FINAL

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Water Resource Management, Bureau of Watershed Management

SOUTHWEST DISTRICT • TAMPA BAY BASIN

TMDL Report

Nutrient and Dissolved Oxygen TMDL for McKay Bay (WBID 1584B)

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Florida Department of Environmental Protection, Bureau of Watershed Management

TMDL Program

http://www.dep.state.fl.us/water/tmdl/index.htm

Identification of Impaired Surface Waters Rule

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STORET Program

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

2002 305(b) Report

http://www.dep.state.fl.us/water/docs/2002_305b.pdf

Criteria for Surface Water Quality Classifications

http://www.dep.state.fl.us/legal/rules/shared/62-302t.pdf

Basin Status Report for the Tampa Bay Basin

http://www.dep.state.fl.us/water/tmdl/stat_rep.htm

Water Quality Assessment Report for the Tampa Bay Basin

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Chapter 1: INTRODUCTION

1.1 Purpose of Report

This report presents the Total Maximum Daily Load (TMDL) for total nitrogen to address the nutrient and dissolved oxygen (DO) impairment for McKay Bay in the Tampa Bay Basin. The estuary was verified as impaired for DO and nutrients, using the methodology described in the Impaired Surface Waters Rule (IWR), Chapter 62-303, Florida Administrative Code (F.A.C.), to identify and verify water quality impairments. It was included on the Verified List of impaired waters for the Tampa Bay Basin that was adopted by Secretarial Order on August 28, 2002. The TMDL establishes the allowable loadings to McKay Bay that would restore the waterbody so that it meets the applicable water quality standards for DO and nutrients. The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and recommends regulatory or other actions to be taken to achieve compliance with applicable water quality standards, based on the relationship between pollution sources and instream water quality conditions.

1.2 Identification of Waterbody

McKay Bay is located in central Hillsborough County in the city of Tampa **(Figure 1.1).** The McKay Bay watershed refers to McKay Bay and 12 associated water segments that are hydrologically connected to the bay. The Palm River and Ybor City Drain are the main inflows to McKay Bay from the north, and water is exchanged with Hillsborough Bay to the south. The watershed is an intensely urbanized basin covering 52 square miles.

McKay Bay is a shallow estuary, with large open-water areas averaging 6 feet in depth and shallow open-water areas along the shoreline. A channel connecting to the Palm River has been dredged to an average depth of 25 feet (Stoker *et al.,* 1995). The 22nd Street causeway separates the shallow McKay Bay to the north from the much deeper East Bay to the south; the latter is the center of shipping activity in Tampa Bay. Tidal mudflats along the northern bay shores become exposed at low tide. Most of the areas surrounding the open-water portions of the bay are poorly drained lowland mudflats, gradually sloping mangrove forest, and salt marshes (McKay Bay Water Quality Management Plan, December 1998). A major freshwater inflow to the bay is the Tampa Bypass Canal, which flows to the Palm River. The canal, controlled by a series of gate structures, was dredged in the 1960s to provide flood control.

For assessment purposes, the Florida Department of Environmental Protection (Department) has divided the Coastal Hillsborough Bay Planning Unit into water assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or stream reach. The McKay Bay watershed comprises 13 WBIDs. The impaired segment that is the subject of this TMDL is the estuarine segment, McKay Bay, WBID 1584B. **Figure 1.2** shows the McKay Bay watershed, as well as the locations of the water quality monitoring stations and flow gages that provided the data used in this report.

The McKay Bay water segment identified on the map also includes East Bay. However, McKay Bay and East Bay are distinctly different waterbodies in terms of both water depth and

