample set equals 8 counts/100 mL fecal coliform, which is below the water quality standard of 14 counts/100 mL fecal coliform. Several samples were flagged with laboratory remark codes. The complete list of data results used in this TMDL analysis is provided in Appendix A, along with any associated laboratory remark codes. Summary statistics for the fecal coliform data are provided in Table 3.

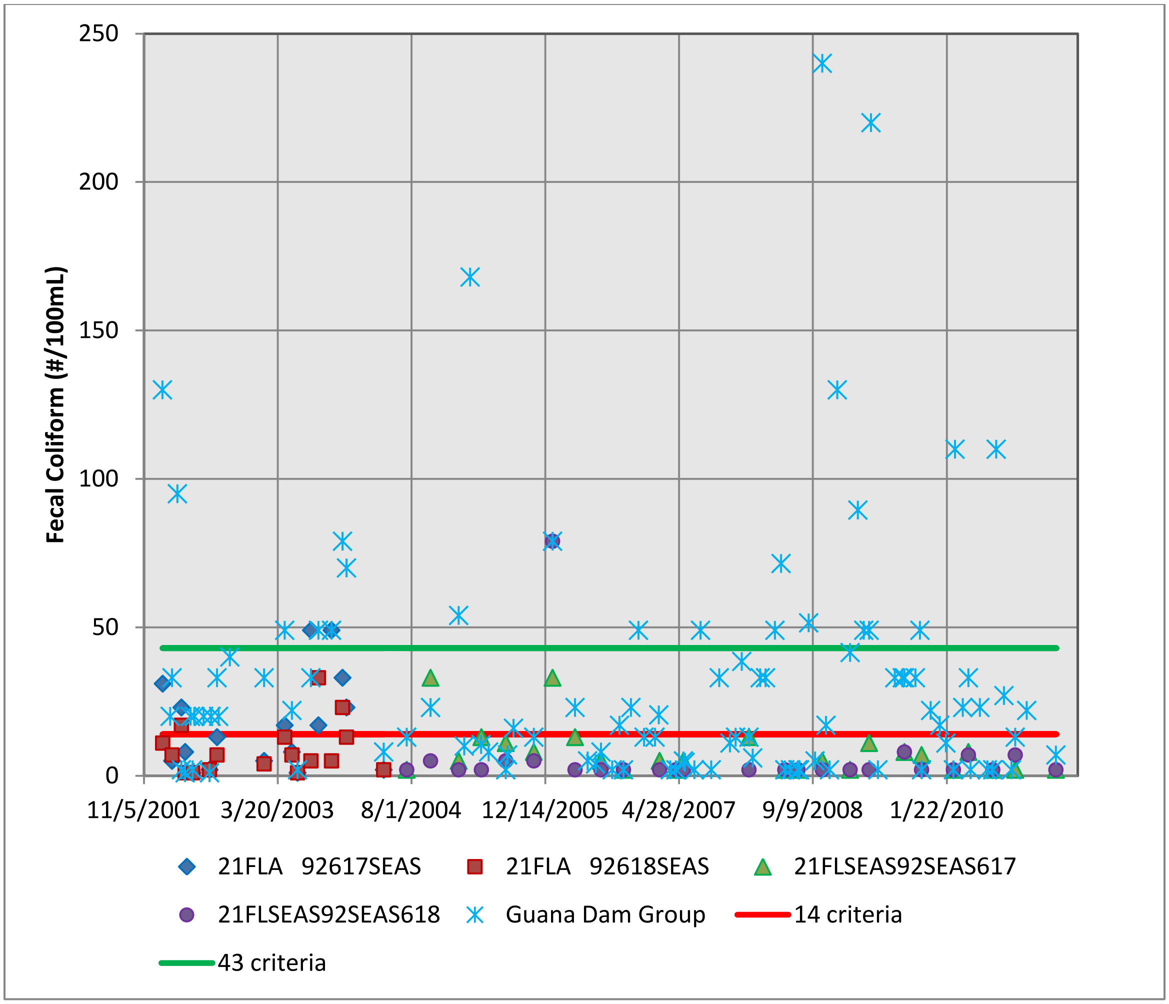

Figure 7. WBID 2320: Guana River Measured Fecal Coliform

Table 3. Water Quality Statistics for Fecal Coliforms

Monitoring Station	Minimum Concentration (#/100ml)	Maximum Concentration (#/100ml)	Mean Concentration (#/100ml)	Standard Deviation (#/100ml)	# Samples >43 (#/100ml)
21FLA 92617SEAS	1.0	49.0	16.9	15.8	2
21FLA 92618SEAS	1.0	33.0	8.9	8.8	0
21FLSEAS92SEAS617	2.0	33.0	7.8	8.4	0
21FLSEAS92SEAS618	2.0	79.0	5.9	15.0	1
Guana Dam Group	1.0	240.0	31.6	41.9	24

Stream flow is an important factor affecting water quality, especially insofar as it can be correlated with observed exceedances and used to determine the available loading capacity for pollutants. However, flow data was not available for Guana River, specifically WBID 2320.

Furthermore, flow in WBID 2320 is controlled by the Guana Dam, not rainfall, so local precipitation data was not included in this TMDL analysis. In order to ensure compliance with the WQS, implementation of this TMDL should address controlling nonpoint sources during both wet and dry weather conditions.

6. Source and Load Assessment

An important part of the TMDL analysis is the identification of source categories, source subcategories, or individual sources of pollutants in the watershed and the amount of loading contributed by each of these sources. Sources are broadly classified as either point or nonpoint sources. Coliform bacteria can enter surface waters from both point and nonpoint sources. Since Guana River is a tidal water, bacteria could potentially be introduced from both upstream and downstream sources.

6.1. Point Sources

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

6.1.1. Wastewater/Industrial Permitted Facilities

There are no wastewater or industrial NPDES permitted facilities that discharge to Guana River.

