FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Environmental Assessment and Restoration
Bureau of Watershed Restoration

SOUTHWEST DISTRICT • SPRINGS COAST BASIN • ANCLOTE RIVER/COASTAL PINELLAS COUNTY PLANNING UNIT

TMDL Report

Dissolved Oxygen and Nutrient TMDL for the Klosterman Bayou Tidal Segment, WBID 1508

Kevin Petrus
Paul Kurisko
James Albright

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For additional information on the watershed management approach and impaired waters in the Springs Coast Basin, contact:

Terry Hansen
Florida Department of Environmental Protection
Bureau of Watershed Restoration
Watershed Planning and Coordination Section
2600 Blair Stone Road, Mail Station 3565
Tallahassee, FL 32399-2400
Email: terry.hansen@dep.state.fl.us
Phone: (850) 245-8561
Fax: (850) 245-8434

Access to all data used in the development of this report can be obtained by contacting:

Kevin Petrus
Florida Department of Environmental Protection
Bureau of Watershed Restoration
Watershed Evaluation and TMDL Section
2600 Blair Stone Road, Mail Station 3555
Tallahassee, FL 32399-2400
Email: kevin.petrus@dep.state.fl.us
Phone: (850) 245-8459
Fax: (850) 245-8536

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Websites

Florida Department of Environmental Protection, Bureau of Watershed Restoration

Total Maximum Daily Load (TMDL) Program
http://www.dep.state.fl.us/water/tmdl/index.htm

Identification of Impaired Surface Waters Rule
https://www.flrules.org/gateway/chapterhome.asp?chapter=62-303

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

Integrated Water Quality Assessment for Florida: *2006 305(b) Report* and 303(d) List Update
http://www.dep.state.fl.us/water/tmdl/docs/2006_Integrated_Report.pdf

Criteria for Surface Water Quality Classifications
http://www.dep.state.fl.us/water/wqssp/classes.htm

Water Quality Status and Assessment Reports for the Springs Coast Basin
http://www.dep.state.fl.us/water/basin411/springscoast/index.htm

U.S. Environmental Protection Agency

Total Maximum Daily Load (TMDL) Program
http://www.epa.gov/OWOW/tmdl/index.html

Region 4: Total Maximum Daily Loads in Florida
http://www.epa.gov/region4/water/tmdl/florida/

National STORET Program
http://www.epa.gov/storet/

Chapter 1: INTRODUCTION

1.1 Purpose of Report

This report presents the Total Maximum Daily Load (TMDL) for nutrients and dissolved oxygen (DO) for the tidal segment of Klosterman Bayou, which is located in the Anclote River/Coastal Pinellas County Planning Unit, which is part of the larger Springs Coast Group 5 Basin. The water segment was verified as impaired for dissolved oxygen and nutrients, and the waterway was included on the Verified List of impaired waters for the Springs Coast Basin that was adopted by Secretarial Order in December 2007.

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and provides water quality targets needed to achieve compliance with applicable water quality standards based on the relationship between pollution sources and in-stream water quality. The TMDLs establish the allowable loadings to the tidal segment of Klosterman Bayou that would restore the waterbody so that it meets its applicable water quality criterion for dissolved oxygen and nutrients.

1.2 Identification of Waterbody

The Klosterman Bayou watershed covers an area of 3.22 square miles (2,072 acres) and is located in the Springs Coast Basin, in a densely populated region of northern Pinellas County, Florida, south of the city of Tarpon Springs **(Figure 1.1).** The watershed lies entirely within Pinellas County. 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 at St. Joseph Sound 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. The primary land uses in the watershed are residential areas and recreational areas, predominantly golf courses. Further discussion of these land uses can be found in Chapter 4 of this report. Additional information about the region's hydrology and geology are available in the Basin Status Report for the Springs Coast (Florida Department of Environmental Protection [Department], 2006).

For assessment purposes, the Department 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. Klosterman Bayou is divided into the Klosterman Bayou tidal segment (WBID 1508) shown in **Figure 1.2,** and the freshwater segment (WBID 1508A), which flows into the tidal segment **(Figure 1.1).** The tidal segment of Klosterman Bayou (WBID 1508) has an adjoining drainage area of approximately 650 acres. Additionally, water from incoming tides may influence the freshwater segment at least as far upstream as ponds located on the Innisbrook golf course property, which are located upstream of the line dividing the tidal and freshwater segments.

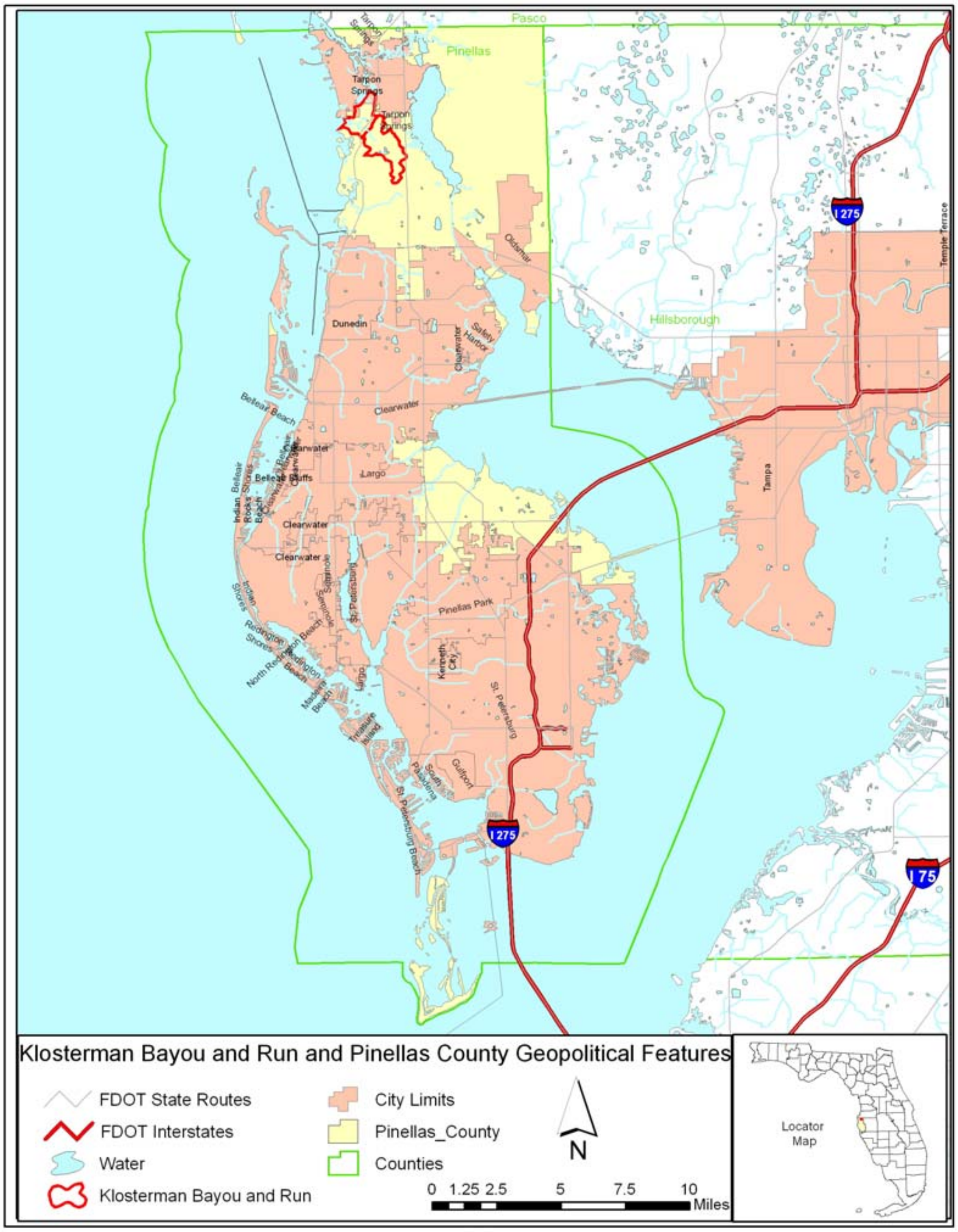

Figure 1.1. Location of the Klosterman Bayou Watershed (WBIDs 1508 and 1508A) and Major Geopolitical Features in Pinellas County

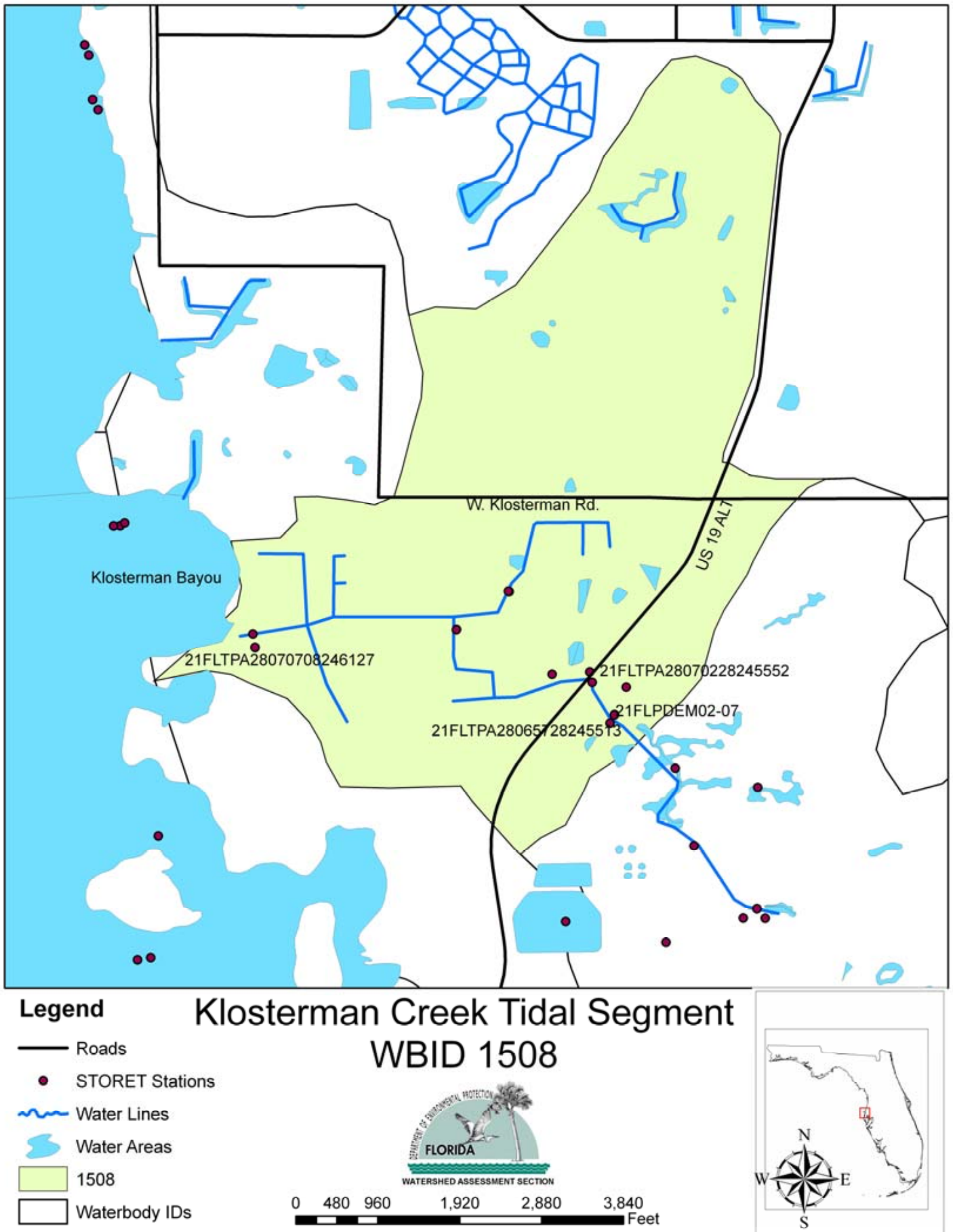

Figure 1.2. Monitoring Locations in the Klosterman Creek Tidal Segment, WBID 1508

