Final

Total Maximum Daily Loads

for

Dissolved Oxygen and Nutrients

in

Owen Creek (WBID 1933) and Myakka River (WBID 1981B)

March 2013

Region4 serving the southeast

In compliance with the provisions of the Federal Clean Water Act, 33 U.S.C §1251 et. seq., as amended by the Water Quality Act of 1987, P.L. 400-4, the U.S. Environmental Protection Agency is hereby establishing the Total Maximum Daily Loads (TMDLs) for dissolved oxygen and nutrients in the Upper Myakka River Basin (WBIDs 1933, 1981B). Subsequent actions must be consistent with these TMDLs.

_______________/s/_________________________ ___3/25/2013__

James D. Giattina, Director
Water Protection Division

Date

Table of Contents

Table of Figures

Table of Tables

LIST OF ABBREVIATIONS

B-MAP	Basin Management Action Plan
BMP	Best Management Practices
BOD	Biochemical Oxygen Demand
CFR	Code of Federal Regulations
CFS	Cubic Feet per Second
CO_2	Carbon Dioxide
DO	Dissolved Oxygen
EMC	Event Mean Concentration
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FLUCCS	Florida Land Use Cover Classification System
FS	Florida Statutes
GIS	Geographic Information System
HSPF	Hydrologic Simulation Program Fortran
HUC	Hydrologic Unit Code
IWR	Impaired Surface Waters Rule
KM^2	Square Kilometers
L	Liters
L/FT^3	Liters per Cubic Foot
LA	Load Allocation
LB/YR	Pounds per year
LSPC	Loading Simulation Program C++
MGD	Million Gallons per Day
MG/L	Milligram per liter
ML	Milliliters
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer Systems
NASS	National Agriculture Statistics Service
NH_4	Ammonia Nitrogen
NO_2	Nitrite
NO_3	Nitrate
NPDES	National Pollutant Discharge Elimination System
OBS	Observations
OSTD	Onsite Treatment and Disposal System

SWFWMD	Southwest Florida Water Management District
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TOC	Total Organic Carbon
TP	Total Phosphorus
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WASP	Water Quality Analysis Simulation Program
WBID	Water Body Identification
WLA	Waste Load Allocation
WQS	Water Quality Standards
WMD	Water Management District
WWTP	Waste Water Treatment Plant

SUMMARY SHEET
Total Maximum Daily Load (TMDL)

1998 303(d) Listed Waterbodies for TMDLs addressed in this report:

WBID	Segment Name	Class and Waterbody Type	Major River Basin	HUC	County	State
1933	Owen Creek	Class IIIF Stream	Upper Myakka River Basin	03100102	Manattee /Hardee	Florida
1981B	Myakka River	Class I River	Upper Myakka River Basin	03100102	Sarasota	Florida

TMDL Endpoints/Targets: Dissolved Oxygen, Nutrients, BOD

TMDL Technical Approach: The TMDL allocations for dissolved oxygen were determined by analyzing the effects of BOD, TN, and TP loads on DO concentrations. For each waterbody, an LSPC model was used to predict both current and natural pollutant loadings and stream flows, and a WASP Eutrophication model was used to evaluate the in-stream impacts of these pollutant loads. Load reduction scenarios were evaluated to determine which loads would allow each WBID to meet water quality standards.

TMDL Waste Load and Load Allocation

	Current Condition		TMDL Condition		MS4	LA
WBID 1933 Owen Creek	**WLA (kg/yr)**	**LA (kg/yr)**	**WLA (kg/yr)**	**LA (kg/yr)**	**% Reduction**	**% Reduction**
BOD	0	24690	0	21000	15	15
TN	0	11745	0	8992	23	23
TP	0	3088	0	1207	61	61
WBID 1981B Myakka River	**WLA (kg/yr)**	**LA (kg/yr)**	**WLA (kg/yr)**	**LA (kg/yr)**	**% Reduction**	**% Reduction**
BOD	NA	66720	NA	59666	11	11
TN	NA	26569	NA	25492	4	4
TP	NA	4733	NA	4155	12	12

Endangered Species Present (Yes or Blank): Yes

USEPA Lead TMDL (USEPA or Blank): USEPA

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

Major NPDES Discharges to surface waters addressed in USEPA TMDL:

Permit ID	Permitee	Permit Type
FLA182966	Farren Dakin Dairy	Dairy Farm- AFO/CAFO
FLA182699	Cameron Dakin Dairy	Dairy Farm- AFO/CAFO
FLS000036	Manatee County and co-permittees	Phase I MS4
FLS000004	Sarasota County and co-permittees	Phase I MS4

1. Introduction

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

The Florida Department of Environmental Protection (FDEP) developed a statewide, watershed-based approach to water resource management. Under the watershed management approach, water resources are managed on the basis of natural boundaries, such as river basins, rather than political boundaries. The watershed management approach is the framework FDEP uses for implementing TMDLs. The state's 52 basins are divided into 5 groups and water quality is assessed in each group on a rotating 5-year cycle. FDEP also established five water management districts (WMD) responsible for managing ground and surface water supplies in the counties encompassing the districts. Owen Creek WBID 1933 and the Myakka River WBID 1981B are located in the Myakka River Basin and are Group 3 waters managed by the Southwest Florida Water Management District (SWFWMD).

For the purpose of planning and management, the WMDs divided the district into planning units defined as either an individual primary tributary basin or a group of adjacent primary tributary basins with similar characteristics. These planning units contain smaller, hydrological based units called drainage basins, which are further divided by FDEP into "water segments". A water segment usually contains only one unique waterbody type (stream, lake, canal, etc.) and is about five square miles. Unique numbers or waterbody identification (WBIDs) numbers are assigned to each water segment. This TMDL report addresses WBID 1933 (Owen Creek) and WBID 1981B (Myakka River).

2. Problem Definition

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

The TMDL addressed in this document is being established pursuant to commitments made by the United States Environmental Protection Agency (USEPA) in the 1998 Consent Decree in the Florida TMDL lawsuit (Florida Wildlife Federation, et al. v. Carol Browner, et al., Civil Action No. 4: 98CV356-WS, 1998). That Consent Decree established a schedule for TMDL development for waters listed on Florida's USEPA approved 1998 section 303(d) list. The 1998 section 303(d) list identified numerous WBIDs in the Myakka River Basin as not meeting WQS. After assessing all readily available water quality data, USEPA is responsible for developing TMDLs for WBID 1933 (Owen Creek) and WBID 1981B (Myakka River). The geographic location of these WBIDs is shown in Figure 1. The parameters addressed in this TMDL are dissolved oxygen (DO), biochemical oxygen demand (BOD) and nutrients.

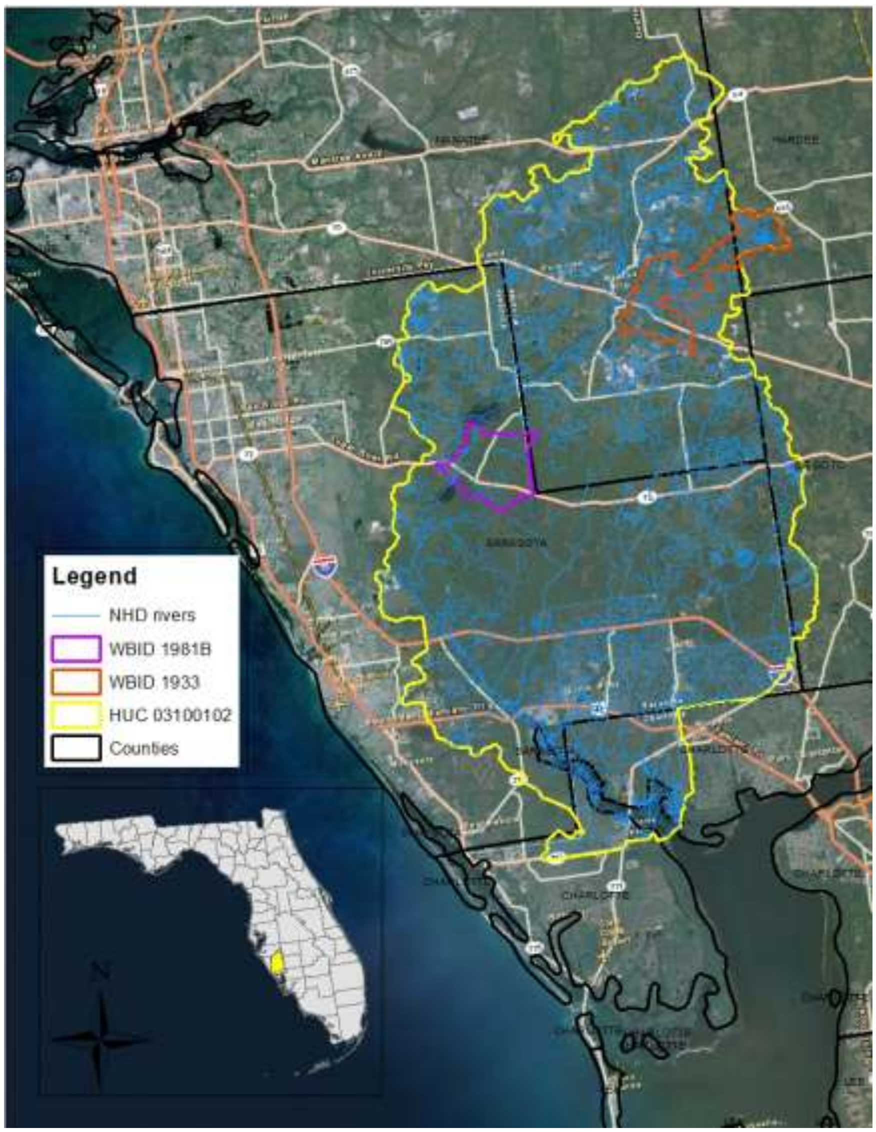

Figure 1. Location of WBIDs 1981B and 1933 in the Myakka River Basin.

3. Watershed Description

The Myakka River watershed drains approximately 600 square miles covering portions of Manatee, Sarasota, Charlotte, Hardee and DeSoto counties in southwest Florida (see Hydrologic Unit Code (HUC) 03100102 in Figure 1). The headwaters of the Myakka River are located near Myakka Head, below which several tributaries converge to form Flatford Swamp. The blackwater Myakka River then flows approximately 66 miles southwest before discharging into the Charlotte Harbor Estuary (FDEP, 2003). The Myakka River is the second largest source of freshwater inflow to Charlotte Harbor, which is widely considered to be one of the healthiest and most productive estuaries in southwest Florida. Charlotte Harbor and the Lower Myakka River are designated as Outstanding Florida Waters (OFWs) by FDEP. In addition, Charlotte Harbor was designated an “Estuary of National Significance” by the National Estuary Program and is considered a priority waterbody for restoration and protection by the SWFWMD Surface Water Improvement and Management (SWIM) program.

The Myakka River basin is a unique and ecologically significant watershed due to its hydrologic characteristics, variety of landscapes and habitats, and diverse wildlife that includes many rare and endangered species. The watershed has extensive tidal wetlands and more freshwater wetlands than any other area draining to Charlotte Harbor. Water levels in Myakka River are highly seasonal, with over 70 percent of the flow measured at the Sarasota gauge occurring between July and October (FDEP, 2003).

