Proposed

Total Maximum Daily Loads

for

Dissolved Oxygen

in

Guana River

WBID 2320

June 2012

United States Environmental Protection Agency

Region 4 serving the southeast

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

SUMMARY SHEET for WBID 2320

Total Maximum Daily Load (TMDL)

2009 303(d) Listed Waterbodies for TMDLs addressed in this report:

WBID	Segment Name	Class and Waterbody Type	Major River Basin	HUC	County	State
2320	Guana River	Class II Freshwater	Upper East Coast	3080201	St. Johns	Florida

TMDL Endpoints/Targets:

Dissolved Oxygen

TMDL Technical Approach:

The TMDL allocations were determined by analyzing the effects of TN, TP, and BOD concentrations and loadings on DO concentrations in the waterbody. A watershed model and estuary model were used to predict delivery of pollutant loads to the waterbody and to evaluate the in-stream impacts of the pollutant loads.

TMDL Waste Load and Load Allocation

Constituent	Current Condition WLA (kg/yr)	Current Condition LA (kg/yr)	TMDL Condition WLA (kg/yr)	TMDL Condition LA (kg/yr)	Percent reduction WLA	Percent Reduction LA
Total Nitrogen	--	18,312	--	9,748	--	47%
Total Phosphorus	--	1,754	--	776	--	56%
Biochemical Oxygen Demand	--	14,022	--	12,562	--	10%

Endangered Species Present (Yes or Blank): Yes

USEPA Lead TMDL (USEPA or Blank): USEPA

TMDL Considers Point Source, Non-point Source, or Both: Non-point

Major NPDES Discharges to surface waters addressed in USEPA TMDL: None

1.0 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. 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 five groups and 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.

For the purpose of planning and management, the WMDs divided the district into planning units defined as either an individual primary tributary basin or a group of adjacent primary tributary basins with similar characteristics. 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 5 square miles. Unique numbers or waterbody identification (WBID) numbers are assigned to each water segment. The waterbody addressed in this report is WBID 2320 within the Tolomato River Planning Unit of the Upper East Coast watershed. WBID 2320 is a Group 5 waterbody managed by the St. Johns River Management District (SJRWMD).

2.0 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 Waters Rule (IWR), Section 62-303 of the Florida Administrative Code (FAC). The IWR is FDEP's methodology for determining whether waters should be included on the state's planning list and verified list. Potential impairments are determined by assessing whether a waterbody meets the criteria for inclusion on the planning list. Once a waterbody is on the planning list, additional data and information will be collected and examined to determine if the water should be included on the verified list.

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 2009 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, USEPA is responsible for developing a TMDL for WBID 2320, depicted in Figure 2.1.

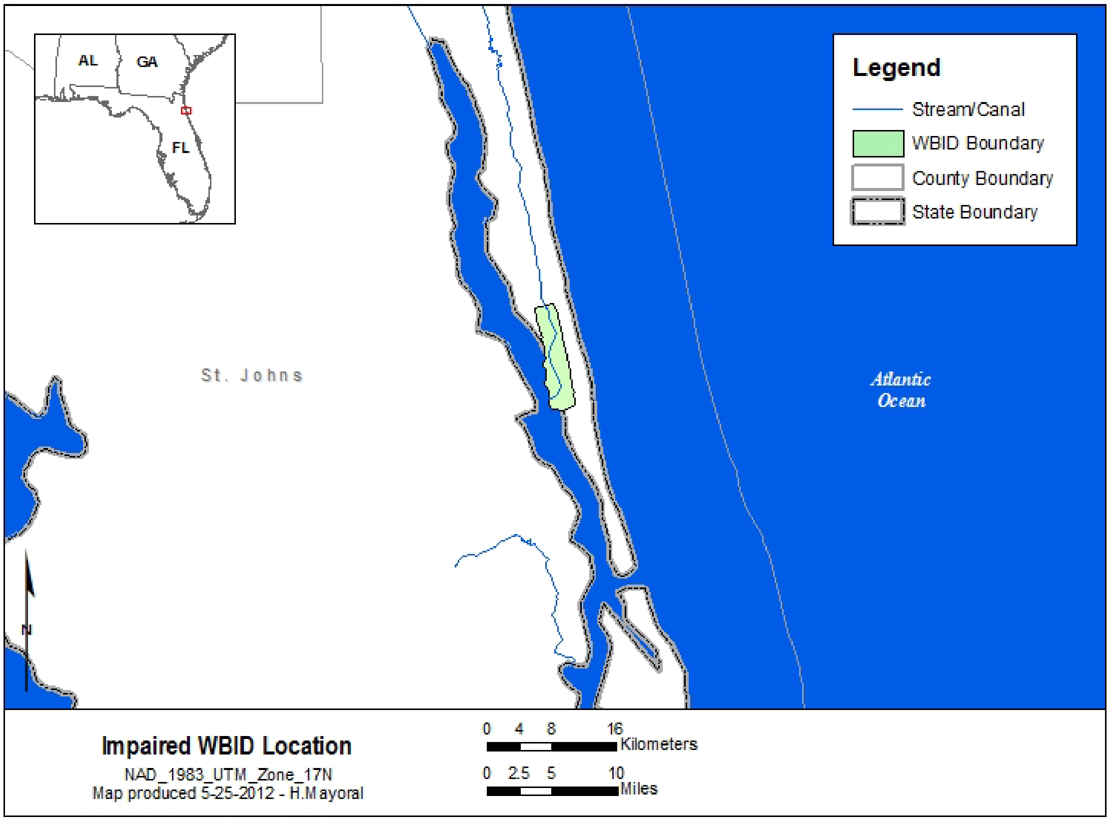

Figure 2.1 Location of the impaired WBID 2320 in the Upper East Coast basin.

3.0 WATERSHED DESCRIPTION

The Upper East Coast Watershed is located along the northeastern coast of Florida between St. Augustine and Jacksonville, and includes portions of the Atlantic Intracoastal Waterway (AICW). The size of the basin is approximately 467,195 acres (SJRWMD 2003), and is characterized by coastal lagoons, tidal flats, shallow bays, and numerous creeks. It is also the northernmost extent of mangrove habitat along the east coast (FDEP). Though separated from the ocean by barrier islands, all eventually drain to the Atlantic via one of three inlets; St. Augustine, Matanzas, and Ponce de Leon (FDEP 2005, SJRWMD 2003).

The watershed is composed of four Planning Units (PUs): the Tolomato River Planning Unit, the Matanzas River Planning Unit, the Pellicer Creek Planning Unit, and the Halifax Planning Unit (SJRWMD 2003). In the Tolomato River Planning Unit is located at the north end of the basin. Just north of St. Augustine, the AICW enter the Tolomato River Planning Unit, and merges with the Tolomato River. The Tolomato River joins the Guana River before further downstream and then drains to the Atlantic Ocean at the St. Augustine Inlet. The Tolomato River Planning Unit is approximately 125, 520 acres (SJRWMD 2003).

The Guana River is located between the Atlantic Ocean and the AICW. It is home to one of the largest populations of endangered wood storks and is used for commercial fishing (FDEP 2011). At the north end of the WBID boundary is Guana dam which forms Ponte Verde Lake. The dam was originally built to increase flooding upstream and provide a wintering area for waterfowl (FDEP 2011). The Guana River is part of the Guana River Marsh Aquatic Preserve, as well as the larger Guana-Tolomato-Mantazas National Estuarine Research Reserve (GTMNERR), which was established in August 1999 (SJRWMD 2003). The dam now serves as the site for the GTMNERR Environmental Education Center.

3.1 Climate

The Guana River Basin is located in Northeastern Florida and experiences a subtropical climate with hot, humid summers and mild, short winters. Temperatures in the summer can reach the low 90s (°F), and in the winter the low 40s (°F) (NWS 2009). An average of 53 inches of rain every year is received in northeast Florida, of which a greater percentage falls during the wet season (May to October), coinciding with hurricane season (NWS 2009).

3.2 Hydrologic characteristics

Guana River is a shallow coastal lagoon between the Atlantic Intracoastal Waterway (AICW) and the Atlantic Ocean. It discharges to the Tolomato River before flowing into the Atlantic through the St. Augustine Inlet. North of Guana dam waters are brackish, yet transition to freshwater the further north from the dam one travels (FDEP 2011). It is one of the few surface waters in the basin designated as a Class II water, however, shellfish harvesting has recently been conditionally approved due to water quality issues (FDEP 2005). In addition, the Guana River and its tributaries have been designated as an 'Outstanding Florida Water (OFW) (FDEP 2005).

3.3 Land Use

Land use within WBID 2320 consists mainly of non-forested wetlands, which comprises 42 percent of the total land use (Figure 3.1 and Table 3.1). Forested land use accounts for an additional 28 percent of the total land use. Most of the forest and wetland land uses are located in the Guana Tolomato Matanzas National Estuarine Research Reserve (GTM NERR). The only developed land uses, 14 acres, are located along State Road A1A. Open water accounts for an additional 26 percent of the total land use.

The actual drainage area for the Guana River varies from the WBID boundary (Figure 3.2 and Table 3.2). The United States Geological Survey National Hydrography Dataset was used to delineate the drainage area. The drainage area is 737 percent larger than the WBID, and over 10,000 acres are in the contributing subwatersheds. The headwaters of the Guana River are located in a highly developed area which includes the cities of Sawgrass, Palm Valley, Ponte Verde, and Jacksonville Beach, and approximately 29 percent of the contributing subwaterseds are developed. Golf courses represent an additional 4 percent of the contributing land use.

Wetland and forest land use accounts for an additional 21 and 18 percent, respectively. Open water accounts for 20 percent of total land use from the actual drainage area.

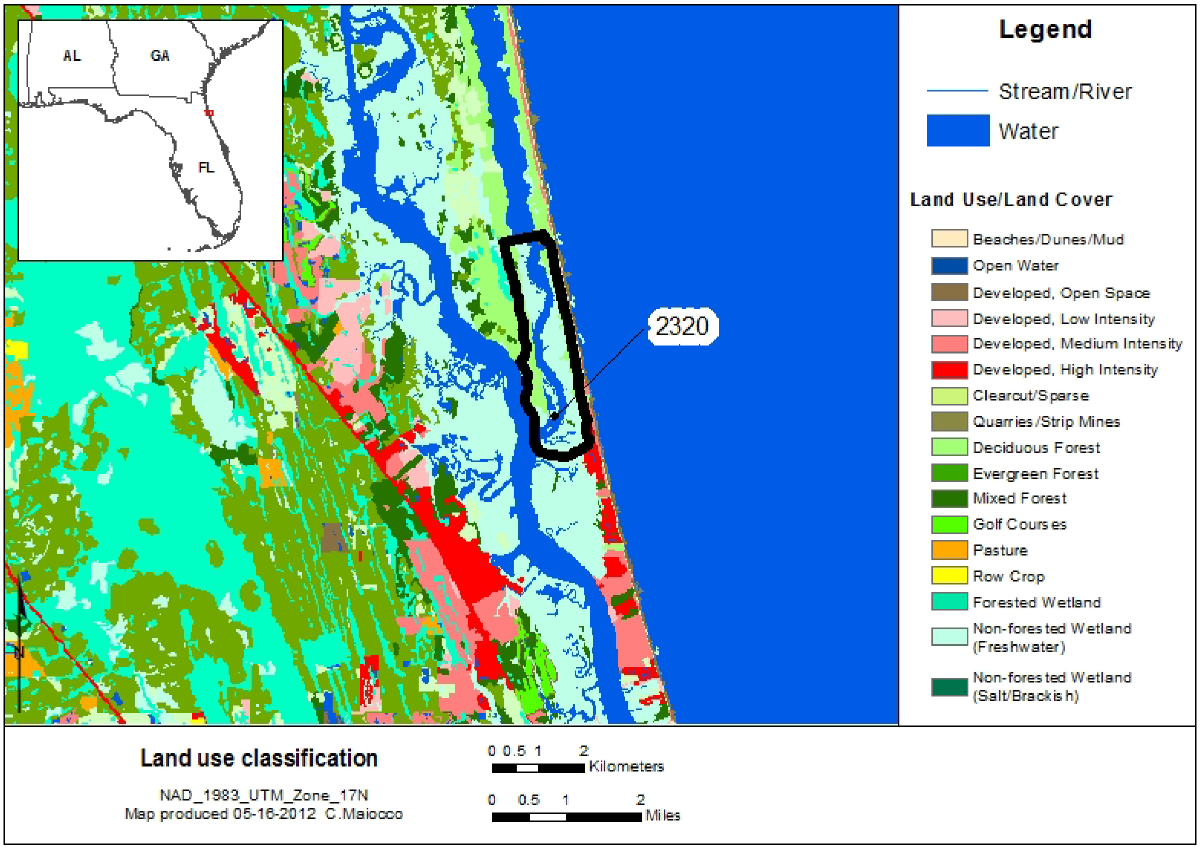

Figure 3.1 Land use for WBID in the Upper East Coast basin

Table 3.1 Land use distribution for WBID 2320 in the Guana River basin

Land Use Classification	WBID 2320	
	Acres	%
Evergreen Forest	0	0%
Deciduous Forest	323	27%
Mixed Forest	12	1%
Forested Wetland	2	0%
Non-Forested Wetland (Freshwater)	512	42%
Open Water	313	26%
Pasture	0	0%
Row Crop	0	0%
Clear cut Sparse	25	2%
Quarries Strip mines	0	0%
Utility Swaths	0	0%
Developed, Open Space	12	1%
Developed, Low intensity	0	0%
Developed, Medium intensity	7	1%
Developed, High intensity	7	1%
Golf Courses	0	0%
Totals	1,213	100%

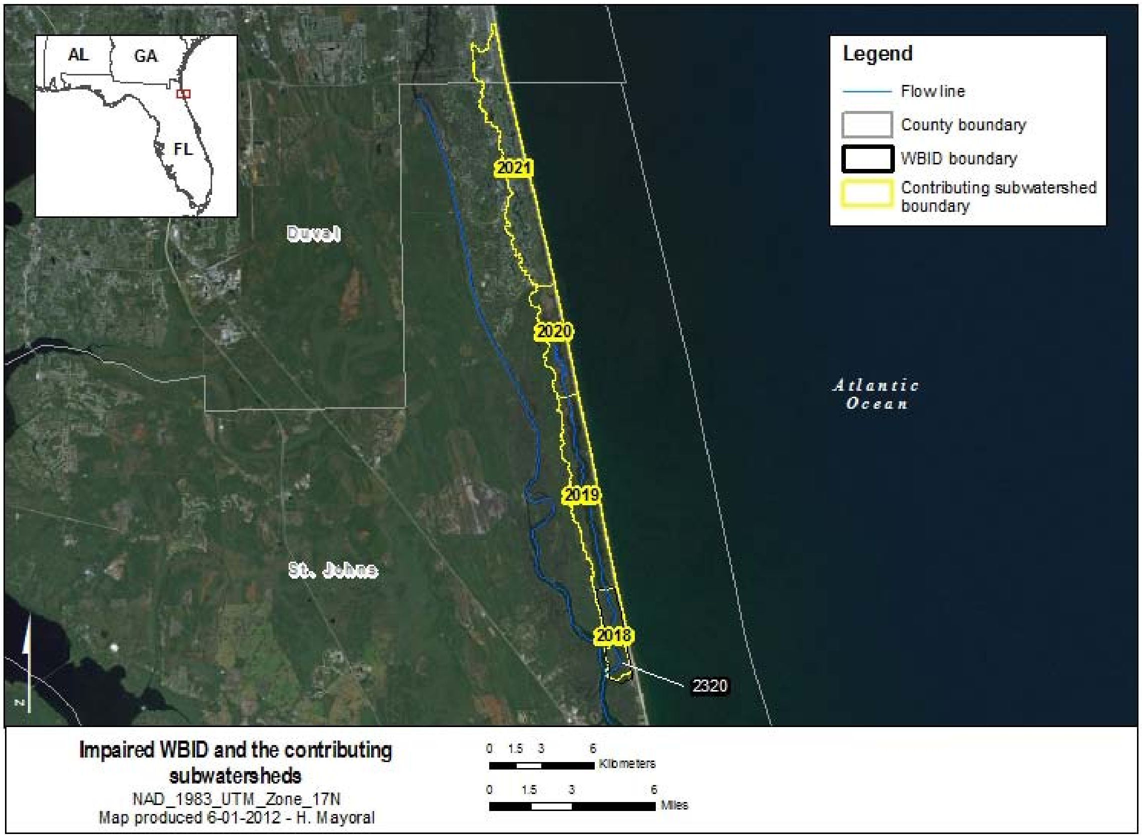

Figure 3.2 Aerial photograph showing contributing subwatersheds and impaired WBID boundary

Table 3.2 Land use distribution for contributing subwatersheds in the Guana River basin

Land Use Classification	Contributing subwatersheds	
	Acres	%
Evergreen Forest	97	1%
Deciduous Forest	1,524	15%
Mixed Forest	179	2%
Forested Wetland	241	2%
Non-Forested Wetland (Freshwater)	1,932	19%
Open Water	2,046	20%
Pasture	0	0%
Row Crop	0	0%

Land Use Classification	Contributing subwatersheds	
	Acres	%
Clear cut Sparse	731	7%
Quarries Strip mines	1	0%
Utility Swaths	0	0%
Developed, Open Space	213	2%
Developed, Low intensity	251	2%
Developed, Medium intensity	1,277	13%
Developed, High intensity	1,226	12%
Golf Courses	441	4%
Totals	10,159	100%

4.0 4. WATER QUALITY STANDARDS/TMDL TARGETS

The waterbodies in the South Fork St. Lucie River WBID are Class III Freshwater with a designated use of Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife. Designated use classifications are described in Florida's water quality standards. See Section 62-302.400, F.A.C. Water quality criteria for protection of all classes of waters are established in Section 62-302.530, F.A.C. Individual criteria should be considered in conjunction with other provisions in water quality standards, including Section 62-302.500 F.A.C., which established minimum criteria that apply to all waters unless alternative criteria are specified. Section 62-302.530, F.A.C. Several of the WBIDs addressed in this report were listed due to elevated concentrations of chlorophyll *a*. While FDEP does not have a streams water quality standard specifically for chlorophyll *a*, elevated levels of chlorophyll *a* are frequently associated with a violation of the narrative nutrient standard, which is described below.