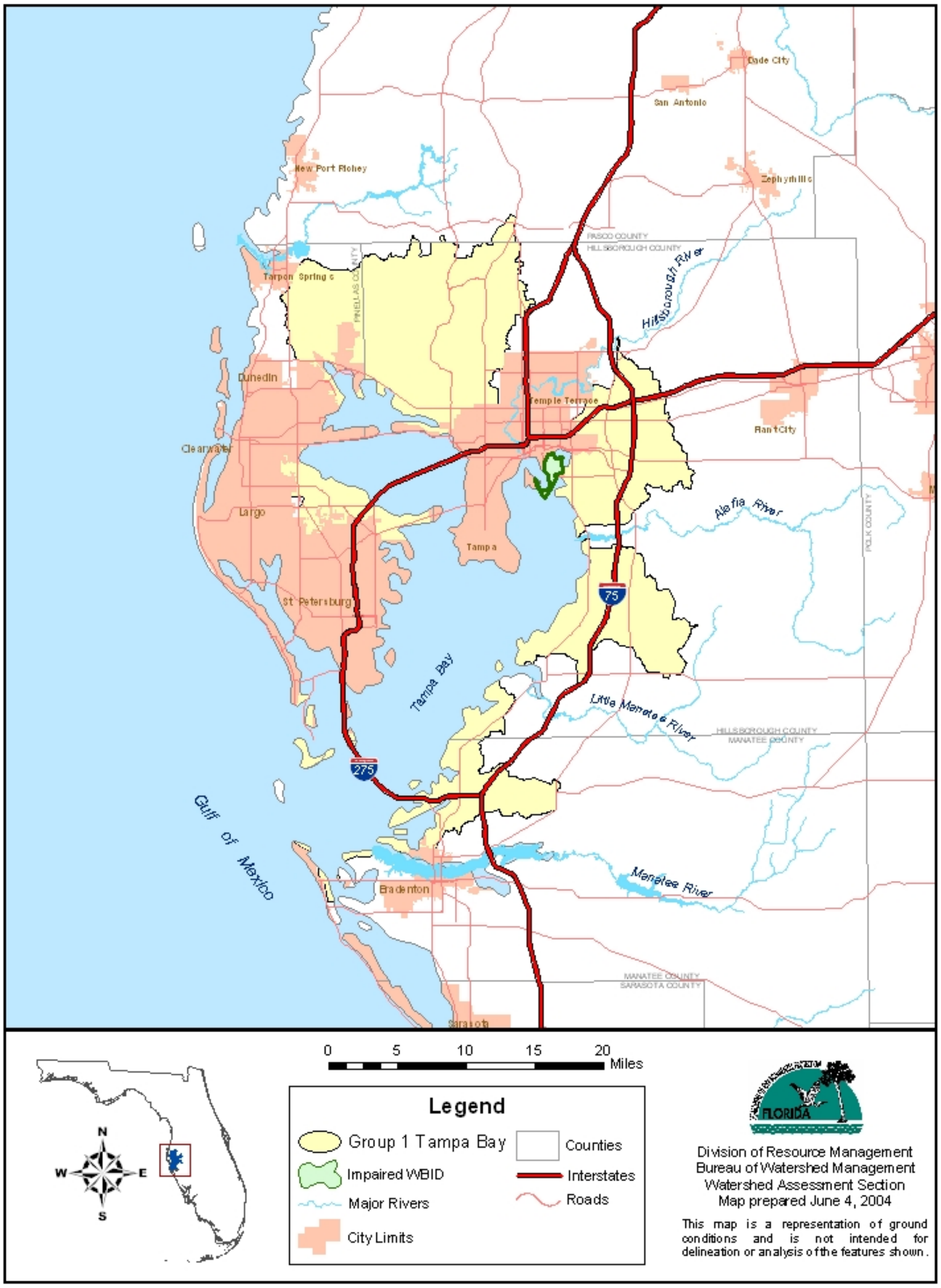

Figure 1.1: Location of McKay Bay, WBID 1584A, and Major Geopolitical Features in the Tampa Bay Basin