Overall, the Myakka River watershed is less developed than other watersheds of its size, particularly in the middle portion where large areas of conservation lands are located (Figure 2). The Myakka River was designated as a “Florida Wild and Scenic River” by the Florida Legislature in 1985, allowing for the creation of Myakka River State Park in Sarasota County to preserve and protect it. As the Myakka River winds its way through this park, it flows through two successive impoundments associated with Upper and Lower Myakka Lakes. Tidal influence extends upstream to a water control structure (Down’s Dam), located below Lower Myakka Lake. This location is often used to divide the Myakka River into upper and lower subbasins, with the upper portion non-tidal freshwater, and the lower portion brackish and tidal. WBID 1981B is a segment of the Myakka River located between Upper and Lower Myakka Lake.

The upper portion of the watershed is flat and marshy, and does not have much urban or residential development. However, most of the agriculture in the watershed is concentrated in the upper basin (Figure 2). Agricultural uses include pasture, dairies, row crops, citrus and tree crops. The Owen Creek tributary (WBID 1933) joins the Myakka River east of Myakka City.

In the lower portion of the watershed, below Myakka River State Park, the river and its floodplain widen significantly. A large fraction of the residential and urban development in the watershed is located in the lower portion, near the cities of North Port and Port Charlotte (Figure 2). The Myakka River receives water from two tributaries, Deer Prairie Creek and Big Slough Canal, before flowing into the aquatic preserve.

In order to identify possible pollutant sources in the watershed, the latest land use coverage was obtained from FDEP. Land use data are based on 2009 land cover features categorized according to the Florida Land Use and Cover Classification System (FLUCCS). Table 1 provides the land use areas and percentages for WBID 1933 of Owen Creek, WBID 1981B of the Myakka River, and the entire Myakka River watershed. Considering the basin as a whole, both agriculture and urban/residential uses are significant, comprising 25 and 19 percent of the area, respectively. Wetland (22 percent), forest (16 percent), and non-forested uplands (13 percent) are also prevalent.

For the area draining to the Owen Creek (WBID 1933) tributary, the predominant land use is agriculture (60 percent), followed by wetlands (16 percent) and forest (15 percent Table 1). Owen Creek also receives discharges from two dairy farms that are permitted to operate in the watershed: the Farren Dakin Dairy (FLA182966) and the Cameron Dakin Dairy (FLA182699). The distribution of land use in WBID 1933 is illustrated in Figure 3.

Wetlands and non-forested uplands such as shrub and brushland comprise the vast majority of the area within WBID 1981B of the Myakka River (Figure 4). However, this section of the river receives drainage from the developed and agricultural uses in the upper watershed.

Table 1. Landuse in WBID 1933, WBID 1981B, and the Myakka River Watershed.

Level 1 FLUCCs Landuse Category[1]	WBID 1933[2]		WBID 1981B[3]		Myakka Watershed[4]	
	Percent of Area:	Square Miles	Percent of Area:	Square Miles	Percent of Area:	Square Miles
Urban & Residential	1.0%	0.19	0.6%	0.08	19%	116
Agriculture	60.6%	11.64	2.2%	0.30	25%	151
Upland Nonforested	7.8%	1.50	47.0%	6.45	13%	78
Upland Forest	14.6%	2.81	3.0%	0.41	16%	98
Water	0%	0.09	1.0%	0.13	3%	18
Wetlands	16%	2.98	46%	6.34	22%	135
Barren Land	0%	0.00	0.0%	0.00	0.1%	0
Transportation & Utilities	0%	0.00	0.1%	0.01	0.7%	4
Total	**100%**	**19.21**	**100%**	**13.72**	**100%**	**602**

Notes:

1. Land use data are based on 2009 SWFWMD land cover features categorized according to the Florida Land Use and Cover Classification System (FLUCCS). The features were photo interpreted at 1:8,000 using 2009 one-foot and six-inch color infrared digital aerial photographs.
2. Percent and area of Level 1 FLUCCs land use classifications within WBID 1933.
3. Percent and area of Level 1 FLUCCs land use classifications within WBID 1981B.
4. Percent and area of Level 1 FLUCCs land use classifications within the Myakka River Watershed (HUC 03100102).
5. The urban/residential and built-up category includes commercial, industrial and extractive uses.
6. The upland non-forested category includes rangeland, shrub and brushland.

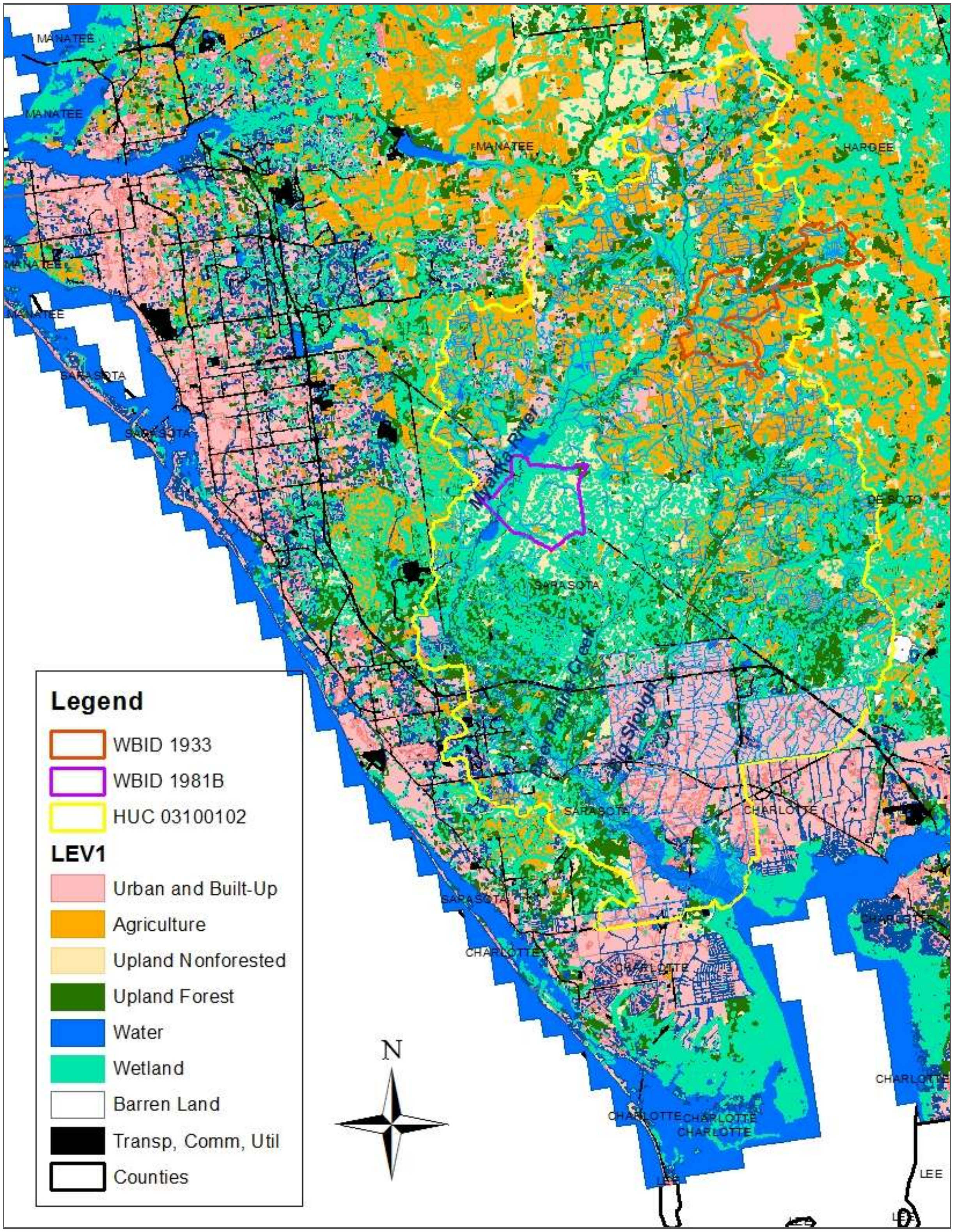

Figure 2 Land use in the Myakka River Watershed.

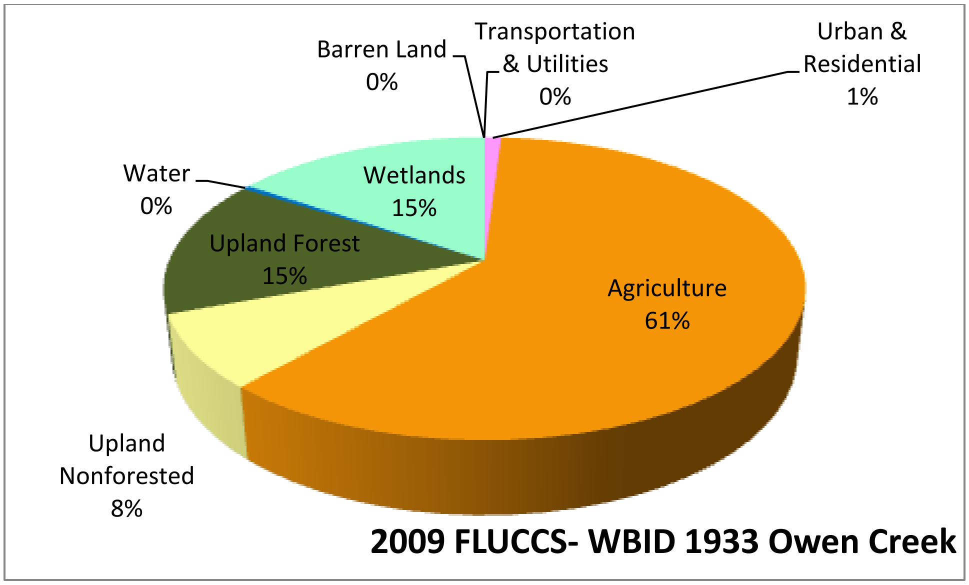

Figure 3. Land use distribution in Owen Creek WBID 1933.

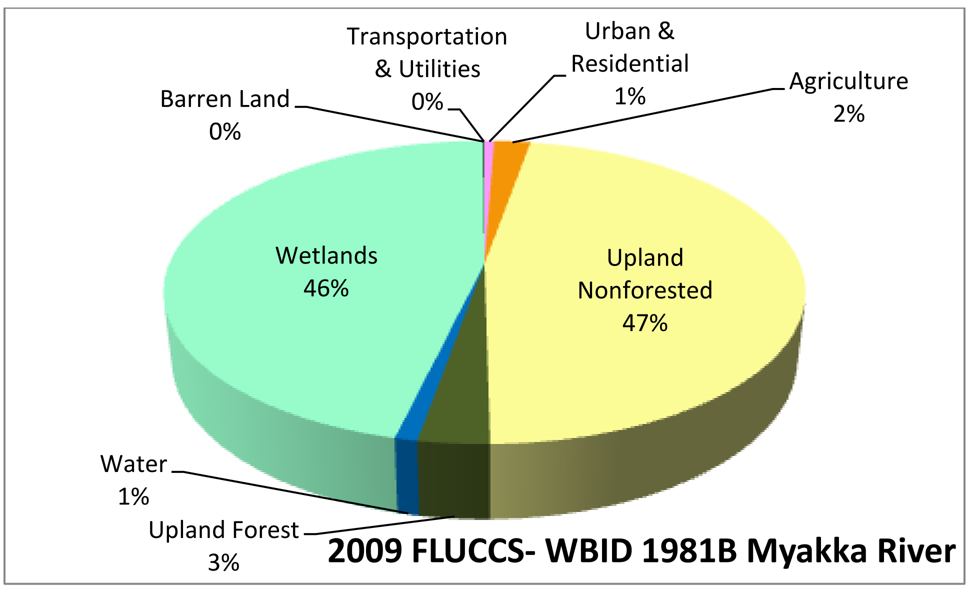

Figure 4. Land use distribution in the Myakka River WBID 1981B.