1.3 Background

This report was developed as part of the Department's watershed management approach for restoring and protecting state waters and addressing TMDL Program requirements. The watershed approach, which is implemented using a cyclical management process that rotates through the state's 52 river basins over a 5-year cycle, provides a framework for implementing the TMDL Program–related requirements of the 1972 federal Clean Water Act and the 1999 Florida Watershed Restoration Act (FWRA, Chapter 99-223, Laws of Florida).

A TMDL represents the maximum amount of a given pollutant that a waterbody can assimilate and still meet water quality standards, including its applicable water quality criteria and its designated uses. TMDLs are developed for waterbodies that are verified as not meeting their water quality standards. They provide important water quality restoration goals that will guide restoration activities.

This TMDL Report will be followed by the development and implementation of a Basin Management Action Plan, or BMAP, to reduce the amount of pollutants that caused the verified impairment of the Klosterman Bayou watershed. These activities will depend heavily on the active participation of the Southwest Florida Water Management District (SWFWMD), local governments, businesses, and other stakeholders. The Department will work with these organizations and individuals to undertake or continue reductions in the discharge of pollutants and achieve the established TMDLs for impaired waterbodies.

Chapter 2: DESCRIPTION OF WATER QUALITY PROBLEM

2.1 Statutory Requirements and Rulemaking History

Section 303(d) of the federal Clean Water Act requires states to submit to the U. S. Environmental Protection Agency (EPA) a list of surface waters that do not meet applicable water quality standards (impaired waters) and establish a TMDL for each pollutant identified as causing the impairment of the listed waters on a schedule. The Department has developed such lists, commonly referred to as 303(d) lists, since 1992. The list of impaired waters in each basin, referred to as the Verified List, is also required by the FWRA (Subsection 403.067[4], Florida Statutes [F.S.]), and the state's 303(d) list is amended annually to include basin updates.

Florida's 1998 303(d) list included 22 waterbodies in the Springs Coast Basin. However, the FWRA (Section 403.067, F.S.) stated that all previous Florida 303(d) lists were for planning purposes only and directed the Department to develop, and adopt by rule, a new science-based methodology to identify impaired waters. The Environmental Regulation Commission adopted the new methodology as Chapter 62-303, Florida Administrative Code (F.A.C.) (Identification of Impaired Surface Waters Rule, or IWR), in April 2001, which was amended in 2006 and 2007.

2.2 Information on Verified Impairment

The Department used the IWR to assess water quality impairments in the Klosterman Bayou tidal segment and verified the impairment for dissolved oxygen **(Table 2.1). Table 2.2** summarizes the DO data collected during the verification period (January 1, 1999–June 30, 2006). The WBID was verified as impaired for dissolved oxygen because more than 10 percent of the values were below the Class III marine criterion of 4 milligrams/liter (mg/L) over the course of the verified period. For verifying nutrient impairment, annual average chlorophyll-*a* (Chl-a) values served as the primary measurement for assessing nutrient impairment in estuaries under the IWR. During the verified period, the annual Chl-a values for WBID 1508 were greater than the estuary threshold of 11 micrograms per liter (µg/L), averaging between 22.7 µg/L and 49.1 µg/L **(Table 2.3** and **Figure 2.3).** If the annual mean Chl-a value for any one-year period is over the Chl-a threshold, the water is considered verified impaired.

The verified impairment was based on data collected by the Pinellas County Environmental Management Division and the Department. Of the Pinellas County STORET stations, all data from the verified period were collected from STORET station 21FLPDEM02-07. The Department collected data from STORET stations 21FLTPA28065728245513, 21FLTPA28070228245552, 21FLTPA28070708246127, and 21FLTPA28071158246059. **Figure 1.2** shows the locations of the sampling sites. **Figure 2.1** displays the dissolved oxygen data collected from 1999 through 2006, while **Figure 2.2** shows the Chl-a data from the same period. The individual water quality measurements used in this analysis are available in the IWR database, and are available upon request.

Table 2.1. Verified Impairment in the Klosterman Bayou Watershed Tidal Segment, WBID 1508

Parameter Causing Impairment	Priority for TMDL Development	Projected Year For TMDL Development
Dissolved Oxygen	High	2007
Nutrients	High	2007

Table 2.2. Summary of Dissolved Oxygen Data for the Klosterman Bayou Watershed Tidal Segment, WBID 1508 (1999–2006)

Number of Samples	Minimum (mg/L)	Mean (mg/L)	Median (mg/L)	Maximum (mg/L)	Number of Exceedances
231	0.47	5.39	5.32	22.2	49

Table 2.3. Summary of Chlorophyll-a Data for the Klosterman Bayou Watershed Tidal Segment, WBID 1508 (1999–2005)

Year	Annual Mean µg/L
1999	27.9
2000	32.4
2001	30.0
2002	22.7
2003	49.1
2004	38.1
2005	45.3

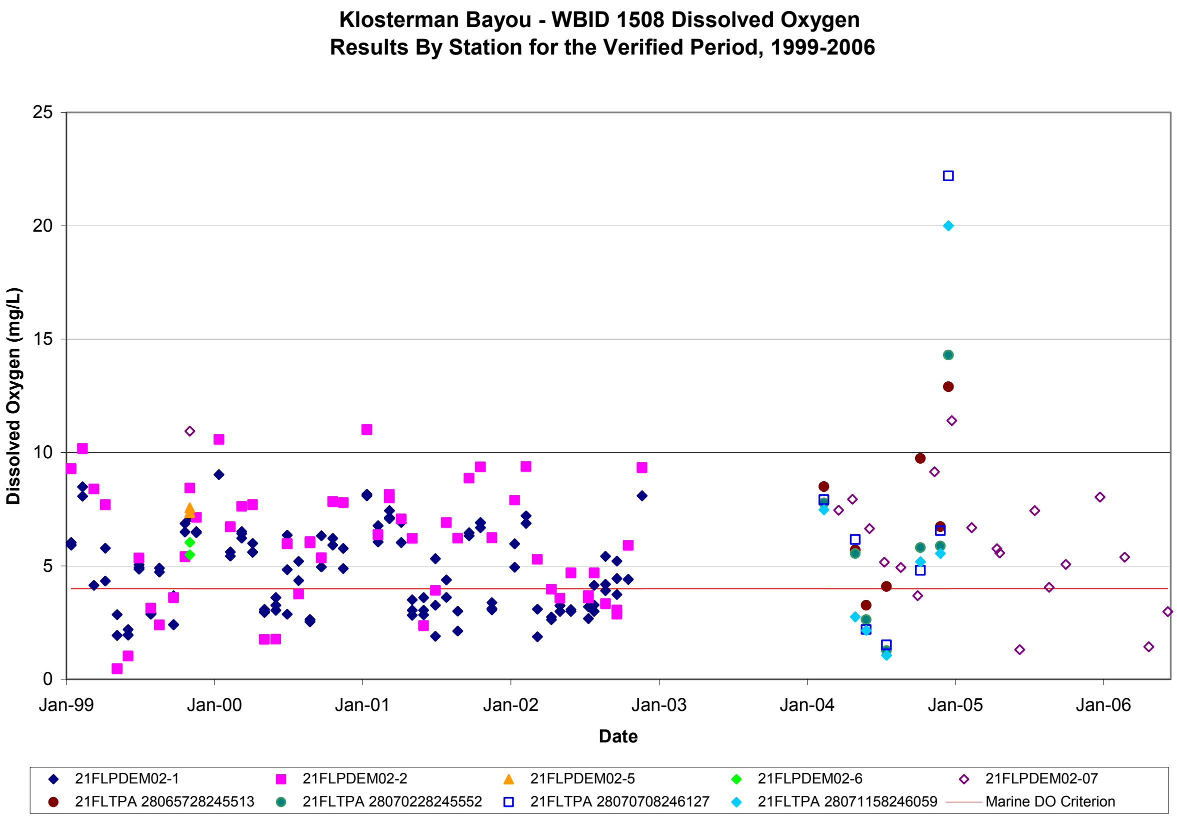

Figure 2.1. Dissolved Oxygen Measurements for the Klosterman Bayou Watershed Tidal Segment, WBID 1508 (1999-2006)

