TOTAL MAXIMUM DAILY LOAD (TMDL)

For

Nutrients, Dissolved Oxygen and Biochemical Oxygen Demand

In

Springs Coast Basin (WBIDs 1668A, 1668B and 1508)

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LIST OF ABBREVIATIONS

BMAP	Basin Management Action Plan
BMP	Best Management Practices
BOD	Biochemical Oxygen Demand
BPJ	Best Professional Judgment
CFS	Cubic Feet per Second
CWA	Clean Water Act
DEM	Digital Elevation Model
DO	Dissolved Oxygen
EMC	Event Mean Concentration
EPA	Environmental Protection Agency
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FLUCC	Florida Land Use and Cover Classification System
GIS	Geographic Information System
HUC	Hydrologic Unit Code
LA	Load Allocation
MGD	Million Gallons per Day
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer Systems
NLCD	National Land Cover Data
NPDES	National Pollutant Discharge Elimination System
OSTD	Onsite Sewer Treatment and Disposal Systems
SOD	Sediment Oxygen Demand
STORET	STORage RETrieval database
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
USGS	United States Geological Survey
WASD	Water and Sewer Department
WBID	Water Body Identification
WLA	Waste Load Allocation
WMP	Water Management Plan
WQS	Water Quality Standards

SUMMARY SHEET

Total Maximum Daily Load (TMDL)

1. 303(d) Listed Waterbody Information

State: Florida

Major River Basin: Springs Coast

Impaired Waterbodies for TMDLs (1998 303(d) List):

WBID	Name	Classification	River Basin	County	Constituents
1668A	St. Joe Creek	3F (Fresh)	Springs Coast	Pinellas	Dissolved Oxygen, Nutrients, Biochemical Oxygen Demand
1668B	Pinellas Ditch #5	3F (Fresh)	Springs Coast	Pinellas	Dissolved Oxygen, Biochemical Oxygen Demand, Nutrients
1508	Klosterman Bayou Run	3M (Marine)	Springs Coast	Pinellas	Dissolved Oxygen, Nutrients

2. WATER QUALITY STANDARDS AND TMDL TARGETS

The targets for the TMDLs are set to the State of Florida's water quality criteria. The State of Florida has a narrative criterion for nutrients stating that 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 and fauna and also not to produce or contribute to conditions that violate the dissolved oxygen criterion, including natural conditions. The narrative criterion for biochemical oxygen demand (BOD) states that it shall not be increased to exceed values which would cause dissolved oxygen (DO) to be depressed below the limit established for each class and, in no case, shall it be great enough to produce nuisance conditions. The criterion for DO requires that in no case shall the concentration of dissolved oxygen average less than 5.0 in a 24-hour period and shall never be less than 4.0 mg/L for marine waters or shall not be less than 5 mg/L for fresh waters.

3. TMDL ANALYTICAL APPROACH

The nutrient targets for the TMDLs were developed by applying a tiered approach, which uses independent approaches that have varying strengths and weaknesses. The first tier applies the regression approach, which attempts to develop a multivariate regression model to analyze the relationship between low instream DO and nutrients. If a regression correlation does not exist, then the second tier is applied. The second tier applies the 25th percentile of an all stream dataset for fresh waters located within the Peninsula Bioregion of Florida. For marine waters, the second tier applies FDEP's list of similar non-impaired marine waters that sustain a healthy balance of flora and fauna to use as candidate WBIDs for determining the nutrient targets. The third tier, EPA's Pollutant Loading (PLOAD) spreadsheet, was not used in developing the TMDL targets as the first two tiers were successful. PLOAD was applied to each waterbody for additional information that may be helpful during TMDL implementation and is discussed in Appendix A. The targets produced by applying the first two tiers can be viewed in the following table.

4. TMDL Targets:

WBID	Parameter	Regression Approach	Bioregion Approach-Fresh	Candidate WBIDS Approach-Estuarine
1668A	TN	49 % reduction	n/a[1]	n/a[1]
	TP	49 % reduction	n/a[1]	n/a[1]
1668B	TN	n/a[1]	27% reduction, 0.94 mg/L	n/a[1]
	TP	n/a[1]	64 % reduction, 0.064 mg/L	n/a[1]
1508	TN	n/a[1]	n/a[1]	69 % reduction, 0.53 mg/L
	TP	n/a[1]	n/a[1]	92 % reduction, 0.05 mg/L

[1] not applicable because the approach was not applied to the WBID

5. **TMDL Allocations:**

WBID	Parameter	WLA	LA	TMDL
		MS4		
1668A	TN	49% reduction	49% reduction	49% reduction
	TP	49% reduction	49% reduction	49% reduction
1668B	TN	27 % reduction, 0.94 mg/L	27 % reduction, 0.94 mg/L	27 % reduction, 0.94 mg/L
	TP	64 % reduction, 0.064 mg/L	64 % reduction, 0.064 mg/L	64 % reduction, 0.064 mg/L
1508	TN	69 % reduction, 0.53 mg/L	69 % reduction, 0.53 mg/L	69 % reduction, 0.53 mg/L
	TP	92 % reduction, 0.05 mg/L	92 % reduction, 0.05 mg/L	92 % reduction, 0.05 mg/L

Note: For these TMDLs, it is not possible to estimate the daily loads due the lack of flow data. However, in order to calculate a daily load, multiple the TMDL concentration by the daily flow and appropriate conversion factors.

5. Endangered Species (yes or blank): Yes

6. **EPA Lead on TMDL (EPA or blank):** EPA

7. TMDL Considers Point Source, Nonpoint Source, or Both: Both

TOTAL MAXIMUM DAILY LOADS FOR NUTRIENTS, LOW DISSOLVED OXYGEN AND BIOCHEMICAL OXYGEN DEMAND IN THE SPRINGS COAST BASIN (WBIDS 1668A, 1668B AND 1508)

1. INTRODUCTION

Section 303(d) of the Clean Water Act (CWA) 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).

For assessment purposes, the Florida Department of Environmental Protection (FDEP) has divided the Springs Coast Basin into water assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or stream reach. This TMDL report addresses three WBIDs, 1668A, 1668B and 1508. The WBIDs are part of the Coastal Pinellas County Planning Unit. Planning units are groups of smaller watersheds (i.e., WBIDs) that are part of a larger basin, in this case the Springs Coast Basin.

2. PROBLEM DEFINITION

Florida's final 1998 Section 303(d) list identified WBIDs 1668A, 1668B and 1508 as not supporting water quality standards (WQS). This report addresses the nutrient, biochemical oxygen demand (BOD) and dissolved oxygen (DO) listings for these WBIDs (Table 1). The geographic locations of these WBIDs are shown in Figure 1. These TMDLs are developed pursuant to EPA commitments 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).

Table 1. Impaired Waterbodies addressed in this TMDL Report

WBID	Name	Classification	River Basin	County	Constituents
1668A	St. Joe Creek	3F (Fresh)	Springs Coast	Pinellas	Dissolved Oxygen, Nutrients, Biochemical Oxygen Demand
1668B	Pinellas Ditch #5	3F (Fresh)	Springs Coast	Pinellas	Dissolved Oxygen, Biochemical Oxygen Demand, Nutrients

1508	Klosterman Bayou Run	3M (Marine)	Springs Coast	Pinellas	Dissolved Oxygen, Nutrients

3. WATERSHED DESCRIPTION

Information about the watershed is summarized from the Springs Coast Water Quality Status Report (FDEP, 2006). The Springs Coast Basin covers approximately 800 square miles and a complex hydrologic system. The southern part of the Springs Coast Basin encompasses western Pinellas County. Pinellas County, which extends from the Anclote River southward to Gulfport and eastward to S.R. 19, is mostly developed and has the highest population density in the State. St. Joe Creek (WBID 1668A), Pinellas Ditch#5 (WBID 1668B) and Klosterman Bayou (WBID 1508) are all located entirely in Pinellas County.

St. Joe Creek

The main stem of St. Joe Creek is divided into a tidal and a freshwater segment identified as 1668E and 1668A, respectively. The fresh water segment of St. Joe Creek (WBID 1668A) is the segment that is addressed in this TMDL report. St. Joe Creek is free flowing for about 4.9 miles until it reaches the upper most portion of its tidal area. The tidal portion begins where the creek crosses under 46th Avenue in the City of St. Petersburg. The tidal portion of the Creek is not addressed in this TMDL report. St. Petersburg is the largest City in Pinellas County and the forth largest in the state of Florida. The population of St. Petersburg is 247,610. Based on the population density in St. Petersburg (4163 persons/square mile), the estimated existing population in the fresh water portion of St. Joe Creek is 124,890 individuals.

Pinellas Ditch #5

Pinellas Ditch #5 is a free flowing freshwater system, which flows into the estuarine segment of St. Joe Creek. The channel length is approximately 1.3 miles and has concrete lined banks along most of its length. The watershed is part of the Pinellas Park Water Management District, which manages the basins within its jurisdiction for stormwater drainage pursuant to Florida Statute. In 2003, the population of the City of Pinellas Park was 46,449, according to the U.S. Census Bureau. Based on the population density of the City of Pinellas Park (3095.8 persons/square mile) the estimated existing population in the Pinellas Park Ditch #5 WBID area is 7,863 individuals.

Klosterman Bayou

The Klosterman Bayou watershed is located in a densely populated region of northern Pinellas County, Florida, south of the city of Tarpon Springs. The tidal segment receives drainage from the freshwater segment of Klosterman Creek originating to the southeast. The total channel length from the headwaters to the bayou's mouth is about 2.4 miles with approximately the last 1.1 miles being influenced by tides. Klosterman Bayou originates as a small creek draining residential and golf course areas and becomes tidally influenced upstream of alternate U.S. Highway 19. The marine portion of the Bayou is heavily modified and channelized and located in a residential area. Ultimately Klosterman Bayou flows into St. Joseph Sound. The tidal segment of Klosterman Bayou (WBID 1508) has an area of approximately 757 acres.