6.1.2. Stormwater Permitted Facilities/MS4s

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

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

> (i) Owned or operated by a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law)...including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal

organization, or a designated and approved management agency under section 208 of the Clean Water Act that discharges into waters of the United States;

(ii) Designed or used for collecting or conveying storm water;

(iii) Which is not a combined sewer; and

(iv) Which is not part of a Publicly Owned Treatment Works."

MS4s may discharge coliform bacteria and other pollutants to waterbodies in response to storm events. In 1990, USEPA developed rules establishing Phase I of the NPDES stormwater program, designed to prevent harmful pollutants from being washed by stormwater runoff into MS4s (or from being dumped directly into the MS4) and then discharged from the MS4 into local waterbodies. Phase I of the program required operators of "medium" and "large" MS4s (those generally serving populations of 100,000 or greater) to implement a stormwater management program as a means to control polluted discharges from MS4s. Approved stormwater management programs for medium and large MS4s are required to address a variety of water quality related issues including roadway runoff management, municipal owned operations, hazardous waste treatment, etc.

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

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

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

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

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

There are no MS4s stormwater permitted facilities that discharge to or upstream of Guana River, specifically WBID 2320. Two facilities with minor Construction Stormwater Generic Permits are located within WBID 2320; however, stormwater run-off from construction/industrial sites is not typically considered a significant source for coliform bacteria.

6.2. Non Point Sources

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

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

6.2.1. Wildlife

Wildlife contribute coliform bacteria by depositing feces onto land surfaces where it can be transported to nearby streams during storm events and by direct deposition to the waterbody by birds and other warm blooded animals. Bacteria originating from local wildlife are generally considered to represent natural background concentrations. In most impaired watersheds, the contribution from wildlife is small relative to the load from urban and agricultural areas. However, almost 70 percent of the land area within the Guana River watershed is designated as a nature landuse (i.e. forested, rangeland, water, or wetland) and protected in the Guana River Marsh Aquatic Preserve. Additionally, 93 percent of the land area within WBID 2320 is designated as a nature landuse. With such a high percentage of natural landuse in and surrounding WBID 2320, wildlife could be a relevant source of bacteria to Guana River.

6.2.2. Agriculture

Agriculture is a potential source of coliform delivery to streams, including runoff of manure from pastureland and cropland, and direct animal access to streams. However, there is no landuse designated as agriculture in the Guana River watershed.

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

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

The Florida Department of Health also maintains a list of OSTDs that have been inspected by the Florida Department of Health. The purpose for the inspections range from new installations to requested repair work. Figure 8 depicts the OSTDs inspection conducted adjacent to Guana River. Without additional information, an explicit source cannot be determined. However, the presence of OSTDs in close proximity to Guana River, specifically WBID 2320, suggests that OSTDs could be potential sources of pathogen loading to Guana River.