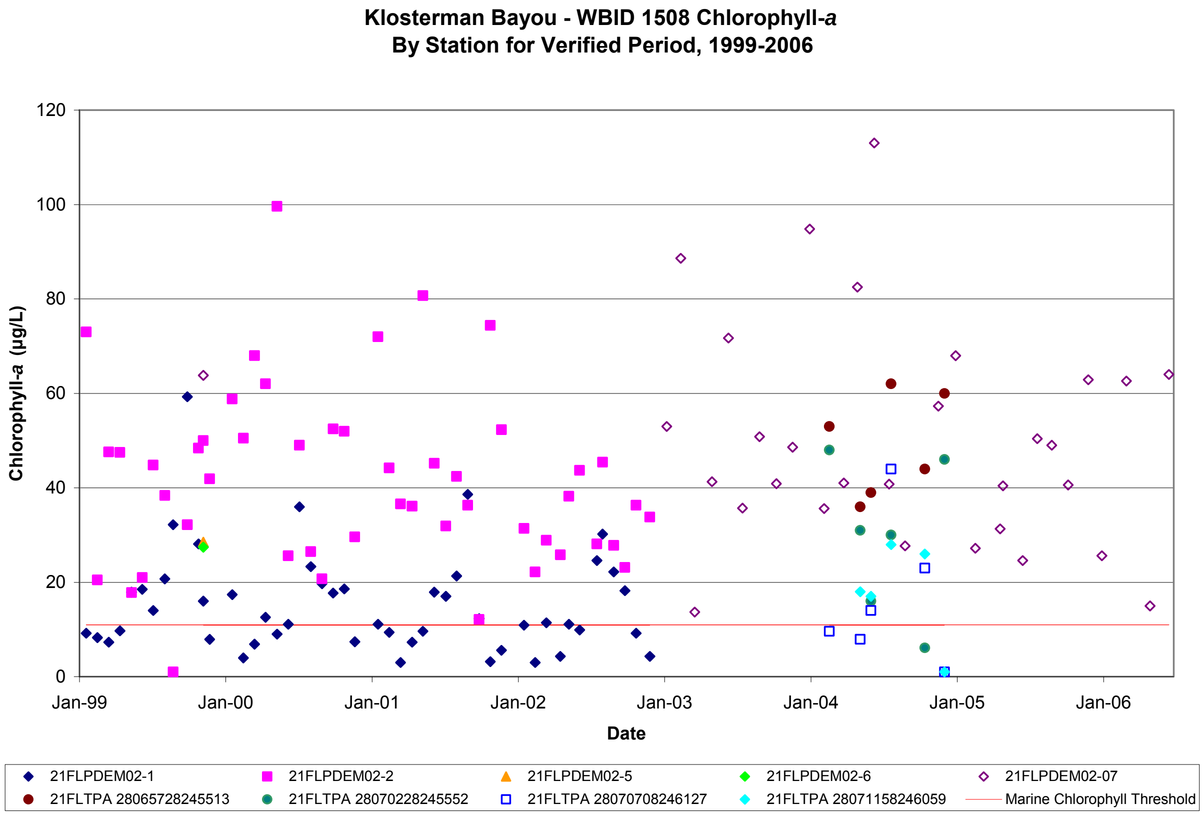

Figure 2.2. Chlorophyll-a Measurements for the Klosterman Bayou Watershed Tidal Segment, WBID 1508 (1999-2006)

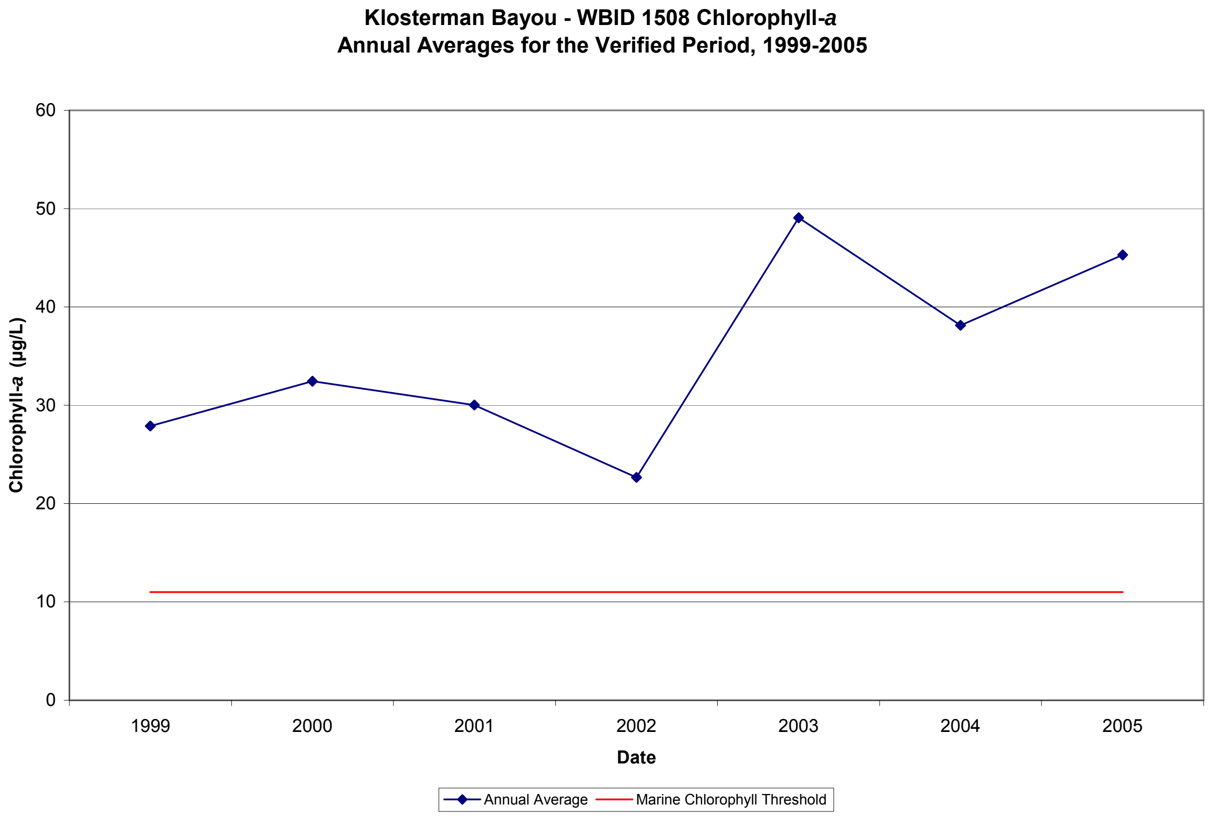

Figure 2.3. Annual Chlorophyll-a Averages for the Klosterman Bayou Tidal Segment (1999-2005)

As part of the verified listing process, the Department attempts to identify the limiting nutrient or nutrients for the impaired waterbody. The limiting nutrient, generally nitrogen or phosphorus, is defined as the nutrient that limits plant growth when it is not available in sufficient quantities. A limiting nutrient is a chemical that is necessary for plant growth, but available in quantities smaller than those needed for algae, represented by Chl-a, and macrophytes to grow. Once the limiting nutrient in a waterbody is exhausted, algae stop growing. If more of the limiting nutrient is added, larger algal populations will result until nutrients or other environmental factors again limit their growth.

In Florida waterbodies, nitrogen and phosphorus are most often the limiting nutrients, and nitrogen is typically the limiting nutrient in most Florida estuaries. There is a general understanding in the marine scientific community that nitrogen is the principal cause of nutrient over enrichment in coastal systems (National Research Council, 1993) and an analysis of the data from the Klosterman Bayou tidal segment supports this conclusion.

Determining the limiting nutrient in a waterbody can be accomplished by calculating the ratio of nitrogen to phosphorus in the waterbody, with water column ratios of total nitrogen (TN) to total phosphorus (TP) of less than 10 indicating that nitrogen is limiting. TN/TP ratios were calculated using TN and TP results collected at the same place and time. The median TN to TP ratio is 3.16 (computed from 142 paired values), indicating that nitrogen is the limiting nutrient in the Klosterman Bayou tidal segment.

Since nitrogen is the limiting nutrient, reductions in TN loadings would be expected to result in decreases in algal growth, and are measured as decreases in Chl-a levels. Reductions in TN loading are also expected to result in additional benefits of concern, including DO and biochemical oxygen demand (BOD). BOD is defined as the amount of oxygen required by bacteria while stabilizing decomposable organic matter under aerobic conditions (Sawyer & McCarty, 1967). Reductions in nutrients will result in lower algal biomass levels in the water column, and lower algal biomass levels will result in smaller diurnal fluctuations in DO, fewer algal-based total suspended solids, and reduced BOD.

Chapter 3. DESCRIPTION OF APPLICABLE WATER QUALITY STANDARDS

3.1 Classification of the Waterbody and Criteria Applicable to the TMDL

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

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

The tidal portion of Klosterman Bayou is a Class III estuarine waterbody, with designated uses for recreation, and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The Class III water quality criteria applicable to the impairment addressed by this TMDL are for DO and the narrative nutrient criteria.

3.2 Applicable Water Quality Standards and Numeric Water Quality Target

3.2.1 Dissolved Oxygen Criterion

The Class III marine criterion for DO, as established by Subsection 62-302.530(30), F.A.C., states that DO shall not average less than 5.0 mg/L in a 24-hour period, and shall not be less than 4 mg/L, and that normal daily and seasonal fluctuations above these levels shall be maintained.

3.2.2 Interpretation of Narrative Nutrient Criterion

Florida's nutrient criterion is narrative only—nutrient concentrations of a body of water shall not be altered so as to cause an imbalance in natural populations of aquatic flora or fauna. Accordingly, a nutrient-related target was needed to represent levels at which an imbalance in flora or fauna is expected to occur. While the IWR provides a threshold for nutrient impairment for estuaries based on annual average Chl-a levels, these thresholds are not standards and need not be used as the nutrient-related water quality target for TMDLs. In fact, in recognition that the IWR thresholds were developed using statewide average conditions, the IWR (Section 62-303.450, F.A.C.) specifically allows the use of alternative, site-specific thresholds that more accurately reflect conditions beyond which an imbalance in flora or fauna occurs in the waterbody.

In translating the narrative nutrient criterion for this TMDL, the Department selected estuarine segments not impaired for nutrients to identify a target Chl-a concentration for establishing the TMDL. Table 3.1 summarizes results for the estuarine segments where the average Chl-a concentrations are less than the 11 ug/L impairment threshold for estuaries. These waters include both open water estuarine segments and tidal stream segments in the area of Klosterman Bayou. Given the uncertainty of nutrient reactions within estuaries, the Department applied a Chl-a target of 8 ug/L for establishing the TMDL, which falls within the range of average Chl-a concentrations in the estuarine waters not impaired for nutrients. Using this target value for establishing the TMDL should result in annual average Chl-a values below the impairment threshold for estuaries of 11 ug/L. This approach minimizes the potential for listing the water as impaired in the future.

Table 3.1. Summary of Chl-a Results for Estuary Segments Not Impaired for Nutrients

WATER SEGMENT	WBID	Average Chl-a (ug/L)[a]
CLEARWATER HARBOR SOUTH	1528	7.6
THE NARROWS	1528A	8.3
DIRECT RUNOFF TO INTERCOASTAL WATERWAY	1528B	7.8
CLEARWATER HARBOR NORTH	1528C	6.4
BOCA CIEGA BAY CENTRAL	1694A	6.5
BOCA CIEGA BAY NORTH	1694B	7.2
BOCA CIEGA BAY	1694C	8.2
ST. JOSEPH SOUND	8045D	4.9
DIRECT RUNOFF TO GULF (MINNOW CREEK)	1535	5.1
ANCLOTE RIVER TIDAL SEGMENT	1440	4.3

[a] Averages calculated from results collected during 1994 to 2006 contained in IWR Run 28.

Chapter 4: ASSESSMENT OF SOURCES

4.1 Types of Sources

An important part of the TMDL analysis is the identification of pollutant source categories, source subcategories, or individual sources of the pollutants of concern in the watershed and the amount of pollutant loading contributed by each of these sources. Sources are broadly classified as either "point sources" or "nonpoint sources." Historically, the term point sources has meant discharges to surface waters that typically have a continuous flow via a discernable, confined, and discrete conveyance, such as a pipe. Domestic and industrial wastewater treatment facilities (WWTFs) are examples of traditional point sources. In contrast, the term "nonpoint sources" was used to describe intermittent, rainfall driven, diffuse sources of pollution associated with everyday human activities, including runoff from urban land uses, agriculture, silviculture, and mining; discharges from failing septic systems, and atmospheric deposition.