4. Water Quality Standards/TMDL Targets

The waterbodies in WBID 1933 are Class III Freshwater with a designated use of Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife. Designated use classifications are described in Florida's water quality standards WBID 1981B is Class I. Designated use classifications are described in Florida's water quality standards. See Section 62-302.400, F.A.C. Water quality criteria for protection of all classes of waters are established in Section 62-302.530, F.A.C. Individual criteria should be considered in conjunction with other provisions in water quality standards, including Section 62-302.500 F.A.C., which established minimum criteria that apply to all waters unless alternative criteria are specified. Section 62-302.530, F.A.C. Several of the WBIDs addressed in this report were listed due to elevated concentrations of chlorophyll *a*. While FDEP does not have a streams water quality standard specifically for chlorophyll *a*, elevated levels of chlorophyll *a* are frequently associated with nonattainment of the narrative nutrient standard, which is described below.

4.1. Nutrients Criteria:

The designated use of Class III waters is recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. In 1979, FDEP adopted a narrative criterion for nutrients. FDEP recently adopted numeric nutrient criteria (NNC) for many Class III waters in the state, including streams, which numerically interprets part of the state narrative criterion for nutrients. FDEP submitted its NNC to EPA for review pursuant to section 303(c) of the CWA. On November 30, 2012, EPA approved those criteria as consistent with the requirements of the CWA. The state criteria, however, are not yet effective for state law purposes.

Also, in November 2010, EPA promulgated numeric nutrient criteria for Class III inland waters in Florida, including streams. On February 18, 2012, the streams criteria were remanded back to EPA by the U.S. District Court for the Northern District of Florida for further explanation. On November 30, 2012, EPA re-proposed its stream NNC for those flowing waters not covered by Florida’s NNC rule.

Therefore, for streams in Florida, the applicable nutrient water quality standard for CWA purposes remains the Class III narrative criterion.

4.1.1 Narrative Nutrient Criteria

Florida's narrative nutrient criteria provide:

> The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards contained in this chapter. Man induced nutrient enrichment (total nitrogen and total phosphorus) shall be considered degradation in relation to the provisions of Sections 62-302.300, 62-302.700, and 62-4.242 F.A.C. See paragraph 62-302.530(47)(a), F.A.C.
>
> In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna. See paragraph 62-302.530(47)(b), F.A.C.

Chlorophyll and DO levels are often used to indicate whether nutrients are present in excessive amounts. The target for this TMDL is based on levels of nutrients necessary to prevent violations of Florida's DO criterion pursuant to paragraph 62-302.530(47)(a), F.A.C., as set out more fully below.

4.1.2 Florida's adopted numeric nutrient criteria for streams

While not yet effective as water quality criteria, the FDEP's numeric nutrient criteria represent the state's most recent interpretation of the second part of Florida's narrative criteria, set out at paragraph 62-302.530(47)(b), F.A.C. See section 62-302.531(2). The first part of the narrative criteria, at paragraph 62-302.530(47)(b), F.A.C., also remains applicable to streams in Florida.

Florida's interpretation of its narrative nutrient criteria applies to streams, including (WBIDs 1933, 1981C). For streams that do not have a site specific criteria, the interpretation provides for biological information to be considered together with nutrient thresholds to determine whether a waterbody is attaining See paragraph 62-302.531(2)(c), F.A.C. The rule provides that the nutrient criteria are attained in a stream segment where information on chlorophyll a levels, algal mats or blooms, nuisance macrophyte growth, and changes in algal species composition indicates there are no imbalances in flora and either the average score of at least two temporally independent SCIs performed at representative locations and times is 40 or higher, with neither of the two most recent SCI scores less than 35, or the nutrient thresholds set forth in Table 2 below are achieved. See paragraph 62-302.531(2)(c).

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

Table 2 Inland Numeric Nutrient Criteria

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

4.2. Dissolved Oxygen Criteria:

Numeric criteria for DO are expressed in terms of minimum and daily average concentrations. Section 62-302(30), F.A.C., sets out the water quality criterion for the protection of Class I and Class III freshwater waters as:

> Shall not be less than 5.0 mg/l. Normal daily and seasonal fluctuations above these levels shall be maintained.

4.3. Biochemical Oxygen Demand Criteria:

The water quality criterion for the biochemical oxygen demand applies to all classes of waters and states that:

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

4.4. Natural Conditions

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

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

> "Natural Background" shall mean the condition of waters in the absence of man-induced alterations based on the best scientific information available to the Department. The establishment of natural background for an altered waterbody may be based upon a similar unaltered waterbody or on historical pre-alteration data. 62-302.200(15), FAC.

Florida's water quality standards also provide that:

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

5. Water Quality Assessment

Owen Creek WBID 1933 and Myakka River WBID 1981B were identified on Florida's 1998 303(d) list as not attaining their respective designated uses due to DO and nutrients. An assessment of available data was conducted to determine the impairment status of both water bodies. The source for current ambient monitoring data was the Impaired Waters Rule (IWR) data Run 46. The IWR database contains data from various sources within the state of Florida, including the WMDs and counties.

5.1. Water Quality Data

The tables and figures below present the station locations and time series data for DO, total nitrogen (TN), total phosphorous (TP), BOD, and chlorophyll-*a* observations for Owen Creek WBID 1933 and Myakka River WBID 1981B. Summary statistics for the water quality data are provided with each figure. The original data are included in the Administrative Record for this report, and are also available upon request.

5.1.1. WBID 1933: Owen Creek

Table 3 identifies monitoring stations located in Owen Creek WBID 1933 and lists the time period over which water quality measurements were made at each location during the assessment period for IWR Version 44. Figure 5 illustrates where these monitoring stations are located.

Table 3 Water Quality Monitoring Stations in Owen Creek (WBID 1933).

Station	Station Name	First Date	Last Date	No. Obs.
21FLSWFD25943	C. Dakin Dairy - Tributary to Owen Creek	10/01/2003	08/05/2009	48
21FLTPA 272033608208271	OCO3-Owen Creek	07/14/2003	12/08/2003	12
21FLTPA 272038708208508	OCO4-Owen Creek	07/16/2003	09/28/2004	64

NOTES: Obs.= Number of observations (TN, TP, CHLAC, DO) in IWR 44 current assessment period.

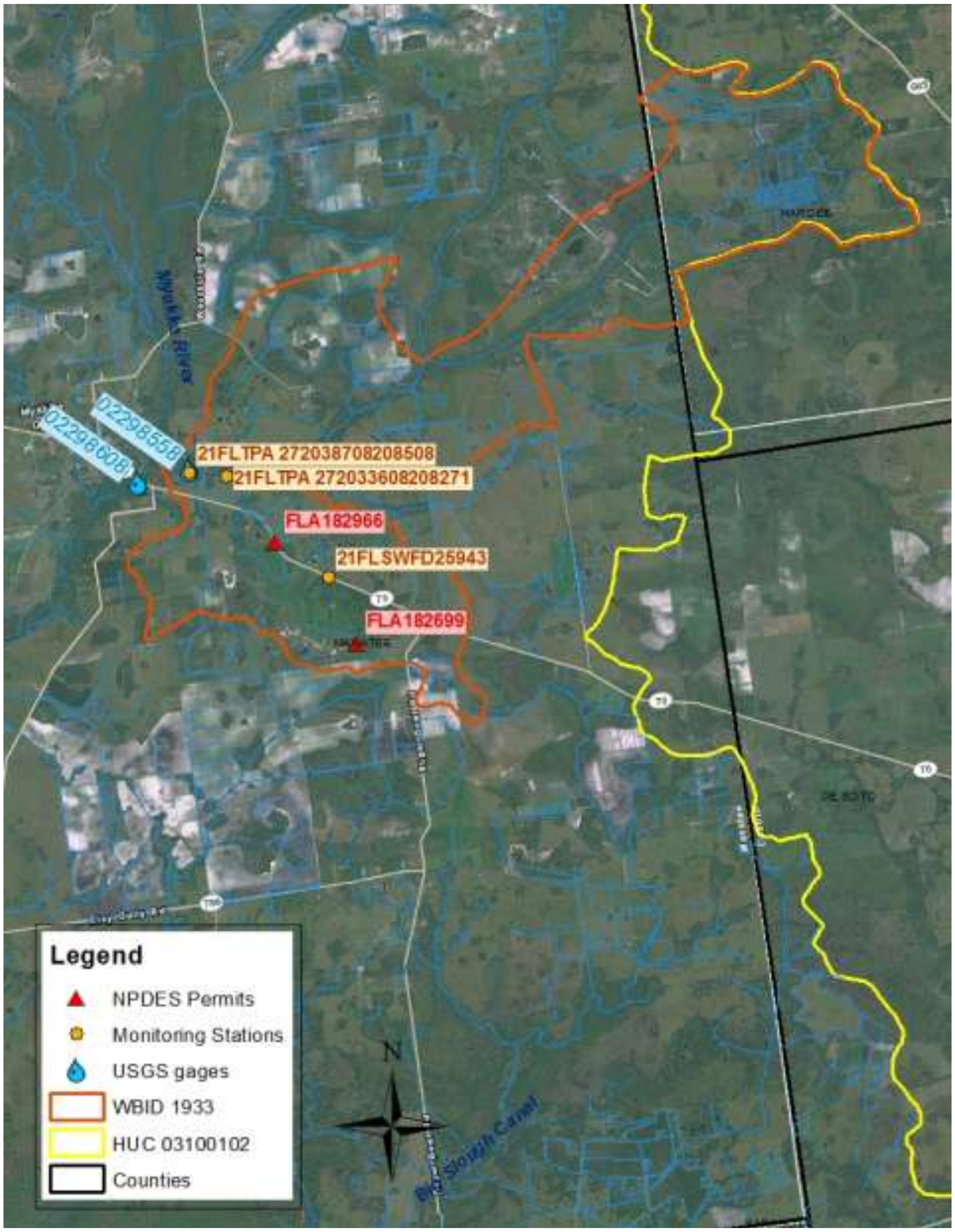

Figure 5. Monitoring stations, flow gages and point sources in Owen Creek WBID 1933.

Dissolved Oxygen

There are several factors that affect the concentration of dissolved oxygen in a waterbody. Oxygen can be introduced by wind, diffusion, photosynthesis, and additions of higher DO water (e.g. from tributaries). DO concentrations are lowered by processes that use up oxygen from the water, such as respiration and decomposition, and by additions of water with lower DO (e.g. swamp or groundwater). Natural DO levels are a function of water temperature, water depth and velocity, and relative contributions of groundwater. Decomposition of organic matter, such as dead plants and animals, also uses up DO.

Figure 6 provides a time series plot for the measured DO concentrations in Owen Creek. There were 3 monitoring stations used in the assessment that included a total of 47 observations of which 20 (43 percent) fell below the water quality standard of 5 mg/l DO. The minimum value was 0.65 mg/l, the maximum was 10.06 mg/l and the average was 5.5 mg/l. The DO concentrations measured at station 21FLSWFD25943 near C. Dakin Dairy appear to be consistently low, whereas the measurements at the other two stations are higher.