Location of St. Joe Creek, Pinellas Ditch #5, and Klosterman Bayou in the Springs Coast Basin

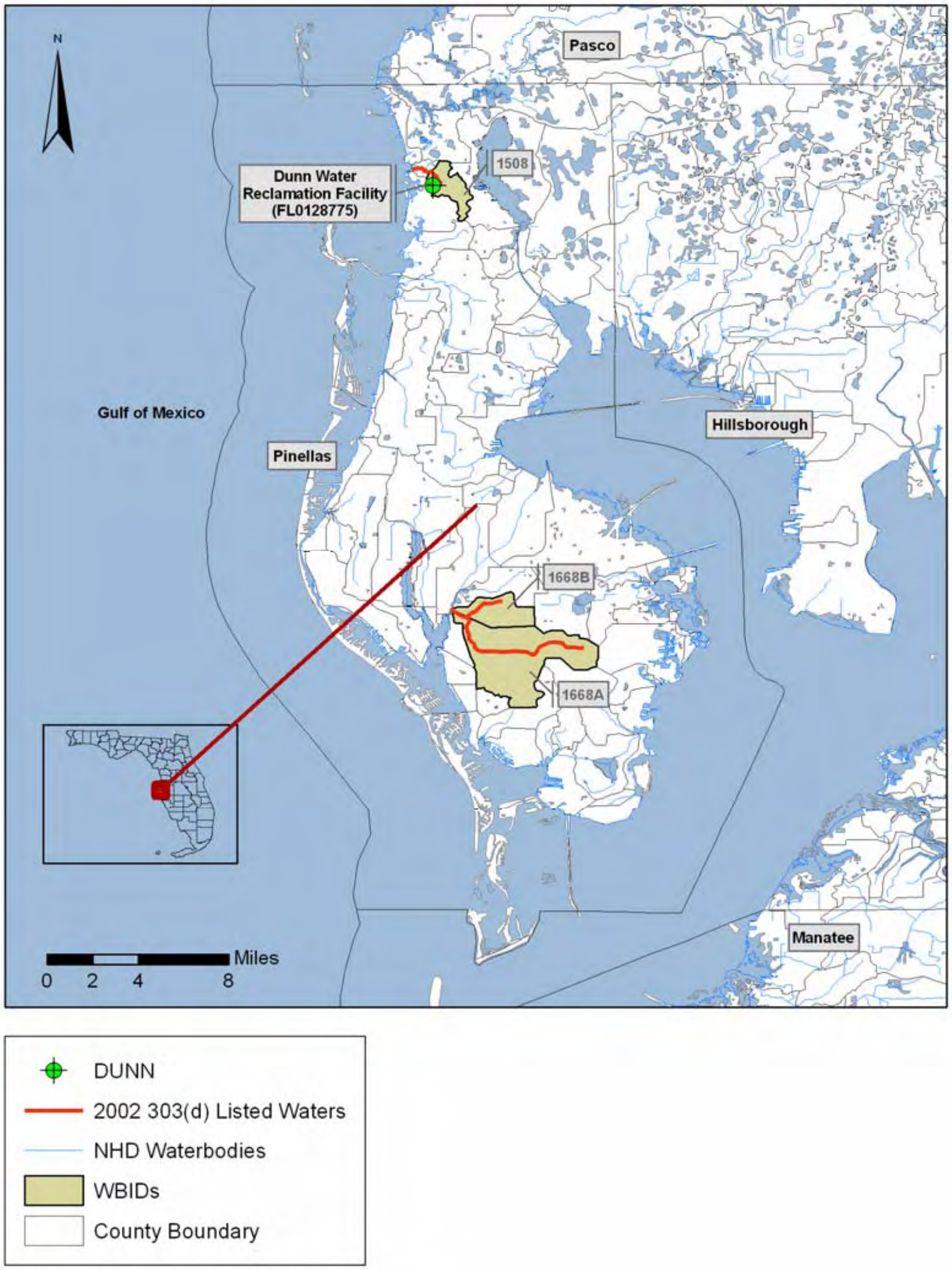

Figure 1. Location of St. Joe Creek , Pinellas Ditch #5 and Klosterman Bayou in the Springs Coast Basin

In the Springs Coast Basin, the Coastal Pinellas Planning Unit covers about 252 square miles and contains the WBIDs addressed in this report. As would be expected from such a highly urbanized landscape, one of the most abundant land uses in each of the three WBIDs is high density residential. High density residential is categorized by having more than 6 dwelling units per acre. St. Joe Creek (WBID 1668A) is 73 percent high density residential, Pinellas Ditch #5 (WBID 1668B) is 44 percent high density residential and Klosterman Bayou (WBID 1508) is 29 percent high density residential (Table 1). Recreational land use is the most predominant land use in Klosterman Bayou. The least abundant land uses in the three WBIDs are agriculture, rangeland, extractive and barrenland.

Table 2. Land Use Distribution

Land Use Description	WBID 1668A		WBID 1668B		WBID1508	
	Area (acres)	Percent (%)	Area (acres)	Percent (%)	Area (acres)	Percent (%)
Residential, Low Density	0.00	0.00	59.0	3.00	46.0	3.50
Residential, Medium Density	0.00	0.00	175	9.00	50.0	4.00
Residential, High Density	535	73.0	860	44.0	384	29.0
Commercial and Services	75.0	10.0	376	19.0	46.0	3.50
Industrial	0.00	0.00	138	7.00	4.17	0.00
Extractive	0.00	0.00	0.00	0.00	0.00	0.00
Institutional	104	14.0	104	5.00	4.17	0.00
Recreational	0.00	0.00	29.0	2.00	430	33.0
Open Land	0.00	0.00	29.0	2.00	4.17	0.00
Agriculture	0.00	0.00	4.20	0.00	0.00	0.00
Rangeland	0.00	0.00	0.00	0.00	0.00	0.00
Forest	0.00	0.00	29.0	2.00	104	8.00
Water	8.40	1.00	33.0	2.00	50.0	4.00
Wetlands	0.00	0.00	63.0	3.00	104	8.00
Barrenland	0.00	0.00	0.00	0.00	0.0	0.00
Transportation, Communication, Utilities	13.0	2.00	54.0	2.00	92.0	7.00
Total	735	100	1954	100	1319	100

4. WATER QUALITY STANDARDS

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

Class I	Potable water supplies
Class II	Shellfish propagation or harvesting
Class III	Recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife
Class IV	Agricultural water supplies
Class V	Navigation, utility, and industrial use

The WBIDs addressed in this report are designated as Class III waters. The designated use of Class III waters is recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The water quality criteria for protection of Class III waters are established by the State of Florida in the Florida Administrative Code (FAC), Section 62-302.530. The individual criteria should be considered in conjunction with other provisions in WQS, 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. In addition, unless otherwise stated, all criteria express the maximum not to be exceeded at any time. The specific criteria that apply to the individual WBIDs are described in the following sections.

4.1 Nutrients

The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards contained in this chapter [Section 62.302 FAC]. 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 and fauna [Section 62.302.530 FAC]. Because the State of Florida does not have numeric criteria for nutrients, total nitrogen, total phosphorus, chlorophyll and DO concentrations are used to indicate whether nutrients are present in excessive amounts.

4.2 Dissolved Oxygen

Fresh: DO shall not be less than 5.0 mg/L. Normal and daily seasonal fluctuations above these levels shall be maintained.

Marine: DO shall not be 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.

The narrative nutrient criterion is also controlling as it related to dissolved oxygen [62-302.530(48)(a)]. The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards contained in this chapter.

The water quality standard for DO also considers the definition of natural background and the directive not to abate natural conditions. Florida standards (62-302.200(15) FAC) states that, "'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." Florida standards also state at 62-302.300(15) FAC, "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."

In the TMDL context, without a Site Specific Alternative Criteria, calculating allocations would be targeted to achieve the natural background loading and instream concentrations in the waterbody. Any allowance of increased pollutant loadings beyond natural background would likely cause other than natural dissolved oxygen levels, which would not be a proper application of the Florida definition. Because the standard prevents abatement of natural conditions, the TMDL can provide an allocation, where necessary, that results in natural conditions.

4.3 Biochemical Oxygen Demand

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.

5. WATER QUALITY TARGET IDENTIFICATION

5.1 Basis and Rationale For Nutrient Targets

Aquatic life becomes impaired by nutrients when excess amounts of nutrients are expressed in excess primary productivity. Primary productivity refers to the collective actions of plants (autotrophs) to utilize the energy of sunlight through the process of photosynthesis to fix carbon and available nutrients into biomass of living organisms. This is, of course, an essential process on which all plants and animals depend, and it serves as an intersection of the global cycles of critical elements carbon, hydrogen, oxygen, nitrogen, and phosphorus (C, H, O, N, & P).
In aquatic systems, the normal cycles of C, H O, N, and P can be distorted by anthropogenic activities in the watershed which generate extra N & P that can enter adjacent waterbodies by surface runoff and ground water inflow. These excess nutrients then drive excess primary productivity, and the extra accumulated biomass is seen as an over-abundance of aquatic plants, i.e., algal blooms and/or increased macrophyte vegetation. This produces nuisance conditions which affect aesthetic values and recreation. When certain algal species are involved which are able to produce toxins, as in Harmful Algal Blooms (HABs), human health can be affected by exposure through drinking water, direct contact, or inhalation.

Aquatic life use can be impacted directly by excess algal blooms and/or macrophyte abundance through loss of habitat or other competitive disadvantages. But even more widespread impact occurs indirectly through depression or depletion of dissolved oxygen that occurs when excess primary production eventually decomposes and creates a great demand for dissolved oxygen. This lowers the available oxygen for other aquatic life. Most aquatic life becomes stressed by chronic low oxygen conditions and is virtually eliminated when oxygen depletion persists for a significant period of time. Impairment of aquatic life use is the common result of excess eutrophication of a waterbody. Since excess primary production is what creates the problem in the waterbody, and that results directly from excess available nutrients, protection of aquatic life requires control of available nutrients, in order to restrict primary productivity. But it should be kept in mind that resultant productivity may lag introduction of nutrients in space and time, and that fact must be considered when correlating nutrient levels and response. Proximal production may be temporarily suppressed by limitation of light, the amount of one nutrient, high velocity/turbulence, or lack of substrate, but transported bio-available nutrients will be utilized at some point. When these excess nutrients are expressed, they will drive excess productivity and adversely affect aquatic life in that location. The frequency and extent of these low oxygen events affects organisms differently, with non-motile and long-lived organisms among the most sensitive.