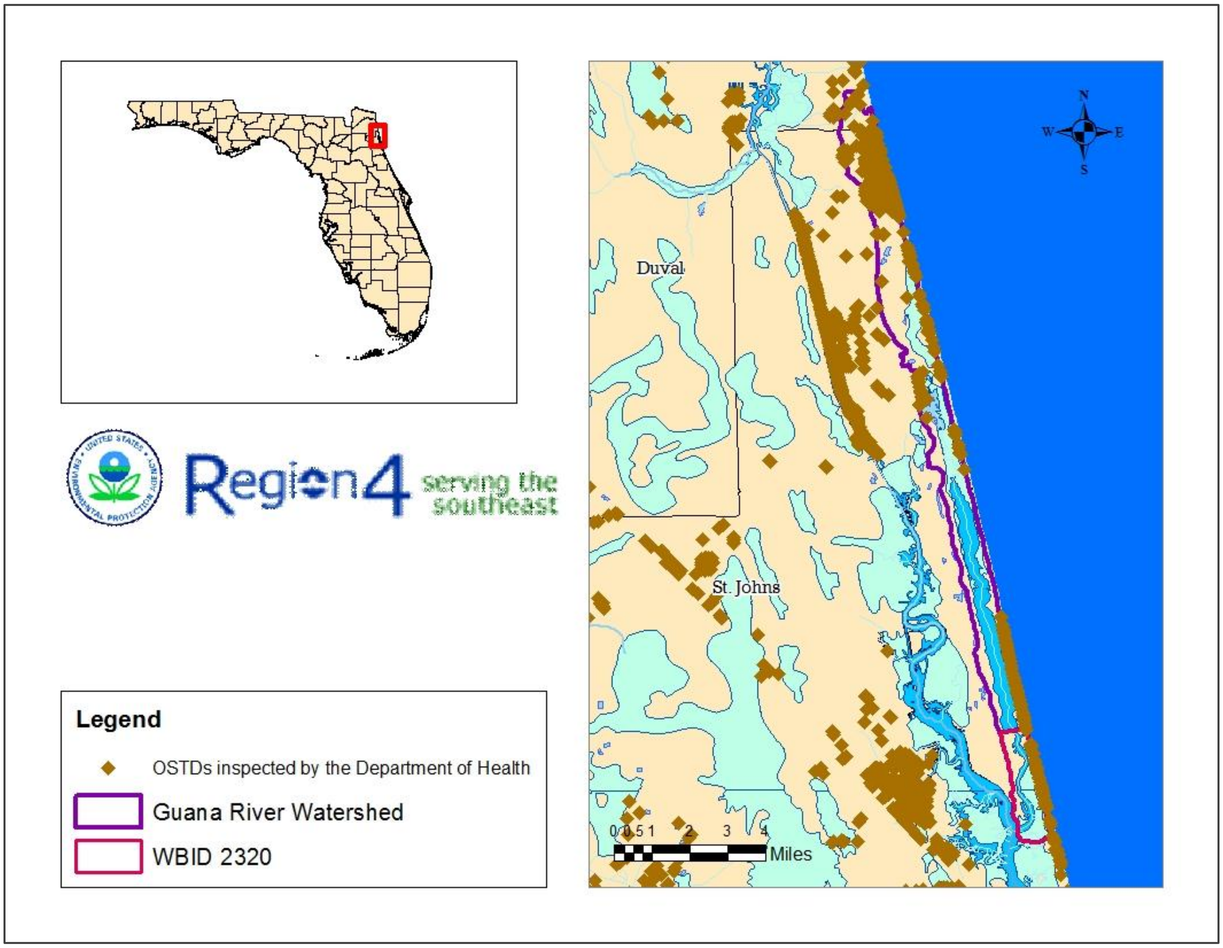

Figure 8. OSTDs inspected in the vicinity of Guana River, WBID 2320

6.2.4. Urban Areas/Pervious

Urban areas include landuses such as residential, industrial, utility swaths, extractive and commercial. Fecal coliform loading from urban areas (whether within an MS4 jurisdiction or not) is attributable to multiple sources including storm water runoff, leaks and overflows from sanitary sewer systems, illicit discharges of sanitary waste, runoff from improper disposal of waste materials, leaking septic systems, and domestic animals.

In 1982, Florida became the first state in the country to implement statewide regulations to address the issue of nonpoint source pollution by requiring new development and redevelopment to treat stormwater before it is discharged. The Stormwater Rule, as outlined in Chapter 403 FS, was established as a technology-based program that relies upon the implementation of BMPs that are designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Chapter 62-40, FAC.

Florida's stormwater program is unique in having a performance standard for older stormwater systems that were built before the implementation of the Stormwater Rule in 1982. This rule states: "the pollutant loading from older stormwater management systems shall be reduced as needed to restore or maintain the beneficial uses of water" (Section 62-4-.432 (5)(c), FAC).

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

Nearly 30 percent of the Guana River watershed is designated as urban development. However, the majority of the urban development is located at the northern portion of the watershed, approximately 14.5 km (9 mi) upstream of WBID 2320. Only three percent of the total land area within WBID 2320 is designated as urban. Additionally, the entire Guana River is included in the Guana River Marsh Aquatic Preserve and is largely undeveloped. However, the presence of urban development in the watershed suggests that urban landuse could be a potential source of pathogen loading to Guana River.

7. Analytical Approach

The approach for calculating fecal coliform TMDLs depends on the number of water quality samples and the availability of flow data. When long-term records of water quality and flow data are not available, the TMDL is expressed as a percent reduction. Load duration curves are used to develop TMDLs when significant data is available to develop a relationship between flow and concentration. Flow measurements were not available for WBID 2320; therefore, this TMDL is expressed as a percent reduction.

7.1. Percent Reduction Approach for TMDL Development

Under this "percent reduction" method, the percent reduction needed to meet the applicable criterion is calculated based on a percentile of all measured concentrations. The (p X 100) percentile is the value with the cumulative probability of p. For example, the 90th percentile has a cumulative probability of 0.90. The 90th percentile is also called the 10 percent exceedance event because it will be exceeded with the probability of 0.10. Therefore, considering a set of water quality data, 90 percent of the measured values are lower than the 90th percentile concentration and 10 percent are higher. There are many formulas for determining the percentile and these can be found in many text books on statistics. The Hazen formula was used in this TMDL since it is recommended in Hunter's Applied Microbiology (2002) article concerning bacteria in water. Application of the Hazen formula to data collected in WBID 2320 is provided in Appendix B.

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

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

8. TMDL Determination

Almost 70 percent of the total watershed and over 95 percent of the land area within WBID 2320 is designated as natural landuse (i.e. forest, water or wetland). Additionally, the Guana River is located within the Guana River Marsh Aquatic Preserve. With such a high percentage of natural landuse in and upstream of WBID 2320, wildlife (i.e. natural background conditions) could be a relevant source of bacteria to Guana River. However, due to the presence of OSTDs and urban development within the watershed, anthropogenic sources cannot be ruled out. Furthermore, WBID 2320 is a Class II Marine waterbody with a designated use of Shellfish Propagation and Harvesting. Due to the risk to human health from harvesting shellfish with elevated levels of bacteria, a TMDL is being established to bring Guana River back into compliance with the Class II fecal coliform WQS.

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

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

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

The percent reduction that meets the acute criteria for Class II waters was calculated by comparing the 90th percentile value with the 43 counts/100 mL criterion. The calculated TMDL reduction for Guana River (WBID 2320) is summarized in Table 4.

Table 4. Summary of TMDL Components

Waterbody	WBID	WLA[1]		LA	TMDL
		Facility (MPN/day)	Stormwater/MS4 (% Reduction)[2]	(% Reduction)[2]	(% Reduction)[2]
Guana River	2320	N/A	N/A	16%	16%

Notes:

1. The WLA is typically separated into the components originating from continuous wastewater NPDES facilities (e.g. WWTPs) and from stormwater NPDES permitted facilities/public bodies (e.g. MS4s).
2. Overall percent reduction required to achieve the 43 counts/100 mL fecal coliform criterion. The MOS is implicit and does not take away from the TMDL value.

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

8.1. Critical Conditions and Seasonal Variation

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

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

Flow data was not available for Guana River, specifically WBID 2320. Furthermore, flow in WBID 2320 is controlled by the Guana Dam, so local precipitation data was not included in this TMDL analysis. Therefore, critical conditions and seasonal variation are accounted for in the TMDL analysis for WBID 2320 by selecting the largest percent reduction from the entire period of measured water quality data, and using it to represent the pollutant reduction required year-round, for the entire watershed.

8.2. Existing Conditions

Existing conditions represent the current water quality conditions of a waterbody. Existing conditions for WBID 2320 are being represented using the 90th percentile of measured concentrations. The 90th percentile and percent reduction required to meet the TMDL target are shown below in Table 5.