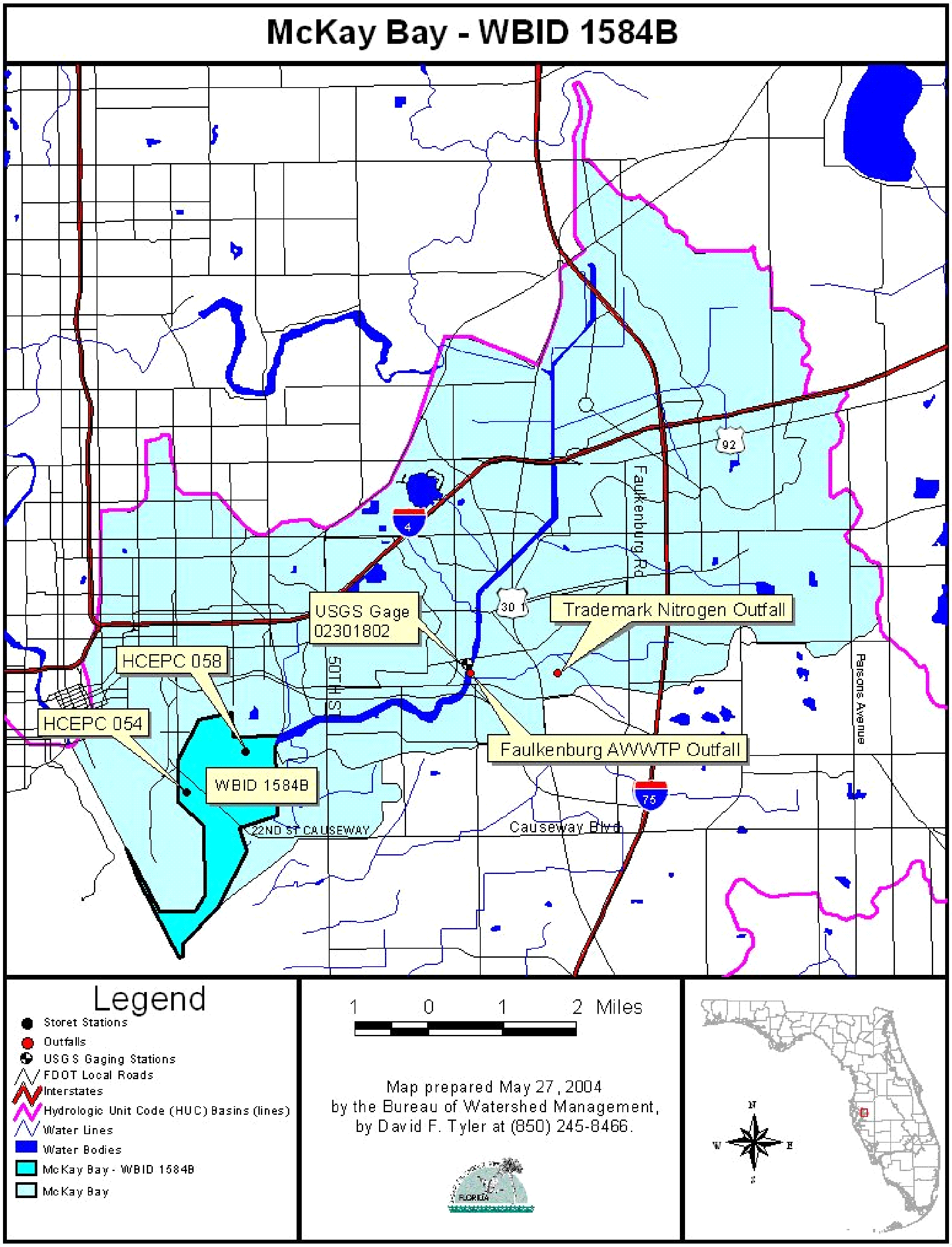

Figure 1.2. McKay Bay Watershed Showing Locations of Monitoring Stations and Outfalls

shoreline characteristics. Data from two long-term Hillsborough County Environmental Protection Commission (HCEPC) stations located in or near to McKay Bay were originally used to place WBID 1584B on the state's 1998 303(d) list. Data from sampling stations located in both McKay Bay and East Bay were used in the IWR analysis to identify the impairment for DO and nutrients in McKay Bay (WBID 1584B). However, the Department now recognizes that McKay Bay and East Bay are separate waterbodies and plans to subdivide WBID 1584B into separate McKay Bay and East Bay WBIDs for the next assessment cycle. To verify that the documented impairment was for McKay Bay, the data collected at the two long-term HCEPC stations were then used to reassess water quality in McKay Bay, following the IWR methodology. The reassessment verified that McKay Bay is impaired for DO and nutrients. The TMDL presented in this report addresses the impairment in McKay Bay only and does not include East Bay.