While controlling one nutrient can prevent productivity, control of both nutrients, N and P, in upstream waters can also provide additional assurance that excess productivity will remain in control. Under conditions of phosphorus limitation, even if local excess primary productivity is controlled to a large extent by phosphorus reduction alone, there will be consequent export of the excess nutrient, nitrogen, because the excess of that nutrient would not have the opportunity for uptake into biomass. The larger the excess of nitrogen, the greater the contribution to nitrogen sensitive downstream systems; therefore, concurrent reduction of nitrogen in the basin is often warranted in order to protect downstream use. But there may also be an additional near-field justification for nitrogen reduction, arising from the fact that at those times when local primary productivity is being effectively suppressed by phosphorous limitation, biological uptake of N is restricted, which may leave the chemically reduced constituents of the nitrogen series, i.e., ammonia and organic N, to directly exert their oxygen demand in a setting that is already under oxygen stress. For these nutrient, DO and BOD TMDLs, control of both TP and TN as nutrient inputs to prevent adverse effects is considered to be necessary.

5.2 Approches for Developing Nutrient Target

The nutrient targets for the TMDLs were developed by applying a tiered approach, which uses independent approaches that have varying strengths and weaknesses. The first tier applies the regression approach, which attempts to develop a multivariate regression model to analyze the relationship between the low instream DO and nutrients. If a regression correlation does not exist, then the second tier is applied. For fresh waters, the second tier applies the 25th percentile of an all stream dataset for the fresh waters that are located within the peninsula bioregion of Florida. For marine waters, the second tier applies FDEP's list of similar non-impaired marine waters that sustain a healthy balance of flora and fauna to use as candidate WBIDs for determining the nutrient targets. The third tier, EPA's Pollutant Loading (PLOAD) spreadsheet, was not used in developing the TMDL targets as the first two tiers were successful. PLOAD was applied to each waterbody for additional information that may be helpful during TMDL implementation and is discussed in Appendix A. A summary of the two approaches that were applied is discussed below. The targets produced by applying the first two tiers can be viewed in the Table 5.

Tier 1: Regression Approach: The regression approach attempts to develop a multivariate regression model to analyze the relationships between the low instream DO and nutrients. The regression approach combines the known kinetic relationships for the sources and sinks of DO with correlation and regression statistics. If the regression model is successful (i.e., inverse relationship between DO and pollutant concentrations), then the variation in the observed DO can be explained by variables such as temperature, BOD, chlorophyll, nutrients, organic carbon, and/or flow.

If correlation exists between DO and nutrients, the regression approach can be used to develop the TMDL. The DO criterion can be targeted in the regression equation to determine the nutrient percent reduction.

Tier 2-Fresh Water: For fresh waters, a reference condition approach consistent with EPA's peer-reviewed nutrient criteria guidance was used to develop the targets for the TMDLs. The 25th percentile of the TP and TN data from an all fresh water stream dataset located in the Peninsula Bioregion was selected as the targets for the TMDLs. Table 3 provides the percentile distribution of TP and TN for the peninsula bioregion of Florida. These percentiles were calculated by determining WBID median values for all TN and TP data within each individual WBID. The percentiles were calculated using all WBID median values. The 25th percentile annual average concentrations for TP and TN are 0.064 mg/L and 0.94 mg/L, respectively.

Table 3 Florida Peninsula Bioregion Percentile Distribution

Percentile	TP	TN
5	0.037	0.59
10	0.045	0.74
15	0.050	0.81
20	0.059	0.89
25	0.064	0.94
30	0.073	0.98
35	0.080	1.01
40	0.088	1.07
45	0.098	1.11
50	0.107	1.14
55	0.120	1.20
60	0.141	1.25
65	0.160	1.32
70	0.190	1.38
75	0.228	1.45
80	0.280	1.56
85	0.376	1.72
90	0.570	1.86
95	0.963	2.23

Tier 2-Marine Water: For the marine waterbody, Klosterman Bayou, FDEP provided EPA a list of marine waters that sustain a healthy balance of flora and fauna for use as candidate WBIDs for determining nutrient targets. A list of these waters is provided in Table 4. An assumption of this TMDL is that if nutrient levels are reduced to concentrations measured in these unimpaired streams, Klosterman Bayou should support a healthy estuary.

Table 4 Candidate WBIDs for Determining Nutrient Targets (source: FDEP, 2007)

Waterbody	**TP (mg/L)**	**TN (mg/L)**
CLEARWATER HARBOR SOUTH - WBID 1528	0.04	0.51
THE NARROWS - WBID 1528A	0.06	0.58
DIRECT RUNOFF TO INTERCOASTAL WATERWAY - WBID 1528B	0.09	N/A
CLEARWATER HARBOR NORTH - WBID 1528C	0.04	0.52
BOCA CIEGA BAY CENTRAL - WBID 1694A	0.05	0.44
BOCA CIEGA BAY NORTH - WBID 1694B	0.04	0.48
BOCA CIEGA BAY - WBID 1694C	0.06	0.55
ST. JOSEPH SOUND - WBID 8045D	0.02	0.51
Anclote River - WBID 1440	0.07	0.66
Average Value:	**0.05**	**0.53**

Table 5 TMDL Targets

WBID	Parameter	Regression Model	Bioregion Approach-Fresh	Candidate WBIDS Approach-Estuarine
1668A	TN	49 % reduction	n/a[1]	n/a[1]
	TP	49 % reduction	n/a[1]	n/a[1]
1668B	TN	n/a[1]	26% reduction, 0.94 mg/L	n/a[1]
	TP	n/a[1]	64 % reduction, 0.064 mg/L	n/a[1]
1508	TN	n/a[1]	n/a[1]	69 % reduction, 0.53 mg/L
	TP	n/a[1]	n/a[1]	92 % reduction, 0.05 mg/L

6. WATER QUALITY ASSESSMENT

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). The IWR defines FDEP's threshold for identifying water quality limited WBIDs to be included on the State's 303 (d) list. The water quality data used to develop that TMDLs are from IWR database, Run 28. In addition, all waters on the 1998 303 (d) list that were not de-listed remain on the current list and require TMDLs. St. Joe Creek and Pinellas Ditch #5 are on FDEP's verified list for DO and nutrients and on FDEP's planning list for BOD. Klosterman Bayou is on FDEP's verified list for DO and nutrients. EPA assessed the data and concluded the WBIDs are impaired for these parameters and a TMDL must be developed.

A list of the monitoring stations located in the impaired WBIDs can be found in Table 6. A summary of the observed monitoring data for DO, TN and TP can be found in Tables 7, 8 and 9. Figures 2 through 12 show the observed monitoring data for DO, TN and TP at all stations in the WBID.

For St. Joe Creek, there is a 62 percent exceedance rate with 203 WQS violations out of 295 observations for DO. The average TN and TP concentrations are 0.91 mg/L and 0.08 mg/L, respectfully. For Pinellas Park Ditch #5, there is a 39 percent exceedance rate with 62 WQS violations out of 161 observations for DO. The average TN and TP concentrations are 1.25 mg/L and 0.18 mg/L, respectfully. The average TN and TP concentrations are only slightly higher than what is considered to be typical concentrations for Florida's streams. The typical average TN and

TP concentrations for Florida's streams are 1.2 mg/L and 0.11 mg/L, respectfully (Freidemann and Hand, 1989). For Klosterman Bayou, there is a 65 percent exceedance rate with 258 WQS violations out of 400 observations. The average TN and TP concentrations are 1.63 mg/L and 0.66 mg/L, respectively. The average TN and TP concentrations are significantly higher that what is considered typical concentrations for Florida's estuaries. The typical average TN and TP concentrations for Florida's estuaries are 0.8 mg/L and 0.10 mg/L (Freidemann and Hand, 1989). The TN, TP and BOD values for all three waterbodies are often times elevated during periods of rainfall.

Table 6 Monitoring Stations in Springs Coast Basin

Waterbody	Station ID
St. Joe Creek	112WRD02308935
	21FLPDEM35-03
	21FLPDEM35-06
	21FLPDEM35-10
	21FLPDEM35-11
	21FLPDEM35-12
	21FLPDEMAMB35-3
	21FLPDEMAMB35-6
	21FLTPA27483438243412
	21FLTPA27483668242429
	21FLTPA27484788240469
	21FLTPA27485048241453
	21FLTPA27485898241143
Pinellas Ditch #5	21FLPDEM35-01
	21FLPDEMAMB35-8
	21FLTPA27501148244127
	21FLTPA27502758243422
Klosterman Bayou	21FLPDEM02-01
	21FLPDEM02-02
	21FLPDEM02-07
	21FLPDEMAMB02-1
	21FLPDEMAMB02-2
	21FLPDEMAMB02-5
	21FLPDEMAMB02-6
	21FLPDEMAMB02-7
	21FLTPA28065728245513
	21FLTPA2807022824552
	21FLTPA28070708246127
	21FLTPA28071158246059

Table 7 Summary of Monitoring Data in St. Joe Creek (WBID 1668A)

Waterbody	Parameter	Observations	Minimum (mg/l)	Median (mg/l)	Maximum (mg/l)
St. Joe Creek	DO	295	0.22	5.97	12.3
St. Joe Creek	TP	223	0.01	0.07	0.38
St. Joe Creek	TN	228	0.21	0.91	2.76
St. Joe Creek	BOD	151	0.26	2.10	8.00