Table 5. Fecal Coliform Existing Conditions in Guana River (WBID 2320)

90th Percentile Fecal Coliform Concentration	Percent Reduction to meet TMDL Target
51	16 percent

Several samples were flagged with laboratory remark codes. The following laboratory remark codes were associated with at least one of the samples analyzed as part of this TMDL. The complete list of data results used in this TMDL analysis is provided in Appendix A, along with any associated laboratory remark codes.

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

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

Remark Code U – The laboratory remark code U indicates that the sample was analyzed but fecal coliform was not detected. The value stored in the database is the detection limit and may be greater than the actual concentration present at the time of sampling. However, the highest detection limit for these samples is less than half of the 43 fecal coliform criteria and does not increase the calculated TMDL percent reduction. Therefore, the samples were included in the TMDL analysis.

8.3. Margin of Safety

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

8.4. Waste Load Allocations

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

8.4.1. Wastewater/Industrial Permitted Facilities

There are no wastewater or industrial NPDES permitted facilities that discharge to Guana River, specifically WBID 2320.

8.4.2. Stormwater Permitted Facilities/MS4s

There are no MS4 areas located within the Guana River watershed. All future MS4s permitted in the area are automatically prescribed a WLA equivalent to the percent reduction assigned to the LA. Best management practices should be developed for all future MS4s in order to meet the percent reduction as prescribed in Table 4. The percent reduction that meets the acute criteria for Class II waters was calculated by comparing the 90th percentile value with the 43 counts/100 mL criterion. The calculated TMDL reduction for Guana River (WBID 2320) is summarized in Table 4.

Two facilities with minor Construction Stormwater Generic Permits are located within WBID 2320; however, stormwater run-off from construction/industrial sites are not typically considered a significant source for coliform bacteria and were not included in the WLA.

8.5. Load Allocations

The load allocation for nonpoint sources was assigned a percent reduction from the current loadings coming into Guana River, specifically WBID 2320.

9. Recommendations

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

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

10. References

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Appendix A

Fecal Coliform Measurements in Guana River (WBID 2320)

Date	Time	Station	Fecal Coliform (count/100mL)	Remark Code
1/26/2005	1100	21FLA 27010169	97	
2/15/2005	1015	21FLA 27010169	10	B
3/9/2005	1129	21FLA 27010169	168	
4/19/2005	1055	21FLA 27010169	8	U
5/17/2005	1150	21FLA 27010169	8	B
7/27/2005	845	21FLA 27010169	7	B
8/18/2005	1307	21FLA 27010169	16	B
1/15/2002	1150	21FLA 92600SEAS	130	
2/19/2002	1226	21FLA 92600SEAS	33	
3/26/2002	1125	21FLA 92600SEAS	2	
4/9/2002	1136	21FLA 92600SEAS	1	
5/7/2002	1238	21FLA 92600SEAS	2	
7/9/2002	1145	21FLA 92600SEAS	1	
8/6/2002	1212	21FLA 92600SEAS	33	
1/29/2003	1139	21FLA 92600SEAS	33	
4/16/2003	1138	21FLA 92600SEAS	49	
5/13/2003	1220	21FLA 92600SEAS	22	
6/3/2003	1105	21FLA 92600SEAS	2	
7/23/2003	1041	21FLA 92600SEAS	33	
8/20/2003	907	21FLA 92600SEAS	49	
10/8/2003	1114	21FLA 92600SEAS	49	
11/18/2003	1011	21FLA 92600SEAS	79	
12/3/2003	1048	21FLA 92600SEAS	70	
4/20/2004	1059	21FLA 92600SEAS	8	
1/15/2002	1144	21FLA 92617SEAS	31	
2/19/2002	1220	21FLA 92617SEAS	5	
3/26/2002	1118	21FLA 92617SEAS	23	
4/9/2002	1131	21FLA 92617SEAS	8	
5/7/2002	1232	21FLA 92617SEAS	1	
7/9/2002	1140	21FLA 92617SEAS	2	
8/6/2002	1208	21FLA 92617SEAS	13	
1/29/2003	1133	21FLA 92617SEAS	5	
4/16/2003	1132	21FLA 92617SEAS	17	
5/13/2003	1215	21FLA 92617SEAS	8	
6/3/2003	1059	21FLA 92617SEAS	1	
7/23/2003	1038	21FLA 92617SEAS	49	
8/20/2003	901	21FLA 92617SEAS	17	
10/8/2003	1109	21FLA 92617SEAS	49	
11/18/2003	1006	21FLA 92617SEAS	33	
12/3/2003	1040	21FLA 92617SEAS	23	
4/20/2004	1052	21FLA 92617SEAS	2	