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. TMDLs 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 nutrients and DO that caused the verified impairment of McKay Bay. These activities will depend heavily on the active participation of the Southwest Florida Water Management District (SWFWMD), HCEPC, 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 causing the impairment of the listed waters on a schedule. The Department has developed these lists, commonly referred to as 303(d) lists, since 1992. The list of impaired waters in each basin is also required by the FWRA (Subsection 403.067[4)] Florida Statutes [F.S.]); the list is amended annually to include updates for each basin statewide.

Florida's 1998 303(d) list included 47 waterbodies in the Tampa Bay 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. After a long rule-making process, the Environmental Regulation Commission adopted the new methodology as Chapter 62-303, F.A.C. (Identification of Impaired Surface Waters Rule, or IWR), in April 2001. The list of waters for which impairments have been verified using the methodology in the IWR is referred to as the Verified List.

2.2 Information on Verified Impairment

The Department used the IWR to assess water quality in McKay Bay and verified the impairments for nutrients and DO **(Table 2.1). Table 2.2** summarizes the DO data for WBID 1584B during the verification period. The estuary was verified as impaired for DO because more than 10 percent of McKay Bay's DO values were below the Class III marine DO criterion of 4 milligrams per liter (mg/L) during the 1995 to 2002 verified period used to identify impaired water segments for the 2002 303(d) list. For the verified nutrient impairment, annual average chlorophyll *a* values served as the primary measurement for assessing nutrient impairment in estuaries under the IWR. During the verified period, the annual chlorophyll *a* values for WBID 1584B were above the estuary threshold of 11 micrograms per liter (μg/L), averaging between 14.5 μg/L and 26.1 μg/L **(Table 2.3).** If the annual mean chlorophyll *a* for any one-year period is over the chlorophyll *a* threshold, the water is verified impaired.

Table 2.1. Verified Impaired Segments in McKay Bay, WBID 1584B

Parameters of Concern	Priority for TMDL Development	Projected Year for TMDL Development
Nutrients	High	2003
DO	High	2003

Note: The parameters listed in **Table 2.1** provide a complete picture of the impairment in the estuary.

Table 2.2. Summary of DO Data for McKay Bay, WBID 1584B

Number of Samples	Minimum (mg/L)	Mean (mg/L)	Median (mg/L)	Maximum (mg/L)	Number of Exceedances
1,035	0.00	5.60	6.04	14.68	208

Table 2.3. Summary of Chlorophyll *a* Data for McKay Bay, WBID 1584B

Year	Annual Mean (µg/L)
1995	25.26
1996	26.07
1997	15.21
1998	18.18
1999	14.56
2000	14.51
2001	19.05

Figures 2.1 and **2.2** display the chlorophyll *a* and DO results, respectively, at the two long-term HCEPC monitoring stations for the verified period, based on the IWR assessment methodology. The verified impairments for McKay Bay, which were used as the basis for developing the TMDL, are based on data collected at these two stations (21FLHILL054 and 21FLHILL058). **Table 2.4** summarizes the DO and chlorophyll *a* data for the verification period. **Appendix B** presents the individual water quality measurements used in the assessment.

As part of the 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 chlorophyll *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.