However, the 1987 amendments to the Clean Water Act redefined certain nonpoint sources of pollution as point sources subject to regulation under the EPA's National Pollutant Discharge Elimination System (NPDES) Program. These nonpoint sources included certain urban stormwater discharges, including those from local government master drainage systems, construction sites over 5 acres, and a wide variety of industries (see **Appendix A** for background information on the federal and state stormwater programs).

To be consistent with Clean Water Act definitions, the term "point source" is used to describe traditional point sources (such as domestic and industrial wastewater discharges) and stormwater systems requiring an NPDES stormwater permit when allocating pollutant load reductions required by a TMDL. However, the methodologies used to estimate nonpoint source loads do not distinguish between NPDES stormwater discharges and non-NPDES stormwater discharges, and as such, this chapter does not make any distinction between the two types of stormwater.

4.2 Point Sources

4.2.1 NPDES Permitted Wastewater Facilities

There is one permitted domestic wastewater treatment facility in the watershed: the William Dunn Water Reclamation Facility (NPDES No. FL0128775). This facility does not discharge directly into Klosterman Bayou; however, the effluent from the facility is used for irrigation in the watershed that may indirectly contribute nutrient loads to Klosterman Bayou via runoff or through ground water interflow. Reclaimed water from the facility is applied at the Innisbrook Highlands Lake and Copperhead Lake golf courses. Approximately 3.0 million gallons per day of reclaimed wastewater is pumped to ponds at the Innisbrook Golf Course, and then used to irrigate the course.

The Suncoast Primate Sanctuary is a small rehabilitation and retirement facility for apes and monkeys that houses 45 primates, primarily common chimpanzees. The sanctuary is located on alternate U.S. 19 near the eastern border of the tidal WBID segment. The facility has a sewer connection to the municipal system, and there is no evidence of overflow events from this location.

Short-term point source discharge episodes may occur when there is an accidental release from the county's sewerage systems. On July 7, 2007, one such overflow event occurred. The Pinellas County Utilities Department cleaned up the spill and monitored the downstream portions of Klosterman Bayou. None of the data involved in the determination of the TMDL come from this period, and there is no evidence of prior spills to surface waters. The data used to determine the TMDL are believed to be representative of ambient surface water conditions and not of episodic events.

4.2.2 Municipal Separate Storm Sewer System Permittees

Municipal separate storm sewer systems (MS4s) may also discharge pollutants to waterbodies in response to storm events. To address stormwater discharges, the EPA developed the NPDES stormwater permitting program in two phases. Phase 1, promulgated in 1990, addresses large and medium-size MS4s located in incorporated areas and counties with populations of 100,000 or more. Phase 2 permitting began in 2003. Regulated Phase 2 MS4s are defined in Section 62-624.800, F.A.C., and typically cover urbanized areas serving jurisdictions with a population of at least 10,000, or discharging into Class I or Class II waters, or into Outstanding Florida Waters.

The stormwater collection systems in the Klosterman Bayou watershed, which are owned and operated by Pinellas County, in conjunction with the Florida Department of Transportation (FDOT), are covered by a Phase 1 MS4 permit. The Klosterman Bayou watershed falls under the Pinellas County Phase 1 MS4 Permit (Number FLS000005). The city of Tarpon Springs and FDOT District 1 are co-permittees, each with portions of their jurisdictions located in the watershed. Currently, no local governments in the watershed have applied for coverage under the Phase 2 NPDES MS4 permit.

4.3 Land Uses and Nonpoint Sources

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

Nutrient loading from urban areas is most often 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. Because the Klosterman Bayou watershed is primarily urban, agricultural fertilizing or nutrients from wildlife and agricultural livestock wastes are not expected to contribute significantly to the nutrient load.

4.3.1 Land Uses

The spatial distribution and acreage of different land use categories were identified using the SWFWMD 2005 land use coverage (scale 1:40,000). Table 4.1 summarizes the land use information which was used in the watershed model for this project. To take into account upstream source contributions to Klosterman Bayou, both the tidal segment (WBID 1508) and the freshwater segment (WBID 1508A) land area were included in the land use calculations. **Figure 4.1** shows the acreage of the principal land uses in the watershed.

The largest land use area is residential, with 42 percent of the land area falling in this category. Of this area, 33 percent is considered to be high density (6 or more dwellings/acre), 5 percent is medium-density residential (2 to 5 dwellings/acre), and the remaining 4 percent is low-density residential (less than 2 dwellings/acre). The second largest area in the watershed are golf courses, covering 25 percent of the land area. Water and wetlands cover approximately 14 percent of the area. Another 4 percent is dedicated to transportation and utilities activities.

Table 4.1. Klosterman Bayou Watershed Land Use Acreage Applied in the Watershed Model, Based on 2005 Data

Land Use Designation	Acres	Percent of Total
Residential High Density	672	32.6
Golf Courses	517	25.1
Hardwood Conifer Mixed	150	7.3
Residential Med Density 2->5 Dwelling Unit	109	5.3
Residential Low Density < 2 Dwelling Units	90	4.4
Cypress	79	3.8
Utilities	70	3.4
Commercial And Services	69	3.3
Lakes	47	2.3
Freshwater Marshes	44	2.1
Recreational	40	1.9
Reservoirs	40	1.9
Wetland Forested Mixed	33	1.6
Bays And Estuaries	27	1.3
Open Land	20	1.0
Transportation	17	0.8
Industrial	16	0.8
Intermittent Ponds	8	0.4
Wet Prairies	6	0.3
Shrub And Brushland	3	0.1
Institutional	2	0.1
Saltwater Marshes	2	0.1
Gulf of Mexico	1	0.0
Total Acreage	**2062**	**100**

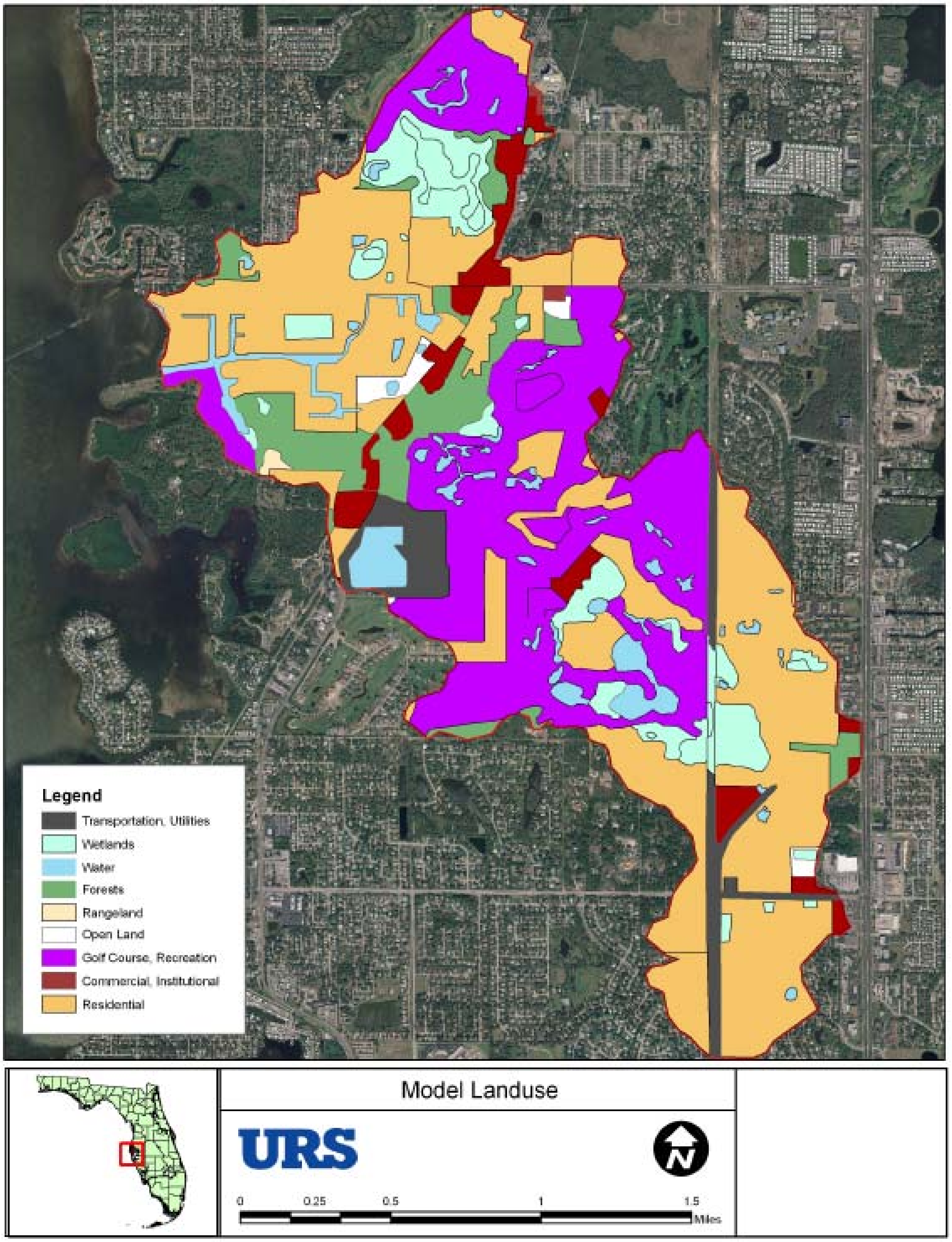

Figure 4.1. Principal Land Uses in the Klosterman Bayou Watershed, WBIDs 1508 and 1508A, in 2005

4.3.2 Estimating Nonpoint Source Loadings

The nonpoint source loadings of BOD and nutrients generated in the Klosterman Bayou watershed were calculated using the *Hydrological Simulation Program-FORTRAN (HSPF*) model. The HSPF model is a public domain model that is supported by the USEPA and the US Geological Survey (USGS). A detailed description of the model set-up and the model calibration/validation procedures and results are provided in the "Klosterman Bayou TMDL Model Development" report (URS, DS, and CDM, 2008).

The loadings of BOD and nutrients from the watershed, for the 1999 to 2006 period, were estimated for both surface water runoff and ground water base flow. The watershed pollutant loading model simulated conditions in the entire watershed, including the representation of major streams, rivers and drainage features. The watershed model provides hydrologic and water quality loads representative of stream discharges via tributaries and direct overland sheet flow discharges into the estuary. The loads estimated by the HSPF model were input as boundary conditions for the EFDC model used to simulate hydrologic and water quality conditions in the Klosterman Bayou tidal segment.