Date	Time	Station	Fecal Coliform (count/100mL)	Remark Code
1/15/2002	1138	21FLA 92618SEAS	11	
2/19/2002	1216	21FLA 92618SEAS	7	
3/26/2002	1112	21FLA 92618SEAS	17	
4/9/2002	1126	21FLA 92618SEAS	1	
5/7/2002	1226	21FLA 92618SEAS	1	
7/9/2002	1137	21FLA 92618SEAS	2	
8/6/2002	1204	21FLA 92618SEAS	7	
1/29/2003	1129	21FLA 92618SEAS	4	
4/16/2003	1126	21FLA 92618SEAS	13	
5/13/2003	1210	21FLA 92618SEAS	7	
6/3/2003	1052	21FLA 92618SEAS	1	
7/23/2003	1032	21FLA 92618SEAS	5	
8/20/2003	855	21FLA 92618SEAS	33	
10/8/2003	1104	21FLA 92618SEAS	5	
11/18/2003	959	21FLA 92618SEAS	23	
12/3/2003	1033	21FLA 92618SEAS	13	
4/20/2004	1046	21FLA 92618SEAS	2	
7/15/2004	857	21FLSEAS92SEAS600	13	
10/12/2004	1104	21FLSEAS92SEAS600	23	
1/25/2005	1238	21FLSEAS92SEAS600	11	
4/20/2005	1120	21FLSEAS92SEAS600	13	
7/20/2005	1058	21FLSEAS92SEAS600	2	
11/2/2005	1035	21FLSEAS92SEAS600	13	
1/11/2006	1130	21FLSEAS92SEAS600	79	
4/5/2006	1151	21FLSEAS92SEAS600	23	
7/11/2006	1237	21FLSEAS92SEAS600	2	U
10/3/2006	1037	21FLSEAS92SEAS600	2	
2/15/2007	946	21FLSEAS92SEAS600	33	
4/17/2007	1238	21FLSEAS92SEAS600	2	
5/15/2007	1144	21FLSEAS92SEAS600	5	
1/15/2008	1200	21FLSEAS92SEAS600	13	
5/28/2008	1158	21FLSEAS92SEAS600	2	
7/16/2008	1116	21FLSEAS92SEAS600	2	U
10/15/2008	1049	21FLSEAS92SEAS600	240	Q
1/27/2009	1058	21FLSEAS92SEAS600	4	Q
4/8/2009	1009	21FLSEAS92SEAS600	49	Q
8/18/2009	1153	21FLSEAS92SEAS600	33	
10/21/2009	1133	21FLSEAS92SEAS600	2	U
2/17/2010	1217	21FLSEAS92SEAS600	2	
4/14/2010	942	21FLSEAS92SEAS600	33	
7/14/2010	1110	21FLSEAS92SEAS600	2	U
10/6/2010	1050	21FLSEAS92SEAS600	13	
3/7/2011	1204	21FLSEAS92SEAS600	7	
7/15/2004	851	21FLSEAS92SEAS617	2	
10/12/2004	1059	21FLSEAS92SEAS617	33	

Date	Time	Station	Fecal Coliform (count/100mL)	Remark Code
1/25/2005	1234	21FLSEAS92SEAS617	5	
4/20/2005	1115	21FLSEAS92SEAS617	13	
7/20/2005	1055	21FLSEAS92SEAS617	11	
11/2/2005	1030	21FLSEAS92SEAS617	8	
1/11/2006	1124	21FLSEAS92SEAS617	33	
4/5/2006	1147	21FLSEAS92SEAS617	13	
7/11/2006	1233	21FLSEAS92SEAS617	5	
10/3/2006	1031	21FLSEAS92SEAS617	2	
2/15/2007	941	21FLSEAS92SEAS617	5	
4/17/2007	1234	21FLSEAS92SEAS617	2	
5/15/2007	1138	21FLSEAS92SEAS617	5	
1/15/2008	1156	21FLSEAS92SEAS617	13	
5/28/2008	1154	21FLSEAS92SEAS617	2	
7/16/2008	1112	21FLSEAS92SEAS617	2	U
10/15/2008	1043	21FLSEAS92SEAS617	5	Q
1/27/2009	1054	21FLSEAS92SEAS617	2	U
4/8/2009	1004	21FLSEAS92SEAS617	11	Q
8/18/2009	1148	21FLSEAS92SEAS617	8	
10/21/2009	1126	21FLSEAS92SEAS617	7	
2/17/2010	1515	21FLSEAS92SEAS617	2	U
4/14/2010	937	21FLSEAS92SEAS617	8	
7/14/2010	1108	21FLSEAS92SEAS617	2	U
10/6/2010	1046	21FLSEAS92SEAS617	2	
3/7/2011	1202	21FLSEAS92SEAS617	2	
7/15/2004	846	21FLSEAS92SEAS618	2	U
10/12/2004	1054	21FLSEAS92SEAS618	5	
1/25/2005	1230	21FLSEAS92SEAS618	2	
4/20/2005	1109	21FLSEAS92SEAS618	2	
7/20/2005	1052	21FLSEAS92SEAS618	5	
11/2/2005	1025	21FLSEAS92SEAS618	5	
1/11/2006	1118	21FLSEAS92SEAS618	79	
4/5/2006	1141	21FLSEAS92SEAS618	2	
7/11/2006	1228	21FLSEAS92SEAS618	2	
10/3/2006	1025	21FLSEAS92SEAS618	2	
2/15/2007	935	21FLSEAS92SEAS618	2	U
4/17/2007	1230	21FLSEAS92SEAS618	2	U
5/15/2007	1131	21FLSEAS92SEAS618	2	
1/15/2008	1151	21FLSEAS92SEAS618	2	
5/28/2008	1151	21FLSEAS92SEAS618	2	
7/16/2008	1107	21FLSEAS92SEAS618	2	
10/15/2008	1038	21FLSEAS92SEAS618	2	Q
1/27/2009	1051	21FLSEAS92SEAS618	2	U
4/8/2009	959	21FLSEAS92SEAS618	2	Q
8/18/2009	1143	21FLSEAS92SEAS618	8	
10/21/2009	1122	21FLSEAS92SEAS618	2	