4.1. Nutrients:

The designated use of Class III waters is recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. In 1979, FDEP adopted a narrative criterion for nutrients. FDEP recently adopted numeric nutrient criteria for many Class III waters in the state, including streams, which numerically interprets part of the state narrative criterion for nutrients. While those criteria have been submitted to EPA for review pursuant to section 303(c) of the CWA, EPA has not completed that review. Therefore, for streams in Florida, the applicable nutrient water quality standard for CWA purposes remains the Class III narrative criterion.

As set out more fully below, should any new or revised state criteria for nutrients in streams in Florida become applicable for CWA purposes before this proposed TMDL is established, EPA will consider the impact of such criteria on the target selected for this TMDL.

Also, in November 2010, EPA promulgated numeric nutrient criteria for Class III inland waters in Florida, including streams. On February 18, 2012, the streams criteria were invalidated by the U.S. District Court for the Northern District of Florida and remanded back to EPA. Should a federally promulgated criterion become effective for CWA purposes before this proposed TMDL is established, EPA will consider the impact of such criteria on the target selected for this TMDL.

4.1.1 Narrative Nutrient Criteria

Florida's narrative nutrient criteria provides:

> The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards contained in this chapter. Man induced nutrient enrichment (total nitrogen and total phosphorus) shall be considered degradation in relation to the provisions of Sections 62-302.300, 62-302.700, and 62-4.242. Section 62-302.530(48)(a), F.A.C.
>
> In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna. Section 62-302.530(48)(b), F.A.C.

Chlorophyll and dissolved oxygen (DO) levels are often used to indicate whether nutrients are present in excessive amounts. The target for this TMDL is based on levels of nutrients necessary to prevent violations of Florida's DO criterion, set out below.

4.1.2 Florida's adopted numeric nutrient criteria for streams

Florida's recently adopted numeric nutrient criteria interprets the narrative water quality criterion for nutrients in paragraph 62-302.530(48)(b), F.A.C. See section 62-302.531(2). The Florida rule provides that the narrative water quality criteria for nutrients in paragraph 62-302.530(47)(a), F.A.C., continues to apply to all Class III waters. See section 62-302.531(1).

Florida's recently adopted rule applies to streams, including (WBID in TMDL). For streams that do not have a site specific criteria, Florida's rule provides for biological informationto be considered together with nutrient thresholds to determine whether a waterbody is attaining 62-302.531(2)(c), F.A.C. The rule provides that the nutrient criteria are attained in a stream segment where information on chlorophyll a levels, algal mats or blooms, nuisance macrophyte growth, and changes in algal species composition indicates there are no imbalances in flora and either the average score of at least two temporally independent SCIs performed at representative locations and times is 40 or higher, with neither of the two most recent SCI scores less than 35, or the nutrient thresholds set forth in table [##] below are achieved. See section 62-302.531(2)(c).

Florida's rule provides that numeric nutrient criteria are expressed as a geometric mean, and concentrations are not to be exceeded more than once in any three calendar year period. Section 62-302.200 (25)(e), F.A.C.

Should FDEP's numeric nutrient criteria for streams become an applicable water quality standard for CWA purposes before this TMDL is established, EPA will consider the nutrient target necessary to attain section 62-302.531(2)(c), F.A.C. EPA will compare that target with the target necessary to attain paragraph 62-302.530(47)(a), F.A.C., to determine which target is more stringent.

Table 4.1 Inland numeric nutrient criteria

Nutrient Watershed Region	Total Phosphorus Nutrient Threshold	Total Nitrogen Nutrient Threshold
Panhandle West	0.06 mg/L	0.67 mg/L
Panhandle East	0.18 mg/L	1.03 mg/L
North Central	0.30 mg/L	1.87 mg/L
Peninsular	0.12 mg/L	1.54 mg/L
West Central	0.49 mg/L	1.65 mg/L
South Florida	No numeric nutrient threshold. The narrative criterion in paragraph 62-302.530(47)(b), F.A.C., applies.	No numeric nutrient threshold. The narrative criterion in paragraph 62-302.530(47)(b), F.A.C., applies.

4.2 Dissolved Oxygen Criteria:

Numeric criteria for DO are expressed in terms of minimum and daily average concentrations.

The water quality criterion for Class III freshwaters is as follows:

Shall not be less than 5.0 mg/L. Normal daily and seasonal fluctuations above these levels shall be maintained. [FAC 62-302.530 (30)]

The water quality criterion for Class III marine waters is as follows:

Shall not average less than 5.0 mg/L in a 24-hour period and shall never be less than 4.0 mg/L. Normal daily and seasonal fluctuations above these levels shall be maintained. [FAC 62-302.530 (30)]

4.3 Natural Conditions

In addition to the standards for nutrients, DO, and BOD described above, Florida's standards include provisions that address waterbodies which do not meet the standards due to natural background conditions.

Florida's water quality standards provide a definition of natural background:

"Natural Background" shall mean the condition of waters in the absence of man-induced alterations based on the best scientific information available to the Department. The establishment of natural background for an altered waterbody may be based upon a similar unaltered waterbody or on historical pre-alteration data. [FAC 62-302.200 (19)]

Florida's water quality standards also provide that:

Pollution which causes or contributes to new violations of water quality standards or to continuation of existing violations is harmful to the waters of this State and shall not be allowed. Waters having water quality below the criteria established for them shall be protected and enhanced. However, the Department shall not strive to abate natural conditions. [FAC 62-302.300 (15)]

4.4 Biological Oxygen Demand Criteria:

Biochemical Oxygen Demand (BOD) shall not be increased to exceed values which would cause dissolved oxygen to be depressed below the limit established for each class and, in no case, shall it be great enough to produce nuisance conditions. [FAC 62-302.530 (11)]

5.0 WATER QUALITY ASSESSMENT

The WBID addressed in this report was listed as not attaining its designated use on Florida's 2009 303(d) list for dissolved oxygen and nutrients. To determine impairment, an assessment of available data was conducted. The source for current ambient monitoring data was the Impaired Waters Rule (IWR) data Run 44, using data ranging January 1, 2002 to December 31, 2010. The IWR database contains data from various sources within the state of Florida, including the WMDs and counties.

5.1 Water Quality Data

A complete list of water quality monitoring stations in WBID 2320are located in Table 5.1, and an analysis of water quality data is documented in Table 5.2. Figure 5.1 shows the locations of the water quality monitoring stations within the WBID. Water quality data for the WBID can be found below in Figure 5.2 through Figure 5.6, with the data from all water quality stations compiled in each figure.

5.1.1 Dissolved Oxygen

There are several factors that affect the concentration of dissolved oxygen (DO) in a waterbody. Oxygen can be introduced by wind, diffusion, photosynthesis, and additions of higher DO water (e.g. from tributaries). DO concentrations are lowered by processes that use up oxygen from the water, such as respiration and decomposition, and by additions of water with lower DO (e.g. swamp or groundwater). Natural DO levels are a function of water temperature, water depth and velocity, and relative contributions of groundwater. Decomposition of organic matter, such as dead plants and animals, also consume DO. The measured dissolved oxygen minimum concentration was 1.80 mg/L, and the maximum measured concentration was 10.40 mg/L. The mean concentration for WBID 2320 was 5.42 mg/L.

5.1.2 Biochemical Oxygen Demand

BOD is a measure of the amount of oxygen used by bacteria as they stabilize organic matter. The process can be accelerated when there is an overabundance of nutrients, increasing the aerobic bacterial activity in a waterbody. In turn, the levels of DO can become depleted, eliminating oxygen essential for biotic survival, and potentially causing extensive fish kills. Additionally, BOD is used as an indicator to determine the presence and magnitude of organic pollution from sources such as septic tank leakage, fertilizer runoff, and wastewater effluent. The mean BOD concentration for WBID 2320 was 3.86 mg/L. The maximum concentration was 6.0 mg/L and the minimum concentration was 1.80 mg/L.

5.1.3 Nutrients

Excessive nutrients in a waterbody can lead to overgrowth of algae and other aquatic plants such as phytoplankton, periphyton and macrophytes. This process can deplete oxygen in the water, adversely affecting aquatic life and potentially restricting recreational uses such as fishing and boating. For the nutrient assessment the monitoring data for total nitrogen, total phosphorus and chlorophyll a are presented. The current standards for nutrients are narrative criteria. The purpose of the nutrient assessment is to present the range, variability and average conditions for the WBID.

5.1.3.1 Total Nitrogen

Total Nitrogen (TN) is comprised of nitrate (NO3), nitrite (NO2), organic nitrogen and ammonia nitrogen (NH4). Though nitrogen is a necessary nutrient required for the growth of most plants and animals, not all forms are readily used or metabolized. Increased levels of organic nitrogen can occur from the decomposition of aquatic life or from sewage, while inorganic forms are generally from erosion and fertilizers. Nitrates are components of industrial fertilizers, yet can also be naturally present in soil, and are converted to nitrite by microorganisms in the environment. Surface runoff from agricultural lands can increase the natural presence of nitrates in the environment and can lead to eutrophication. The total nitrogen minimum concentration was 0.34 mg/L, with the maximum concentration was 13.35 mg/L. The mean total nitrogen concentration in WBID 2320 was 1.09 mg/L.

5.1.3.2 Total Phosphorus

In natural waters, total phosphorus exists in either soluble or particulate forms. Dissolved phosphorus includes inorganic and organic forms, while particulate phosphorus is made up of living and dead plankton, and adsorbed, amorphous, and precipitated forms. Inorganic forms of phosphorus include orthophosphate and polyphosphates, though polyphosphates are unstable and convert to orthophosphate over time. Orthophosphate is both stable and reactive, making it the form most used by plants. Excessive phosphorus can lead to overgrowth of algae and aquatic plants, the decomposition of which uses up oxygen from the water. The total phosphorus minimum concentration was 0.06 mg/L, and the maximum concentration was.02 mg/L. The mean total phosphorus concentration was 0.15 mg/L in WBID 2320.

5.1.3.3 Chlorophyll-a

Chlorophyll is the green pigment in plants that allows them to create energy from light. In a water sample, chlorophyll is indicative of the presence of algae, and chlorophyll-*a* is a measure of the active portion of total chlorophyll. Corrected chlorophyll refers to chlorophyll-*a* measurements that are corrected for the presence of pheophytin, a natural degradation product of chlorophyll that can interfere with analysis because it has an absorption peak in the same spectral region. It is used as a proxy indicator of water quality because of its predictable response to nutrient availability. Increases in nutrients can potentially lead to blooms in phytoplankton biomass, affecting water quality and ecosystem health. The corrected chlorophyll a maximum concentration was 238.70 µg/L, and the mean was 15.87 µg/L.

Table 5.1 Water quality data for impaired WBID in the Guana River basin.

WBID	Station Number
2320	21FLA 27010169
	21FLSJWMGAR
	21FLA 92618SEAS
	21FLSEAS92SEAS618
	21FLA 92617SEAS
	21FLSEAS92SEAS617
	21FLA 92600SEAS

Table 5.2 Water quality data for impaired WBID in the Guana River basin.

Parameter	Stats	WBID 2320
BOD, 5 Day, 20°C (mg/L)	# of obs	7
	min	2.00
	max	6.00
	mean	3.86
	Geomean	3.59
DO, Analysis by Probe (mg/L)	# of obs	311
	min	1.80
	max	10.40
	mean	5.42
	Geomean	5.14
Nitrogen, Total (mg/L as N)	# of obs	135
	min	0.34
	max	13.35
	mean	1.09
	Geomean	0.94
Phosphorus, Total (mg/L as P)	# of obs	135
	min	0.06
	max	1.02
	mean	0.15
	Geomean	0.14
Chlorophyll-A-corrected (μg/L)	# of obs	131
	min	1.00

Parameter	Stats	WBID 2320
	max	238.70
	mean	15.87
	Geomean	9.99

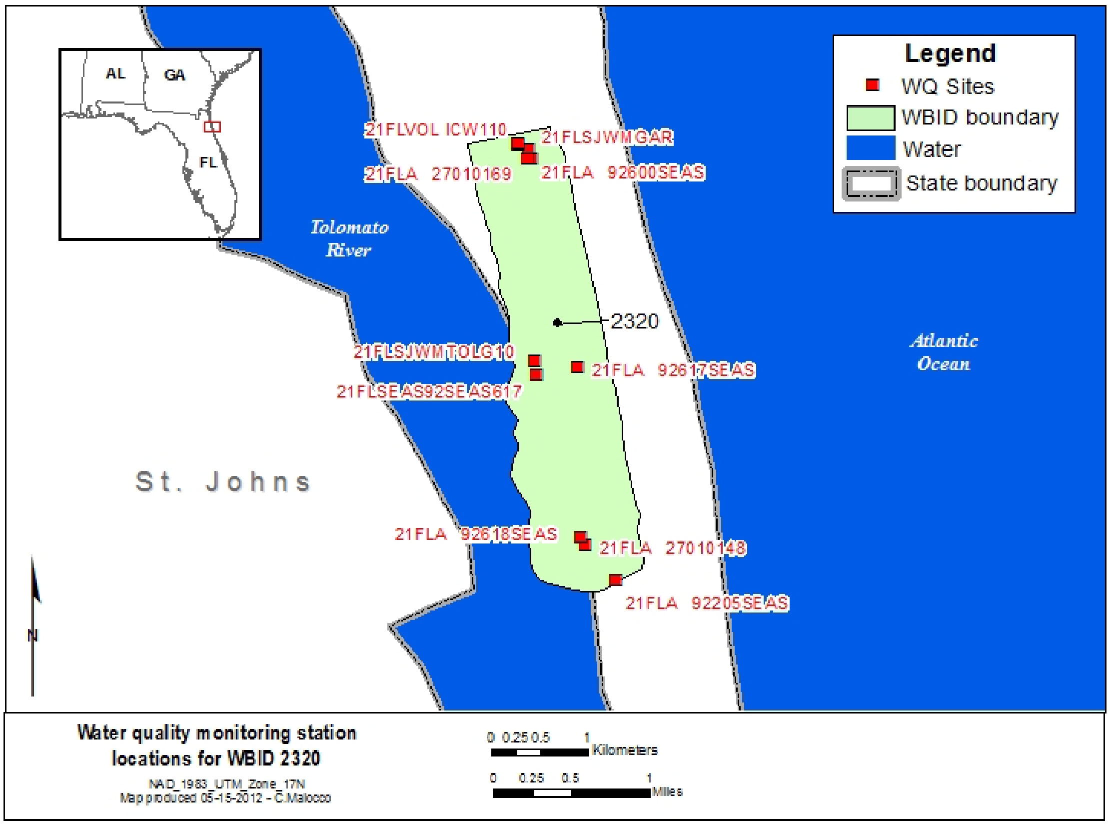

Figure 5.1 Water quality monitoring station locations for impaired WBID 2320 in the Guana River basin.