Included in the nonpoint source watershed loading estimates are load contributions originating from septic tanks and the application of reclaimed water from the William E. Dunn domestic wastewater treatment facility. In the East Klosterman Road subbasin, described in the "Klosterman Bayou TMDL Model Development" report, the single-family dwellings north of Klosterman Road are older and have a high density of septic tanks. The William E. Dunn facility is permitted to discharge reclaimed wastewater to nearby golf courses for spray irrigation purposes. In the Klosterman Bayou watershed, reclaimed water is applied at the Innisbrook Highlands Lake and Copperhead Lake golf courses. Approximately 3.0 million gallons per day of reclaimed wastewater is pumped to ponds at the Innisbrook Golf Course, and then used to irrigate the course.

Table 4.2 is a summary of the estimated average annual nonpoint source loads from each land use category using the HSPF model. Additional load estimates are included in the "Klosterman Bayou TMDL Model Development" report (URS, DS, and CDM, 2008).

Table 4.2 Biochemical Oxygen Demand and Nutrient Loading Estimates by Land Use to the Klosterman Bayou Tidal Segment for the 1999 to 2006 Period, Annual Average Load (in pounds/year)

Land Use Designation	CBODu (lbs/year)	TN (lbs/year)	TP (lbs/year)
Residential Med Density 2->5 Dwelling Unit	1,203	316	102
Residential Low Density < 2 Dwelling Units	606	210	47
Residential High Density	10,762	2,366	776
Commercial And Services	754	206	61
Industrial	166	44	14
Institutional	34	9	3
Golf Courses	4,304	2,325	1,673
Recreational	308	144	85
Open Land	160	29	6
Shrub And Brush land	13	2	0
Hardwood Conifer Mixed	271	201	16
Lakes/Reservoirs	301	285	20
Cypress	216	74	12
Wetland Forested Mixed	150	53	10
Freshwater Marshes	94	38	4
Saltwater Marshes	4	0	0
Wet Prairies	29	10	2
Intermittent Ponds	38	13	3
Transportation	215	65	17
Utilities	879	264	71
Total	20,508	6,654	2,923

$CBOD_u$ = Ultimate Carbonaceous Biochemical Oxygen Demand
TN = Total Nitrogen
TP = Total Phosphorus

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Determination of Loading Capacity Approach

The goal of this TMDL development is to identify the maximum allowable nutrient and biochemical oxygen demand loadings from the watershed, that will allow the Klosterman Bayou tidal segment (WBID 1508) to meet the DO water quality criteria and the narrative nutrient water quality criterion; thereby maintaining it's function and designated use as Class III marine water. The DEP contracted with URS Corporation (URS), Dynamic Solutions, LLP (DS) and Camp Dresser and McKee Inc. (CDM) (hereinafter referred to as the consultants) to develop a watershed pollutant loading model and surface water hydrodynamic and water quality model. The *Hydrological Simulation Program-FORTRAN (HSPF*) was selected as the watershed-scale pollutant loading model, and the *Environmental Fluids Dynamics Code (EFDC)* model was selected as the receiving water hydrodynamic and water quality model. After the models were developed for the system, the DEP applied them in assessing pollutant load reductions required for the tidal segment of the bayou to meet the applicable criteria for DO and nutrients.

The *HSPF* model was used to conduct the watershed pollutant loading modeling to generate watershed flows and pollutant loads associated with each of the aggregated land use categories from all of the sub-basin areas. The watershed loads output from *HSPF* provided the hydrologic and water quality constituent inputs needed for the *EFDC* hydrodynamic and water quality model developed for the Klosterman Bayou tidal segment.

In the set up of the *EFDC* model, St Joseph Sound/Clearwater Harbor served as the downstream boundary condition, and *HSPF* flows and concentrations developed for the individual sub-basins served as inflow boundaries to the *EFDC* model domain. Appendix B of the "Klosterman Bayou TMDL Model Report" summarizes the development of the site-specific hydrodynamic model of St. Joseph Sound/Clearwater Harbor (Dynamic Solutions, LLC, 2008). The time series results for stream flow and water quality concentration generated by *HSPF* were linked as input to the *EFDC* model to simulate DO and Chl-a responses in the waterbody to ultimate carbonaceous BOD ($CBOD_u$) and nutrient loadings from the watershed. BOD expressed as $CBOD_u$ is a measurement of the oxygen required for the total degradation of carbonaceous organic material and is the form of BOD estimated by the HSPF model. Both the HSPF and EFDC models were calibrated and validated using the available hydrologic data and water quality results collected in the Klosterman Bayou watershed.

Although the focus of this TMDL is reductions in BOD and nutrient loadings to address the DO and nutrient impairments, other factors can affect the DO in surface waters. These factors include: reaeration, temperature, salinity, color, light transmission, total suspended solids (TSS) and sediment parameters such as sediment oxygen demand (SOD) and nutrient flux rates.

5.2 Overview of the Hydrological Simulation Program- FORTRAN (*HSPF*) Model

The *HSPF* model was used to simulate both hydrologic and water quality loads from watershed runoff and the freshwater tributaries. This *HSPF* model included the input of rainfall, temperature (including air), evaporation, evapotranspiration, upstream or tributary inflows and constituent pervious and impervious nonpoint source loads, sediment mass and associated other constituent loads, e.g., ground water baseflow and interflow. To conduct watershed simulations, the model also included the input of parameters related to the physical characteristics of subwatersheds (e.g., topography), land uses and soil characteristics. The primary purpose of the HSPF model implementation is to provide estimates of daily discharges and pollutant loads to the EFDC model.

The USEPA and USGS jointly developed the modifications to the original model for water quality purposes in the 1980s (USGS, HSPF). Detailed information about the set up, input data and application of this *HSPF* model for the Klosterman Bayou watershed is contained in the "Klsoterman Bayou TMDL Model Development" report (URS, DS, and CDM, 2008).

5.3 Overview of the Environmental Fluids Dynamics Code (*EFDC*) Model

The EFDC model was used to simulate three dimensional flow, transport, and bio-geochemical processes in the Klosterman Bayou tidal surface water system. A public domain model, *EFDC* was originally developed at the Virginia Institute of Marine Science for estuarine and coastal applications, and a version of the model is supported by the USEPA.

The Klosterman Bayou tidal segment was segmented into curvilinear computational grid cells representing three dimensions, using bathymetric data, for the hydrodynamic and water quality model. A discussion of the grid development, bathymetry and model boundary conditions is contained in the "Klosterman Bayou TMDL Model Development" report (URS, DS, and CDM, 2008).

5.4 *HSPF* Model Calibration and Validation

The *HSPF* model was set up, refined, calibrated and validated. The *HSPF* model was developed to simulate watershed runoff and stream flows and water quality constituent loads for the period beginning on January 1, 1999 and ending on December 31, 2006. Simulated results were compared against available ambient water quality monitoring data collected between 1999 and 2006.

The period from August 22, 2006 through December 31, 2006 was chosen as the *HSPF* stream flow calibration period, and the *HSPF* model was not validated for stream flow. Simulated stream flow was calibrated against instantaneous flow measurements collected by Pinellas County at "Weir A-8." **Figure 5.1.** displays the approximate flow measurement location. Poor correlation between the flow and rainfall exists, see **Figure 5.2,** which is most likely due to a high surface storage capacity in the watershed. The poor correlation can be attributed to the highly permeable soils, a large natural and man-made storage capacity, control structures and water management practices on the golf course. In order to simulate the discharge characteristics observed at "Weir A-8", the HSPF model characteristics were modified. A discussion of the calibration/validation process and results can be found in Chapter 4.1 of the **"**TMDL Model Development**"** report (URS, DS, and CDM, 2008).

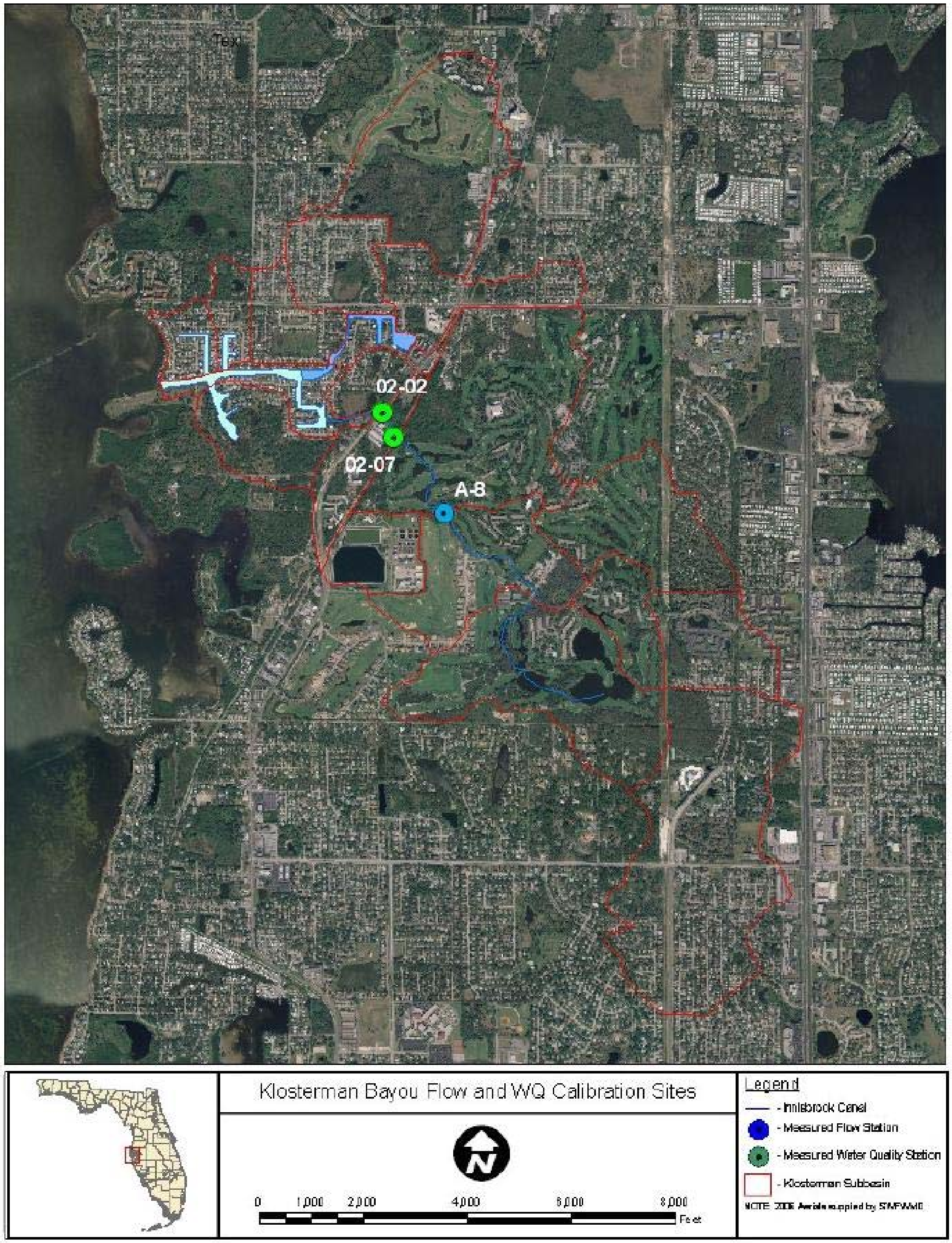

Figure 5.1. Flow and Water Quality Monitoring Station Locations in the Freshwater Reaches