Date	Time	Station	Fecal Coliform (count/100mL)	Remark Code
2/17/2010	1214	21FLSEAS92SEAS618	2	U
4/14/2010	932	21FLSEAS92SEAS618	7	
7/14/2010	1106	21FLSEAS92SEAS618	2	U
10/6/2010	1043	21FLSEAS92SEAS618	7	
3/7/2011	1200	21FLSEAS92SEAS618	2	U
1/14/2002	1115	21FLSJWMGAR	130	
1/14/2002	1115	21FLSJWMGAR	130	
2/12/2002	1240	21FLSJWMGAR	20	U
2/12/2002	1240	21FLSJWMGAR	20	U
3/11/2002	1101	21FLSJWMGAR	80	
3/11/2002	1101	21FLSJWMGAR	80	
3/11/2002	1100	21FLSJWMGAR	110	
3/11/2002	1100	21FLSJWMGAR	110	
4/29/2002	1310	21FLSJWMGAR	20	
4/29/2002	1310	21FLSJWMGAR	20	
5/13/2002	1330	21FLSJWMGAR	20	U
5/13/2002	1330	21FLSJWMGAR	20	U
5/13/2002	1331	21FLSJWMGAR	20	U
5/13/2002	1331	21FLSJWMGAR	20	U
6/17/2002	1200	21FLSJWMGAR	20	U
6/17/2002	1200	21FLSJWMGAR	20	U
7/15/2002	1235	21FLSJWMGAR	20	
7/15/2002	1235	21FLSJWMGAR	20	
8/12/2002	1250	21FLSJWMGAR	20	U
8/12/2002	1250	21FLSJWMGAR	20	U
8/12/2002	1251	21FLSJWMGAR	20	U
8/12/2002	1251	21FLSJWMGAR	20	U
9/23/2002	1240	21FLSJWMGAR	40	
9/23/2002	1240	21FLSJWMGAR	40	
5/22/2006	905	21FLSJWMGAR	5	Q
6/21/2006	855	21FLSJWMGAR	4	Q
7/13/2006	830	21FLSJWMGAR	14	Q
8/22/2006	1010	21FLSJWMGAR	2	U
9/18/2006	940	21FLSJWMGAR	17	Q
10/31/2006	1030	21FLSJWMGAR	13	Q
10/31/2006	1031	21FLSJWMGAR	33	Q
11/28/2006	1110	21FLSJWMGAR	49	Q
12/19/2006	950	21FLSJWMGAR	13	Q
1/29/2007	1030	21FLSJWMGAR	13	Q
2/12/2007	1055	21FLSJWMGAR	8	Q
3/27/2007	830	21FLSJWMGAR	2	U
5/21/2007	1101	21FLSJWMGAR	2	U
5/21/2007	1100	21FLSJWMGAR	7	Q
6/25/2007	850	21FLSJWMGAR	2	Q
7/18/2007	820	21FLSJWMGAR	49	Q

Date	Time	Station	Fecal Coliform (count/100mL)	Remark Code
8/27/2007	915	21FLSJWMGAR	2	Q
9/26/2007	1040	21FLSJWMGAR	33	Q
11/5/2007	915	21FLSJWMGAR	11	Q
11/26/2007	910	21FLSJWMGAR	13	Q
12/19/2007	1016	21FLSJWMGAR	31	Q
12/19/2007	1015	21FLSJWMGAR	46	Q
1/29/2008	1240	21FLSJWMGAR	6	Q
2/26/2008	955	21FLSJWMGAR	33	Q
3/17/2008	930	21FLSJWMGAR	33	Q
4/21/2008	915	21FLSJWMGAR	49	Q
5/14/2008	830	21FLSJWMGAR	49	Q
5/14/2008	831	21FLSJWMGAR	94	Q
6/18/2008	905	21FLSJWMGAR	2	U
7/22/2008	1000	21FLSJWMGAR	2	U
8/25/2008	1210	21FLSJWMGAR	33	Q
8/25/2008	1211	21FLSJWMGAR	70	Q
9/18/2008	925	21FLSJWMGAR	5	Q
10/29/2008	845	21FLSJWMGAR	17	Q
11/11/2008	835	21FLSJWMGAR	2	Q
12/10/2008	800	21FLSJWMGAR	130	
1/28/2009	810	21FLSJWMGAR	79	
2/25/2009	816	21FLSJWMGAR	49	
2/25/2009	815	21FLSJWMGAR	130	
3/19/2009	835	21FLSJWMGAR	49	
4/15/2009	820	21FLSJWMGAR	220	
5/11/2009	1030	21FLSJWMGAR	2	U
7/13/2009	930	21FLSJWMGAR	33	
8/10/2009	1115	21FLSJWMGAR	33	
9/28/2009	940	21FLSJWMGAR	33	
10/15/2009	830	21FLSJWMGAR	49	
11/24/2009	1145	21FLSJWMGAR	22	
12/28/2009	835	21FLSJWMGAR	17	
1/20/2010	1000	21FLSJWMGAR	11	
2/23/2010	905	21FLSJWMGAR	110	
3/24/2010	1005	21FLSJWMGAR	23	
4/22/2010	1200	21FLSJWMGAR	2	
5/27/2010	830	21FLSJWMGAR	23	
6/24/2010	925	21FLSJWMGAR	2	U
7/27/2010	1030	21FLSJWMGAR	110	
8/25/2010	1100	21FLSJWMGAR	27	
9/22/2010	1025	21FLSJWMGAR	2	U
11/18/2010	1030	21FLSJWMGAR	22	