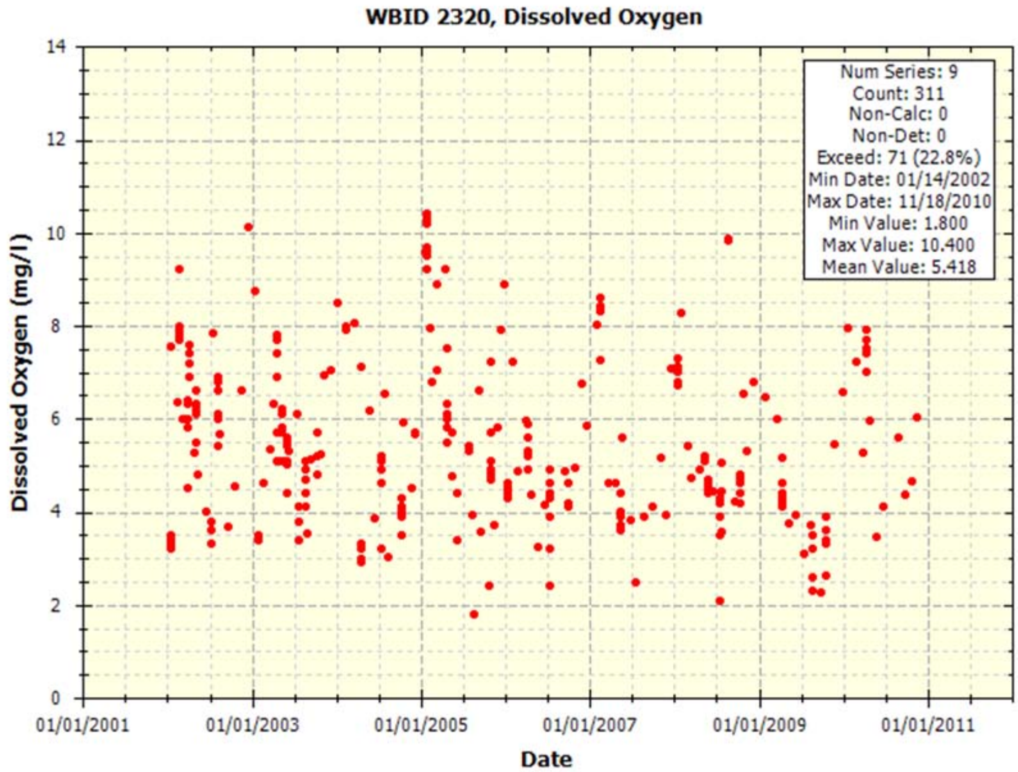

Figure 5.2 Dissolved Oxygen concentrations for WBID 2320

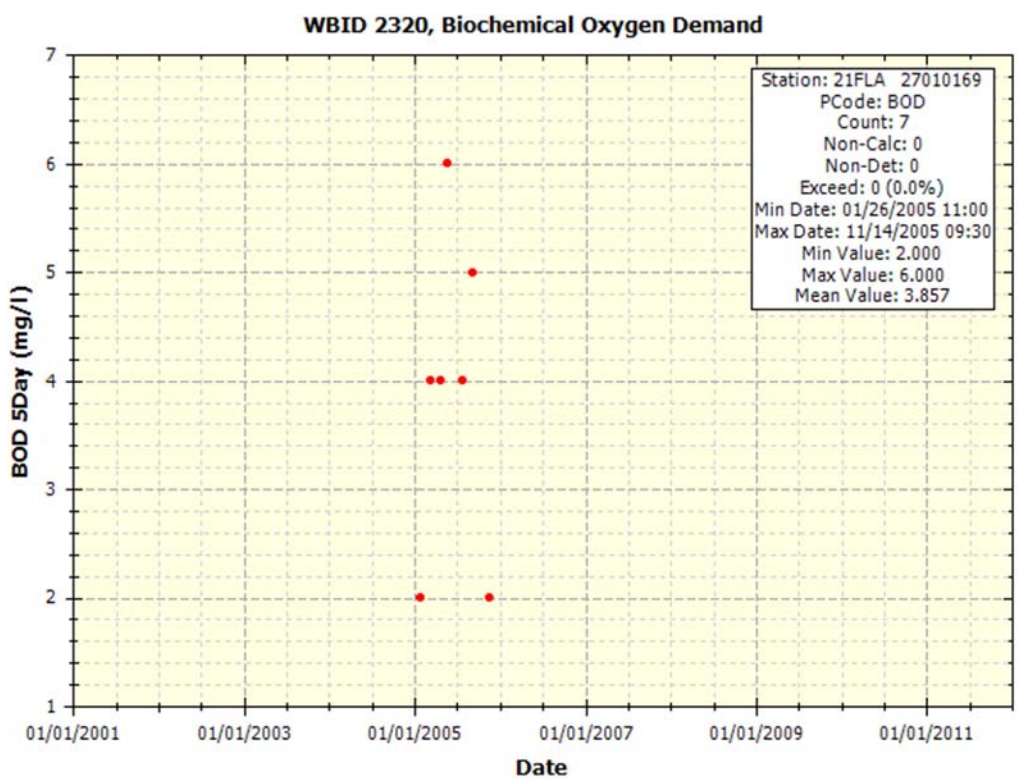

Figure 5.3 Biochemical Oxygen Demand concentrations for WBID 2320

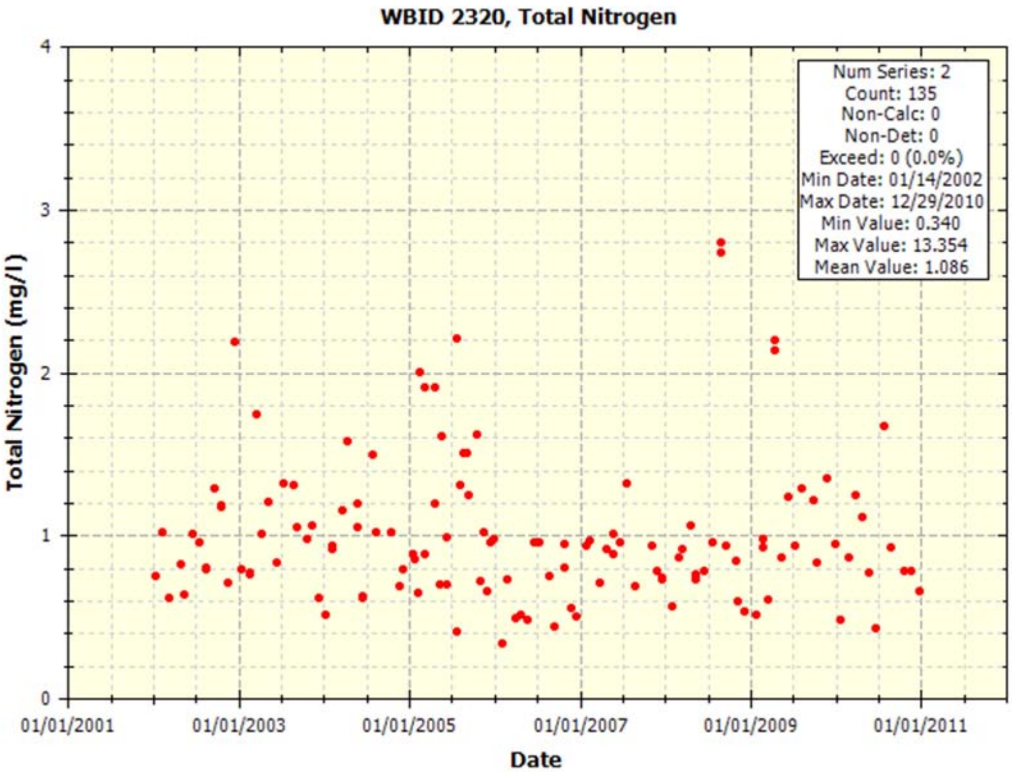

Figure 5.4 Total Nitrogen concentrations for WBID 2320

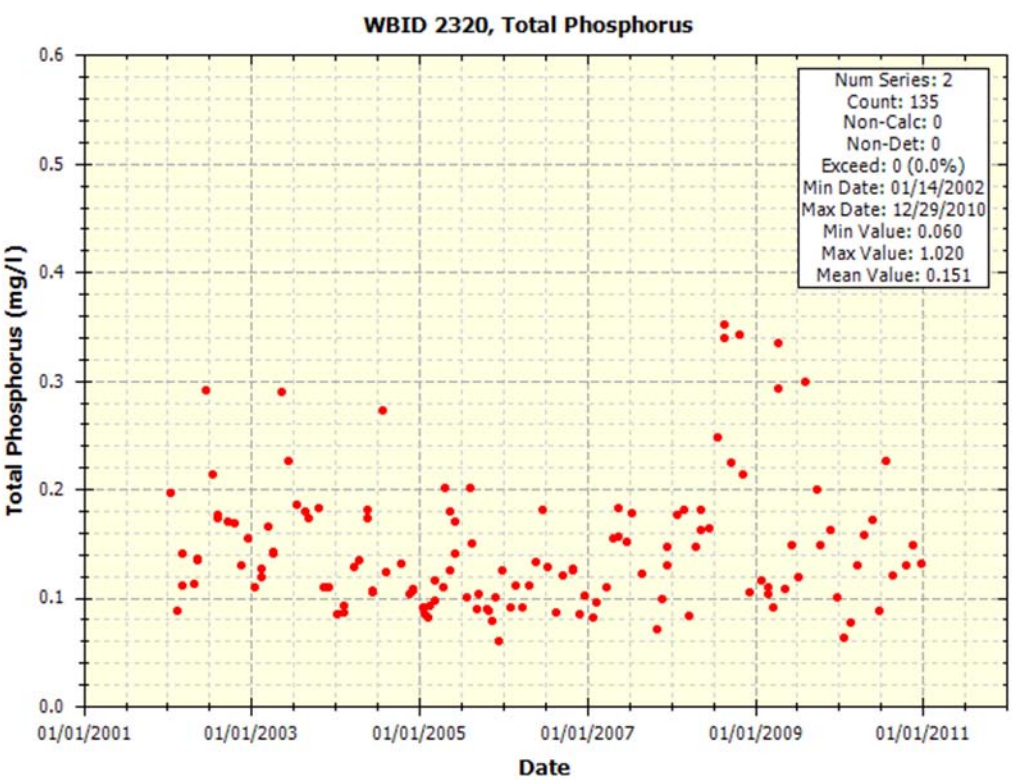

Figure 5.5 Total Phosphorus concentrations for WBID 2320

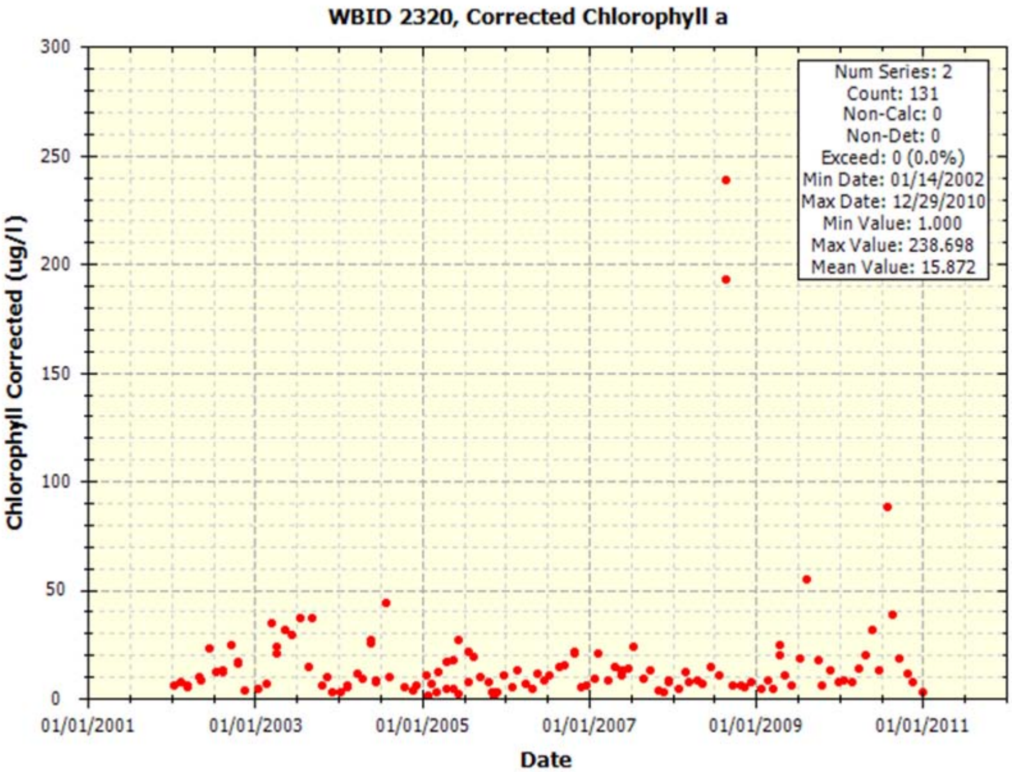

Figure 5.6 Corrected Chlorophyll a concentrations for WBID 2320

6.0 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. Nutrients can enter surface waters from both point and nonpoint 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 National Pollutant Discharge Elimination System (NPDES) permits. NPDES permitted discharges include continuous discharges such as wastewater treatment facilities as well as some stormwater driven sources such as municipal separate stormwater sewer systems (MS4s), certain industrial facilities, and construction sites over one acre.

6.1.1 Wastewater/Industrial Permitted Facilities

A TMDL wasteload allocation (WLA) is given to wastewater and industrial NPDES permitted facilities discharging to surface waters within an impaired watershed. There are no NPDES-permitted facilities in WBID 2320.

6.1.2 Stormwater Permitted Facilities/MS4s

MS4s are point sources also regulated by the NPDES program. 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 nutrients 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.

Stormwater discharges conveyed through the storm sewer system covered by the permit are subject to the WLA of the TMDL. Any newly designated MS4s will also be required to achieve the percent reduction allocation presented in this TMDL. There is one Phase II C MS4 associated with the impaired WBID, for St. Johns County (FLR04E025), which also falls under the District III Florida Department of Transportation permit.

6.2 Nonpoint Sources

Nonpoint sources of pollution are diffuse sources that cannot be identified as entering a waterbody through a discrete conveyance at a single location. For nutrients, these sources include runoff of agricultural fields, golf courses, and lawns, septic tanks, and residential developments outside of MS4 areas. Nonpoint source pollution generally involves a buildup of pollutants on the land surface that wash off during rain events and as such, represent contributions from diffuse sources, rather than from a defined outlet. Potential nonpoint sources are commonly identified, and their loads estimated, based on land cover data. Most methods calculate nonpoint source loadings as the product of the water quality concentration and runoff water volume associated with certain land use practices. The mean concentration of pollutants in the runoff from a storm event is known as the event mean concentration. Figure 3.1 provides a map of the land use, while Table 3.1 lists the land use distribution in the WBID.

The following sections are organized by land use. Each section provides a description of the land use, the typical sources of nutrient loading (if applicable), and typical total nitrogen and total phosphorus event mean concentrations.