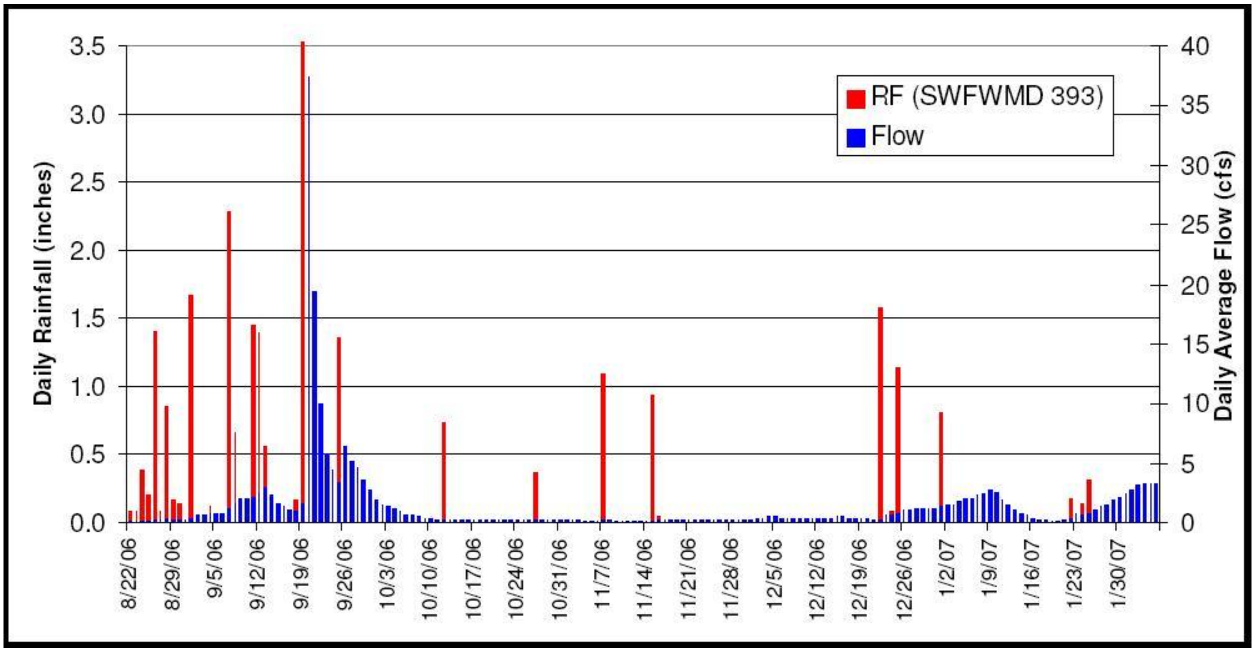

Figure 5.2. Correlation of Rainfall and Flow in the Klosterman Bayou Watershed

The period from January 1, 1999 through December 31, 2002 was chosen as the *HSPF* model water quality calibration period, and the period from January 1, 2003 through December 31, 2006 was chosen as the *HSPF* model validation period. The data from two water quality stations monitored by Pinellas County, were used for model calibration and validation. Data are available at station 21FLPDEM02-02 for the 1999 to 2002 calibration period and at station 21FLPDEM02-07 for the 2003 to 2006 validation period. Model simulated water quality was calibrated and validated for the following constituents:

- Water Temperature – ^{O}C
- Dissolved Oxygen (DO) – mg/L
- Chlorophyll-a – *u*g/L
- Total Phosphorus (TP) – mg/L
- Orthophosphates – mg/L
- Total Nitrogen (TN) – mg/L
- Total Kjeldahl Nitrogen (TKN) – mg/L
- Total Nitrite plus Nitrate Nitrogen – mg/L
- Total Ammonia Nitrogen – mg/L
- Carbonaceous Biochemical Oxygen Demand ultimate ($CBOD_u$) – mg/L

In the case of $CBOD_u$ there are no direct measures of $CBOD_u$ in the surface waters. To evaluate model performance with respect to BOD, the BOD_5 ambient monitoring results were converted to $CBOD_u$ using a multiplier of 2.47, as recommended in EPA guidance (USEPA, 1997), in the absence of site specific data.

Results for model calibration and validation are provided in Section 4.1.5 of the “Klosterman Bayou TMDL Model Development” report (URS, DS, and CDM, 2008).

5.5 *HSPF* Model Sensitivity

A model sensitivity analysis was performed to identify model parameters influence on the model simulations. Various parameter changes were made to test the sensitivity of the model. Four simulations were conducted for each parameter, representing a 10% and 20% increase in the parameter value and a 10% and 20% decrease in the parameter value. The parameters and the sensitivity analysis results are shown in Tables 5.1 – 5.4. Each table shows the median value of DO, BOD, TN and TP for each simulation as well as the percent change in the median value when compared to the baseline value. Results of the sensitivity analysis concluded a minor to moderate level of sensitivity. Additional information on the *HSPF* model sensitivity analysis is provided in Section 4.1.7 of the “Klosterman Bayou TMDL Model Development” report (URS, DS, and CDM, 2008).

Table 5.1 Sensitivity to Accumulate Rate

	-20%	-10%	Baseline	10%	20%
	Median Concentration (mg/L)				
DO	5.80	5.79	5.89	5.87	5.80
BOD	2.35	2.33	2.35	2.36	2.42
TN	1.02	1.03	1.02	1.03	1.03
TP	1.02	1.02	1.02	1.02	1.02
	Percent Change (%)				
DO	-1.44	-1.61	0.00	-0.25	0.00
BOD	0.26	-0.68	0.00	0.68	3.06
TN	0.05	0.29	0.00	0.39	0.58
TP	-0.27	-0.13	0.00	0.00	0.09

Table 5.2 Sensitivity to BOD Oxidation Rate

	-20%	-10%	baseline	10%	20%
	Median Concentration (mg/L)				
DO	5.92	5.89	5.89	5.87	5.85
BOD	2.44	2.332	2.35	2.274	2.35
TN	1.01	1.01	1.02	1.02	1.03
TP	1.01	1.02	1.02	1.02	1.03
	Percent Change (%)				
DO	0.59	0	0	-0.33	-0.67
BOD	3.8	-0.76	0	-3.23	0.25
TN	-0.68	-0.826	0	-0.04	0.77
TP	-0.83	-0.44	0	0.28	0.38

Table 5.3 Sensitivity to Algal Respiration Rate

	-20%	-10%	Baseline	10%	20%
	Median Concentration (mg/L)				
DO	6.64	6.31	5.89	5.58	5.35
BOD	2.31	2.42	2.35	2.83	2.60
TN	0.86	0.96	1.03	1.08	1.11
TP	0.97	0.99	1.03	1.09	1.17
	Percent Change (%)				
DO	12.7	7.05	0.00	-5.26	-9.25
BOD	-1.79	2.81	0.00	20.5	10.7
TN	-16.7	-6.92	0.00	5.50	8.09
TP	-5.37	-3.61	0.00	6.28	14.1

Table 5.4 Sensitivity to Algal Growth Rate

	-20%	-10%	baseline	10%	20%
	Median Concentration (mg/L)				
DO	6.09	6.00	5.89	6.05	6.19
BOD	2.37	2.73	2.35	2.61	2.70
TN	1.13	1.07	1.03	0.98	0.93
TP	1.16	1.09	1.03	1.00	0.99
	Percent Change (%)				
DO	3.40	1.87	0.00	2.63	5.09
BOD	0.68	16.26	0.00	11.23	14.81
TN	10.28	3.75	0.00	-4.63	-9.16
TP	13.44	6.19	0.00	-2.49	-4.01

5.6 *EFDC* Model Calibration and Validation

The period selected for water quality model calibration was from January 1, 2002 to December 31, 2002 and model validation was based on data collected from January 1, 1999 to December 31, 1999. These periods have an adequate set of salinity, temperature, meteorology, and water quality data.

Data were collected in the tidal segment during 1999 and 2002 by the Pinellas County Department of Environmental Management. The stations used are; 21FLPDEM02-01 (Basin02Site01) and 21FLPDEM02-02 (Basin02Site02). The locations of the stations are shown in **Figure 5.3.**

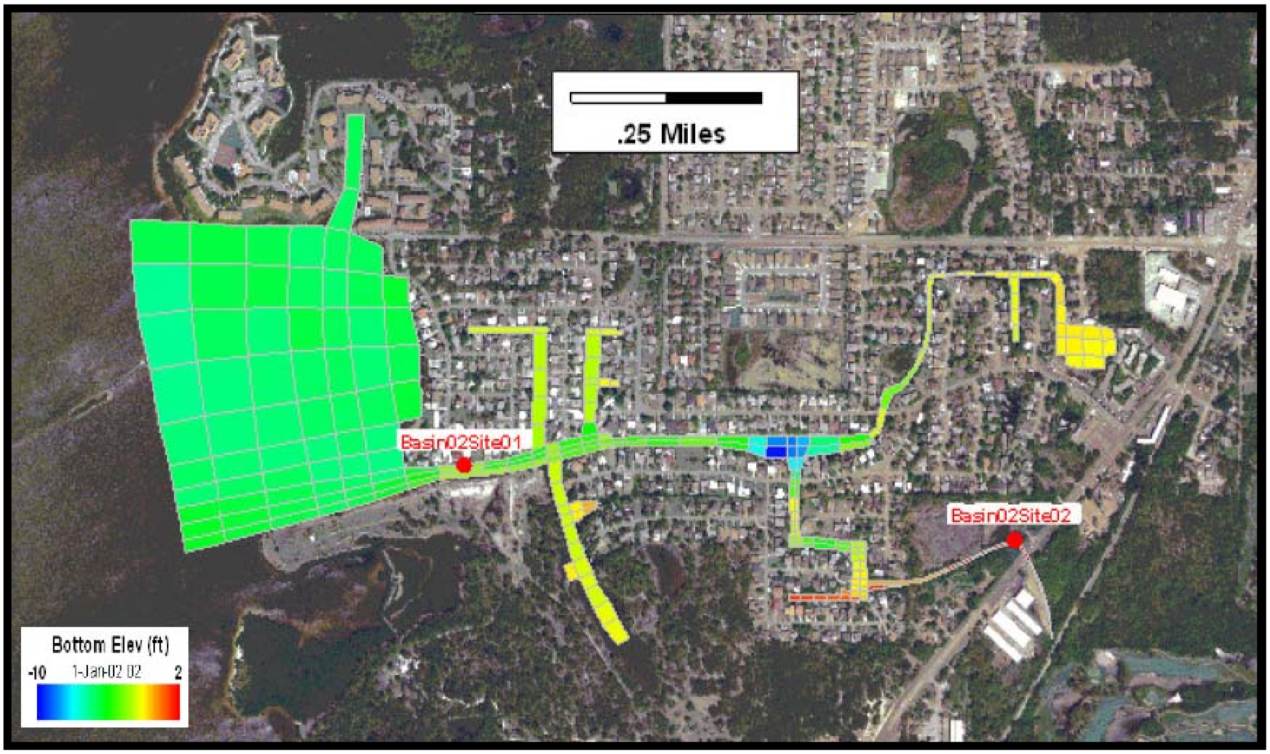

Figure 5.3. EFDC Model Domain with Monitoring Station Locations Used for Model Calibration and Validation

As there were no tide or water level gages within the tidally influenced region of Klosterman Bayou, the boundary tidal forcing for the Klosterman Bayou model was assigned using stage, salinity and temperature data extracted from the small scale coastal model of Clearwater Harbor and St. Joseph Sound that was developed for this project (URS, DS, and CDM, 2008).