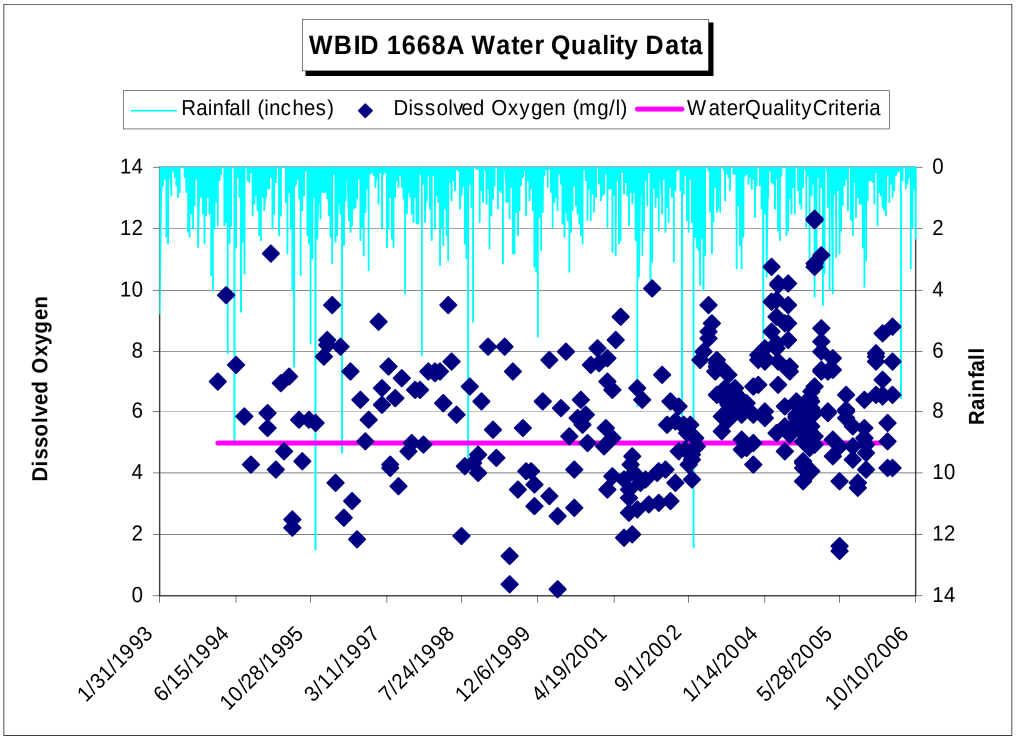

Figure 2. Summary of DO Monitoring Data in St. Joe Creek

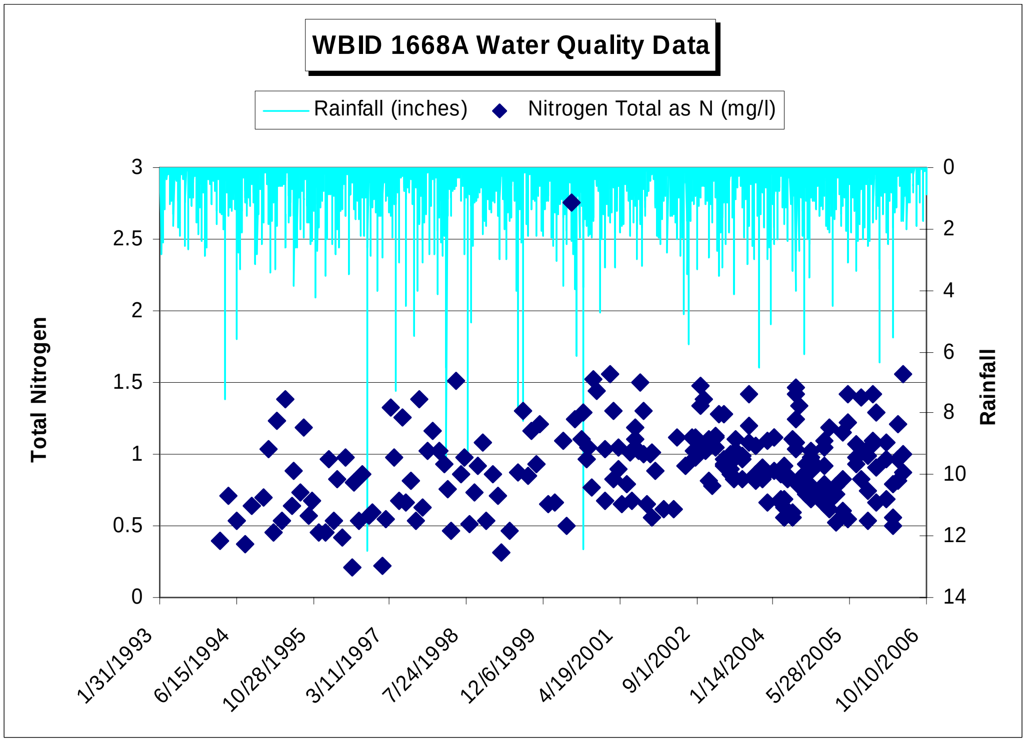

Figure 3. Summary of TN Monitoring Data in St. Joe Creek

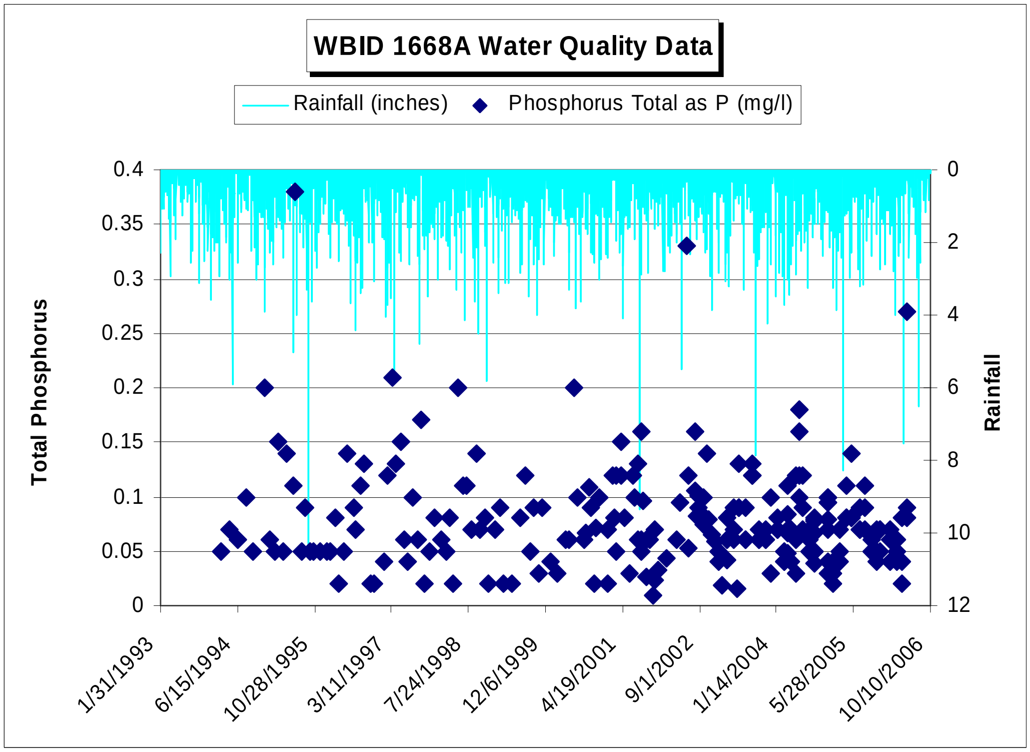

Figure 4. Summary of TP Monitoring Data in St. Joe Creek

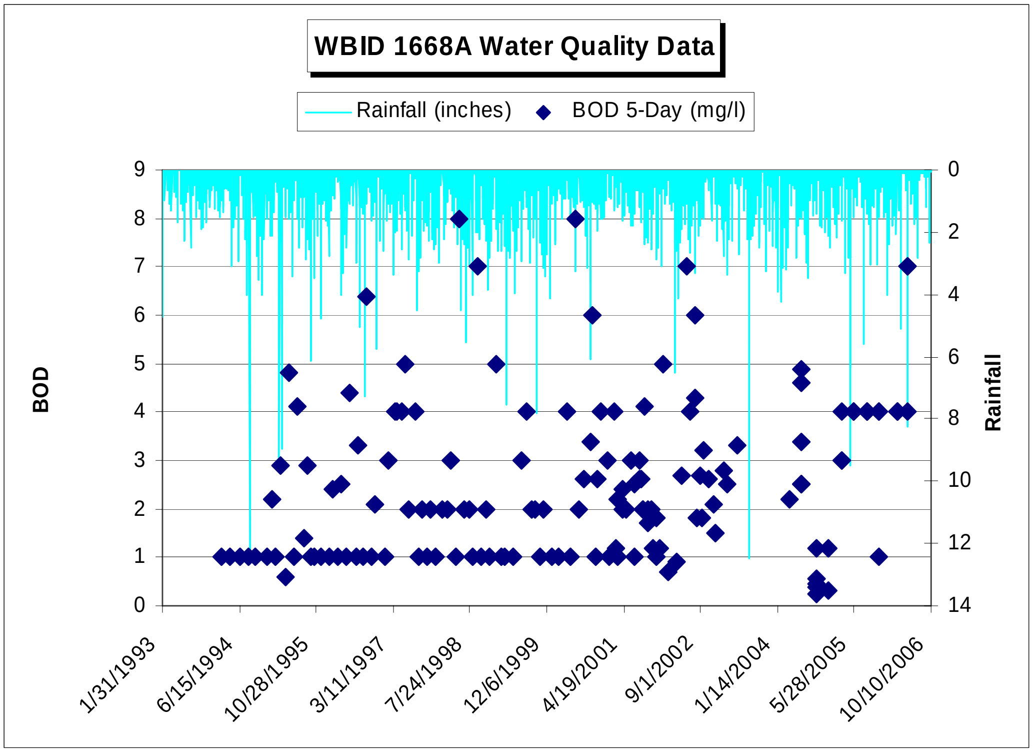

Figure 5 Summary of BOD Monitoring Data in St. Joe Creek

Table 8 Summary of Monitoring Data in Pinellas Ditch #5 (WBID 1668B)