6.2.1 Urban Areas

Urban areas include land uses such as residential, industrial, extractive and commercial. Land uses in this category typically have somewhat high total nitrogen event mean concentrations and average total phosphorus event mean concentrations. Nutrient loading from MS4 and non-MS4 urban areas is attributable to multiple sources including stormwater 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 Best Management Practices (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." [FAC 62-40-.432(2)(c)]

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.

Urban, residential, and commercial developments are likely a significant nonpoint source of nutrients and oxygen-demanding substances in WBID 2320 because a large portion of the contributing subwatershed is developed. Urban, developed land use is 29 percent of the total contributing drainage area, and most of the developed land is classified as medium and high density developments.

Onsite Sewage Treatment and Disposal Systems (Septic Tanks)

As stated above leaking septic tanks or onsite sewage treatment and disposal systems (OSTDs) can contribute to nutrient loading in urban areas. Water from OSTDs is typically released to the ground through on-site, subsurface drain fields or boreholes that allow the water from the tank to percolate (usually into the surficial aquifers) and either transpire to the atmosphere through surface vegetation or add to the flow of shallow ground water. 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 receives natural biological treatment in the soil and 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 State of Florida Department of Health publishes data on new septic tank installations and the number of septic tank repair permits issued for each county in Florida. Table 6.1 summarizes the cumulative number of septic systems installed in St. Johns County since the 1970 census and the total number of repair permits issued for the ten years between 1999-2000 and 2009-2010 (FDOH 2009). The data do not reflect septic tanks removed from service. Leaking septic systems could potentially be a relevant source of organic and nutrient loading in the watershed.

Table 6.1 County estimates of Septic Tanks and Repair Permits.

County	Number of Septic Tanks (1970-2008)	Number of Repair Permits Issued (2000-2010)
St. Johns	29,023	4,472

Note: Source: http://www.doh.state.fl.us/environment/ostds/statistics/ostdsstatistics.htm

6.2.2 Pastures

Pastures include cropland and improved and unimproved pasturelands, such as non-tilled grasses woodland pastures, feeding operations, nurseries and vineyards; as well as specialty farms. Agricultural activities, including runoff of fertilizers or animal wastes from pasture and cropland and direct animal access to streams, can generate nutrient loading to streams. High total nitrogen and total phosphorus event mean concentrations are associated with agricultural land uses. There are no pastures within the contributing drainage area, therefore pastures are not a source of nutrients in WBID 2320.

6.2.3 Clear cut/Sparse

The clear cut/sparse land use classification includes recent clear cuts, areas of sparse vegetation or herbaceous dry prairie, shrub and brushland, other early successional areas, and mixed rangeland. Event mean concentrations for clear cut/sparse can be relatively low for total nitrogen and total phosphorus. Clear cut/sparse land uses account for 7 percent of the total land use contributing to WBID 2320.

6.2.4 Forests

Upland forests include flatwoods, oak, various types of hardwoods, conifers and tree plantations. Wildlife, located within forested areas, deposit their feces onto land surfaces where it can be transported to nearby streams during storm events. Generally, the pollutant load from wildlife is assumed to represent background concentrations. Event mean concentrations for upland forests are low for both total nitrogen and total phosphorus. Combined forested land use accounts for 18 percent of the total contributing land use in WBID 2320.

6.2.5 Water and Wetlands

Water and wetlands often have very low nutrient loadings, although decaying organic matter in wetlands can contribute to high organic nutrient concentrations. Open water accounts for 20 percent of total land use, while both forested and non-forested wetlands combined accounts for 21 percent of the drainage area of WBID 2320.

6.2.6 Quarries/Strip mines

Land use classification includes quarries, strip mines, exposed rock and soil, fill areas, reclaimed lands, and holding ponds. Event mean concentrations for some barren lands tend to be higher in total nitrogen. Less than 1 percent of the land use in WBID 2320 is classified as quarries/strip mines.

7.0 ANALYTICAL APPROACH

In the development of a TMDL there needs to be a method for relating current loadings to the observed water quality problem. This relationship could be: statistical (regression for a cause and effect relationship), empirical (based on observations not necessarily from the waterbody in question) or mechanistic (physically and/or stochastically based) that inherently relate cause and effect using physical and biological relationships.

Mechanistic models were used in the development of the Guana River TMDL to relate the physical and biological relationships. A dynamic watershed model was used to predict the quantity of water and pollutants associated with runoff from rain events. The watershed model was linked to a hydrodynamic model that simulated tidal influences in the river. Both models were linked to a water quality simulation model that integrated the loadings and flow from the watershed model with flow from the hydrodynamic model to predict the water quality in the receiving waterbodies.

The period of simulation that was considered in the development of this TMDL is January 1, 2002 to December 31, 2009. The models were used to predict time series for BOD, TN, TP, and DO. The models were calibrated to current conditions and were then used to predict improvements in water quality as function of reductions in loadings.

7.1 Mechanistic Models

7.1.1 Loading Simulation Program C++ (LSPC)

LSPC is the Loading Simulation Program in C++, a watershed modeling system that includes streamlined Hydrologic Simulation Program Fortran (HSPF) algorithms for simulating hydrology, sediment, and general water quality overland as well as a simplified stream fate and transport model. LSPC is derived from the Mining Data Analysis System (MDAS), which was originally developed by USEPA Region 3 (under contract with Tetra Tech) and has been widely used for TMDLs. In 2003, the USEPA Region 4 contracted with Tetra Tech to refine, streamline, and produce user documentation for the model for public distribution. LSPC was developed to serve as the primary watershed model for the USEPA TMDL Modeling Toolbox. LSPC was used to simulate runoff (flow, biochemical oxygen demand, total nitrogen, total phosphorus and dissolved oxygen) from the land surface using a daily timestep for current and natural conditions. LSPC provided tributary flows and temperature to the EFDC estuary models and tributary water quality concentrations to WASP7 estuary models.

In order to evaluate the contributing sources to a waterbody and to represent the spatial variability of these sources within the watershed model, the contributing drainage area was represented by a series of sub-watersheds. The subwatersheds were developed using the USGS 12-digit hydrologic unit code, USGS National Hydrographic Dataset.

The LSPC model is driven by precipitation and other climatological data (e.g., air temperature, evapotranspiration, dew point, cloud cover, wind speed, solar radiation), and data from nearby weather stations were used in the modeling effort. The subwatersheds were represented by the hydrologic soil group that had the highest percentage of coverage within the boundaries of the subwatershed.

The basis for distributing hydrologic and pollutant loading parameters throughout the watershed is correlated to soil characteristics and land use practices. The 2006 National Land Use Cover Database (NLCD), 2006 St. Johns Water Management District Land Cover, and the soil survey geographic database (SSURGO) were used in the modeling effort and subsequent TMDL development.

The modeling assumptions are outlined in the Technical Support Document for U.S. EPA's Proposed Rule for Numeric Nutrient Criteria for Florida's Estuaries, Coastal Waters, and Southern Inland Flowing Waters - Volume 1: Estuaries, Appendix C: Watershed Hydrology and Water Quality Modeling Report for 19 Florida Watersheds (USEPA 2012a). The calibration results for the Daytona Watershed are located in the Technical Support Document for U.S. EPA's Proposed Rule for Numeric Nutrient Criteria for Florida's Estuaries, Coastal Waters, and Southern Inland Flowing Waters - Volume 1: Estuaries, Appendix C Attachment 12: The Daytona Watershed (USEPA 2012b).

7.1.2 Environmental Fluids Dynamic Code (EFDC)

The EFDC model is a part of the USEPA TMDL Modeling Toolbox due to its application in many TMDL-type projects. As such, the code has been peer reviewed and tested and has been freely distributed and supported by Tetra Tech. EFDC was developed by Dr. John Hamrick (Hamrick 1992) and is currently supported by Tetra Tech for USEPA Office of Research and Development (ORD), USEPA Region 4, and USEPA Headquarters. The models, tools, and databases in the TMDL Modeling Toolbox are continually updated and upgraded through TMDL development in Region 4. EFDC is a multifunctional, surface-water modeling system, which includes hydrodynamic, sediment contaminant, and eutrophication components. The EFDC model is capable of 1, 2, and 3-dimensional spatial resolution. The model employs a curvilinear-orthogonal horizontal grid and a sigma or terrain following vertical grid.

The EFDC hydrodynamic model can run independently of a water quality model. The EFDC model simulates the hydrodynamic and constituent transport and then writes a hydrodynamic linkage file for a water quality model such as the Water Quality Analysis Program (WASP7) model. This model linkage, from EFDC hydrodynamics to WASP water quality, has been applied on many USEPA Region 4 projects in support of TMDLs and has been well tested (Wool et al. 2003).

The bathymetry in the bay was used to create the grid for the EFDC model. Inland boundary grid cells received LSPC simulated watershed discharges and point source discharges. Hourly water surface elevation time series data from the National Oceanic and Atmospheric Administration (NOAA) tidal stations were initially used to simulate tides at the open boundary. Observed temperature data at water quality stations were used to simulate the temperature at the open boundaries, and average salinity in the bay was used to simulate salinity.

The modeling assumptions are outlined in the Technical Support Document for U.S. EPA's Proposed Rule for Numeric Nutrient Criteria for Florida's Estuaries, Coastal Waters, and Southern Inland Flowing Waters - Volume 1: Estuaries, Appendix D: Hydrodynamic and Water Quality Modeling Report for Nutrient Criteria for 11 Florida Estuary Systems (USEPA 2012c).

7.1.3 Water Quality Analysis Simulation Program (WASP7)

The Water Quality Analysis Simulation Program Version 7.4.1 (WASP7) is an enhanced Windows version of the USEPA Water Quality Analysis Simulation Program (WASP) (Di Toro et al., 1983; Connolly and Winfield, 1984; Ambrose, R.B. et al., 1988), with upgrades to the user's interface and the model's capabilities. The major upgrades to WASP have been the addition of multiple BOD components, addition of sediment diagenesis routines, and addition of periphyton routines. The hydrodynamic file generated by EFDC is compatible with WASP7 and it transfers segment volumes, velocities, temperature and salinity, as well as flows between segments. The time step is set in WASP7 based on the hydrodynamic simulation.

WASP7 helps users interpret and predict water quality responses to natural phenomena and man-made pollution for various pollution management decisions. WASP7 is a dynamic compartment-modeling program for aquatic systems, including both the water column and the underlying benthos. The time-varying processes of advection, dispersion, point and diffuse mass loading and boundary exchange are represented in the basic program. Water quality processes are represented in special kinetic subroutines that are either chosen from a library or written by the user. WASP is structured to permit easy substitution of kinetic subroutines into the overall package to form problem-specific models. WASP7 comes with two such models, TOXI for toxicants and EUTRO for conventional water quality.

WASP7 utilized the same grid cells that were developed for the EFDC model. Water quality loads from point sources discharging into the estuary were obtained from DMR data from the PCS database. Water quality loading from the LSCP model was used to simulate loads coming from rivers and streams into the estuary. Offshore boundary conditions were calculated from water quality stations within the estuary.

The modeling assumptions are outlined in the Technical Support Document for U.S. EPA's Proposed Rule for Numeric Nutrient Criteria for Florida's Estuaries, Coastal Waters, and Southern Inland Flowing Waters - Volume 1: Estuaries, Appendix D: Hydrodynamic and Water Quality Modeling Report for Nutrient Criteria for 11 Florida Estuary Systems (USEPA 2012c).

7.1.4 Guana River Mechanistic Model

To model the Guana River basin, the relatively large subwatersheds in the Daytona Watershed Model were re-delineated using the USGS NHD catchments. Only the subwatersheds draining to the Guana River were used in the Guana River model, and the re-delineated model used the same parameterization as the larger Daytona watershed model.

The St. Marys EFDC and WASP model calibration parameters and setup were used to parameterize the Guana EFDC and WASP models. The calibration results for the St. Marys Model, along with additional information on assumptions, are located in the Technical Support Document for U.S. EPA's Proposed Rule for Numeric Nutrient Criteria for Florida's Estuaries, Coastal Waters, and Southern Inland Flowing Waters - Volume 1: Estuaries, Appendix D Attachment 9: The St. Marys and Nassau Hydrodynamic and Water Quality Model Calibration and Validation: Tables and Figures (USEPA 2012d).

The Guana EFDC and WASP models include both the downstream tidal reach of the Guana River and the non-tidal but saltwater influenced Guana Lake reach (Lake Ponte Vedra). LSPC predicted stormwater and base flow inputs enter the lake at its upstream end and at roughly mid-lake. Wet weather flows passing through the lake are discharged to the downstream tidal reach over a spillway at the dam, which maintains the lake depth at approximately 4 feet.

During higher tides, saltwater from the downstream reach is allowed to pass upstream into the lake through a special diversion structure, resulting in largely estuarine conditions within its southern end. However, due to its length (approximately 9 miles), narrow width (approximately 0.5 miles or less) and shallow depths throughout, a saltwater gradient exists along the lake's length. Near its northern end the lake is usually freshwater. The EFDC model simulates the control strictures located at the lake outlet using two identical flow-versus-stage discharge rating curves, one for downstream and the other for upstream flow transfers. Multiplication factors for each curve were determined by calibration to historical salinity observations made immediately below the dam and within the southern portion of the lake.

The downstream tidal boundary of the models is located approximately 3 miles south of the dam, at the confluence of the Guana River and the Tolomato River. St. Augustine Inlet is located approximately 6 miles south of the downstream tidal boundary. Due to the lack of site-specific tide level data, tidal stage boundary conditions at this boundary were assumed to be the same as those observed near the mouth of the St. Marys River (Fernandina Beach), approximately 60 miles north of St. Augustine Inlet.

Following re-delineation of the Guana River LSPC model and set-up of the WASP and EFDC model, the calibration was reviewed. The calibration and parameterization were then updated to better reflect the conditions occurring in the Guana River basin.

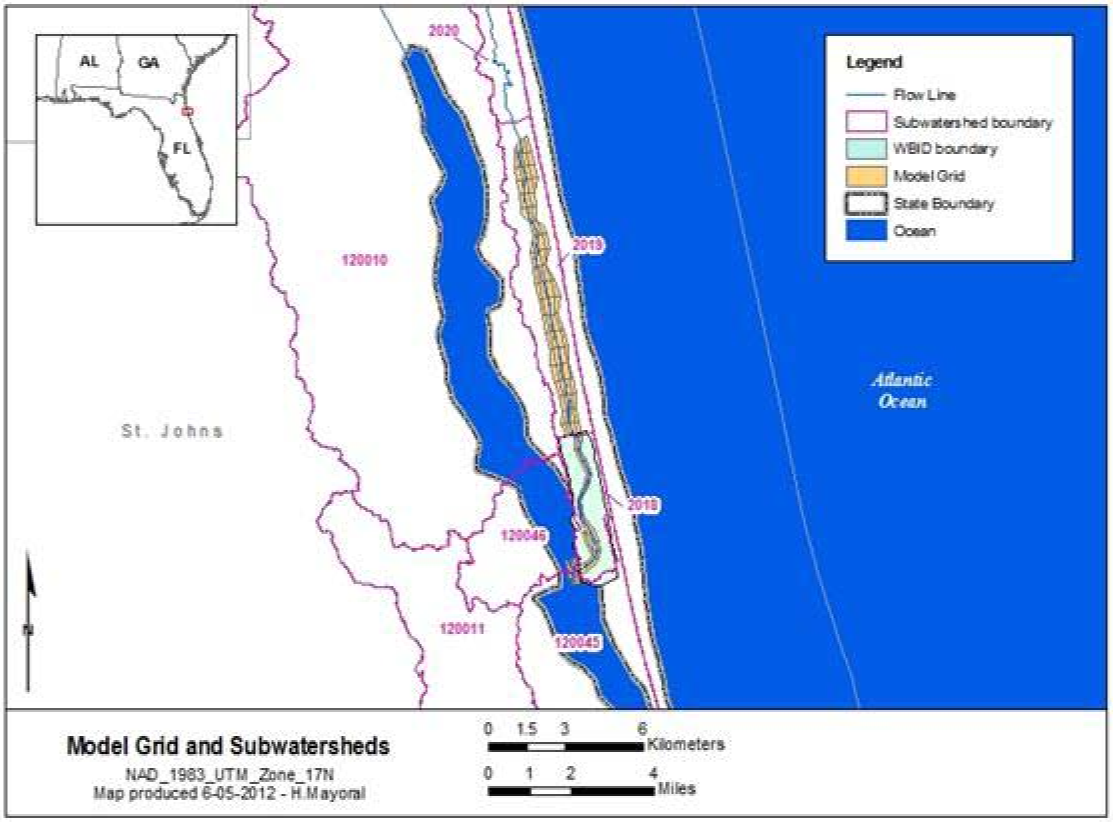

Figure 7.1 Location of LSPC modeled subwatersheds and WASP grid for the Guana River model

7.2 Scenarios

Two modeling scenarios were developed and evaluated in this TMDL determination: a current condition and a natural condition scenario. Concentrations and loadings were evaluated to determine if DO concentrations in the natural condition scenario could meet the DO standard, and the impact of nutrients on the DO concentrations. The results from the scenarios were used to develop the TMDL

7.2.1 Current Condition

The current condition scenario evaluated current hydrologic and water quality conditions in the watershed, specifically water quality concentration and loadings at the outlet of WBID 2320. The current condition annual average concentrations for the Guana River WBID are presented in Table 7.1. The current condition simulation was used to determine the base loadings for the WBID. These base loadings (Table 7.2), when compared with the TMDL scenarios, were used to determine the percent reduction in nutrient loads that will be needed to achieve water quality standards. Figure 7.2 through Figure 7.11 provide the calibrated current condition modeled parameters for WBID 2320.