A description of the model development and discussion of the model calibration and validation results are provided in Section 4.2 of the “Klosterman Bayou TMDL Model Development” report (URS, DS, and CDM, 2008).

5.8 *EFDC* Model Sensitivity

A sensitivity analysis of the *EFDC* model was performed. The base model for this analysis was the calibrated model for the year 2002. Sixteen model runs with different parameter values were evaluated to investigate the model sensitivity. Table 5.5. shows the parameters selected for the sensitivity analysis, the base run values (Run00), and the +/- 50% values.

Table 5.5. EFDC Model Parameters for Sensitivity Analysis

Parameters	Reference Case Run00	Values changed (- ~50%)		Values changed (+~50%)	
		Run	New Value	Run	New Value
Maximum growth Rate for Greens (1/day)	2.700	Run01a	1.395	Run01	4
Predation Rate on Greens (1/day)	0.215	Run02	0.107	Run02a	0.322
Basal Metabolism Rate for Greens (1/day)	0.010	Run03	0.005	Run03a	0.015
Background Light Extinction Coefficient (1/m)	0.450	Run04	0.225	Run04a	0.675
Settling velocity for Greens (m/day)	0.05	Run05	0	Run05a	0.075
PO4 at Inflows		Run06	Double	Run07	Half
NH4 at Inflows		Run08	Double	Run09	Half
Reaeration Rate Constant (3.933 for OConnor-Dobbins; 5.32 for Owen-Gibbs)	0.400	NA		Run21	0.600
SOD	-2.000	Run20	-3.000		

The conclusions were that the model was not very sensitive to the range of parameter variation analyzed; however, reducing the algal predation rate increases the Chl-a prediction, and increasing the SOD rate predicts a higher reduction in DO. A discussion of the sensitivity analysis run descriptions and results are included in Section 4.2.6 of the final "TMDL Model Development" report (URS, DS, and CDM, 2008).

5.9 Determination of Loading Capacity

The calibrated and validated *HSPF* and *EFDC* models developed for the Klosterman Bayou watershed were designed to assist in predicting future water quality responses, as a result of reductions in existing pollutant loads, in order to determine the waterbody's assimilative capacity to meet the applicable DO and nutrient surface water quality criteria and establish the TMDLs. The models were used to simulate the eutrophication processes in the freshwater tributaries and the tidal segment of Klosterman Bayou.

The contractors provided the models set up to simulate conditions during the 1999 to 2006 period. The DEP then used the models to determine the pollutant load reductions required for the tidal segment of the bayou to meet the applicable criteria for DO and nutrients. The loading capacity for the tidal segment was determined by performing multiple model design runs where the nonpoint source loads were reduced until the applicable DO criteria and selected Chl-a target were achieved.

Reductions in watershed nonpoint source loads were evaluated with the *EFDC* model to determine load reductions needed for $CBOD_5$ and TN loadings to set the TMDL. As described in Chapter 4, the loading from the William E. Dunn WRF was input into the HSPF model so that the loading is accounted for in the model output for surface runoff and ground water baseflow.

As a result of reduced loadings, the SOD and benthic nutrient flux rates are expected to be reduced as a result of reduced inputs of organic matter, primarily in the form of algal biomass, deposited to the waterbody sediments. Since the model was not set up to simulate the sediment dynamics in the bayou, the SOD and benthic nutrient flux rates needed to be modified in the model simulations with the load reduction alternatives. A common approach for adjusting SOD and benthic nutrient flux rates is to use a linear relationship between the rates and the organic carbon content of sediment related to water column productivity (Chapra, 1997). The formula for the linear assumption that reductions in SOD and benthic nutrient flux rates are directly related to reductions in phytoplankton primary productivity is as follows:

$$(SOD)_{rev} = \frac{(Chl\text{-}a)_{out}}{(Chl\text{-}a)_{cal}} \times (SOD)_{cal}$$

Where:

$(SOD)_{rev}$ is the revised SOD (or benthic ammonia and/or phosphorus flux) rate under the reduction scenario under evaluation;

$(Chl\text{-}a)_{out}$ is the chlorophyll-a annual average value from the reduction scenario model run;

$(Chl\text{-}a)_{cal}$ is the chlorophyll-a annual average value from the calibrated model run;

$(SOD)_{cal}$ is the SOD (or benthic ammonia and/or phosphorus flux) rate from the calibrated model run

Note: The Chl-a annual averages used in these SOD and benthic nutrient flux rate revisions were calculated following the IWR methodology

After each load reduction scenario was completed, the same EFDC model was re-run with the revised SOD and benthic nutrient flux rates. The DO and Chl-a model output results were then evaluated against the appropriate water quality targets. The EFDC model results that were compared to the water quality criteria and the Chl-a threshold were obtained from the model grid locations where the ambient monitoring stations, used for model calibration and validation, are located. The sampling stations used in this analysis, along with the EFDC model grid domain are presented in **Figure 5.3.**

The objective of the evaluation was to determine a model scenario where the DO criteria would not be exceeded in more than 10% of the modeled output values, and where the predicted average Chl-a concentration would not exceed the selected Chl-a target of 8 ug/L. After each design scenario was completed, the percent DO exceedances (< 4 mg/L), and overall average Chl-a values were calculated The DO results in the model grids where sampling stations are located were compared against the DO 10 percent exceedance rate. Annual average Chl-a values were calculated following the IWR methodology for each model grid location where a sampling station is located, and then an overall average value was calculated using the annual average values at each sampling location.

The load reduction scenario where the nonpoint source loads were reduced by 80 percent resulted in the DO and Chl-a targets being met. Reductions of TP loads were not included in the evaluation for establishing the TMDL, because the DO and Chl-a response to TP load reductions was determined to be negligible. A load reduction alternative where the nonpoint source loads were reduced by 70 percent was also conducted; however, under this scenario the Chl-a target is not met.

A summary of the model predicted DO and Chl-a results for the current loading condition (baseline) and the alternative load reduction scenarios evaluated are presented in **Table 5.6**. Both the DO exceedance rate and average Chl-a concentration met the applicable targets under the 80 percent reduction in BOD and TN loads. The DO water quality criteria is predicted to be exceeded 9.1 percent of the time and the average Chl-a concentration of 7.9 ug/L is below the target value.

Table 5.6 Summary of Predicted Dissolved Oxygen and Chlorophyll a Model Results (1999-2006)

Model Run	Total Number of Model Observations[a]	Number of DO Values Less Than 4 mg/L	Percent of DO Values Less Than 4 mg/L	Average Chlorophyll a (ug/L)
Baseline - Current Conditions	23,344	3,378	14.5 %	28.7
Design Run - 80% NPS Load Reduction, WRF at Existing Loads	23,344	2,132	9.1 %	7.9
Design Run - 80% NPS Load Reduction with No TP Reduction, WRF at Existing Loads	23,344	2,123	9.1 %	7.9
Design Run - 70% NPS Load Reduction, WRF at Existing Loads	23,344	2,316	9.9 %	10.9

[a] Number of output results at model grids where monitoring stations are located for the 1999-2006 period.
mg/L – milligrams per liter
ug/L – micrograms per liter
NPS – nonpoint source
WRF – Water Reclamation Facility
Existing Loads – based on monthly average discharge data from 2001-2006

Figures 5.4 and **5.5** present the predicted Chl-a annual averages for the current baseline condition and the selected load reduction scenario, respectively, during the eight-year model simulation period. The results show that for the design run selected, annual average Chl-a values at each station grid do not exceed the estuary threshold of 11 ug/L, and the average of the annual averages meet both the IWR estuary threshold and the selected Chl-a target.

Based on the *EFDC* modeling results, the load reduction scenario identified, if implemented, is expected to achieve the DO water quality criterion and the Chl-a target.

In this modeling effort, an explicit margin of safety (MOS) was considered in the TMDL development. For the alternative scenario selected, the DO exceedance rate of 9.0 percent is below the 10 percent exceedance rate target and the overall average Chl-a value is significantly below the estuary threshold of 11 ug/L.

5.10 Critical Conditions

The TMDLs were based on conditions observed throughout the eight-year model simulation period rather than critical/seasonal conditions because the methodology used to determine impairment was based on water quality results collected throughout the year.

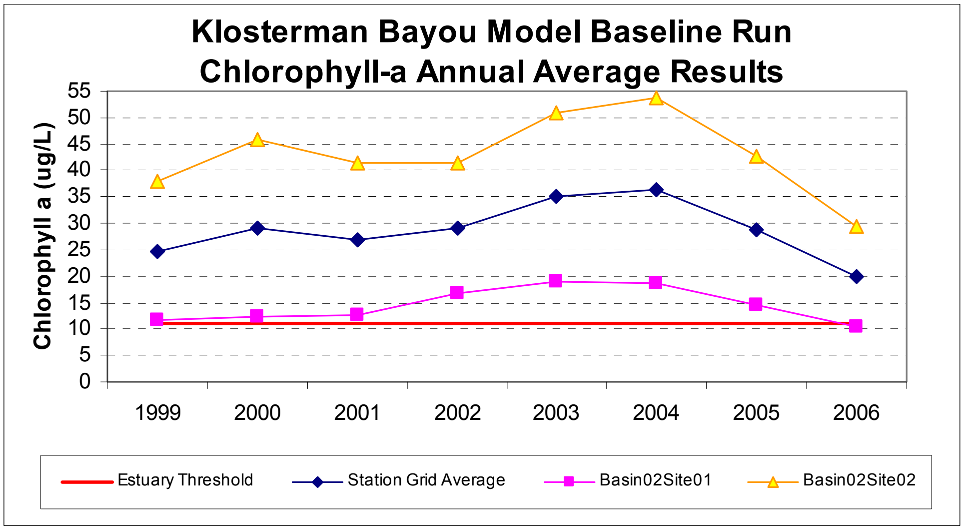

Figure 5.4 Predicted Annual Average Chlorophyll-a Values for the Baseline Condition (1999-2006)