Waterbody	Parameter	Observations	Minimum (mg/l)	Median (mg/l)	Maximum (mg/l)
Pinellas Ditch #5	DO	161	0.12	4.26	14.3
Pinellas Ditch #5	TP	133	0.02	0.12	2.76
Pinellas Ditch #5	TN	131	0.31	1.09	18.05
Pinellas Ditch #5	BOD	123	0.05	2.00	15.0

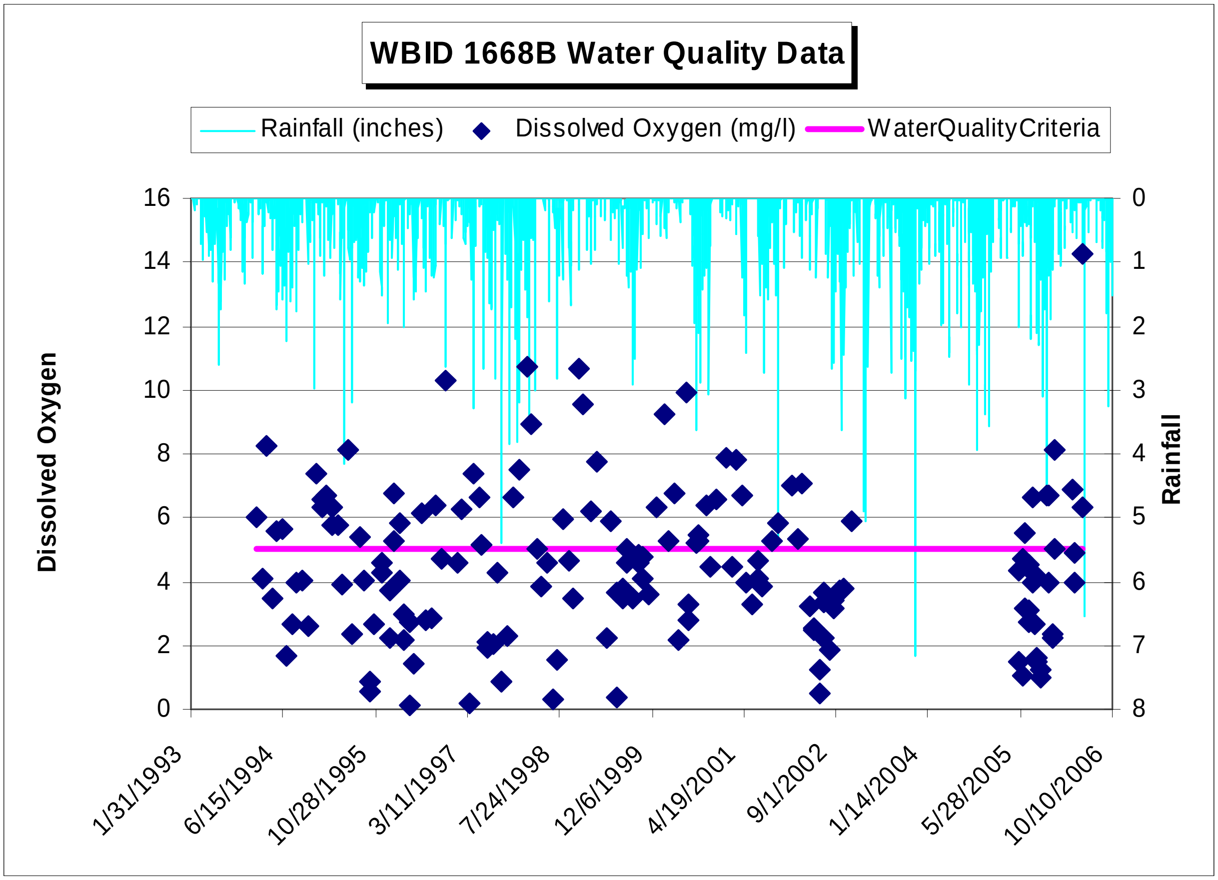

Figure 6 Summary of DO Monitoring Data in Pinellas Ditch #5

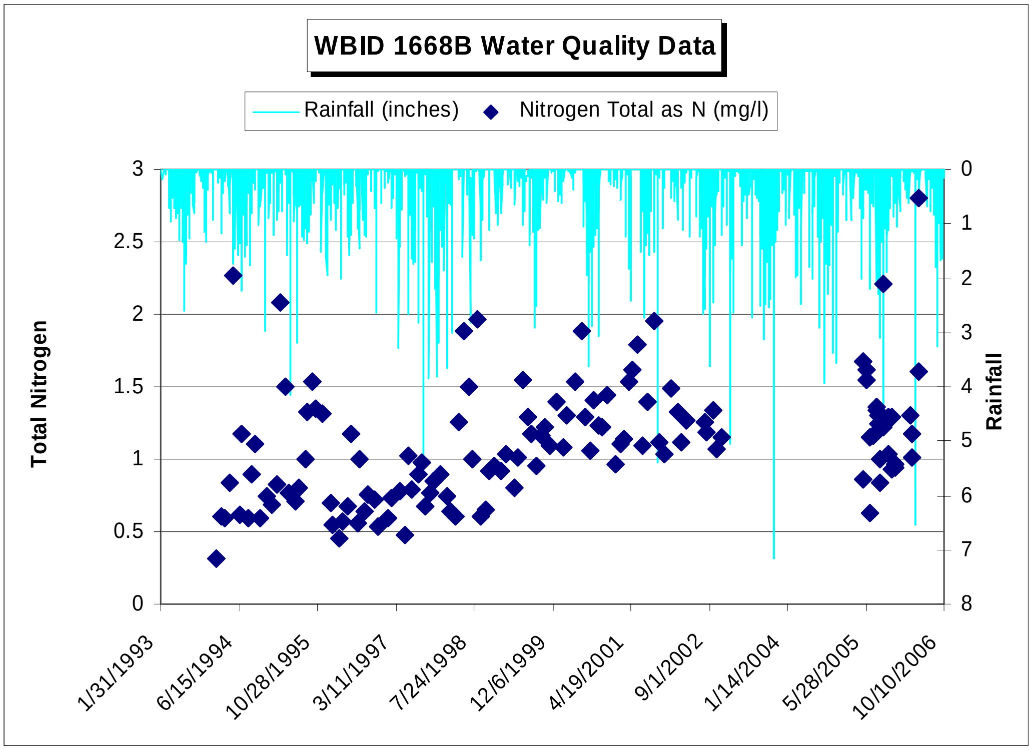

Figure 7 Summary of TN Monitoring Data in Pinellas Ditch #5

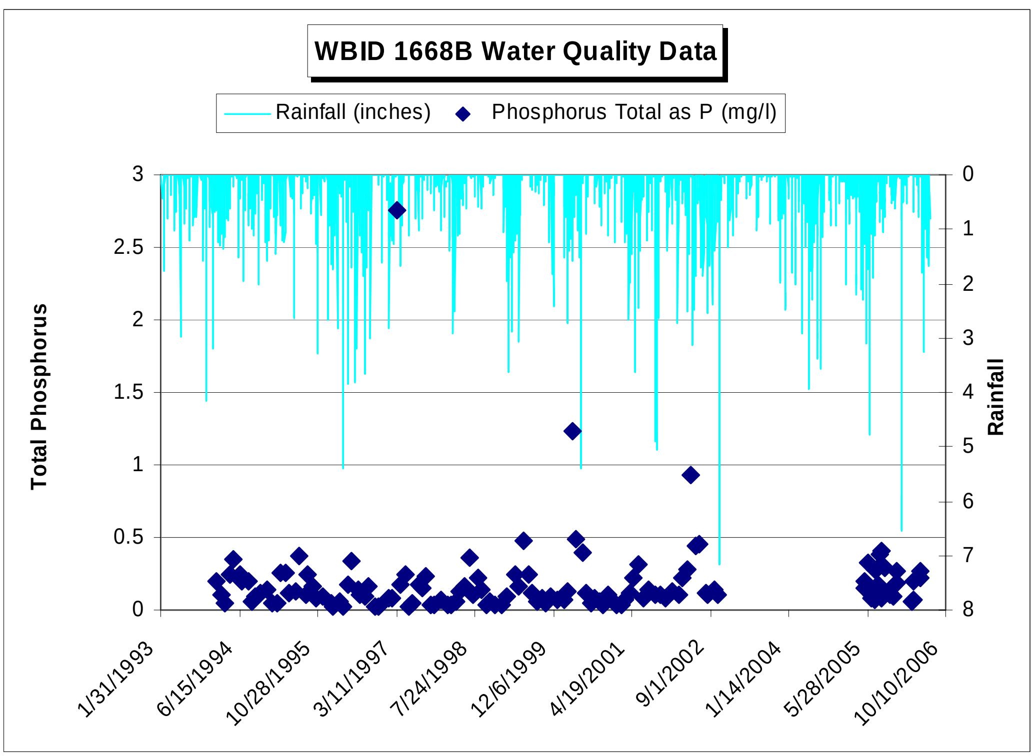

Figure 8 Summary of TP Monitoring Data in Pinellas Ditch #5

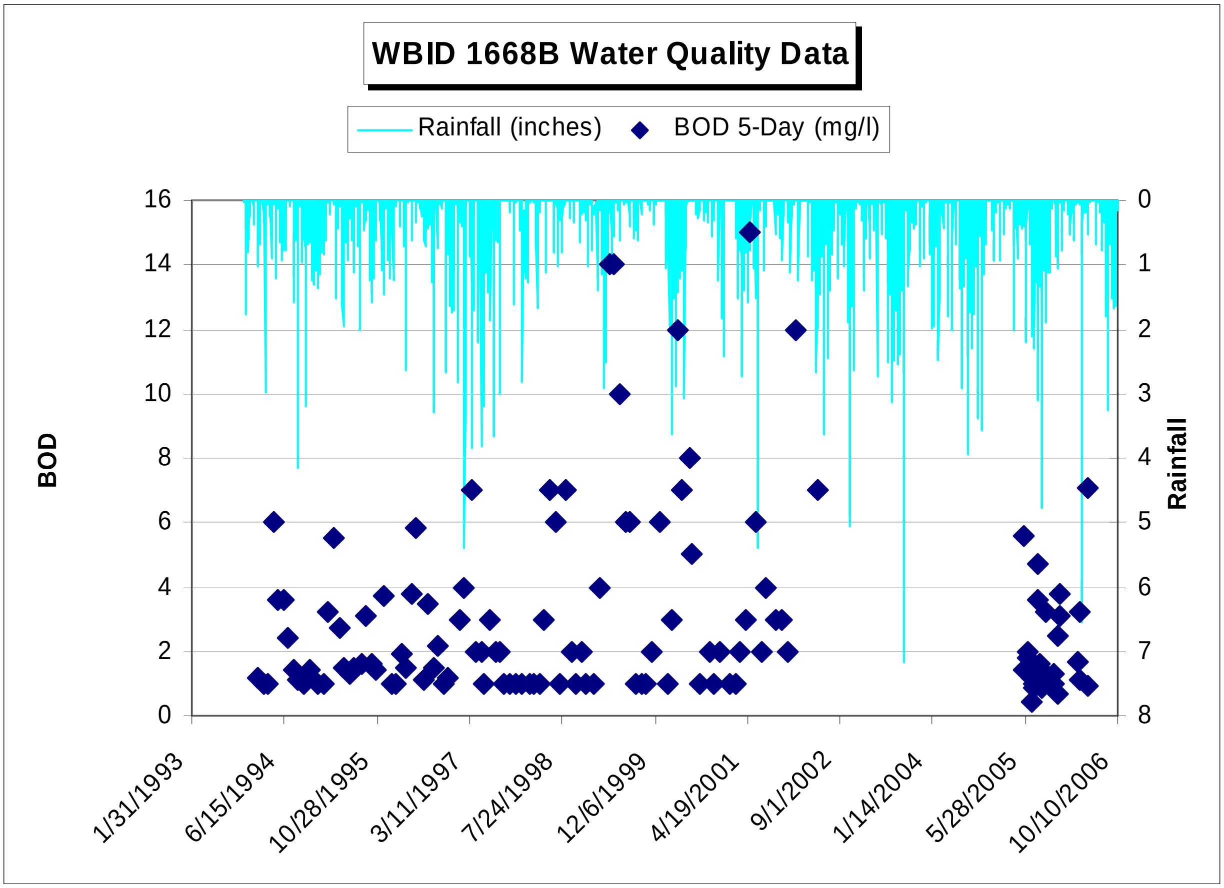

Figure 9 Summary of BOD Monitoring Data in Pinellas Ditch #5

Table 9 Summary of Monitoring Data in Klosterman Bayou (WBID 1508)

Waterbody	Parameter	Observations	Minimum (mg/l)	Median (mg/l)	Maximum (mg/l)
Klosterman Bayou	DO	400	0.04	5.03	22.2
Klosterman Bayou	TP	243	0.02	0.48	3.58
Klosterman Bayou	TN	227	0.49	1.53	5.26