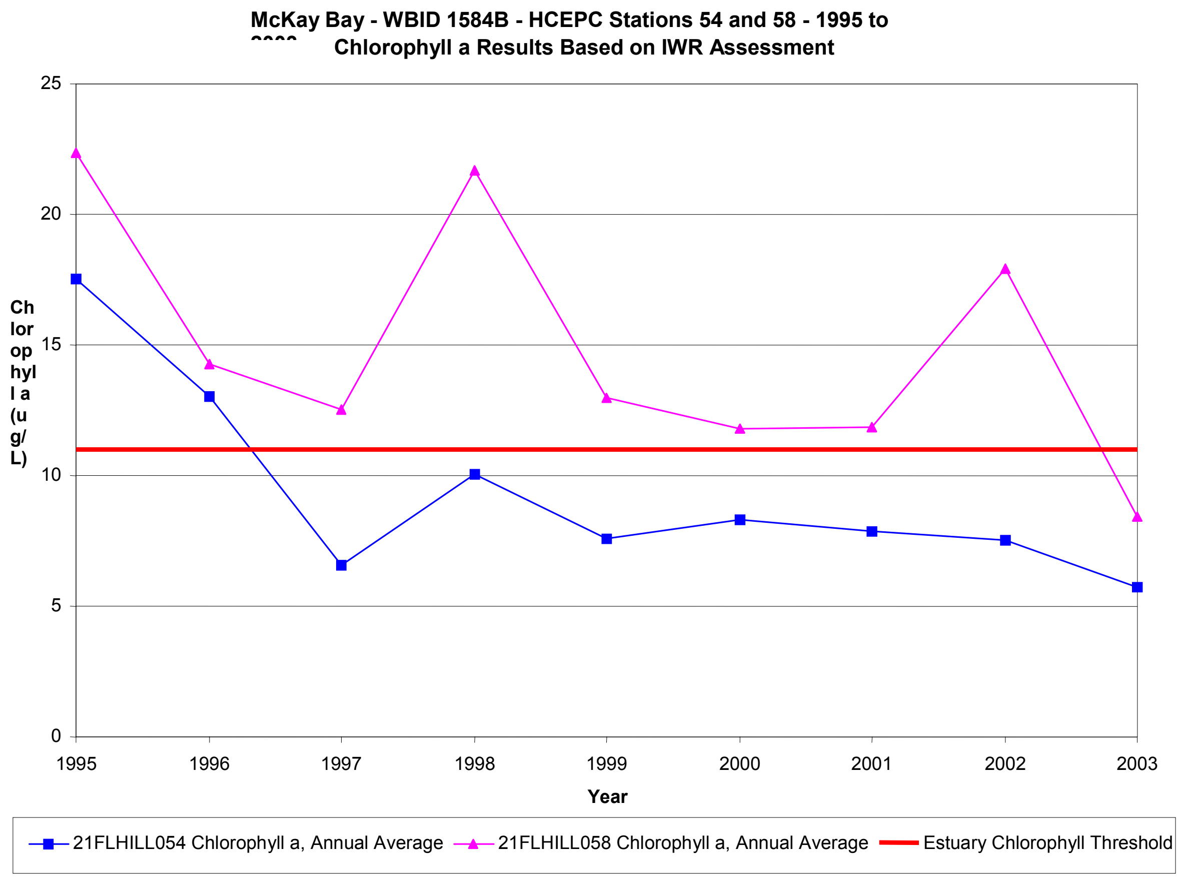

Figure 2.1. Annual Average Chlorophyll *a* Results at Long-Term Monitoring Stations in the McKay Bay Watershed, WBID 1584B