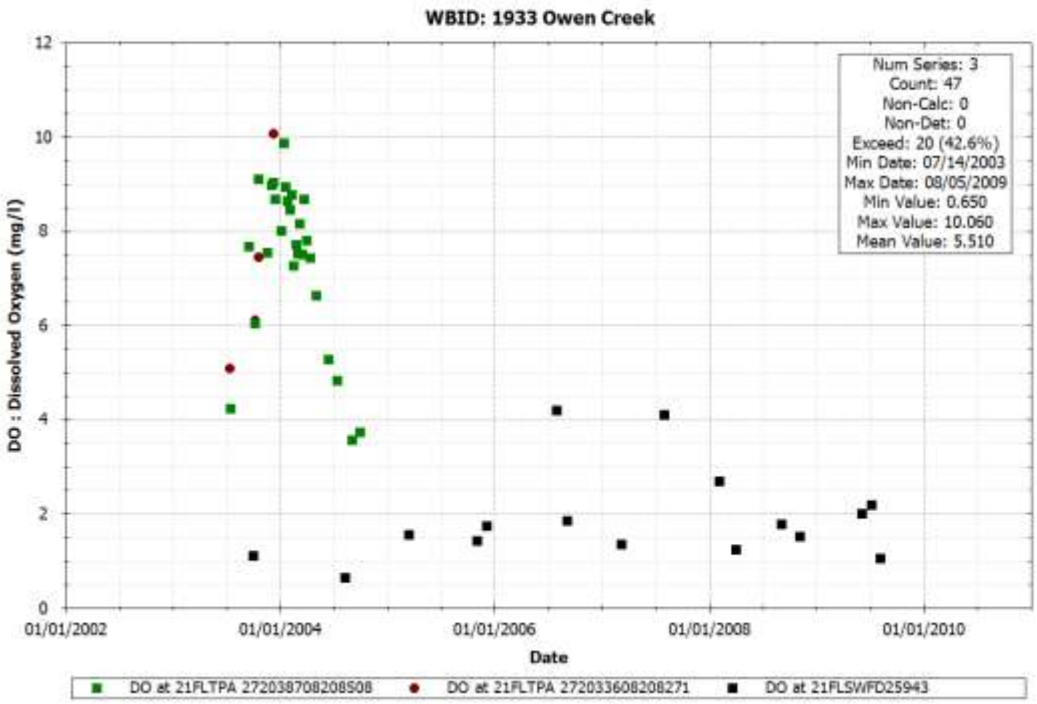

Figure 6. WBID 1933 (Owen Creek) Measured DO.

Biochemical Oxygen Demand

BOD is a measure of the amount of oxygen used by bacteria as they stabilize organic matter. Natural sources of organic compounds in water bodies include riparian vegetation, aquatic plants, and drainage from swamps and wetlands. Anthropogenic sources of organic matter include discharges of sewage and wastewater, discharges from pulp and paper production, and discharges from food or meat processing. Excessive algal blooms due to elevated nutrient levels can also increase BOD concentrations, particularly as the algae die and decay. BOD measurements are frequently used to evaluate the efficiency of wastewater treatment discharges, since treatment should reduce the levels of biodegradable organic compounds (and therefore BOD) in the water. Elevated levels of BOD in a water body lower DO concentrations, which can adversely impact resident aquatic populations. There are no BOD measurements available for WBID 1933.

Nutrients

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

Total Nitrogen

Total Nitrogen is comprised of nitrate (NO3), nitrite (NO2), organic nitrogen and ammonia nitrogen (NH4). Figure 7 provides a time series plot for the measured TN concentrations in Owen Creek. There were 3 monitoring stations used in the assessment that included a total of 35 observations. The minimum value was 0.61 mg/l, the maximum was 147.88 mg/l and the average was 19.47 mg/l. The TN concentrations show a marked difference based on station locations, with the measured values being much lower at the monitoring locations on the main stem, and much higher at station 21FLSWFD25943.

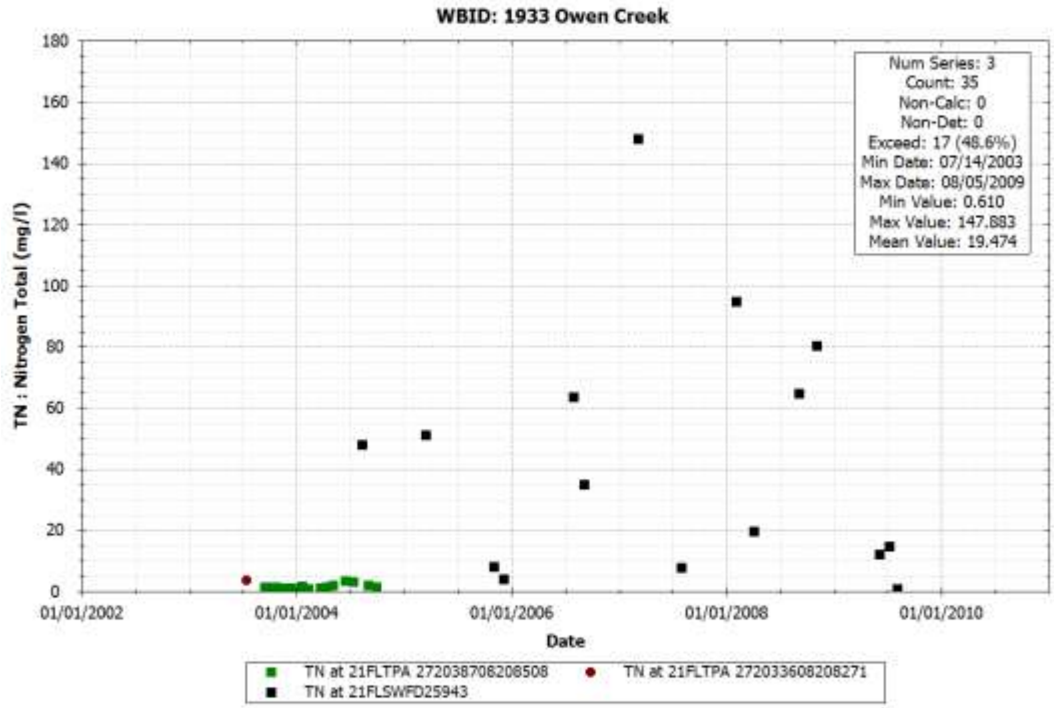

Figure 7. WBID 1933 (Owen Creek) Measured Total Nitrogen.

Total Phosphorus

In natural waters, total phosphorus exists in either soluble or particulate forms. Dissolved phosphorus includes inorganic and organic forms, while particulate phosphorus is made up of living and dead plankton, and adsorbed, amorphous, and precipitated forms. Inorganic forms of phosphorus include orthophosphate and polyphosphates, though polyphosphates are unstable and convert to orthophosphate over time. Orthophosphate is both stable and reactive, making it the form most used by plants. Excessive phosphorus can lead to overgrowth of algae and aquatic plants, the decomposition of which uses up oxygen from the water. Figure 8 provides a time series plot for the measured total phosphorus concentrations in Prairie Creek. There were 3 monitoring stations used in the assessment that included a total of 35 observations. The minimum value was 0.15 mg/l, the maximum was 17.40 mg/l and the average was 5.14 mg/l. The trend in TP concentrations is similar to that of TN, in that the range of concentrations measured at station 21FLSWFD25943 appear to be higher than the concentrations measured at stations on the main stem.

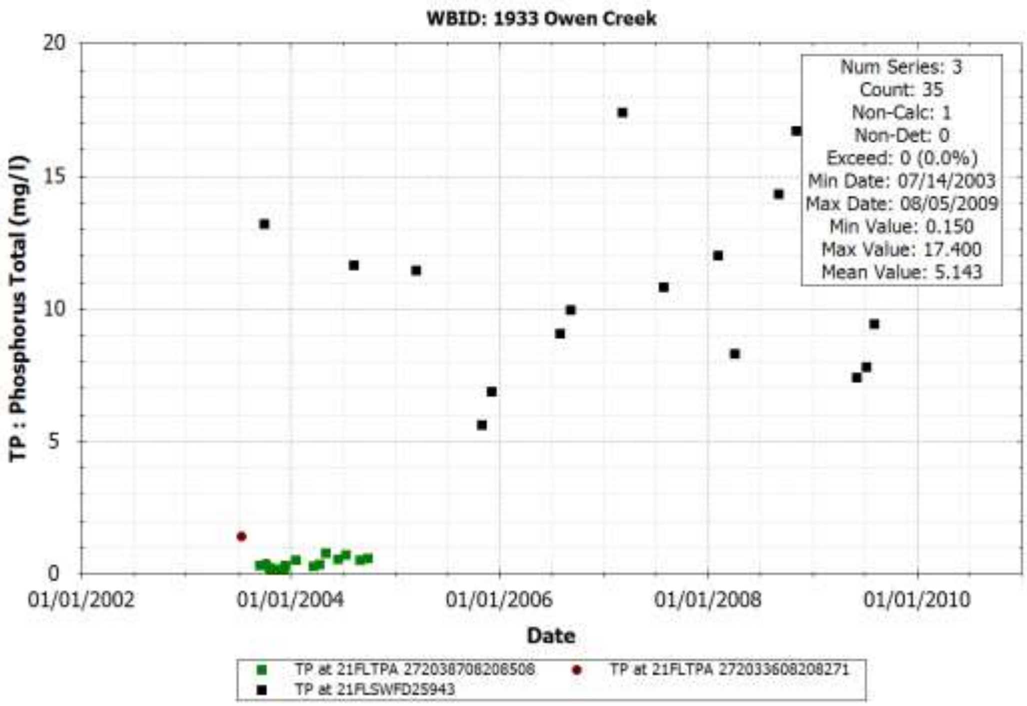

Figure 8. WBID 1933 (Owen Creek) Measured Total Phosphorus.

Chlorophyll-a

Chlorophyll is the green pigment in plants that allows them to create energy from light. In a water sample, chlorophyll is indicative of the presence of algae, and chlorophyll-*a* is a measure of the active portion of total chlorophyll. Corrected chlorophyll refers to chlorophyll-*a* measurements that are corrected for the presence of pheophytin, a natural degradation product of chlorophyll that can interfere with analysis because it has an absorption peak in the same spectral region.

The data for corrected chlorophyll in Owen Creek are limited (Figure 9). There were two monitoring stations used in the assessment that included a total of six observations. The minimum value was 1.00 µg/l, the maximum was 4.25 µg/l and the average was 1.86 µg/l.