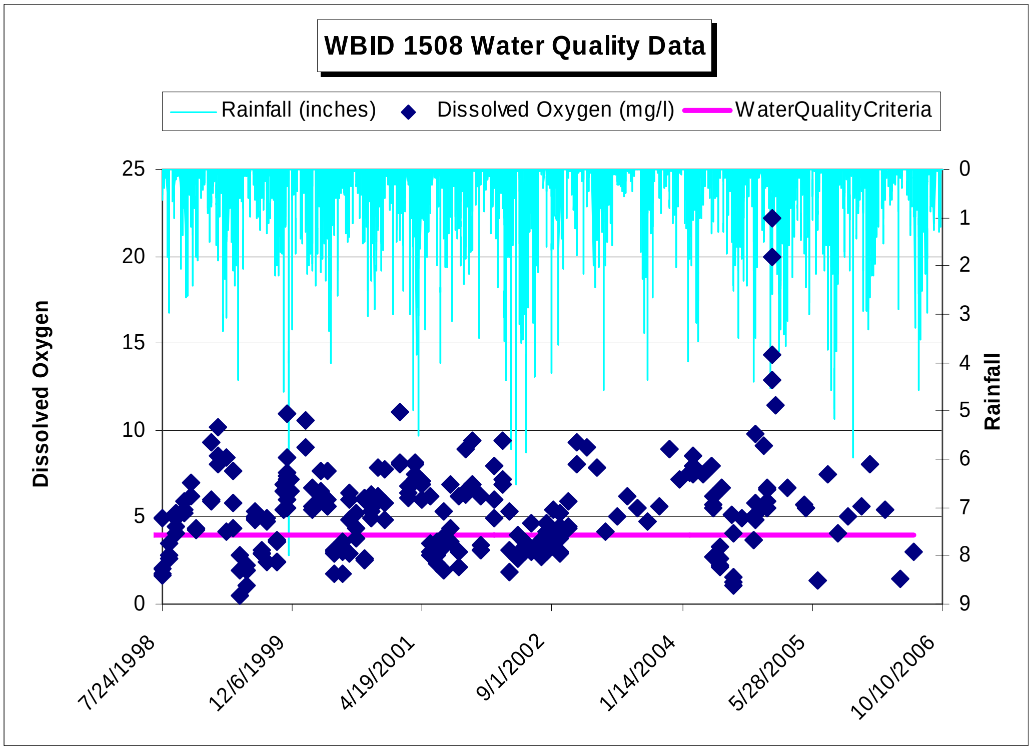

Figure 10 Summary of DO Monitoring Data in Klosterman Bayou

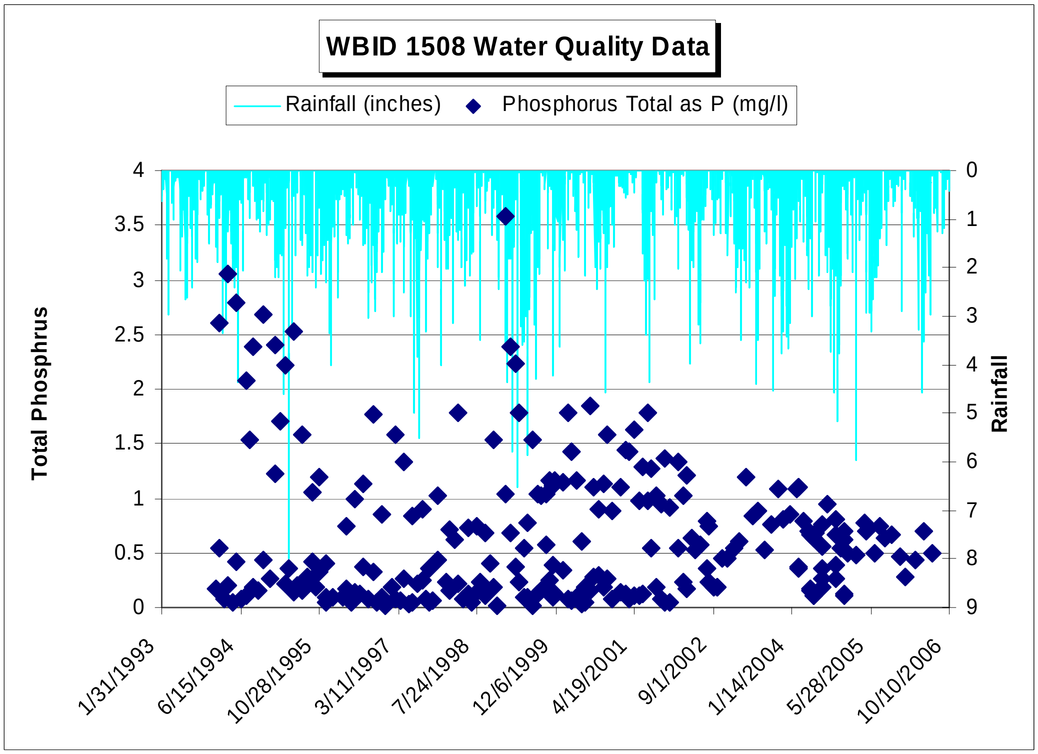

Figure 11 Summary of TP Monitoring Data in Klosterman Bayou

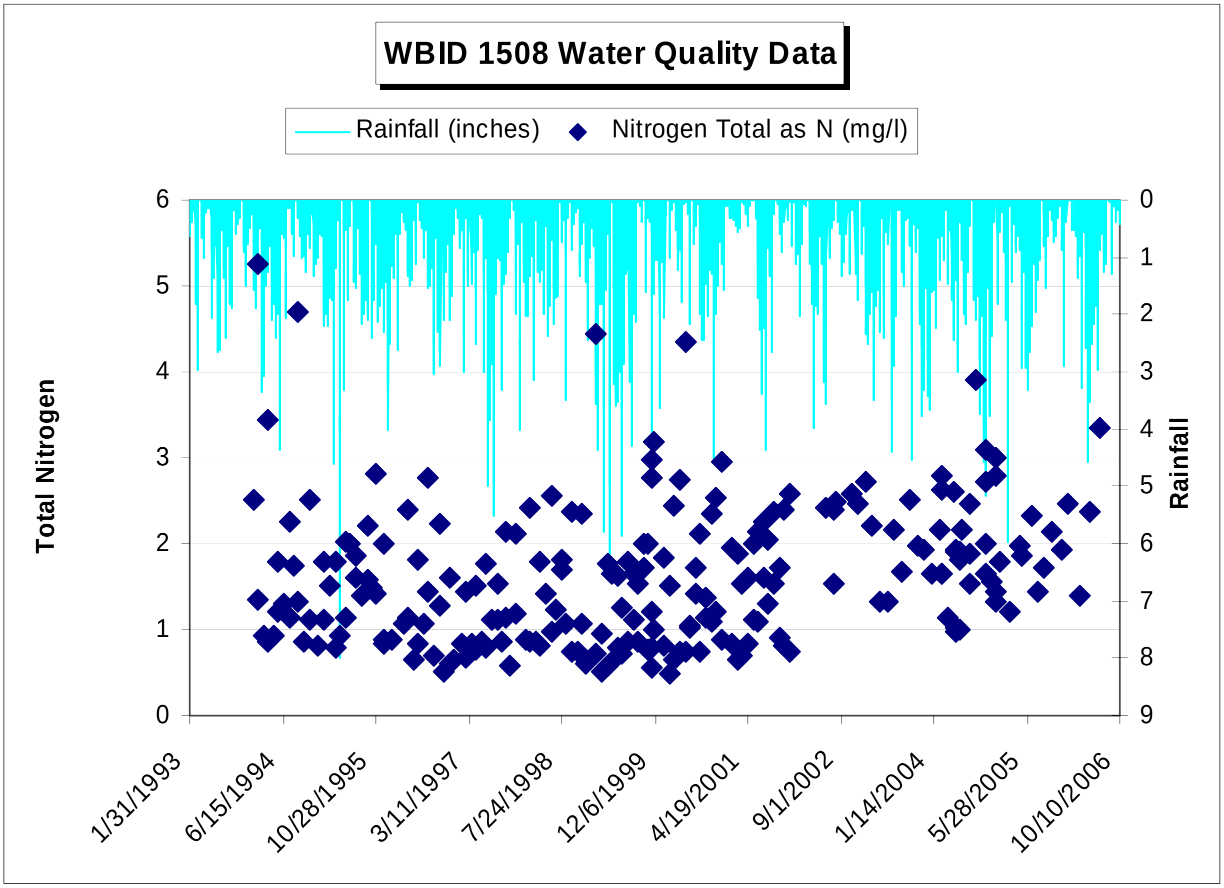

Figure 12 Summary of TN Monitoring Data in Klosterman Bayou

7. SOURCE 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 enter surface waters from both point and nonpoint 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 facilities, including certain urban stormwater discharges such as municipal separate stormwater systems (MS4 areas), certain industrial facilities, and construction sites over one acre, are storm-water driven sources considered "point sources" in this report.

Nonpoint sources of pollution are diffuse sources that cannot be identified as entering a waterbody through a discrete conveyance at a single location. These include animal waste, septic tanks and application of fertilizers to golf courses and lawns. Runoff from agricultural sites is not considered to be a source of nutrients in these WBIDs since the land use is currently zero percent agriculture. The sources generally, but not always, involve accumulation of nutrients on land surfaces and wash off as a result of storm events.

7.1 Point Sources

A wasteload allocation (WLA) is provided to industrial and domestic wastewater NPDES facilities and to permitted Municipal Separate Storm Sewer Systems (MS4s) discharging to surface waters.

7.1.1 Wastewater Treatment Facilities

There is one domestic wastewater treatment facility (WWTF) located in one of the impaired WBIDs. This facility is the William E. Dunn Water Reclamation Facility (FL0128775), which is located in Palm Harbor at 4111 Dunn Drive in Pinellas County, WBID 1508. An existing annual average daily flow of 9.0 million gallons per day (MGD) of reclaimed water is permitted to irrigate golf courses, common areas, residential subdivisions, parks, schools, athletic facilities and various other public and private areas. Klosterman Bayou runs through the Innisbrook Golf Course, which receives 1.77 MGD of reclaimed water from the Dunn Facility in order to serve its 506 acres. Since this facility does not discharge directly to Klosterman Bayou (WBID 1508), it is not included in the WLA. However, the surface water runoff from the Innisbrook Golf Course could be a potential non-point source and is included in the load allocation portion of the TMDL for Klosterman Bayou.

7.1.2 Municipal Separate Storm Sewer Systems (MS4s)

Municipal Separate Storm Sewer Systems (MS4s) may also discharge nutrients to waterbodies in response to storm events. Large and medium MS4s serving populations greater than 100,000 people are required to obtain a NPDES storm water permit under the Phase I storm water regulations. After March 2003, small MS4s serving urbanized areas are required to obtain a permit under the Phase II storm water regulations. An urbanized area is defined as an entity with a residential population of at least 50,000 people and an overall population density of 1,000 people per square mile.