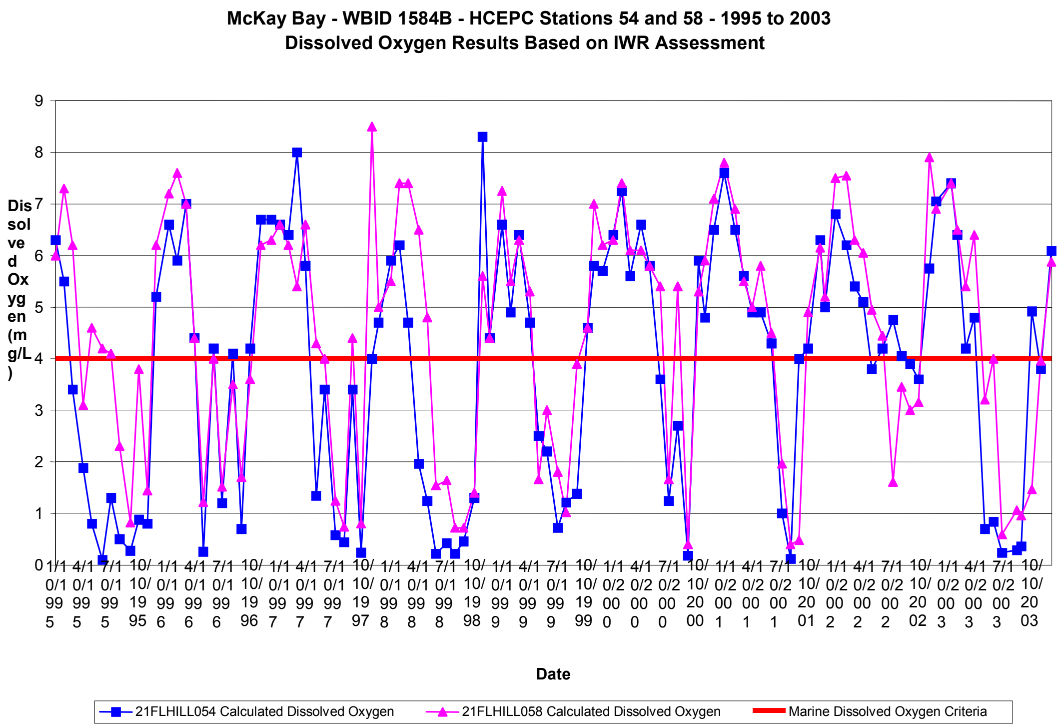

Figure 2.2. DO Results at Long-Term Monitoring Stations in the McKay Bay Watershed, WBID 1584B

Table 2.4. Summary Statistics for DO and Chlorophyll *a* at Long-Term Monitoring Stations in McKay Bay, WBID 1584B (1995 – 2002)

Parameter	Station ID	Number of Samples	Minimum	Mean	Median	Maximum	Number of Exceedances
Chlorophyll *a (ug/L)*	21FHILL054	98	0.40	9.94	7.60	65.89	NA[1]
DO (mg/L)	21FHILL054	96	0.10	3.93	4.35	8.30	59
Chlorophyll *a (ug/L)*	21FHILL058	98	1.60	15.90	13.35	78.60	NA[1]
DO (mg/L)	21FHILL058	96	0.40	4.58	5.00	8.50	47

[1] NA = Not Applicable. Chlorophyll *a* is a nutrient-related surrogate target to represent imbalances in flora and fauna.

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 overenrichment in coastal systems (National Research Council, 1993) and an analysis of the data from McKay Bay 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 nitrogen limitation. The median TN to TP ratios at HCEPC Stations 54 and 58 are 4.2 and 3.6, respectively, indicating that nitrogen is the limiting nutrient in the McKay Bay estuary.

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 chlorophyll *a* levels. Reductions in TN loading are also expected to result in additional benefits for other parameters of concern, including DO and biochemical oxygen demand (BOD). Reductions in nitrogen 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. The expectation that reductions in nitrogen loading will provide improvements in other parameters is supported by a statistical evaluation of data from HCEPC Station 58. A simple linear regression of chlorophyll *a* versus BOD showed a positive correlation, with an r^2 value of 0.53 **(Figure 2.3).**

Processes that consume oxygen from the water column, such as the microbial breakdown of organic material and sediment oxygen demand (SOD), are fairly constant over the short term. Algal populations, however, can increase rapidly, and the production of oxygen as a result of photosynthesis during daylight hours and the respiration or consumption of water from the water column at night can result in large diurnal fluctuations of DO in the water column. A fraction of increased algal biomass will also become part of the organic material that will be broken down by microbes or settle to the bottom. The proposed nitrogen reduction is expected to decrease algal biomass to the point that the estuarine threshold of 11 μg/l will not be exceeded. The reduction in nitrogen loads is also expected to improve DO by reducing the diurnal fluctuations in DO and improving DO levels.

Recent stormwater treatment projects implemented in the watershed, and described in Chapter 5, will result in nitrogen removal that will benefit surface water quality. Since the beginning of the verified period in 1995, annual average chlorophyll *a* values at the two long-term HCEPC stations have exhibited a declining trend, and 2003 was the first year when the annual average values at both stations were below the IWR estuarine threshold of 11 μg/L **(Figure 2.1).**