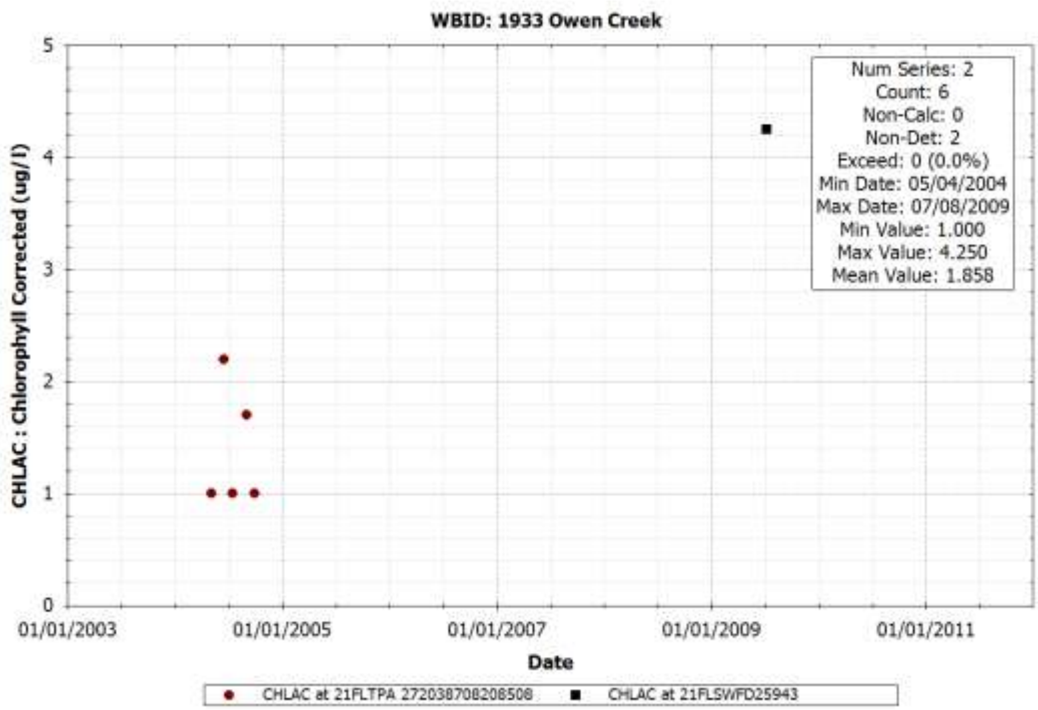

Figure 9. Measured Chlorophyll-*a* Concentrations in WBID 1933 (Owen Creek).

5.1.2. WBID 1981B : Myakka River

Table 4 provides a list of the water quality monitoring stations in WBID 1981B of the Myakka River, including the date range and the number of observations at each station. Figure 10 illustrates where these monitoring stations are located.

Table 4. Water Quality Monitoring Stations in Myakka River (WBID 1981B).

Station	Station Name	First Date	Last Date	No. Obs.
21FLGW 38456	Z4-LR-4010 MYAKKA RIVER	04/15/2010	04/15/2010	5
21FLTPA 27144448218239	TP191-Myakka River	08/26/2003	11/17/2009	57
21FLSWFD26046	Myakka River near Sarasota	07/08/2003	12/08/2010	449
21FLTPA 27142688218502	TP192-Myakka River	08/26/2003	11/17/2009	58
21FLTPA 25030405	MY09 - Myakka River	03/30/2009	03/30/2009	1
21FLGW 37940	Z4-LR-3006R MYAKKA RIVER	10/26/2009	10/26/2009	5
21FLGW 36999	Z4-LR-3006 MYAKKA RIVER	04/08/2009	04/08/2009	5
21FLTPA 271405508218415	MY10 - Myakka River	03/30/2009	03/30/2009	1

NOTES: Obs.= Number of observations (TN, TP, DO, CHLAC) in IWR 44 current assessment period.

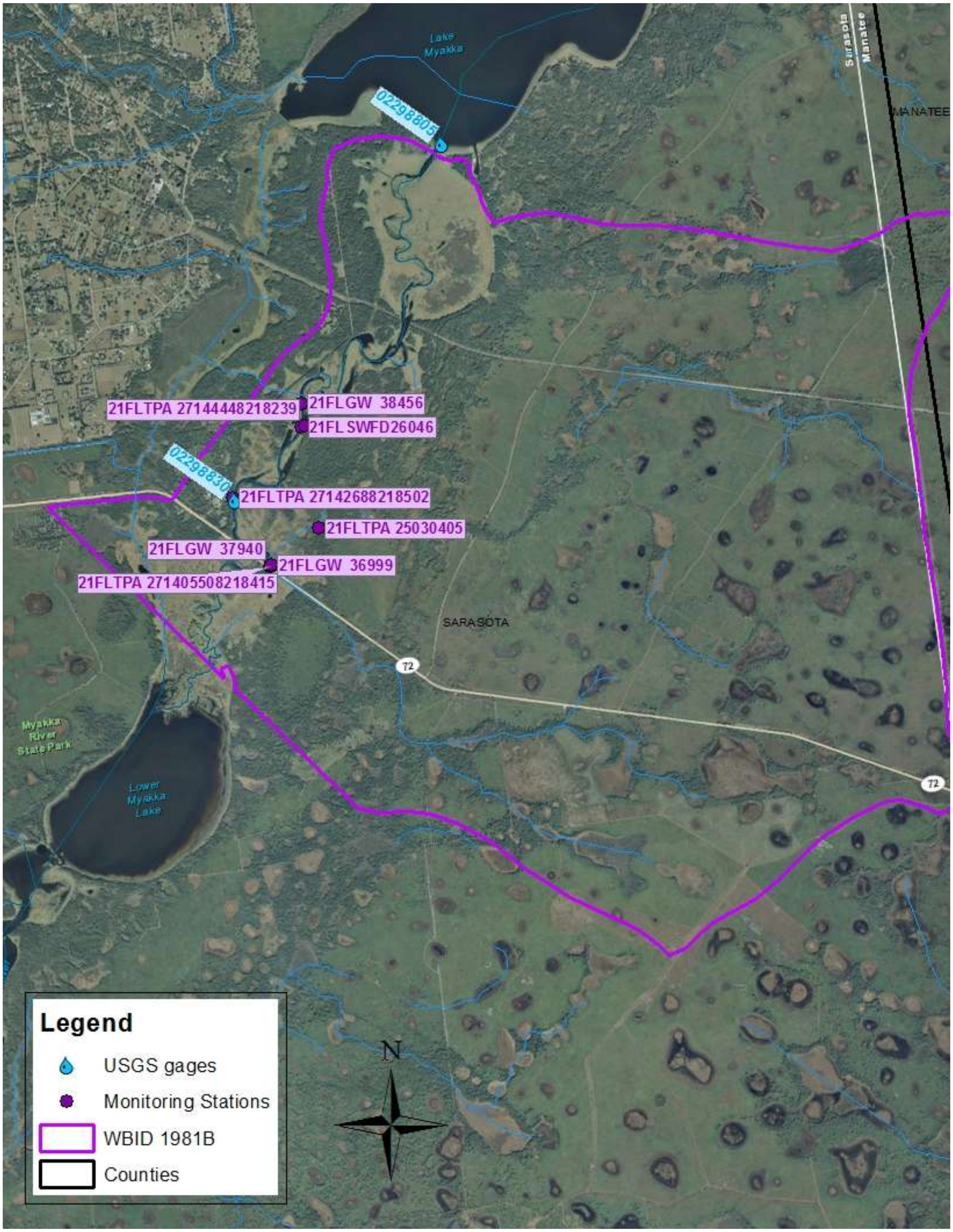

Figure 10. Location of monitoring stations and gages in Myakka River WBID 1981B.

Dissolved Oxygen

Figure 11 provides a time series plot for the measured DO concentrations in the Myakka River WBID 1981B. There were 8 monitoring stations used in the assessment that included a total of 185 observations of which 91 (49 percent) fell below the water quality standard of 5 mg/l DO. The minimum value was 0.07 mg/l, the maximum was 16.92 mg/l and the average was 4.8 mg/l. The pattern of DO shows a seasonal trend, with higher concentrations measured in the cooler months between December through April, and lower concentrations measured in the warmer months from late summer into the fall.

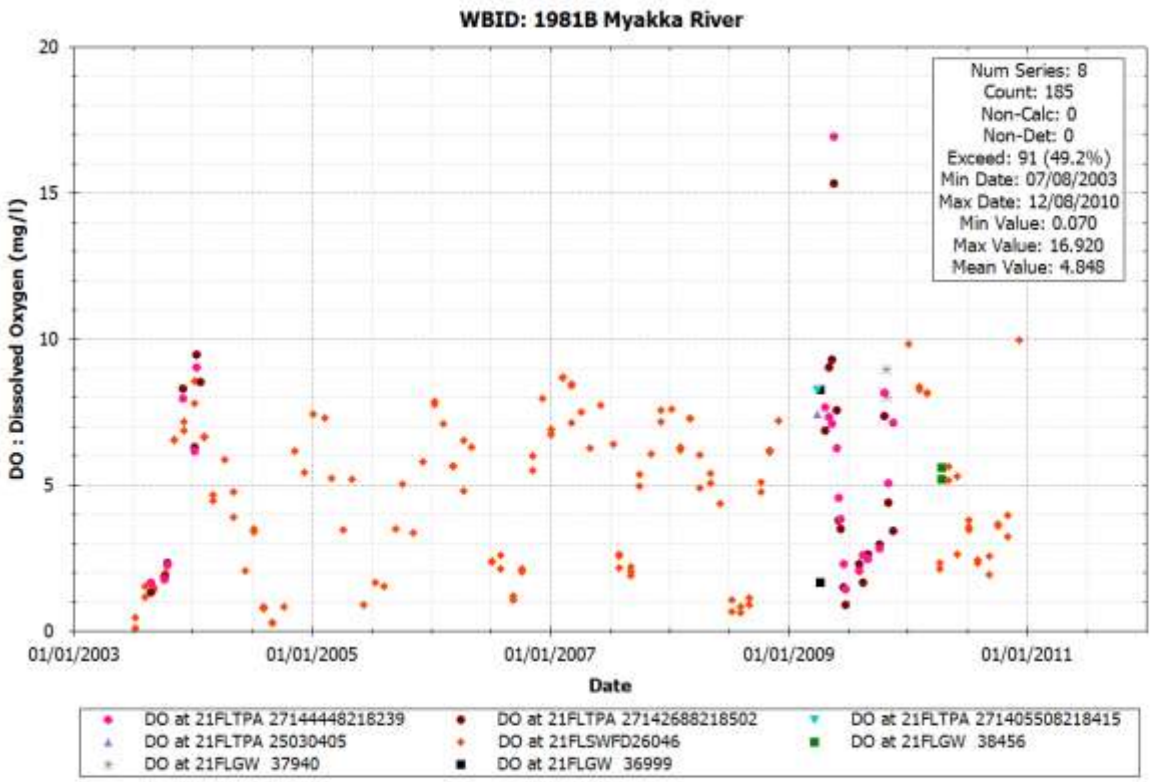

Figure 11. WBID 1981B (Myakka River) Measured DO.

Biochemical Oxygen Demand

Figure 12 provides a time series plot for the measured BOD concentrations in the Myakka River. There were 4 monitoring stations used in the assessment that included a total of 28 observations collected between March and November 2009. The minimum value was 2.0 mg/l, the maximum was 8.9 mg/l and the average was 4.06 mg/l.