The waterbodies located in the Springs Coast Basin that are within Pinellas County are all within MS4 jurisdictions. St. Joe Creek and Klosterman Bayou are under the jurisdiction of the Pinellas County Phase I MS4 Permit (FLS000005) that was issued in March 2004, which covers all areas located within the political boundary of Pinellas County. Each permittee covered in the permit is ultimately responsible for the MS4 dischargers resulting from their jurisdiction, including TMDLs and WLAs. The Pinellas Park Ditch #5 is within the City of Pinellas Park jurisdictional boundary, but is owned and operated by the Pinellas Park Water Management District (PPWMD). The PPWMD has not been issued an MS4 Permit.

7.2 Nonpoint Sources

Nonpoint sources that ultimately contribute to depletion of in-stream DO include sources of nutrients such as animal waste, fertilizer application to open areas that drain directly into the creek, and malfunctioning onsite sewage treatment and disposal systems, or septic tank systems. In the TMDL analysis, nonpoint sources are represented by the load allocation (LA). Nonpoint source loads from fertilizer application to open areas, such as lawns and golf courses that enters the creek directly, and not from storm drains, is outside the MS4 jurisdiction and is considered a source of nutrients.

8. ANALYTICAL APPROACH

St. Joe Creek (WBID 1668A)

A statistical regression model was used to analyze the relationship between the low instream DO and nutrients. This approach combines the known kinetic relationships for the sources and sinks of DO with correlation and regression statistics. Data collected in St. Joe Creek indicates that DO can be reasonable predicted with TN, TP and temperature. The regression equation indicates that a 49 percent reduction in TN and TP will improve DO and result in a DO concentration of 5.0 mg/L. The predicted DO can be determined by the following regression equation:

Predicted DO = (-4.743*[TP]) 0.51 + (-0.570*[TN]) 0.51 + (-0.109*Temperature) + 9.502
Where,
TP Slope = -4.743
TN Slope =-0.570
Temperature Slope = -0.109
Intercept = 9.502
Percent Reduction Multiplier =0.51 (1-0.51=0.49; 0.49*100= 49 percent reduction)
[TP] = Concentration of total phosphorus
[TN] = Concentration of total nitrogen

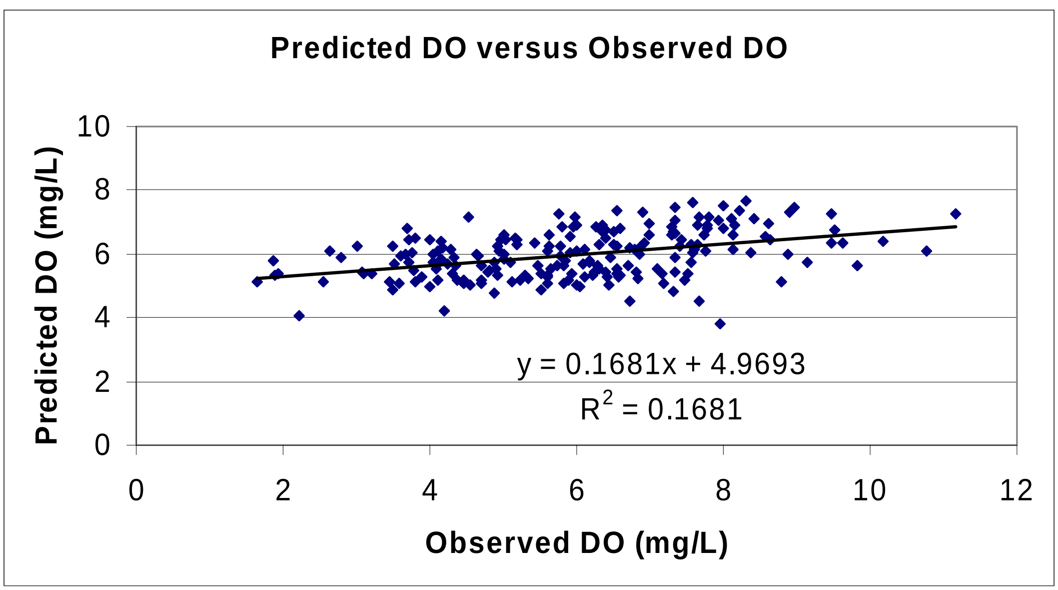

Figure 13 Predicted DO Versus Observed DO for St. Joe Creek

Pinellas Ditch #5

The statistical regression model could not be applied to Pinellas Ditch #5 because the relationship between low DO and nutrients was inconclusive. A reference condition approach consistent with EPA's peer-reviewed nutrient criteria guidance was used to develop the targets for the TMDLs. Data was extracted from FDEP's IWR Run 28 database for all WBIDs located in the Peninsula Bioregion of Florida. Only WBIDs within the Peninsula Bioregion of Florida classified as freshwater streams were used in this analysis. This consists of 349 WBIDs containing 2,392 water quality monitoring stations. This robust dataset of 53,688 TP measurements and 47,444 TN measurements were collapsed to WBID median values and statistically ranked. For the development of this TMDL, the 25^{th} percentile of TP and TN were selected as targets. EPA's guidance suggests that the 25^{th} percentile of the data is inherently protective of water quality. The 25^{th} percentile annual average concentrations for TN and TP are 0.94 mg/L and 0.064 mg/L, respectively and are used to represent annual average conditions.