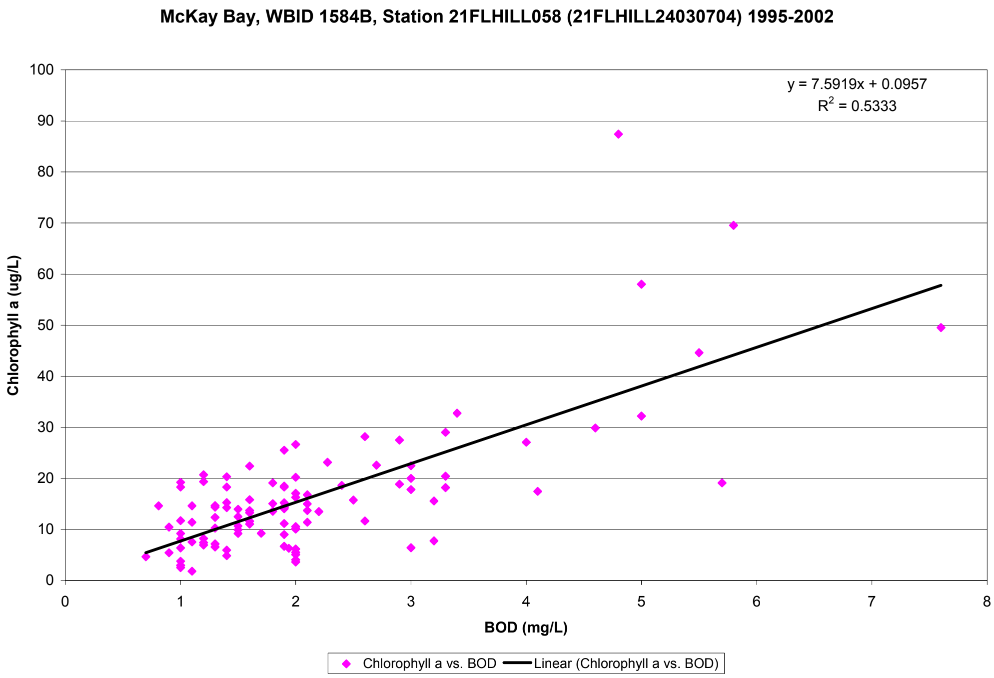

Figure 2.3. Relationship between Chlorophyll *a* and BOD in the McKay Bay Watershed, WBID 1584B

2.3 Other Indications of Impairment

Anthropogenic activities inherently contribute to water quality degradation. McKay Bay is intensely urbanized, receiving stormwater from industrial and residential areas. Tidal fluctuations are the dominant forces influencing the bay's flow patterns. Water exchange has been constricted by the construction of the 22nd Street Causeway. This constriction reduces tidal flushing and contributes to the nutrient enrichment observed in the bay. Dredge-and-fill activities along mangrove shorelines and the bay bottom, former landfills, seawalls, and mosquito ditches all affect the bay's water quality.

Chapter 3. DESCRIPTION OF APPLICABLE WATER QUALITY STANDARDS AND TARGETS

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 McKay Bay estuarine segment is a Class III marine waterbody, with a designated use of recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife. The Class III water quality criteria applicable to the observed impairment addressed in this TMDL are the DO and narrative nutrient criteria.

3.2 Applicable Water Quality Standards and Numeric Water Quality Targets

3.2.1 DO Criterion

The Class III marine criterion for DO, as established by Subsection 62-302.530(31), 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 chlorophyll *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 wanted to ensure that the bay would not be identified as impaired by nutrients in the future according to the assessment methodology in the Impaired Waters Rule (IWR). Given the uncertainty of nutrient reactions within estuaries, the Department applied a chlorophyll *a* target for this TMDL that should result in an annual average chlorophyll below the IWR impairment threshold for estuaries (11 ug/L). The analysis of chlorophyll a data collected at the HCEPC stations indicate the annual averages have exceeded the threshold of 11 ug/L during the verified period. For developing this TMDL, a water quality target of 8.4 ug/L as an annual average was used, rather than the annual average chlorophyll *a* value of 11 μg/L. The value of 8.4 ug/L was selected based on a review of the existing chlorophyll a trends in McKay Bay at HCEPC Station 58. The lower water quality target will be protective of waters adjacent to McKay Bay, as well.

Not only will this approach minimize the potential for listing the water as impaired in the future, it also provides an additional margin of safety that the narrative nutrient criterion will be met. However, since the target is not based specifically on a site-specific evaluation of when imbalance of flora or fauna occurs, the TMDL will be revisited in the future to determine if a more site-specific target can be used.