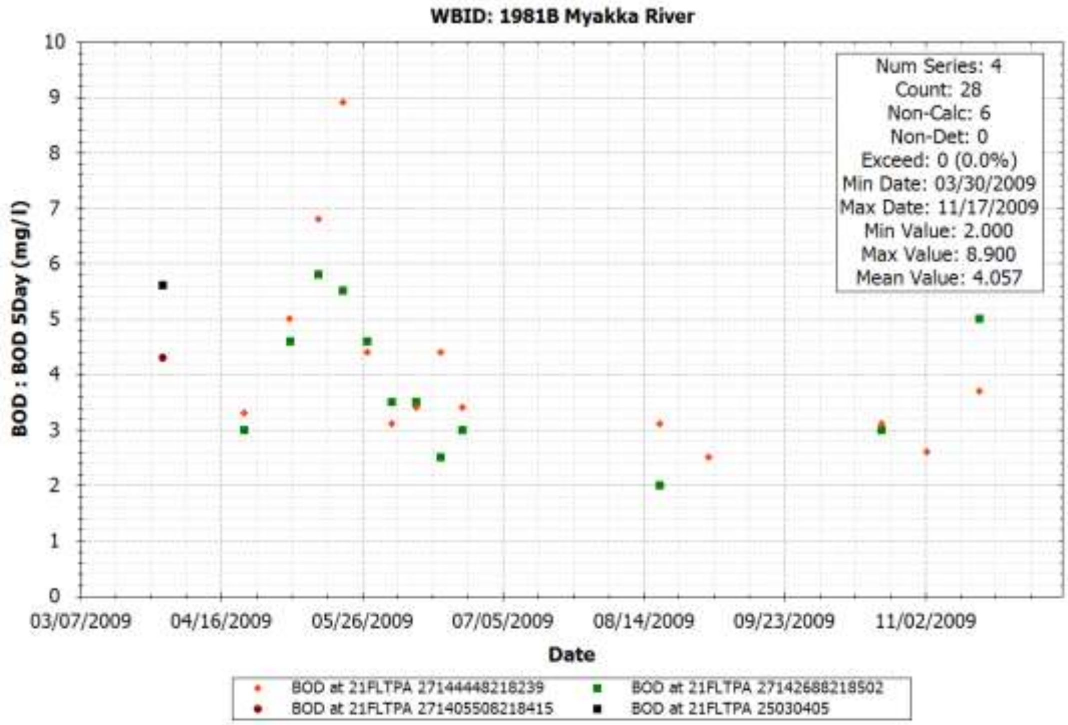

Figure 12. WBID 1981B (Myakka River) Measured BOD.

Total Nitrogen

Figure 13 provides a time series plot for the measured TN concentrations in WBID 1981B of the Myakka River. There were 6 monitoring stations used in the assessment that included a total of 134 observations, with the longest period of record at station 21FLSWFD26046. The minimum value was 0.81 mg/l, the maximum was 3.1 mg/l and the average was 1.3 mg/l.

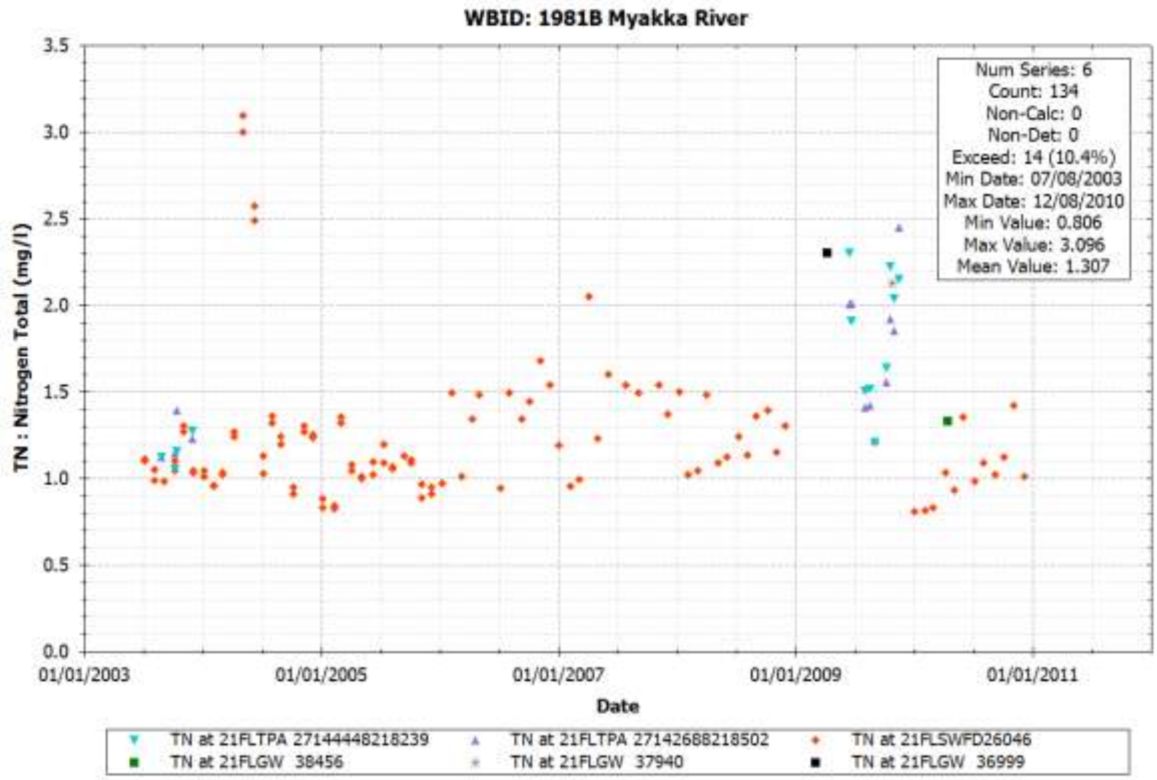

Figure 13. WBID 1981B (Myakka River) Measured Total Nitrogen.

Total Phosphorus

Figure 14 provides a time series plot for the measured total phosphorus concentrations in WBID 1981B of the Myakka River. There were 6 monitoring stations used in the assessment that included a total of 135 observations. The minimum value was 0.14 mg/l, the maximum was 1.1 mg/l and the average was 0.38 mg/l.

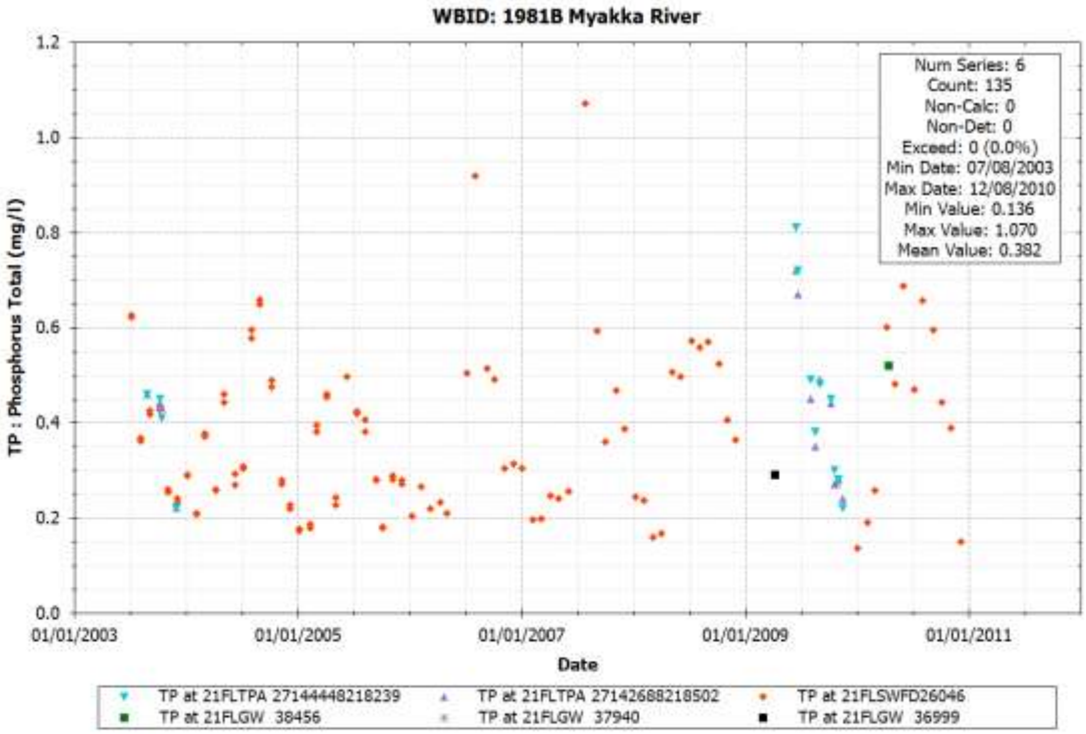

Figure 14. WBID 1981B (Myakka River) Measured Total Phosphorus.

Chlorophyll a

Figure 15 provides a time series plot for corrected chlorophyll a concentrations in Myakka River WBID 1981B. There were six monitoring stations used in the assessment that included a total of 96 observations. The minimum value was 3.2 µg/l, the maximum was 55 µg/l and the average was 15.3 µg/l.

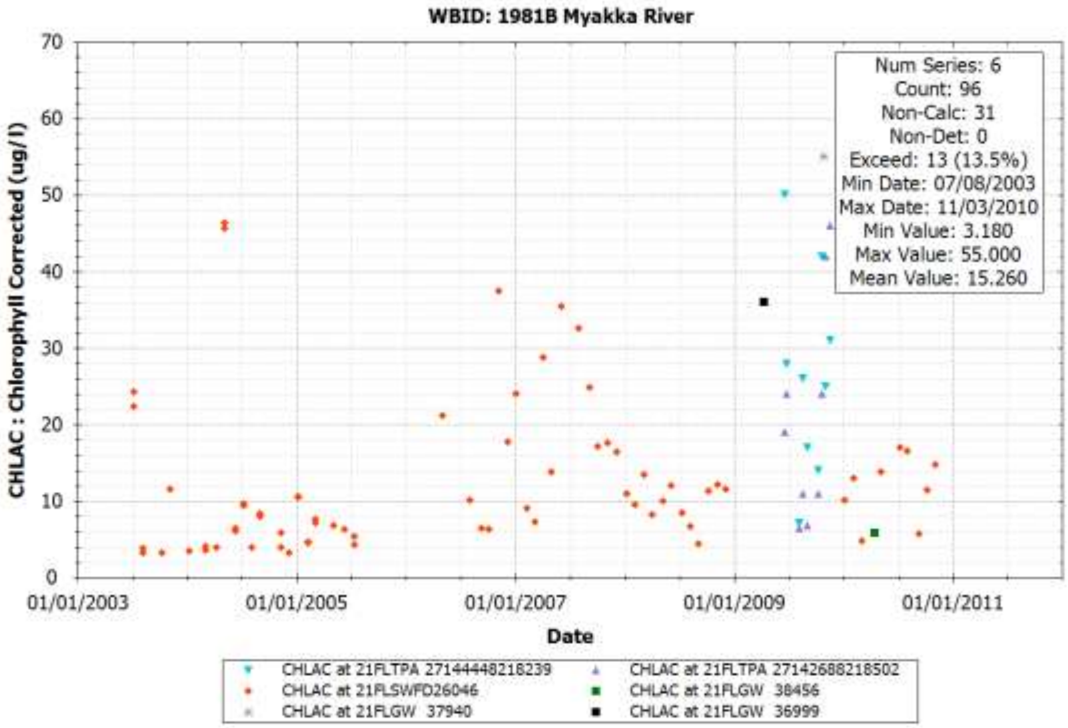

Figure 15. WBID 1981B (Myakka River) Corrected Chlorophyll-a Concentrations.

5.2. Summary of Data Assessments

A review of the available water quality data for Owen Creek appears to show marked differences in the ranges for nutrient and DO concentrations between station locations within the same watershed. The nutrient, DO and chlorophyll-*a* data for Myakka River WBID 1981B also show high ranges in concentrations. DO levels in that segment of the river average below the applicable water quality standard. Based on this information, and the presence of potential pollutant sources in the watershed, TMDLs for DO and nutrients are being established for WBIDs 1933 and 1981B.

6. Source and Load Assessment

An important part of the TMDL analysis is the identification of source categories, source subcategories, or individual sources of pollutants in the watershed and the amount of loading contributed by each of these sources. Sources are broadly classified as either point or nonpoint sources. Nutrients can enter surface waters from both point and nonpoint sources.