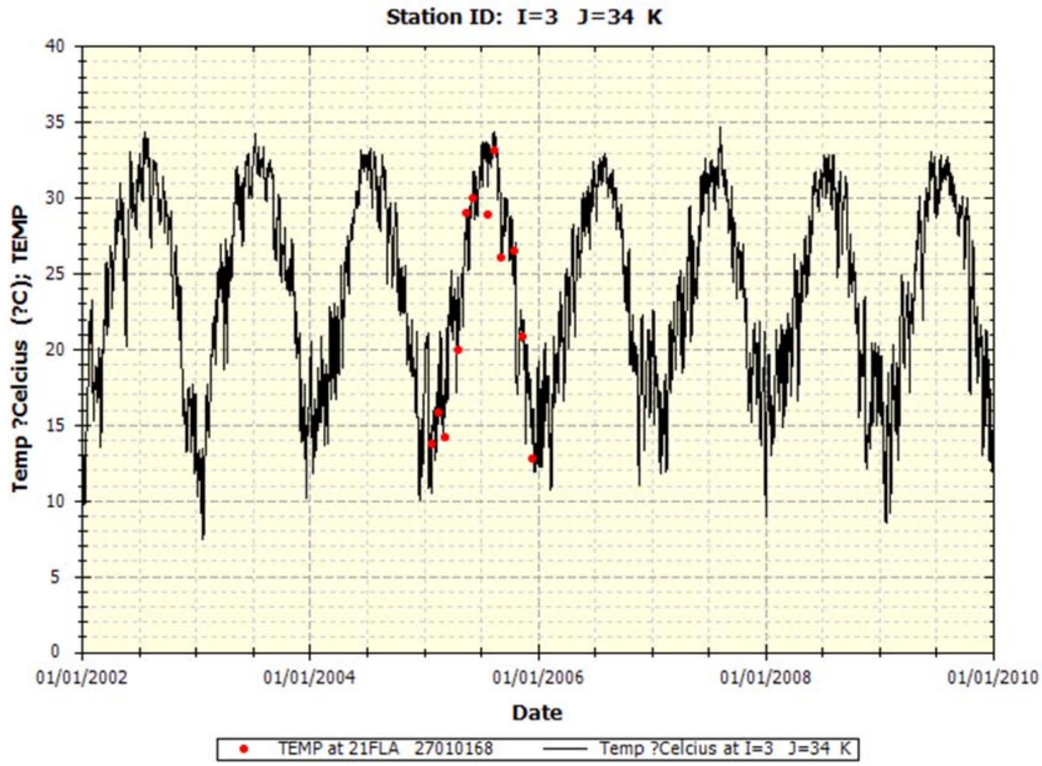

Figure 7.2 Simulated temperature verse measured temperature in the Guana River basin at station 21FLA 27010168

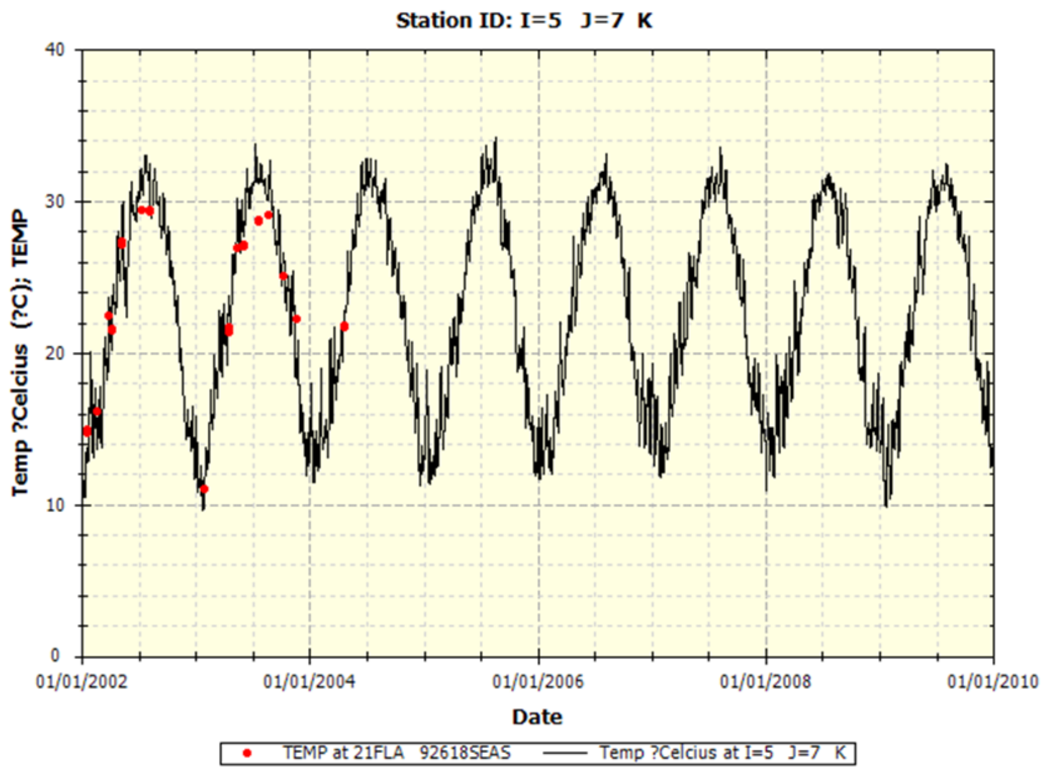

Figure 7.3 Simulated temperature verse measured temperature in the Guana River basin at station 21FLA 92618SEAS

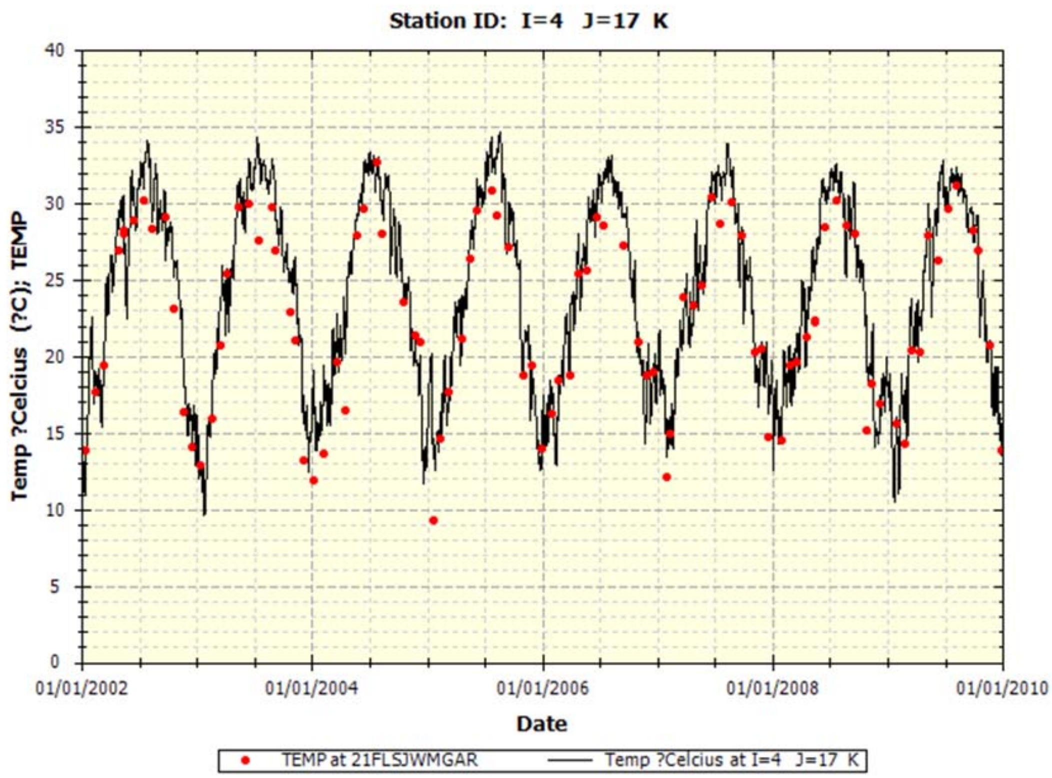

Figure 7.4 Simulated temperature verse measured temperature in the Guana River basin at station 21FLSJWMGAR

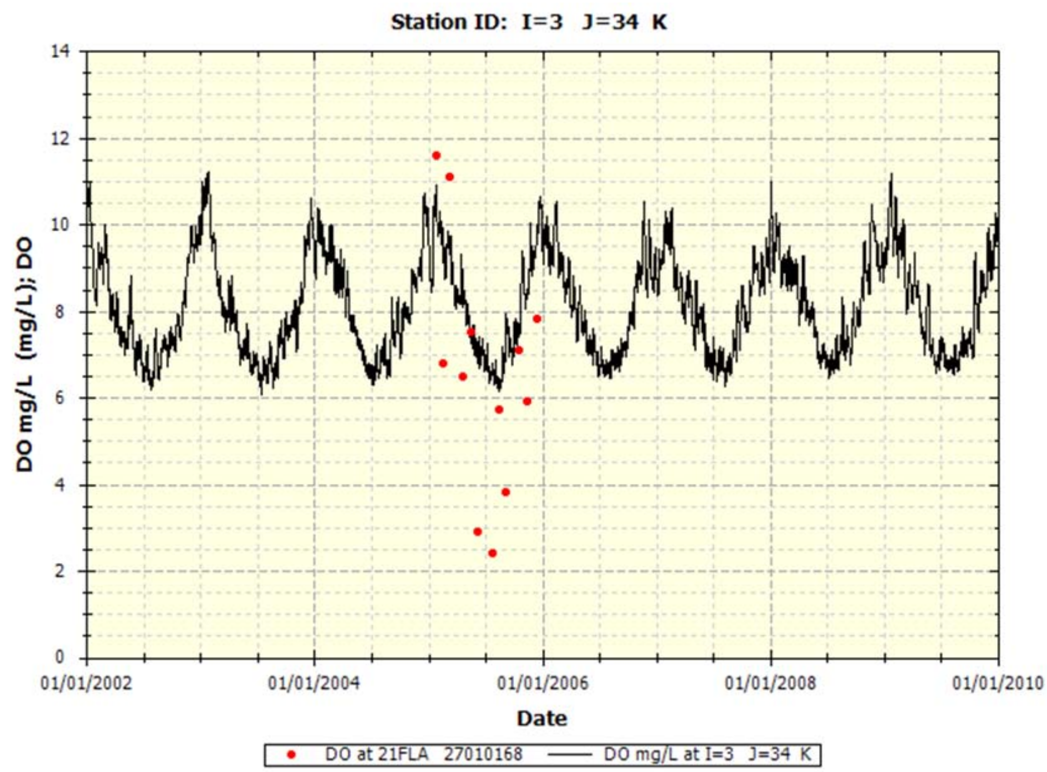

Figure 7.5 Simulated dissolved oxygen verse measured dissolved oxygen in the Guana River basin at station 21FLA 27010168

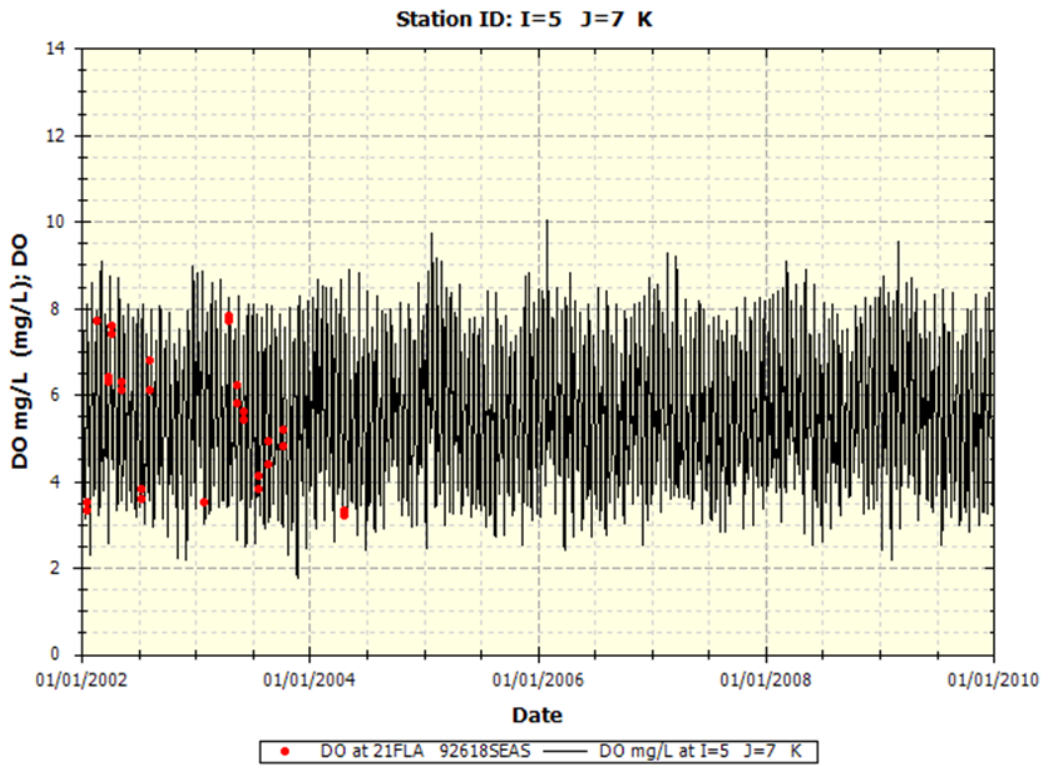

Figure 7.6 Simulated dissolved oxygen verse measured dissolved oxygen in the Guana River basin at station 21FLA 92618SEAS