Appendix B

Fecal Coliform Data and Percentiles for WBID 2320

Date	Station	Fecal Coliform (counts/100mL)	Rank	Percentile by Hazen Method
5/7/2002	21FLA 92617SEAS	1	1	0%
6/3/2003	21FLA 92617SEAS	1	1	0%
4/9/2002	21FLA 92618SEAS	1	1	0%
5/7/2002	21FLA 92618SEAS	1	1	0%
6/3/2003	21FLA 92618SEAS	1	1	0%
4/9/2002	Guana Dam Group	1	1	0%
7/9/2002	Guana Dam Group	1	1	0%
7/9/2002	21FLA 92617SEAS	2	8	4%
4/20/2004	21FLA 92617SEAS	2	8	4%
7/9/2002	21FLA 92618SEAS	2	8	4%
4/20/2004	21FLA 92618SEAS	2	8	4%
7/15/2004	21FLSEAS92SEAS617	2	8	4%
10/3/2006	21FLSEAS92SEAS617	2	8	4%
4/17/2007	21FLSEAS92SEAS617	2	8	4%
5/28/2008	21FLSEAS92SEAS617	2	8	4%
7/16/2008	21FLSEAS92SEAS617	2	8	4%
1/27/2009	21FLSEAS92SEAS617	2	8	4%
2/17/2010	21FLSEAS92SEAS617	2	8	4%
7/14/2010	21FLSEAS92SEAS617	2	8	4%
10/6/2010	21FLSEAS92SEAS617	2	8	4%
3/7/2011	21FLSEAS92SEAS617	2	8	4%
7/15/2004	21FLSEAS92SEAS618	2	8	4%
1/25/2005	21FLSEAS92SEAS618	2	8	4%
4/20/2005	21FLSEAS92SEAS618	2	8	4%
4/5/2006	21FLSEAS92SEAS618	2	8	4%
7/11/2006	21FLSEAS92SEAS618	2	8	4%
10/3/2006	21FLSEAS92SEAS618	2	8	4%
2/15/2007	21FLSEAS92SEAS618	2	8	4%
4/17/2007	21FLSEAS92SEAS618	2	8	4%
5/15/2007	21FLSEAS92SEAS618	2	8	4%
1/15/2008	21FLSEAS92SEAS618	2	8	4%
5/28/2008	21FLSEAS92SEAS618	2	8	4%
7/16/2008	21FLSEAS92SEAS618	2	8	4%
10/15/2008	21FLSEAS92SEAS618	2	8	4%
1/27/2009	21FLSEAS92SEAS618	2	8	4%
4/8/2009	21FLSEAS92SEAS618	2	8	4%
10/21/2009	21FLSEAS92SEAS618	2	8	4%
2/17/2010	21FLSEAS92SEAS618	2	8	4%
7/14/2010	21FLSEAS92SEAS618	2	8	4%
3/7/2011	21FLSEAS92SEAS618	2	8	4%
3/26/2002	Guana Dam Group	2	8	4%

Date	Station	Fecal Coliform (counts/100mL)	Rank	Percentile by Hazen Method
5/7/2002	Guana Dam Group	2	8	4%
6/3/2003	Guana Dam Group	2	8	4%
7/20/2005	Guana Dam Group	2	8	4%
8/22/2006	Guana Dam Group	2	8	4%
10/3/2006	Guana Dam Group	2	8	4%
3/27/2007	Guana Dam Group	2	8	4%
4/17/2007	Guana Dam Group	2	8	4%
6/25/2007	Guana Dam Group	2	8	4%
8/27/2007	Guana Dam Group	2	8	4%
5/28/2008	Guana Dam Group	2	8	4%
6/18/2008	Guana Dam Group	2	8	4%
7/16/2008	Guana Dam Group	2	8	4%
7/22/2008	Guana Dam Group	2	8	4%
11/11/2008	Guana Dam Group	2	8	4%
5/11/2009	Guana Dam Group	2	8	4%
10/21/2009	Guana Dam Group	2	8	4%
2/17/2010	Guana Dam Group	2	8	4%
4/22/2010	Guana Dam Group	2	8	4%
6/24/2010	Guana Dam Group	2	8	4%
7/14/2010	Guana Dam Group	2	8	4%
9/22/2010	Guana Dam Group	2	8	4%
1/29/2003	21FLA 92618SEAS	4	63	33%
6/21/2006	Guana Dam Group	4	63	33%
5/21/2007	Guana Dam Group	**5**	65	34%
2/19/2002	21FLA 92617SEAS	5	66	34%
1/29/2003	21FLA 92617SEAS	5	66	34%
7/23/2003	21FLA 92618SEAS	5	66	34%
10/8/2003	21FLA 92618SEAS	5	66	34%
1/25/2005	21FLSEAS92SEAS617	5	66	34%
7/11/2006	21FLSEAS92SEAS617	5	66	34%
2/15/2007	21FLSEAS92SEAS617	5	66	34%
5/15/2007	21FLSEAS92SEAS617	5	66	34%
10/15/2008	21FLSEAS92SEAS617	5	66	34%
10/12/2004	21FLSEAS92SEAS618	5	66	34%
7/20/2005	21FLSEAS92SEAS618	5	66	34%
11/2/2005	21FLSEAS92SEAS618	5	66	34%
5/22/2006	Guana Dam Group	5	66	34%
5/15/2007	Guana Dam Group	5	66	34%
9/18/2008	Guana Dam Group	5	66	34%
1/29/2008	Guana Dam Group	6	81	42%
2/19/2002	21FLA 92618SEAS	7	82	43%
8/6/2002	21FLA 92618SEAS	7	82	43%
5/13/2003	21FLA 92618SEAS	7	82	43%
10/21/2009	21FLSEAS92SEAS617	7	82	43%
4/14/2010	21FLSEAS92SEAS618	7	82	43%