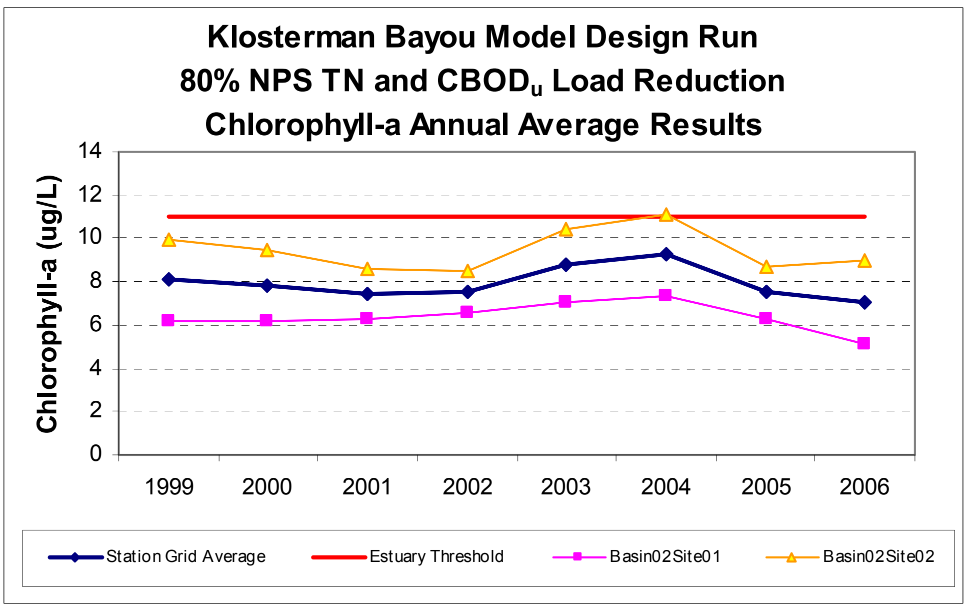

Figure 5.5 Predicted Annual Average Chlorophyll-a Values for the Load Reduction Scenario Selected for the TMDL (1999-2006)

Chapter 6: DETERMINATION OF THE TMDL

6.1 Expression and Allocation of the TMDL

The objective of a TMDL is to provide a basis for allocating acceptable loads amongst all of the known pollutant sources in a watershed so that appropriate control measures can be implemented and water quality standards achieved. A TMDL is expressed as the sum of all point source loads (Waste Load Allocations, or WLAs), nonpoint source loads (Load Allocations, or LAs), and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

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

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

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

It should be noted that the various components of the revised TMDL equation may not sum up to the value of the TMDL because a) the WLA for NPDES stormwater is typically based on the percent reduction needed for nonpoint sources and is also accounted for within the LA, and b) TMDL components can be expressed in different terms (for example, the WLA for stormwater is typically expressed as a percent reduction, and the WLA for wastewater is typically expressed as mass per day).

WLAs for stormwater discharges are typically expressed as “percent reduction” because it is very difficult to quantify the loads from MS4s (given the numerous discharge points) and to distinguish loads from MS4s from other nonpoint sources (given the nature of stormwater transport). The permitting of stormwater discharges also differs from the permitting of most wastewater point sources. Because stormwater discharges cannot be centrally collected, monitored, and treated, they are not subject to the same types of effluent limitations as wastewater facilities, and instead are required to meet a performance standard of providing treatment to the “maximum extent practical” through the implementation of BMPs.

This approach is consistent with federal regulation 40 CFR § 130.2[I] (U.S. Environmental Protection Agency, 2003), which states that TMDLs can be expressed in terms of mass per time (e.g., pounds per day), toxicity, or other appropriate measure. The TMDLs for the Klosterman Bayou tidal segment (WBID 1508) are expressed in terms of pounds per year and pounds per day in **Tables 6.1.a.** and **Table 6.1.b.**, respectively. The TMDLs represent the maximum annual and daily load the tidal segment can assimilate to maintain the marine DO water quality criterion and the narrative nutrient criterion. The TMDLs to be implemented are those expressed on a mass per year basis, and the expression of the TMDL on a mass per day basis is for information purposes only.

Table 6.1.a. TMDL Components by Year for the Klosterman Bayou Tidal Segment, WBID 1508

Parameter	WLA Wastewater (lbs/year)	WLA NPDES Stormwater (percent reduction)	LA (lbs/year)	MOS	TMDL (lbs/year)
$CBOD_5$	N.A.	80	1,444	Explicit	1,444
TN	N.A.	80	1,331	Explicit	1,331

N.A. – Not Applicable

Table 6.1.b. TMDL Components by Day for the Klosterman Bayou Tidal Segment, WBID 1508

Parameter	WLA Wastewater (lbs/day)	WLA NPDES Stormwater (percent reduction)	LA (lbs/day)	MOS	TMDL (lbs/day)
$CBOD_5$	N.A.	80	4.0	Explicit	4.0
TN	N.A.	80	3.6	Explicit	3.6

N.A. – Not Applicable

6.2 Load Allocation (LA)

The LA was determined by reducing the estimated nonpoint source loadings by the amount required to meet the assimilative capacity of the waterbody so that the water quality criteria for DO and nutrients are met. Based on the model simulations, the assimilative capacity was estimated to be an 80 percent reduction in the existing annual average BOD and TN loads during the 1999 to 2006 period, which are presented in Table 4.2. The estimated annual average nonpoint source loadings needed to meet the criteria in the Klosterman Bayou tidal segment are 1,444 lbs/year for 5-day CBOD ($CBOD_5$) and 1,331 lbs/year for TN. The $CBOD_u$ loads predicted by the HSPF model, were converted to a $CBOD_5$ load using a ratio of $CBOD_u$ to $CBOD_5$ of 2.84, as recommended in EPA guidance (USEPA 1997), in the absence of site specific data. The BOD load is expressed as $CBOD_5$ in the TMDL as this form of BOD is more commonly used for establishing BOD limits, particularly for point source dischargers.

6.3 Wasteload Allocation (WLA)

6.3.1 NPDES Wastewater Discharges

As previously mentioned, there are no permitted wastewater treatment facilities that discharge directly to the Klosterman Bayou tidal segment; therefore, the WLA is not applicable.

6.3.2 NPDES Stormwater Discharges

As noted in Chapter 4, loadings from stormwater discharges permitted under the NPDES stormwater program are placed in the WLA, rather than the LA. As it is difficult to quantify the load from this source, the allocation is expressed as a percent reduction. Since the nonpoint source component of the TMDL needs to be reduced by 80 percent, this percent reduction is likewise applied to the NPDES stormwater WLA. This includes loads from MS4s. It should be noted that any MS4 permittee is only responsible for reducing the loads associated with stormwater outfalls that it owns or otherwise has responsible control over, and it is not responsible for reducing other nonpoint source loads in its jurisdiction.

6.4 Margin of Safety

TMDLs must address uncertainty issues by incorporating a MOS into the analysis. The MOS is a required component of a TMDL and accounts for the uncertainty about the relationship between pollutant loads and the quality of the receiving waterbody (Clean Water Act, Section 303[d][1][c]). Considerable uncertainty is usually inherent in estimating pollutant loading from nonpoint sources, as well as predicting water quality response. The effectiveness of management activities (e.g., stormwater management plans) in reducing loading is also subject to uncertainty.

The MOS can either be implicitly accounted for by choosing conservative assumptions about loading or water quality response, or explicitly accounted for during the allocation of loadings. In the TMDL development for the tidal segment of Klosterman Bayou, an explicit MOS was considered since the load reduction scenario selected produced water quality model results that are less than the DO and Chl-a targets being applied. The load reduction is expected to maintain less than a 10 percent DO exceedance rate, and annual average Chl-a values well below the impairment threshold for estuaries of 11 ug/L.

Chapter 7: NEXT STEPS: IMPLEMENTATION PLAN DEVELOPMENT AND BEYOND

7.1 Basin Management Action Plan

Following the adoption of this TMDL by rule, the next step in the TMDL process is to develop an implementation plan for the TMDL, which will be a component of the Basin Management Action Plan (BMAP) for the Springs Coast Basin. This document will 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 load reduction allocations among the affected parties,
- A description of the load reduction activities to be undertaken, including structural projects, nonstructural BMPs, and public education and outreach,
- A description of further research, data collection, or source identification needed in order to achieve the TMDL,
- Timetables for implementation,
- Confirmed and potential funding mechanisms,
- Any applicable signed agreement(s),
- Local ordinances defining actions to be taken or prohibited,
- Any applicable local water quality standards, permits, or load limitation agreements,
- Milestones for implementation and water quality improvement, and
- Implementation tracking, water quality monitoring, and follow-up measures.

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

References

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Appendix A: Background Information on Federal and State Stormwater Programs

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

The rule requires the state’s water management districts (WMDs) to establish stormwater pollutant load reduction goals (PLRGs) and adopt them as part of a Surface Water Improvement and Management (SWIM) plan, other watershed plan, or rule. Stormwater PLRGs are a major component of the load allocation part of a TMDL. To date, stormwater PLRGs have been established for Tampa Bay, Lake Thonotosassa, the Winter Haven Chain of Lakes, the Everglades, Lake Okeechobee, and Lake Apopka. No PLRG had been developed for Newnans Lake at the time this report was developed.

In 1987, the U. S. Congress established Section 402(p) as part of the federal Clean Water Act Reauthorization. This section of the law amended the scope of the federal NPDES stormwater permitting program to designate certain stormwater discharges as “point sources” of pollution. These stormwater discharges include certain discharges that are associated with industrial activities designated by specific standard industrial classification (SIC) codes, construction sites disturbing 5 or more acres of land, and master drainage systems of local governments with a population above 100,000, which are better known as MS4s. However, because the master drainage systems of most local governments in Florida are interconnected, the EPA has implemented Phase 1 of the MS4 permitting program on a countywide basis, which brings in all cities (incorporated areas), Chapter 298 urban water control districts, and the FDOT throughout the 15 counties meeting the population criteria.

An important difference between the federal and state stormwater permitting programs is that the federal program covers both new and existing discharges, while the state program focuses on new discharges. Additionally, Phase 2 of the NPDES Program will expand the need for these permits to construction sites between 1 and 5 acres, and to local governments with as few as 10,000 people. The revised rules require that these additional activities obtain permits by 2003. While these urban stormwater discharges are now technically referred to as “point sources” for the purpose of regulation, they are still diffuse sources of pollution that cannot be easily collected and treated by a central treatment facility, as are other point sources of pollution such as domestic and industrial wastewater discharges. The Department recently accepted delegation from the EPA for the stormwater part of the NPDES Program. It should be noted that most MS4 permits issued in Florida include a re-opener clause that allows permit revisions to implement TMDLs once they are formally adopted by rule.

Florida Department of Environmental Protection
Division of Environmental Assessment and Restoration
2600 Blair Stone Road, Mail Station 3565
Tallahassee, Florida 32399-2400
(850) 245-8561
http://www.dep.state.fl.us/water/