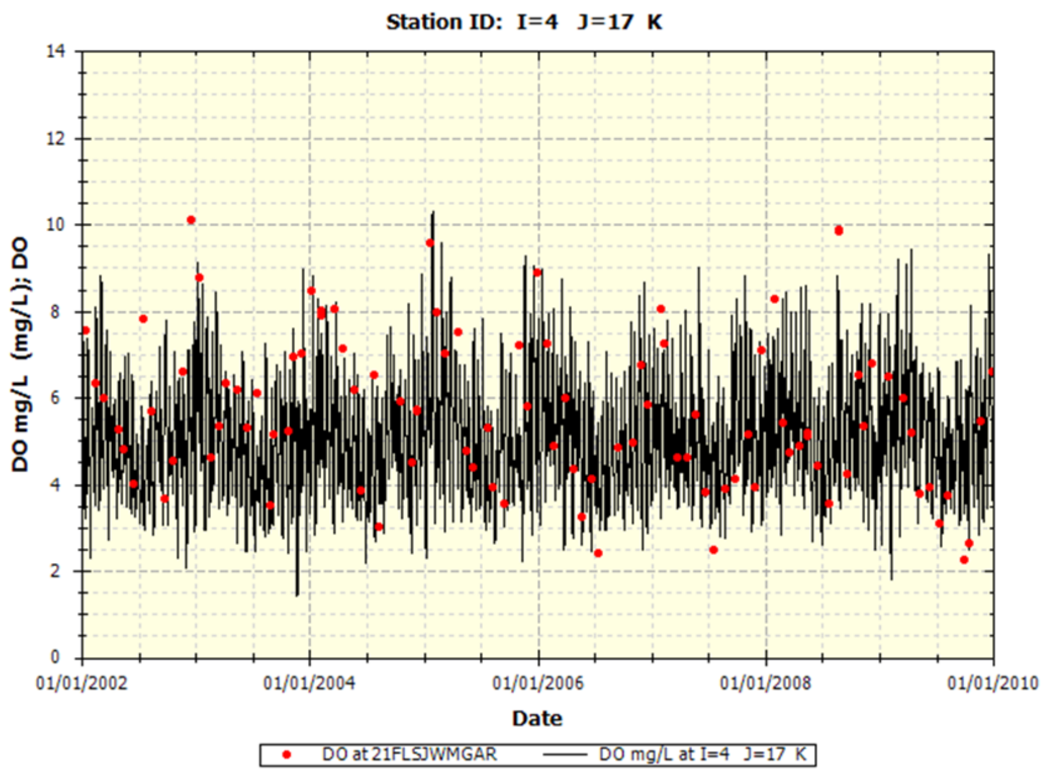

Figure 7.7 Simulated dissolved oxygen verse measured dissolved oxygen in the Guana River basin at station 21FLSJWMGAR

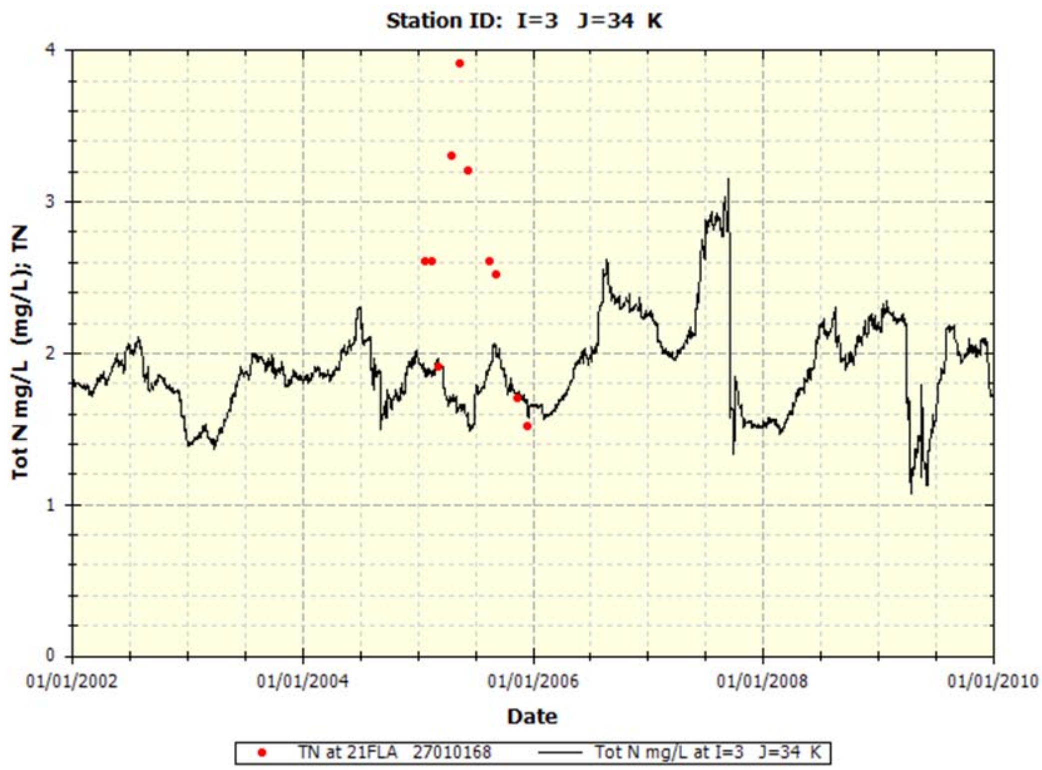

Figure 7.8 Simulated total nitrogen verse measured total nitrogen in the Guana River basin at station 21FLA 27010168

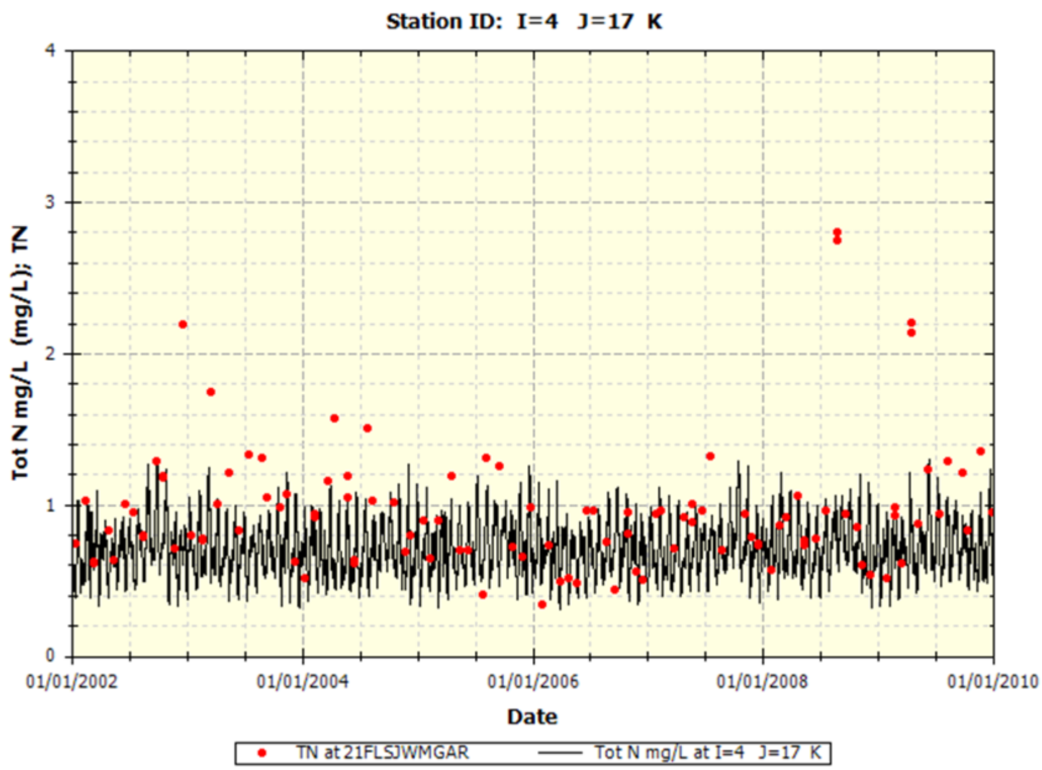

Figure 7.9 Simulated total nitrogen verse measured total nitrogen in the Guana River basin at station 21FLSJWMGAR

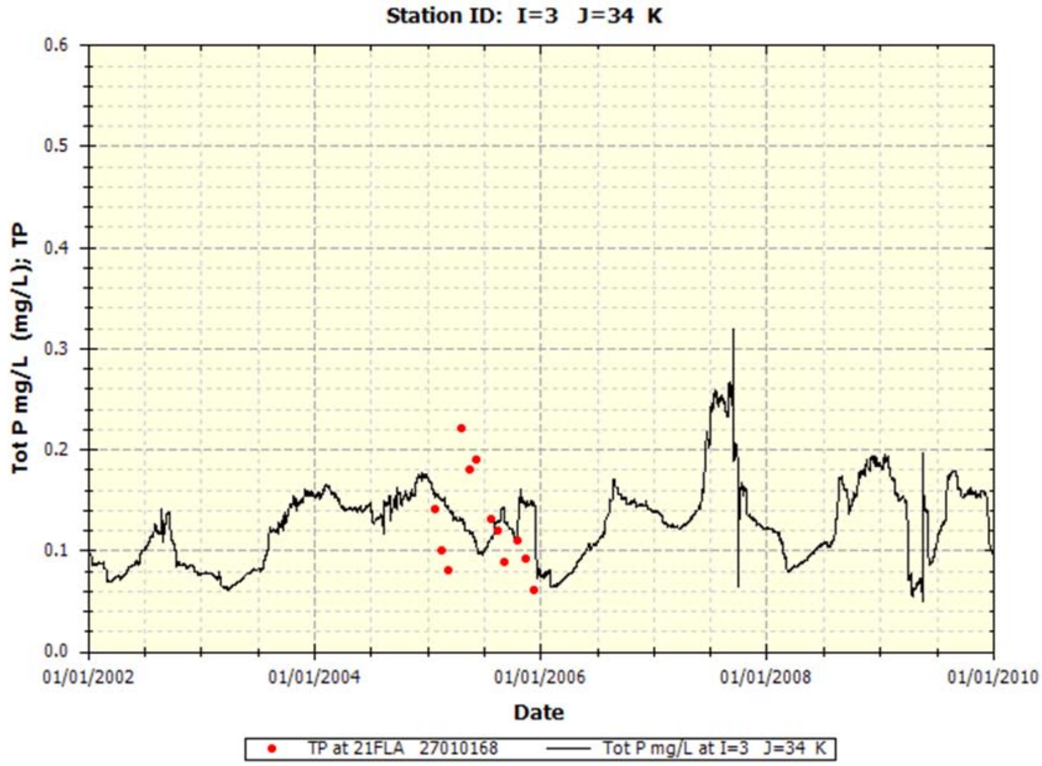

Figure 7.10 Simulated total phosphorus verse measured total phosphorus in the Guana River basin at station 21FLA 27010168

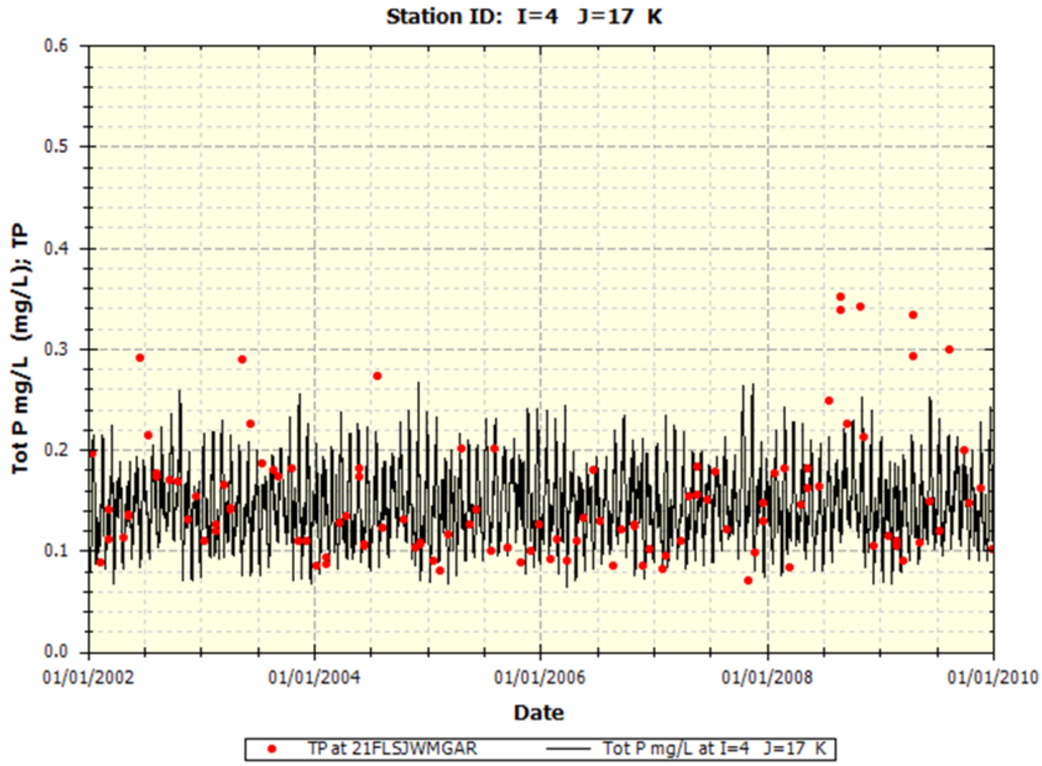

Figure 7.11 Simulated total phosphorus verse measured total phosphorus in the Guana River basin at station 21FLSJWMGAR

Table 7.1 Current condition concentrations in WBID 2320, Guana River

Parameter	WBID 2320
Total nitrogen (mg/L)	0.682
Total phosphorus (mg/L)	0.140
BOD (mg/L)	1.526
DO (mg/L)	4.936

Table 7.2 Current condition loadings in WBID 2320, Guana River

Parameter	WBID 2320	
	WLA (kg/yr)	LA (kg/yr)
Total nitrogen (mg/L)	--	18,312
Total phosphorus (mg/L)	--	1,754
BOD (mg/L)	--	14,022

7.2.2 Natural Condition

The natural condition scenario was developed to estimate water quality conditions if there was no impact from anthropogenic sources. The point sources located in the model were removed for the natural condition analysis. Land uses that were associated with anthropogenic activities (urban, agriculture, transportation, barren lands and rangeland) were converted to upland forests or forested wetlands based on the current ration of forest and wetland land uses in the model. The natural condition water quality predictions are presented in Table 7.3 and Table 7.4.

The purpose of the natural conditions scenario was to determine whether water quality standards could be achieved without abating the naturally occurring loads from the watershed. The natural condition modeling scenario indicated that the DO standard is not achievable under natural conditions, indicating that low DO is a naturally occurring phenomenon in WBID 2320. Figure 7.12 through Figure 7.21 provide the natural condition scenario modeled parameters for WBID 2320.