6.1. Point Sources

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

6.1.1. Wastewater/Industrial Permitted Facilities

A TMDL wasteload allocation (WLA) is given to traditional wastewater and industrial NPDES permitted facilities discharging to surface waters within an impaired watershed. There are no NPDES-permitted facilities that discharge to surface waters within or just upstream of WBID 1981B of the Myakka River. In WBID 1933, two dairies are permitted to discharge to the surface waters in the watershed: the Farren Dakin Dairy (FLA182966) and the Cameron Dakin Dairy (FLA182699). The locations of these discharges are shown in Figure 5. The permits for both dairies require that the facilities be designed, constructed, operated and maintained to contain all runoff and precipitation from their storage pond up to a 25-year, 24-hour precipitation event (FDEP, 2005 and FDEP, 2006). Therefore, neither of the permits apply discharge limitations, but instead require the facilities to measure and report BOD, TP, TN, ammonia, temperature, pH, fecal coliforms, total suspended solids and flow in their effluent in the event they have a discharge. They are also required to report any discharges to FDEP. A check of the past five years of discharge monitoring reports shows that no discharges have been reported from either facility during that time.

6.1.2. Stormwater Permitted Facilities/MS4s

MS4s are point sources also regulated by the NPDES program. According to 40 CFR 122.26(b)(8), an MS4 is "a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains):

> (i) Owned or operated by a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law)...including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the Clean Water Act that discharges into waters of the United States;
>
> (ii) Designed or used for collecting or conveying storm water;
>
> (iii) Which is not a combined sewer; and
>
> (iv) Which is not part of a Publicly Owned Treatment Works."

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

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

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

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

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

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

MS4 permits that affect WBIDs 1933 and 1981B include Phase I permit FLS000004, held by Sarastoa County, FDOT District 1 and several co-permittees, and Phase I permit FLS000036, held by Manatee County, FDOT District 1, and other co-permittees. Stormwater discharges conveyed through the storm sewer system covered by the permit are subject to the WLA of the TMDL. Any newly designated MS4s will also be required to achieve the percent reduction allocation presented in this TMDL.

6.2. Nonpoint Sources

Nonpoint sources of pollution are diffuse sources that cannot be identified as entering a waterbody through a discrete conveyance at a single location. For nutrients, these sources include runoff of agricultural fields, golf courses, lawns, septic tanks, and residential developments outside of MS4s. Nonpoint source pollution generally involves a buildup of pollutants on the land surface that wash off during rain events and as such, represent contributions from diffuse sources, rather than from a defined outlet. Potential nonpoint sources are commonly identified, and their loads estimated, based on land cover data. Most methods calculate nonpoint source loadings as the product of the water quality concentration and runoff water volume associated with certain land use practices. The mean concentration of pollutants in the runoff from a storm event is known as the Event Mean Concentration, or EMC.

6.2.1. Urban Areas

Urban areas include land uses such as residential, industrial, extractive and commercial. Land uses in this category typically have somewhat high total nitrogen event mean concentrations and average total phosphorus event mean concentrations. Nutrient loading from MS4 and non-MS4 urban areas is attributable to multiple sources including stormwater runoff, leaks and overflows from sanitary sewer systems, illicit discharges of sanitary waste, runoff from improper disposal of waste materials, leaking septic systems, and domestic animals.

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

Florida’s stormwater program is unique in having a performance standard for older stormwater systems that were built before the implementation of the Stormwater Rule in 1982. This rule states: “the pollutant loading from older stormwater management systems shall be reduced as needed to restore or maintain the beneficial uses of water.” [FAC 62-40-.432(2)(c)]

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

Urban, residential, and commercial developments are not likely very important nonpoint sources of nutrients and oxygen-demanding substances in Owen Creek or the portion of the Myakka River watershed that drains to WBID 1981B. Only about one percent of WBID 1933 falls into this land use category. Although there are some low-density residential developments upstream of WBID 1981B, land uses in this category comprise less than one percent of the area within WBID 1981B. Note that some of the areas classified as "built-up" near the northern tip of the watershed represent mining activities.

Onsite Sewage Treatment and Disposal Systems (Septic Tanks)

As stated above, leaking septic tanks or onsite sewage treatment and disposal systems (OSTDs) can contribute to nutrient loading in urban areas. Water from OSTDs is typically released to the ground through on-site, subsurface drain fields or boreholes that allow the water from the tank to percolate (usually into the surficial aquifers) and either transpire to the atmosphere through surface vegetation or add to the flow of shallow ground water. When properly sited, designed, constructed, maintained, and operated, OSTDs are a safe means of disposing of domestic waste. The effluent from a well-functioning OSTD receives natural biological treatment in the soil and is comparable to secondarily treated wastewater from a sewage treatment plant. When not functioning properly, OSTDs can be a source of nutrients, pathogens, and other pollutants to both ground water and surface water.

The state of Florida Department of Health publishes data on new septic tank installations and the number of septic tank repair permits issued for each county in Florida. Table 5 summarizes the cumulative number of septic systems installed in Manatee, Hardee and Sarasota counties since the 1970 census and the total number of repair permits issued for the last ten fiscal years between 2001-02 and 2010-11 (FDOH, 2012). The data do not reflect septic tanks removed from service. Leaking septic systems could be a relevant source of organic and nutrient loading in the Owen Creek and Myakka River watersheds.

Table 5. County Estimates of Septic Tanks and Repair Permits.

County	Number of Septic Tanks (1970- 2011)	Number of Repair Permits Issued (2001 – 2011)
Hardee	8,757	324
Manatee	36,411	348
Sarasota	80,370	3,250

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

6.2.2. Agriculture

Agricultural lands include improved and unimproved pasture, row and field crops, tree crops, nurseries, and specialty farms. Agricultural activities, including runoff of fertilizers or animal wastes from pasture and cropland and direct animal access to streams, can generate nutrient loading to streams. The highest total nitrogen and total phosphorus event mean concentrations are associated with agricultural land uses.

The USDA National Agricultural Statistics Service (NASS) compiles Census of Agriculture data by county for virtually every facet of U.S. agriculture (USDA NASS, 2007). According to 2007 Census of Agriculture data, there were 368 farms which fertilized approximately 63,814 acres with commercial fertilizer, lime and soil conditioners in Manatee County, Florida. In Hardee County, 664 farms treated 75,129 acres with commercial fertilizers, and in Sarasota County, 100 farms treated 7,975 acres. Livestock counts of cattle and pigs in

Manatee, Hardee and Sarasota counties are provided in Table 6. Because agricultural census data are collected at the county level, the extent to which these values pertain to agricultural fields within the impaired WBIDS is not specified. However, land use data and aerial images of the watershed show that agriculture is a significant use in the upper Myakka River watershed draining to WBID 1981B, and in the subwatershed draining to Owen Creek (Figure 2, Table 1).

Table 6. 2007 Agricultural Census Data for Manatee, Hardee and Sarasota Counties, FL.

County	Livestock	Number of Farms	Number of Animals
Hardee	Cattle and Calves	648	85,680
	Hogs and Pigs	24	142
Manatee	Cattle and Calves	421	35,437
	Hogs and Pigs	39	145
Sarasota	Cattle and Calves	149	16,845
	Hogs and Pigs	19	44

Note: 1. A farm is defined as any place from which $1,000 or more of agricultural products were produced and sold, or normally would have been sold, during the census year.

6.2.3. Rangeland

Rangeland includes herbaceous, scrub, disturbed scrub coastal scrub and other upland non-forested areas. Event mean concentrations for rangeland are about average for total nitrogen and low for total phosphorus. Rangeland comprises 8 percent of the land use in the WBID 1933 (Owen Creek), and 47 percent of the land use in WBID 1981B (Myakka River).

6.2.4. Upland Forests

Upland forests include flatwoods, oak, various types of hardwoods, conifers and tree plantations. Event mean concentrations for upland forests are low for both total nitrogen and total phosphorus. Upland Forests consist of 15 percent of the land use in WBID 1933, and 3 percent in WBID 1981B.

6.2.5. Water and Wetlands

Wetlands are significant land covers in both the Owen Creek and Myakka River watersheds. Open water and wetland areas tend to have very low event mean concentrations. Approximately 16 percent of WBID 1933 and 47 percent of WBID 1981B are comprised of water and wetlands.

6.2.6. Barren Land

Barren land includes beaches, borrow pits, disturbed lands and fill areas. Event mean concentrations for barren lands tend to be higher in total nitrogen. Neither WBID has area classified as barren.

6.2.7. Transportation, Communications and Utilities

Transportation uses include airports, roads and railroads. Event mean concentrations for these types of uses are in the mid-range for total nitrogen and total phosphorus. This land use does not comprise a significant fraction of the area in either WBID. However, State Road 72 traverses WBID 1981B, and State Road 70 traverses WBID 1933, so runoff from roads could affect both water bodies.

7. Analytical Approach

In the development of a TMDL, there needs to be a method for relating current pollutant loadings to the observed water quality problem. This relationship could be established statistically (e.g. using a regression to describe a cause and effect relationship), empirically (e.g. using a model based on observations) or mechanistically (e.g. using a physically and/or stochastically-based model) that describe cause and effect using physical and biological relationships.

Two mechanistic models were used in the development of this TMDL. The first model is a dynamic watershed model that predicts the quantity of water and pollutants that are associated with the rainfall-runoff process. The second model is an in-stream dynamic water quality model that integrates the loadings from the watershed model to predict the water quality in the receiving waterbody.

The period of simulation that was considered in the development of this TMDL is 1999 to 2009. The models were used to predict time series for total nitrogen, total phosphorus, BOD, dissolved oxygen, and chlorophyll a. The models were calibrated to current conditions and were then used to predict improvements in water quality as function of reductions in these loadings.

More details on the model application in the development of the Owen Creek and Myakka River TMDLs are presented in Appendix A.

7.1. Loading Simulation Program C++ (LSPC)

The Loading Simulation Program C++ (LSPC) was used to represent the hydrological and water quality conditions in the Myakka River/Owen Creek watershed. LSPC is a comprehensive data management and modeling system that is capable of representing loading, both flow and water quality, from non-point and point sources and simulating in-stream processes. It is capable of simulating flow, sediment, metals, nutrients, pesticides, and other conventional pollutants, as well as temperature and pH for pervious and impervious lands and water bodies. LSPC was configured to simulate the watershed as a series of hydrologically connected sub-watersheds.

LSPC was used to simulate runoff (flow, total nitrogen, total phosphorus and BOD) from the land surface using an hourly timestep for current and natural conditions in the Owen Creek and Myakka River watersheds. The predicted time series were used as boundary conditions for the WASP model to predict in-stream water quality of the receiving waters.

7.2. Water Quality Analysis Simulation Program (WASP)

The Water Quality Analysis Simulation Program (WASP v7.5) is a dynamic compartment-modeling program for aquatic systems, including both the water column and the underlying benthos. The time-varying processes of advection, dispersion, point and diffuse mass loading and boundary exchange are represented in the basic program. The conventional pollutant model within the WASP framework is capable of predicting time varying concentrations for chlorophyll *a*, dissolved oxygen, nutrients (nitrogen, phosphorus) as function of loadings, flows, and environmental conditions.

WASP was calibrated to the current conditions in Owen Creek and the Myakka River using loadings from the LSPC model. Furthermore, WASP was used in determining the load reductions that would be needed to achieve the water quality standards for DO and the identified nutrient targets for WBIDs 1933 (Owen Creek) and WBID 1981B (Myakka River).

7.3. Scenarios

Several modeling scenarios were developed and evaluated in this TMDL determination. A full description of each of these scenarios is presented in Appendix A.