Date	Station	Fecal Coliform (counts/100mL)	Rank	Percentile by Hazen Method
10/6/2010	21FLSEAS92SEAS618	7	82	43%
7/27/2005	Guana Dam Group	7	82	43%
3/7/2011	Guana Dam Group	7	82	43%
4/9/2002	21FLA 92617SEAS	8	90	47%
5/13/2003	21FLA 92617SEAS	8	90	47%
11/2/2005	21FLSEAS92SEAS617	8	90	47%
8/18/2009	21FLSEAS92SEAS617	8	90	47%
4/14/2010	21FLSEAS92SEAS617	8	90	47%
8/18/2009	21FLSEAS92SEAS618	8	90	47%
4/20/2004	Guana Dam Group	8	90	47%
5/17/2005	Guana Dam Group	8	90	47%
7/11/2006	Guana Dam Group	**8**	90	47%
2/15/2005	Guana Dam Group	10	99	52%
4/19/2005	Guana Dam Group	**11**	100	52%
1/15/2002	21FLA 92618SEAS	11	101	53%
7/20/2005	21FLSEAS92SEAS617	11	101	53%
4/8/2009	21FLSEAS92SEAS617	11	101	53%
11/5/2007	Guana Dam Group	11	101	53%
1/20/2010	Guana Dam Group	11	101	53%
8/6/2002	21FLA 92617SEAS	13	106	55%
4/16/2003	21FLA 92618SEAS	13	106	55%
12/3/2003	21FLA 92618SEAS	13	106	55%
4/20/2005	21FLSEAS92SEAS617	13	106	55%
4/5/2006	21FLSEAS92SEAS617	13	106	55%
1/15/2008	21FLSEAS92SEAS617	13	106	55%
7/15/2004	Guana Dam Group	13	106	55%
11/2/2005	Guana Dam Group	13	106	55%
12/19/2006	Guana Dam Group	13	106	55%
1/29/2007	Guana Dam Group	13	106	55%
11/26/2007	Guana Dam Group	13	106	55%
1/15/2008	Guana Dam Group	13	106	55%
10/6/2010	Guana Dam Group	13	106	55%
8/18/2005	Guana Dam Group	16	119	62%
4/16/2003	21FLA 92617SEAS	17	120	63%
8/20/2003	21FLA 92617SEAS	17	120	63%
3/26/2002	21FLA 92618SEAS	17	120	63%
9/18/2006	Guana Dam Group	17	120	63%
10/29/2008	Guana Dam Group	17	120	63%
12/28/2009	Guana Dam Group	17	120	63%
2/12/2002	Guana Dam Group	**20**	126	66%
4/29/2002	Guana Dam Group	**20**	126	66%
5/13/2002	Guana Dam Group	**20**	126	66%
6/17/2002	Guana Dam Group	**20**	126	66%
7/15/2002	Guana Dam Group	**20**	126	66%
8/12/2002	Guana Dam Group	**20**	126	66%

Date	Station	Fecal Coliform (counts/100mL)	Rank	Percentile by Hazen Method
2/12/2007	Guana Dam Group	**21**	132	69%
5/13/2003	Guana Dam Group	22	133	69%
11/24/2009	Guana Dam Group	22	133	69%
11/18/2010	Guana Dam Group	22	133	69%
3/26/2002	21FLA 92617SEAS	23	136	71%
12/3/2003	21FLA 92617SEAS	23	136	71%
11/18/2003	21FLA 92618SEAS	23	136	71%
10/12/2004	Guana Dam Group	23	136	71%
4/5/2006	Guana Dam Group	23	136	71%
10/31/2006	Guana Dam Group	**23**	136	71%
3/24/2010	Guana Dam Group	23	136	71%
5/27/2010	Guana Dam Group	23	136	71%
8/25/2010	Guana Dam Group	27	144	75%
1/15/2002	21FLA 92617SEAS	31	145	76%
11/18/2003	21FLA 92617SEAS	33	146	76%
8/20/2003	21FLA 92618SEAS	33	146	76%
10/12/2004	21FLSEAS92SEAS617	33	146	76%
1/11/2006	21FLSEAS92SEAS617	33	146	76%
2/19/2002	Guana Dam Group	33	146	76%
8/6/2002	Guana Dam Group	33	146	76%
1/29/2003	Guana Dam Group	33	146	76%
7/23/2003	Guana Dam Group	33	146	76%
9/26/2007	Guana Dam Group	33	146	76%
2/26/2008	Guana Dam Group	33	146	76%
3/17/2008	Guana Dam Group	33	146	76%
7/13/2009	Guana Dam Group	33	146	76%
8/10/2009	Guana Dam Group	33	146	76%
8/18/2009	Guana Dam Group	33	146	76%
9/28/2009	Guana Dam Group	33	146	76%
4/14/2010	Guana Dam Group	33	146	76%
12/19/2007	Guana Dam Group	**39**	162	85%
9/23/2002	Guana Dam Group	**40**	163	85%
1/27/2009	Guana Dam Group	**42**	164	86%
7/23/2003	21FLA 92617SEAS	49	165	86%
10/8/2003	21FLA 92617SEAS	49	165	86%
4/16/2003	Guana Dam Group	49	165	86%
8/20/2003	Guana Dam Group	49	165	86%
10/8/2003	Guana Dam Group	49	165	86%
11/28/2006	Guana Dam Group	49	165	86%
7/18/2007	Guana Dam Group	49	165	86%
4/21/2008	Guana Dam Group	49	165	86%
3/19/2009	Guana Dam Group	49	165	86%
4/8/2009	Guana Dam Group	49	165	86%
10/15/2009	Guana Dam Group	49	165	86%
8/25/2008	Guana Dam Group	**52**	176	92%

Date	Station	Fecal Coliform (counts/100mL)	Rank	Percentile by Hazen Method
1/25/2005	Guana Dam Group	**54**	177	92%
12/3/2003	Guana Dam Group	70	178	93%
5/14/2008	Guana Dam Group	**72**	179	93%
1/11/2006	21FLSEAS92SEAS618	79	180	94%
11/18/2003	Guana Dam Group	79	180	94%
1/11/2006	Guana Dam Group	79	180	94%
2/25/2009	Guana Dam Group	**90**	183	96%
3/11/2002	Guana Dam Group	**95**	184	96%
2/23/2010	Guana Dam Group	110	185	97%
7/27/2010	Guana Dam Group	110	185	97%
1/14/2002	Guana Dam Group	**130**	187	98%
12/10/2008	Guana Dam Group	130	187	98%
3/9/2005	Guana Dam Group	168	189	99%
4/15/2009	Guana Dam Group	220	190	99%
10/15/2008	Guana Dam Group	240	191	100%

Note: Results depicted in red text are median values.

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

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

For example, for WBID 2320 on August 6, 2002, a fecal coliform concentration of 13 counts/100 mL was measured at station 21FLA 92617SEAS. This concentration ranks number 106 out of 191 samples collected in WBID 2320. The associated percentile is calculated as:

Percentile = (106-0.5)/191 = 0.55 = 55%

This implies that 55 percent of the time, the instream concentration is less than 13 counts/100 mL.