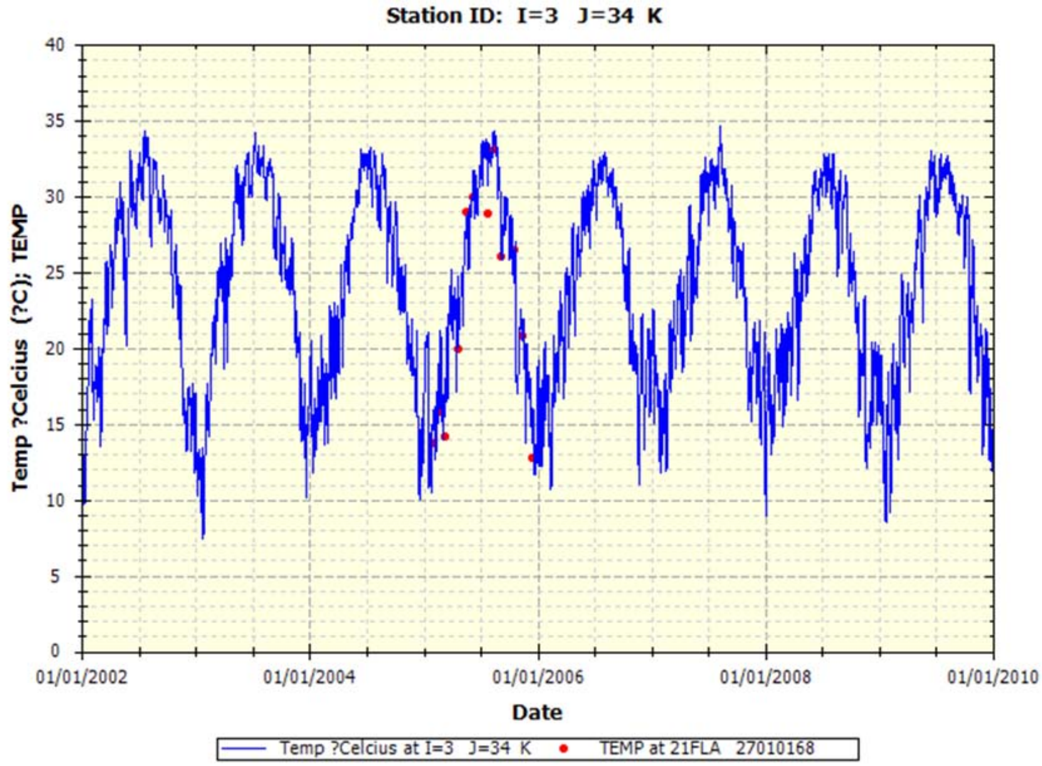

Figure 7.12 Natural condition temperature in the Guana River basin at existing calibration water quality station 21FLA 27010168

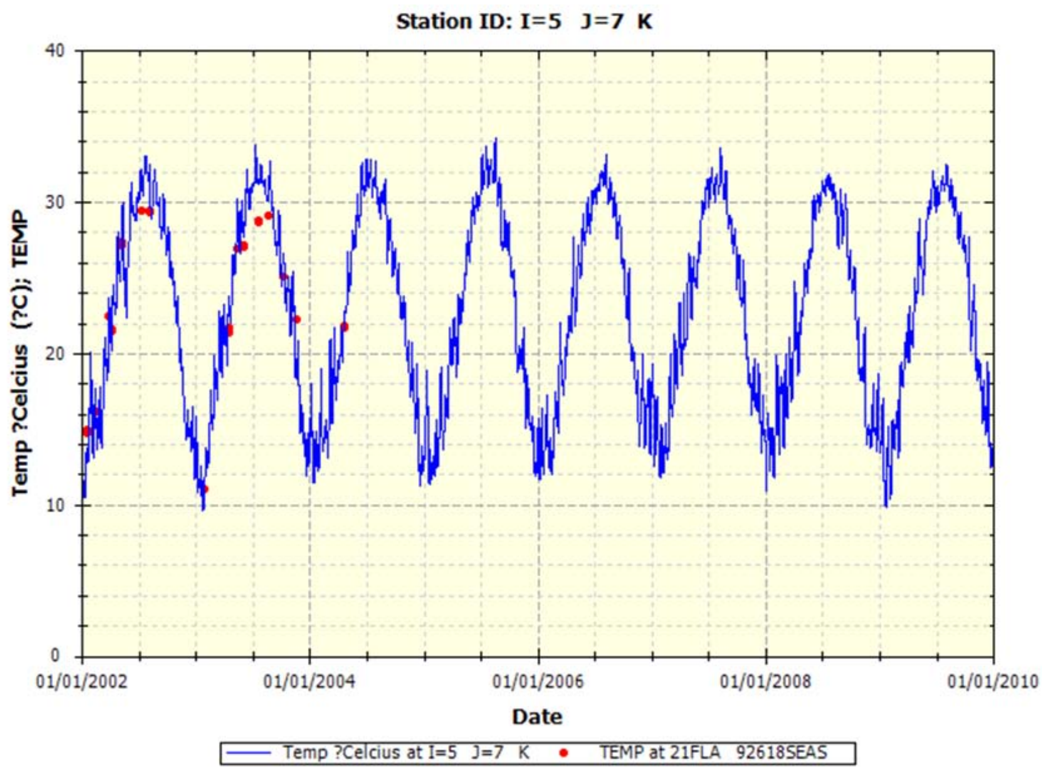

Figure 7.13 Natural condition temperature in the Guana River basin at existing calibration water quality station 21FLA 92618SEAS

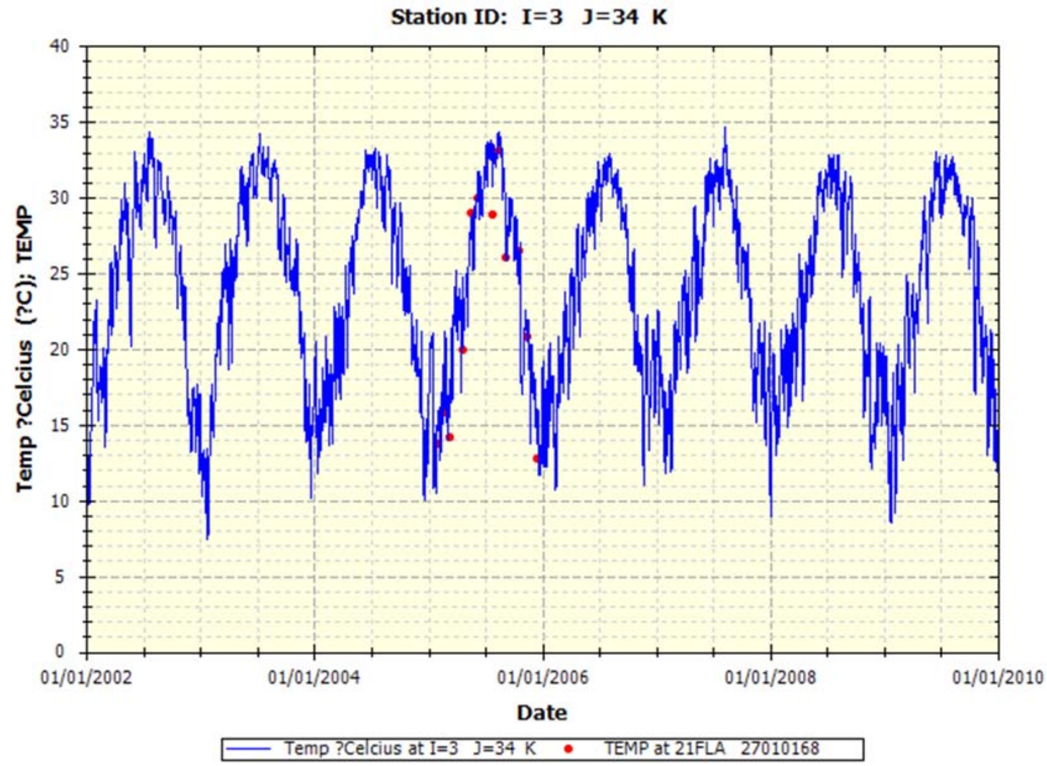

Figure 7.14 Natural condition temperature in the Guana River basin at existing calibration water quality station 21FLSJWMGAR

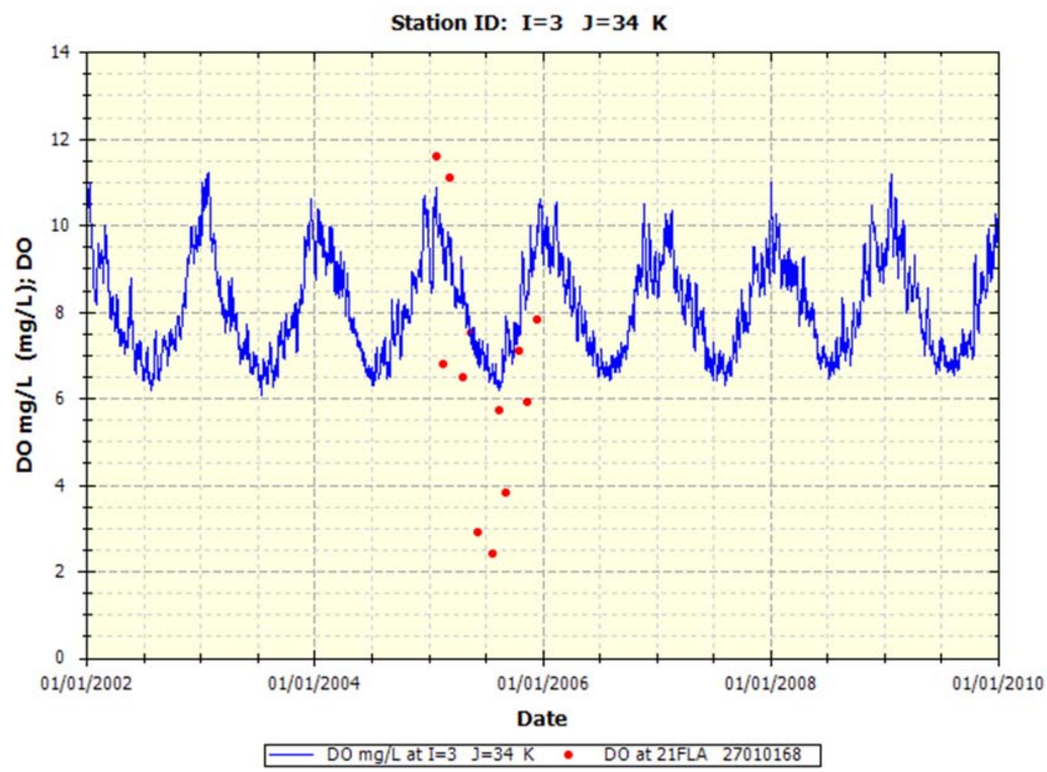

Figure 7.15 Natural condition dissolved oxygen in the Guana River basin at existing calibration water quality station 21FLA 27010168

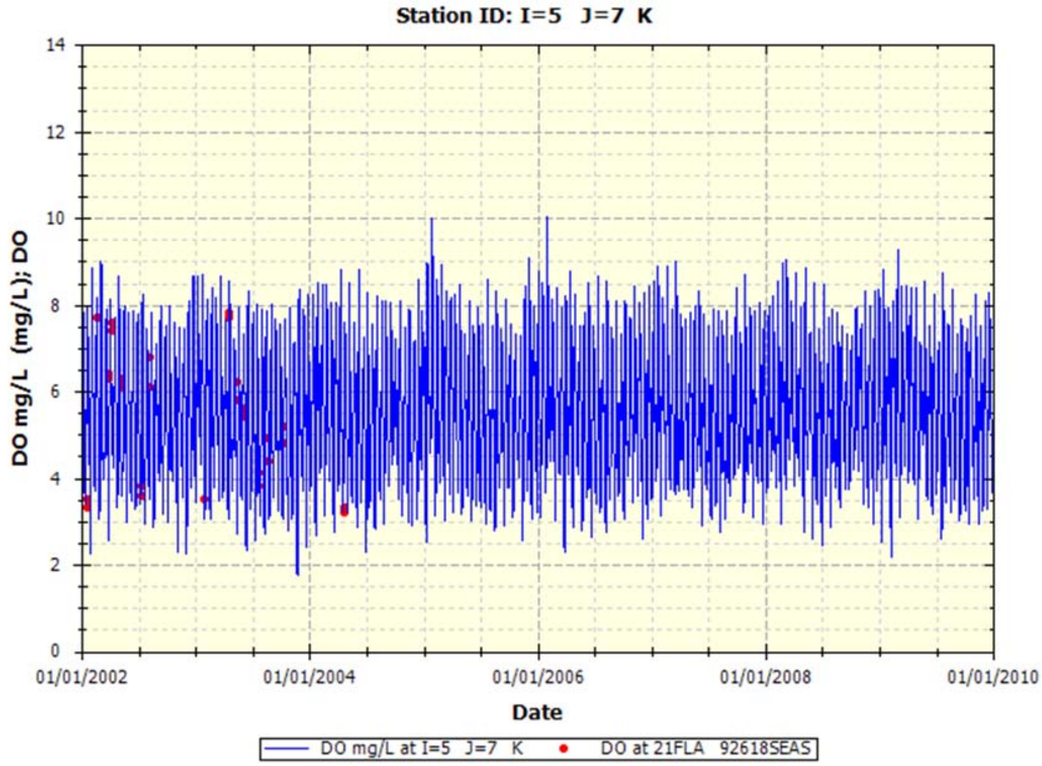

Figure 7.16 Natural condition dissolved oxygen in the Guana River basin at existing calibration water quality station 21FLA 92618SEAS

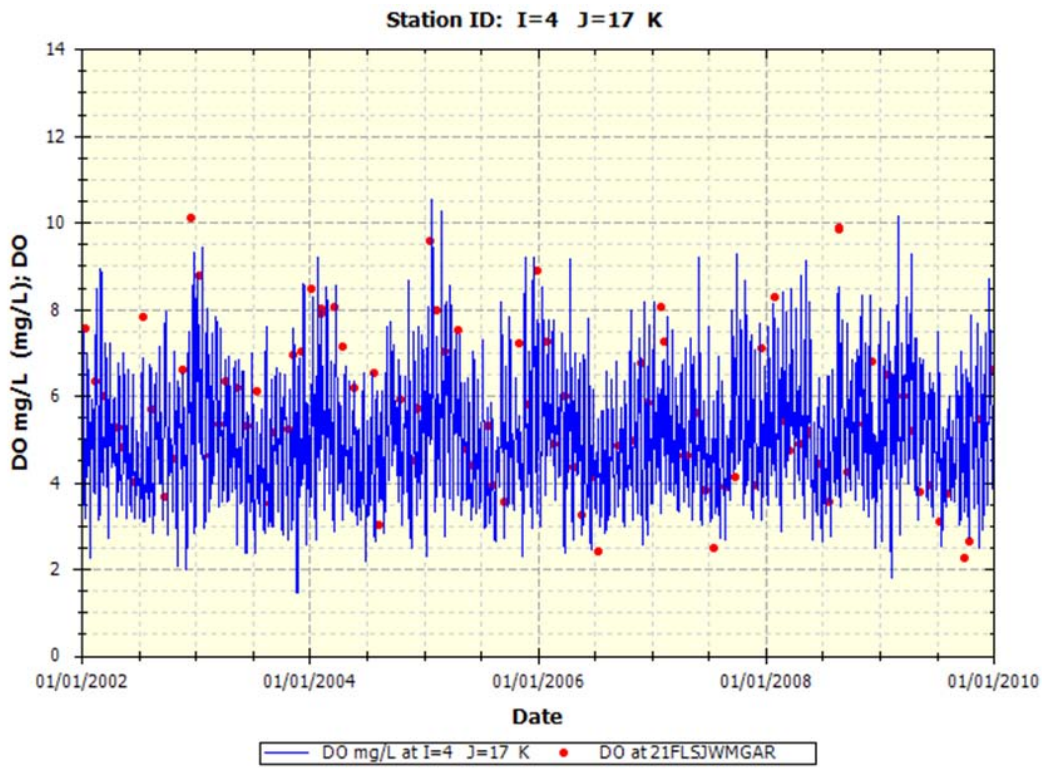

Figure 7.17 Natural condition dissolved oxygen in the Guana River basin at existing calibration water quality station 21FLSJWMGAR

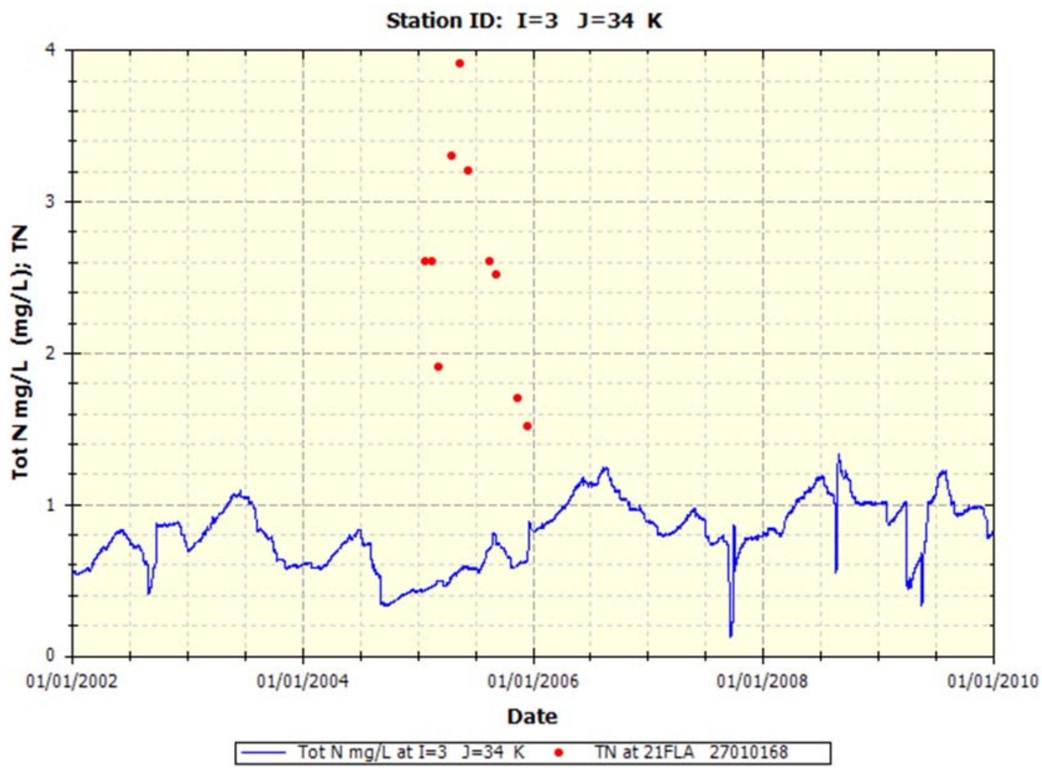

Figure 7.18 Natural condition total nitrogen in the Guana River basin at existing calibration water quality station 21FLA 27010168