7.3.1. Current Condition

The first scenario is to model the current conditions of the watershed. The watershed model was parameterized using the current land uses and measured meteorological conditions to predict the current loadings of nitrogen, phosphorus and BOD. The predicted water quality loadings and flow time series were passed on to the in-stream water quality model where algal, nitrogen, phosphorus, BOD and DO concentrations were predicted over time. The models (watershed and water quality) were calibrated to an eleven year period of time to take into account varying environmental, meteorological or hydrological conditions on water quality. The predicted existing condition annual average concentrations are presented in Table 7.

Table 7. Existing Condition Annual Average Model Predictions (WBID mean, 1999-2009).

Constituent	WBID 1933	WBID 1981B
TN (mg/L)	1.109	1.212
TP (mg/L)	0.269	0.269
BOD (mg/L)	4.0	5.5
DO (mg/L)	7.8	4.6
Chlorophyll a (ug/L)	1.1	8.9

The current condition simulation was used to determine the base loadings for Owen Creek and the Myakka River (Table 8). These existing condition loadings were compared with the TMDL scenario to determine the percent reduction in nutrient loads that will be needed to achieve water quality standards.

Table 8. Existing Condition Annual Average Nutrient Loads (1999-2009).

	WBID 1933		WBID 1981B	
Constituent	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)
BOD	0	24690	0	66720
TN	0	11745	0	26569
TP	0	3088	0	4733

7.3.2. Natural Condition

The natural condition scenario was developed to estimate the water quality conditions that would exist if there were minimal to no impact from anthropogenic sources. There are no wastewater/industrial point source dischargers in WBID 1981B of the Myakka River watershed, and there are two dairies permitted to discharge to Owen Creek WBID 1933. However, these dairies are required to be designed, operated and maintained to contain up to 25-year, 24-hour storm events. For the purpose of this analysis, any land uses that are associated with anthropogenic activities (urban, agriculture, transportation, barren lands and rangeland) were converted to the native, undisturbed land use and the associated event mean concentration for nitrogen, phosphorus and BOD were used. These natural condition loadings from the watershed model were passed onto the water quality model where natural water quality conditions were predicted. The natural condition water quality predictions are presented in Table 9.

Table 9. Natural Condition Annual Average Model Predictions (WBID mean, 1999-2009).

Constituent	WBID 1933	WBID 1981B
TN (mg/L)	0.988	1.098
TP (mg/L)	0.164	0.183
BOD (mg/L)	3.7	3.6
DO (mg/L)	8.0	6.6
Chlorophyll a (ug/L)	1.1	8.8

The purpose of the natural conditions scenario is to determine whether water quality standards can be achieved without abating the naturally occurring loads from the watershed. Simulation results show that the DO standard is not achievable under natural conditions. Therefore, the TMDL determination will set the allowable loads to the natural condition scenario.

Table 10 provides the annual average load predictions for total nitrogen, total phosphorus, and BOD.

Table 10. Natural Condition Annual Average Nutrient Loads (1999-2009).

	WBID 1933		WBID 1981B	
Constituent	**WLA (kg/yr)**	**LA (kg/yr)**	**WLA (kg/yr)**	**LA (kg/yr)**
BOD	0	21000	NA	59666
TN	0	8992	NA	25492
TP	0	1207	NA	4155

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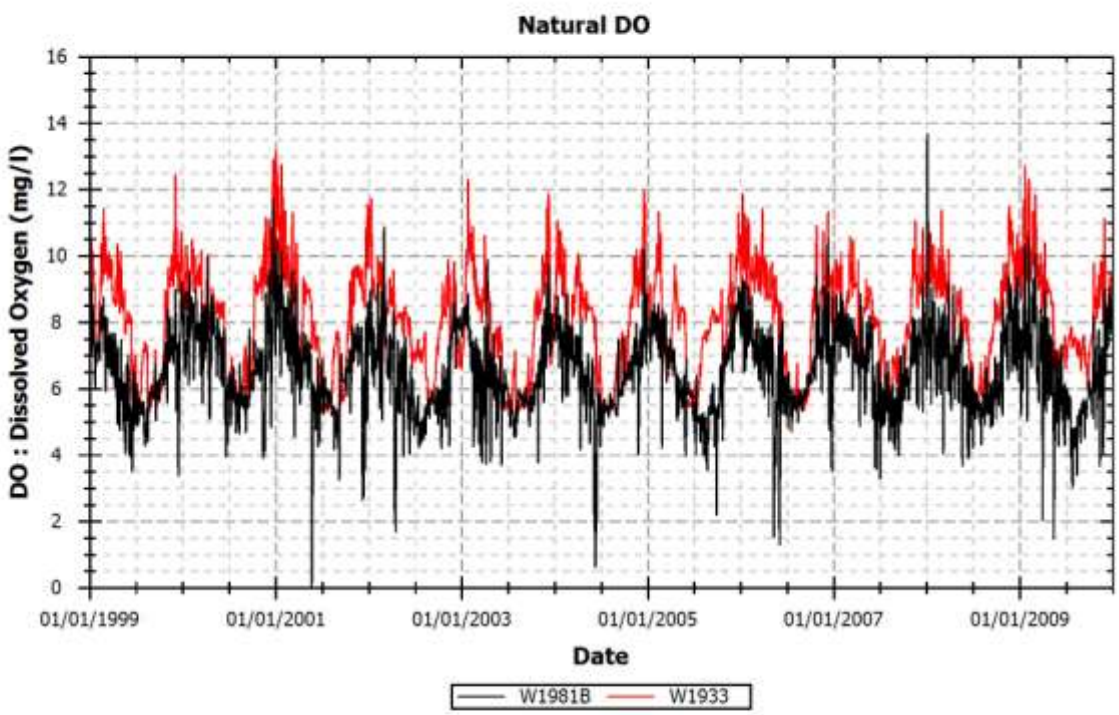

Figure 16. DO Concentration Time Series under Natural Condition.

8. TMDL Determination

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

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

The TMDL is the total amount of pollutant that can be assimilated by the receiving waterbody and still achieve water quality standards and the waterbody's designated use. In TMDL development, allowable loadings from all pollutant sources that cumulatively amount to no more than the TMDL must be set and thereby provide the basis to establish water quality-based controls. These TMDLs are expressed as annual mass loads, since the approach used to determine the TMDL targets relied on annual loadings. The TMDLs targets were determined to be the conditions needed to restore and maintain a balanced aquatic system. Furthermore, it is important to consider nutrient loading over time, since nutrients can accumulate in waterbodies.

During the development of this TMDL, it was determined that the natural condition scenario (removal of all anthropogenic sources and land uses) does not meet the Florida standards for DO. The reductions prescribed in this TMDL reduce the current loadings to the natural condition. The allocations are given in Table 11.

Table 11. TMDL Load Allocations for Owen Creek (WBID 1933) and Myakka River (WBID 1981B).

WBID 1933	Current Condition		TMDL Condition		MS4	LA
Constituent	WLA (kg/yr)	LA (kg/yr)	WLA[1] (kg/yr)	LA (kg/yr)	% Reduction	% Reduction
BOD	0	24690	0	21000	15	15
TN	0	11745	0	8992	23	23
TP	0	3088	0	1207	61	61
WBID 1981B	Current Condition		TMDL Condition		MS4	LA
Constituent	WLA (kg/yr)	LA (kg/yr)	WLA[1] (kg/yr)	LA (kg/yr)	% Reduction	% Reduction
BOD	NA	66720	NA	59666	11	11
TN	NA	26569	NA	25492	4	4
TP	NA	4733	NA	4155	12	12

8.1. Critical Conditions and Seasonal Variation

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

The critical condition for nonpoint source loadings and wet weather point source loadings is typically an extended dry period followed by a rainfall-runoff event. During the dry weather period, nutrients build up on the land surface, and are washed off by rainfall. The critical condition for continuous point source loading typically occurs during periods of low stream flow when dilution is minimized. Although loading of nonpoint source pollutants contributing to a nutrient impairment may occur during a runoff event, the expression of that nutrient impairment is more likely to occur during warmer months, and at times when the waterbody is poorly flushed. Because of the eleven year simulation period used in the model development, the model encompasses both critical and seasonal variations to determine the annual average allowable load.

8.2. Margin of Safety

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

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

The Owen Creek and Myakka River TMDLs were developed using an implicit margin of safety by using conservative assumptions throughout the modeling process.

8.3. Waste Load Allocations

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

8.3.1. Wastewater/Industrial Permitted Facilities

There are no continuous discharge NPDES permitted point sources discharging to WBID 1981B of the Myakka River Watershed; therefore, no WLA was calculated. There are two dairies permitted to discharge to Owen Creek, WBID 1933. Currently, the permits require that the facilities be designed, constructed, operated and maintained to contain all runoff and precipitation from their storage pond up to a 25-year, 24-hour precipitation event (FDEP, 2005 and FDEP, 2006). Neither of the permits apply discharge limitations, but instead require the facilities to measure and report BOD, TP, TN, ammonia, temperature, pH, fecal coliforms, total suspended solids and flow in their effluent in the event they have a discharge. Because these facilities should not discharge, except under rare and extreme precipitation events, no WLA is reserved for either facility.

8.3.2. Municipal Separate Storm Sewer System Permits

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

This TMDL assumes for the reasons stated above that it is infeasible to calculate numeric water quality-based effluent limitations for stormwater discharges. Therefore, in the absence of information presented to the permitting authority showing otherwise, this TMDL assumes that water quality-based effluent limitations for stormwater sources of nutrients derived from this TMDL can be expressed in narrative form (e.g., as best management practices), provided that: (1) the permitting authority explains in the permit fact sheet the reasons it expects the chosen BMPs to achieve the aggregate wasteload allocation for these stormwater discharges; and (2) the state will perform ambient water quality monitoring for nutrients for the purpose of determining whether the BMPs in fact are achieving such aggregate wasteload allocation.

All Phase 1 MS4 permits issued in Florida include a re-opener clause allowing permit revisions for implementing TMDLs once they are formally adopted by rule. Florida may designate an area as a regulated Phase II MS4 in accordance with Rule 62-620.800, FAC. Florida's Phase II MS4 Generic Permit has a "self-implementing" provision that requires MS4 permittees to update their stormwater management program as needed to meet their TMDL allocations once those TMDLs are adopted. Permitted MS4s will be responsible for reducing only the loads associated with stormwater outfalls which it owns, manages, or otherwise has responsible control. MS4s are not responsible for reducing other nonpoint source loads within its jurisdiction. All future MS4s permitted in the area are automatically prescribed a WLA equivalent to the percent reduction assigned to the LA. The MS4 service areas described in Section 6.2.1 of this report are required to meet the percent reduction prescribed in Table 11 through the implementation of BMPs.

8.4. Load Allocations

The load allocations for nonpoint sources were assigned percent reductions from the current BOD and nutrient loadings coming into Owen Creek, WBID 1933, and Myakka River, WBID 1981B (Table 11).

9. Recommendations/Implementation

This TMDL is based on mechanistic modeling of the dissolved oxygen and eutrophication processes using available meteorologic data, hydrologic data, stream geometry, water chemistry data and the evidence of low reaeration, high detrital loading, strong photosynthetic activity, and SOD. The lack of SOD measurements, reaeration measurements, aquatic macrophyte and periphyton measurements introduces uncertainty into this TMDL. Collection of these additional data will help reduce uncertainty and better assess the contribution of potential sources, the timing of any water quality exceedances, and necessary reductions.

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

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

10. References

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

Florida Administrative Code. Chapter 62-303, Identification of Impaired Surface Waters.

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