The existing annual average TN and TP values for Pinellas Ditch #5 are 1.27 mg/L and 0.181 mg/L, respectively. These concentrations were calculated by averaging the yearly average nutrient concentrations observed in the waterbody. In order to meet the targeted TN and TP concentrations, a 27 percent reduction in TN and a 65 percent reduction in TP is required. The percent reduction in pollutant concentrations necessary to achieve the targets were calculated using the following equation:

Percent Reduction = (existing concentration – TMDL concentration)/existing concentration * 100

Klosterman Bayou

The statistical regression model could not be applied to Klosterman Bayou because the relationships between low DO and nutrients were inconclusive. Therefore, the TMDL for Klosterman Bayou is based on achieving water quality observed in similar non-impaired marine waters. FDEP provided EPA a list of marine waters that sustain a healthy balance of flora and fauna for use as candidate WBIDs for determining nutrient targets. A list of these waters is provided in Table 4**Error! Reference source not found.** An assumption of this TMDL is that if nutrient and BOD levels are reduced to concentrations measured in these unimpaired streams, Klosterman Bayou should support a healthy estuary.

The average of the median TN and TP values from FDEP's list of candidate WBIDs are 0.53 mg/L and 0.05 mg/L, respectfully. These values were selected as the target for Klosterman Bayou. The existing annual average TN and TP values for Klosterman Bayou are 1.65 mg/L and 0.64 mg/L. The existing annual average concentrations were calculated by averaging the yearly average nutrient concentrations observed in the waterbody. In order to meet the targeted TN and TP concentrations, a 68 percent reduction in TN and a 92 percent reduction in TP will be required. The percent reduction in pollutant concentrations necessary to achieve the reference marine concentrations was calculated using the following equation:

Percent Reduction = (existing concentration – TMDL concentration)/existing concentration * 100

9. DEVELOPMENT OF THE TMDL

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and recommends regulatory or other actions to be taken to achieve compliance with applicable WQS based on the relationship between pollution sources and in-stream water quality conditions. A TMDL can be expressed as the sum of all point source loads (WLA), nonpoint source loads (LA), and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

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

The objective of a TMDL is to allocate among all of the known pollutant sources throughout a watershed so that appropriate control measures can be implemented and WQS achieved. 40 CFR §130.2 (i) states that TMDLs can be expressed in terms of mass per time (e.g. pounds per day), toxicity, or <u>other appropriate measures</u>. TMDLs for St. Joe Creek, Pinellas Ditch#5 and Klosterman Bayou are expressed as percent reductions and instream nutrient concentrations.

9.1 Critical Conditions

Critical conditions can be defined as the environmental conditions requiring the largest reduction to meet standards. By achieving the reduction for critical conditions, WQS should be achieved during all other times. The critical condition in St. Joe Creek, Pinellas Ditch #5 and Klosterman Bayou is a result of a stormwater event. Prior to a rainfall event, pollutants build up on the land surface, and are washed off by rainfall.

9.2 Margin of Safety

TMDLs shall include a margin of safety (MOS) that takes into account any lack of knowledge about the pollutant loading and in-stream water quality. There are two methods for incorporating a MOS in the analysis: 1) implicitly incorporate the MOS using conservative model assumptions to develop allocations; or 2) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. An implicit MOS was used in these TMDLs because the measured water quality was used directly to determine the reduction to meet the water quality standard.

9.3 Determination of TMDL Components

The TMDL components are expressed as percent reductions in concentrations of TN and TP to attain the necessary WQS. The Best Management Practices (BMPs) used to implement the percent reductions should result in meeting WQS on a daily basis. The percent reductions are applied equally to both point and nonpoint sources, as the WLA is comprised completely of the MS4. The TMDL components are summarized in Table 10.

Table 10 Summary of TMDL Components

WBID	Parameter	WLA	LA	TMDL
		MS4		
1668A	TN	49% reduction	49% reduction	49% reduction
	TP	49% reduction	49% reduction	49% reduction
1668B	TN	27 % reduction, 0.94 mg/L	27 % reduction, 0.94 mg/L	27 % reduction, 0.94 mg/L
	TP	64 % reduction, 0.064 mg/L	64 % reduction, 0.064 mg/L	64 % reduction, 0.064 mg/L
1508	TN	69 % reduction, 0.53 mg/L	69 % reduction, 0.53 mg/L	69 % reduction, 0.53 mg/L
	TP	92 % reduction, 0.05 mg/L	92 % reduction, 0.05 mg/L	92 % reduction, 0.05 mg/L

9.4 Seasonal Variation

Seasonal variation is considered in the TMDL to ensure that WQS will be met during all seasons. Seasonal variation was addressed in the selection of the nutrient target concentrations by considering all data collected during all seasons.

9.5 Recommendations

Following the adoption of this TMDL by rule, the next step in the TMDL process is to develop an implementation plan, referred to as a Basin Management Action Plan (BMAP). This document should be developed over the next year in cooperation with local stakeholders and will attempt to reach consensus on more detailed allocations and on how load reductions will be accomplished. The BMAP will include the following:

- Appropriate allocations among the affected parties,
- A description of the load reduction activities to be undertaken,
- Timetables for project implementation and completion,
- Funding mechanisms that may be utilized,
- Any applicable signed agreement,
- Local ordinances defining actions to be taken or prohibited,
- Local WQS, permits, or load limitation agreements, and
- Monitoring and follow-up measures.

10. References

Florida Administrative Code. Chapter 62-302, Surface Water Quality Standards.

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Florida Department of Environmental Protection (FDEP). February 2001. A Report to the Governor and the Legislature on the Allocation of Total Maximum Daily Loads in Florida. Tallahassee, Florida: Bureau of Watershed Management.

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Friedemann, Mark and Hand, Joe. Typical Water Quality Values for Florida's Lakes, Streams and Estuaries. July 1989

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U. S. Census Bureau Web site. 2004. Available: http://www.census.gov/.

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USEPA, 1991. Guidance for Water Quality –based Decisions: The TMDL Process. U.S. Environmental Protection Agency, Office of Water, Washington, DC. EPA-440/4-91-001, April 1991.

USEPA. 2001. BASINS PLOAD Version 3.0 Users Manual. U.S. Environmental Protection Agency, Office of Water, Washington, DC. 2001.

USEPA, 2000. Nutrient Criteria Technical Guidance Manual, Rivers and Streams. USEPA, Office of Water, Washington, DC EPA-822-B-00-002.

Appendix A EPA's Pollutant Loading (PLOAD) Spreadsheet

TMDLs can be addressed by estimating pollutant loadings from an undisturbed land use condition using EPA's Pollutant Loading (PLOAD) spreadsheet. PLOAD was not used in the development of the TMDLs for St. Joe Creek, Pinellas Ditch #5 or Klosterman Bayou. However, the information provided by PLOAD may be useful during TMDL implementation in understanding how landuse affects the pollutant loading for implementation purposes.

The PLOAD model can be used to estimate nutrient and BOD non-point source loadings to the stream based on existing land use conditions and undisturbed land use conditions. This approach estimates the effect of anthropogenic sources on runoff loadings of nutrients and oxygen demanding substances in the watershed. The model uses average annual rainfall and event mean concentrations (EMCs) to estimate pollutant loading transported off a particular land use. The model assumes all lands are connected to the stream, resulting in a conservative estimate of average annual loads. An assumed annual average rainfall of 53.8 inches was used for Pinellas County (SWFWMD, 2007). The default ratio of 0.9 for storms producing runoff was used. Land use data entered into the spreadsheet were based on the SouthWest Florida Water Management District (SWFWMD) 2004 land use/cover features categorized according to the Florida Land Use and Cover Classification System (FLUCCS). EMC values assumed for the various land uses are from Harper and Baker (2003).

Table 3. EMCs for Storm Events

Land Use	BOD (mg/L)	Total N (mg/L)	Total P (mg/L)
Urban Open	7.4	1.12	0.18
Low Density Residential	4.3	1.64	0.191
Medium Density Residential	7.4	2.18	0.335
High Density Residential	11.0	2.42	0.49
Agriculture	3.8	2.32	0.344
Rangeland	3.8	2.32	0.344
Forest/Rural Open	1.23	1.09	0.046
Open Water	1.60	1.60	0.07
Water/ Wetlands	2.63	1.01	0.09
Barrenland/Transition	3.8	2.32	0.344
Communication and Transportation	6.7	2.23	0.27

For this analysis, the existing disturbed land use was changed to forest and wetlands for purposes of representing undisturbed land use conditions. In the analysis, disturbed lands were assumed to be all land use categories with the exception of forest, water, and wetlands. The assumption made is that BOD and nutrients have the major controllable impacts on DO. To return DO to an undisturbed condition, not impacted by pollutants, the BOD and nutrient loadings will also need to be returned to an undisturbed condition.

PLOAD can be used to estimate the pollutant loadings for undisturbed land uses by returning the disturbed land uses to forest and wetlands by using the following equation:

$$LP = \Sigma u (P * PJ * RVu * Cu * Au * 2.72 / 12)$$

Where: LP = Pollutant load, lbs
P = Precipitation, inches/year
PJ = Ratio of storms producing runoff (default = 0.9)
RVu= Runoff Coefficient for land use type u, inches of runoff/inches of rain
RVu=0.05 + (0.009 * Iu); Iu = percent imperviousness
Cu = Event Mean Concentration for land use type u, milligrams/liter
Au = Area of land use type u, acres

Model results for existing conditions are shown in Tables 1, 2 and 3. The percent reductions in pollutant loadings necessary to achieve "undisturbed" conditions were calculated using the following equation:

Percent Reduction = (existing load – TMDL load)/existing load * 100

Table 1 St. Joe Creek: Estimated Existing and Natural TN, TP and BOD Loads

WBID	Total Annual Load (lbs/year)		
	TN	TP	BOD
1668A	6831	1295	32653
1668A Natural	731	31	807
Percent Reduction	89	98	98

Table 2. Pinellas Ditch #5: Estimated Existing and Natural TN, TP and BOD Loads

WBID	Total Annual Load (lbs/year)		
	TN	TP	BOD
1668B	16120	2839	76968
1668B Natural	2063	122	3344
Percent Reduction	87	96	97

Table 3. Klosterman Bayou: Estimated Existing and Natural TN, TP and BOD Loads

WBID	Total Annual Load (lbs/year)		
	TN	TP	BOD
1508	10243	1659	45466
1508 Natural	1832	100	2667
Percent Reduction	82	94	94