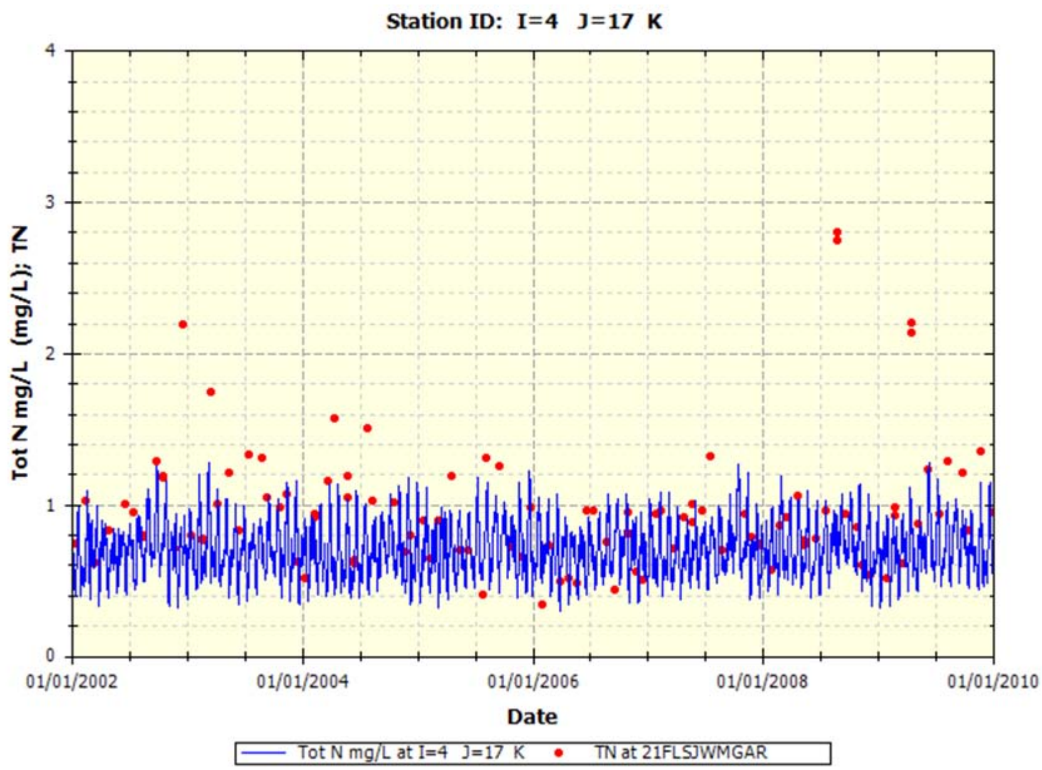

Figure 7.19 Natural condition total nitrogen in the Guana River basin at existing calibration water quality station 21FLSJWMGAR

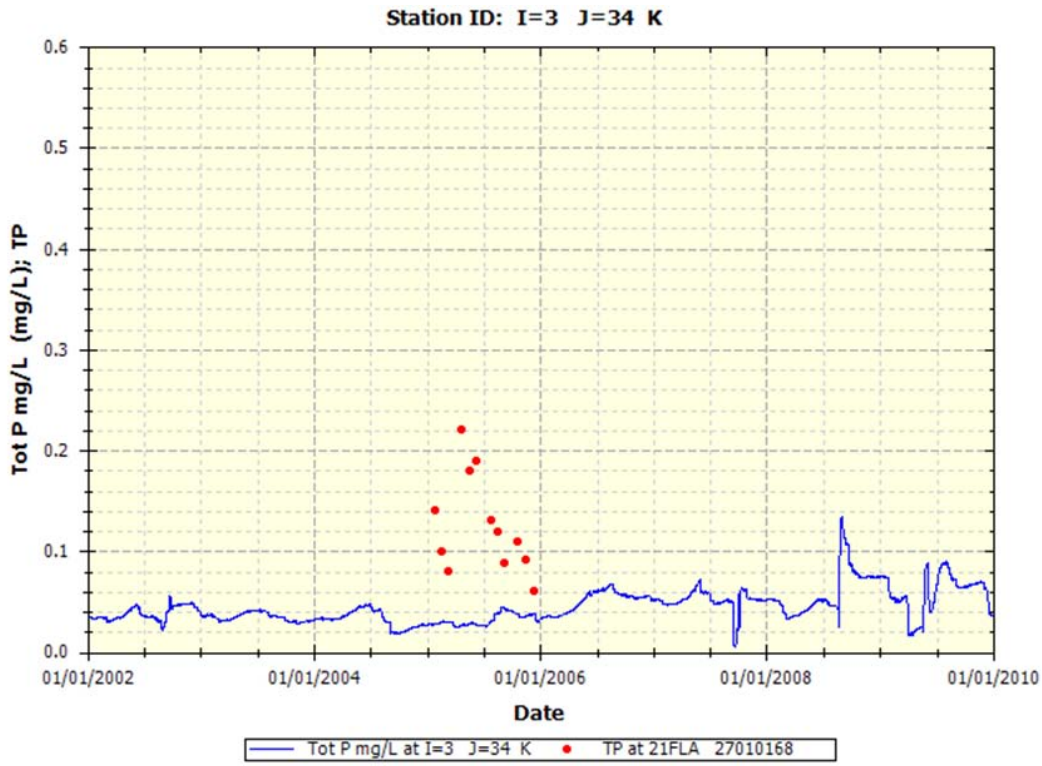

Figure 7.20 Natural condition total phosphorus in the Guana River basin at existing calibration water quality station 21FLA 27010168

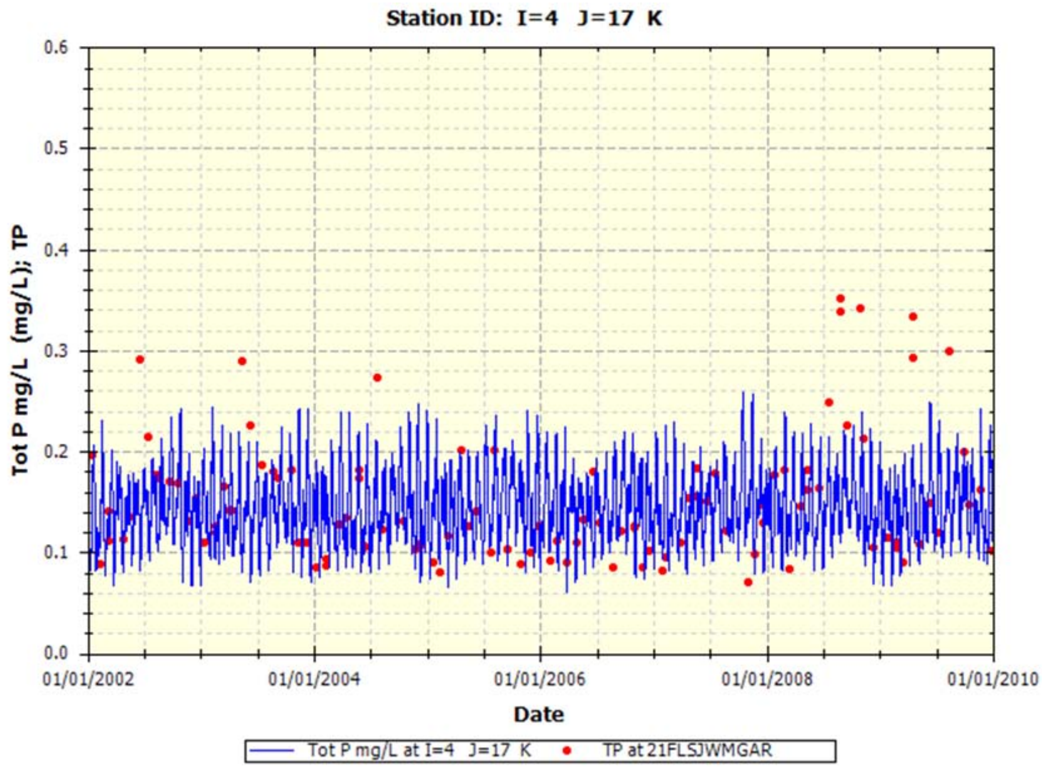

Figure 7.21 Natural condition total phosphorus in the Guana River basin at existing calibration water quality station 21FLSJWMGAR

Table 7.3 Natural condition concentrations in WBID 2320, Guana River

Parameter	WBID 2320
Total nitrogen (mg/L)	0.677
Total phosphorus (mg/L)	0.139
BOD (mg/L)	1.513
DO (mg/L)	4.935

Table 7.4 Natural condition loadings in WBID 2320, Guana River

Parameter	WBID 2320	
	WLA (kg/yr)	LA (kg/yr)
Total nitrogen (mg/L)	--	9,748
Total phosphorus (mg/L)	--	776
BOD (mg/L)	--	12,562

8.0 TMDL DETERMINATION

The TMDL for a given pollutant and waterbody is comprised of the sum of individual wasteload 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:

$$TMDL = \sum WLAs + \sum LAs + MOS$$

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 this TMDL development, allowable concentrations 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. These TMDLs are expressed as annual geometric mean concentrations, since the approach used to determine the TMDL targets relied on geometric means. The TMDLs targets were determined to be the conditions needed to restore and maintain a balanced aquatic system. Furthermore, it is important to consider nutrient loading over time, since nutrients can accumulate in waterbodies.

The TMDL was determined for the concentrations and loadings at the outlet of WBID 2320, and included all loadings from upstream sources and streams. During the development of this TMDL, it was determined that the natural condition scenario (removal of all anthropogenic sources and land uses) did not meet the Florida standards for DO. For this reason, the Natural Condition narrative rule was used to reduce nutrients in the estuary to prevent any further potential degradation of the system. The allocations for WBID 2320 for total nitrogen, total phosphorus, and biochemical oxygen demand are presented in Table 8.1.

Table 8.1 TMDL Load Allocations for the Guana River, WBID 2320

Constituent	Current Condition WLA (kg/yr)	Current Condition LA (kg/yr)	TMDL Condition WLA (kg/yr)	TMDL Condition LA (kg/yr)	Percent reduction WLA	Percent Reduction LA
Total Nitrogen	--	18,312	--	9,748	--	47%
Total Phosphorus	--	1,754	--	776	--	56%
Biochemical Oxygen Demand	--	14,022	--	12,562	--	10%

8.1 Seasonal Variation

EPA regulations at 40 CFR 130.7(c)(1) require TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. The critical condition is the combination of environmental factors creating the "worst case" scenario of water quality conditions in the waterbody. By achieving the water quality standards at critical conditions, it is expected that water quality standards should be achieved during all other times. Seasonal variation must also be considered to ensure that water quality standards will be met during all seasons of the year, and that the TMDLs account for any seasonal change in flow or pollutant discharges, and any applicable water quality criteria or designated uses (such as swimming) that are expressed on a seasonal basis.

The critical condition for nonpoint source concentration and wet weather point source concentrations is typically an extended dry period followed by a rainfall runoff event. During the dry weather period, nutrients build up on the land surface, and are washed off by rainfall. The critical condition for continuous point source concentrations typically occurs during periods of low stream flow when dilution is minimized. Although loading of nonpoint source pollutants contributing to a nutrient impairment may occur during a runoff event, the expression of that nutrient impairment is more likely to occur during warmer months, and at times when the waterbody is poorly flushed.

8.2 Margin of Safety

The Margin of Safety accounts for uncertainty in the relationship between a pollutant load and the resultant condition of the waterbody. There are two methods for incorporating an MOS into TMDLs (USEPA 1991):

- Implicitly incorporate the MOS using conservative model assumptions to develop allocations
- Explicitly specify a portion of the total TMDL as the MOS and use the remainder for Allocations

This TMDL uses an implicit MOS since the TMDL targets for nutrients were set to natural background conditions.

8.3 Waste Load Allocations

Only MS4s and NPDES facilities discharging directly into lake 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.

8.3.1 Wastewater/Industrial Permitted Facilities

A TMDL wasteload allocation (WLA) is given to wastewater and industrial NPDES-permitted facilities discharging to surface waters within an impaired watershed. There are no continuous discharge NPDES-permitted point sources in WBID 2320, therefore no WLA was calculated.

8.3.2 Municipal Separate Storm Sewer System Permits

The WLA for MS4s are expressed in terms of percent reductions equivalent to the reductions required for nonpoint sources. Given the available data, it is not possible to estimate concentrations coming exclusively from the MS4 areas. Although the aggregate concentration allocations for stormwater discharges are expressed in numeric form, i.e., percent reduction, based on the information available today, it is infeasible to calculate numeric WLAs for individual stormwater outfalls because discharges from these sources can be highly intermittent, are usually characterized by very high flows occurring over relatively short time intervals, and carry a variety of pollutants whose nature and extent varies according to geography and local land use. For example, municipal sources such as those covered by this TMDL often include numerous individual outfalls spread over large areas. Water quality impacts, in turn, also depend on a wide range of factors, including the magnitude and duration of rainfall events, the time period between events, soil conditions, fraction of land that is impervious to rainfall, other land use activities, and the ratio of stormwater discharge to receiving water flow.

This TMDL assumes for the reasons stated above that it is infeasible to calculate numeric water quality-based effluent limitations for stormwater discharges. Therefore, in the absence of information presented to the permitting authority showing otherwise, this TMDL assumes that water quality-based effluent limitations for stormwater sources of nutrients derived from this TMDL can be expressed in narrative form (e.g., as best management practices), provided that:

(1) the permitting authority explains in the permit fact sheet the reasons it expects the chosen BMPs to achieve the aggregate wasteload allocation for these stormwater discharges; and (2) the state will perform ambient water quality monitoring for nutrients for the purpose of determining whether the BMPs in fact are achieving such aggregate wasteload allocation.

All Phase 1 MS4 permits issued in Florida include a re-opener clause allowing permit revisions for implementing TMDLs once they are formally adopted by rule. Florida may designate an area as a regulated Phase II MS4 in accordance with Rule 62-620.800, FAC. Florida's Phase II MS4 Generic Permit has a "self-implementing" provision that requires MS4 permittees to update their stormwater management program as needed to meet their TMDL allocations once those TMDLs are adopted. Permitted MS4s will be responsible for reducing only the loads associated with stormwater outfalls which it owns, manages, or otherwise has responsible control. MS4s are not responsible for reducing other nonpoint source loads within its jurisdiction. All future MS4s permitted in the area are automatically prescribed a WLA equivalent to the percent reduction assigned to the LA. The MS4 service areas described in Section 6.1.2 of this report are required to meet the percent reduction prescribed in Table 8.1 through the implementation of BMPs.

8.4 Load Allocations

The load allocation for nonpoint sources was assigned a percent reduction in nutrient concentrations from the current concentrations coming into the WBID addressed in the TMDL report.

9.0 RECOMMENDATIONS/IMPLEMENTATION

The initial step in implementing a TMDL is to more specifically locate pollutant source(s) 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

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