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 pollutant 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 are two permitted wastewater treatment facilities that discharge significant nutrient loads and other wastewater constituents directly into the McKay Bay watershed; these consist of one domestic wastewater facility and one industrial wastewater facility. Falkenburg Road is a domestic wastewater facility with an advanced wastewater treatment (AWT) system and a permitted discharge of 6.0 million gallons per day (mgd) to the Palm River, which flows into McKay Bay. The facility also has an existing land application system permitted for 0.116 mgd. Falkenburg Road is owned by the Hillsborough County Water Department and is part of the county's master reuse plan in the Brandon area. Conceptually, the reuse plan will have a capacity of 21.3 mgd, including current and potential users. Currently the reuse capacity is limited to 10.0 mgd, based on the combined permitted capacities of the Falkenburg Road and Valrico facilities.

The industrial wastewater facility discharging to the bay is Trademark Nitrogen Corporation, a fertilizer manufacturer. The facility has a design flow of 25 mgd, but the typical average daily flow is only 0.09 mgd (discharge monitoring reports show monthly flow averages ranging from 0.02 to 0.34 mgd). Process water and stormwater are treated in a retention ditch for the uptake and settling of solids. The wastewater can be recycled by manual pumping back into the system. Further treatment through aeration and pH control is performed prior to discharging. The effluent outfall discharges to an unnamed ditch, which flows to the Palm River and then to McKay Bay.

Table 4.1 provides the permitted wastewater flows and nitrogen limits for both facilities. Based on discharge monitoring data collected between 1995 and 2003, the combined point source TN loading from the facilities contributes approximately 3 to 14 percent of the annual TN loading to McKay Bay. (**Table 4.6** provides the annual loads calculated for each facility.) To calculate the loads, discharge monitoring report data from the treatment facilities were used to create a time-varying input dataset for effluent flow and nitrogen concentrations. Daily or monthly monitoring data for water quality concentrations were multiplied by monthly average flow data to determine the monthly load. The annual loads are calculated as the sum of the monthly loads.

Table 4.1. Point Sources in the McKay Bay Watershed, WBID 1584B

Facility	NPDES Permit	Discharge Point	Design Flow (mgd)	Flow (mgd)	Annual TN Effluent Limits	Maximum Load (lbs/year)[1]
Trademark Nitrogen Corporation	FL0000647	Tributary to Palm River	25.0[2]	0.09[3]	3 mg/L[4]	822
Falkenburg Road	FL0040614	Palm River	6.0	6.0	3 mg/L	54,794
					Combined Load	**55,616**

[1] Annual Load = Monthly Average Flow * Concentration * 8.34 pounds/gallon * 12 months/year
[2] The design capacity was not used to develop effluent limitations.
[3] Average daily flow of existing discharge.
[4] Effluent limit is monthly average.

4.2.2 Municipal Separate Storm Sewer System Permittees

Municipal separate storm sewer systems (MS4s) may also discharge nutrients to waterbodies in response to storm events. To address stormwater discharges, the EPA developed the NPDES stormwater permitting program in two phases. Phase I, promulgated in 1990, addresses large and medium MS4s located in incorporated places and counties with populations of 100,000 or more. Phase II began in 2003. Regulated Phase II 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 discharge into Class I or Class II waters, or Outstanding Florida Waters.

Within the McKay Bay watershed, several Phase I MS4 permits have been issued. Plant City, Hillsborough County, and the Florida Department of Transportation are copermittees under

Permit FLS000006. The city of Tampa and the city of Temple Terrace have individual permits, FLS000008 and FLS000009, respectively. Most of the watershed lies within the jurisdiction of these three permits. McKay Bay, WBID 1584B, lies within the city of Tampa's permitted authority.

4.3 Land Uses and Nonpoint Sources

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 McKay Bay watershed is primarily urban, wildlife and agricultural animals/livestock sources are not expected to contribute significantly to the TN load.

The total nonpoint source loads for each pollutant were quantified based on land use areas in the watershed. The loadings include runoff from urban areas and transportation and utility areas. Part of the surface runoff loads come from atmospheric deposition that falls directly onto the land surface. Although not specifically quantified, the runoff from residential areas includes leachate from septic systems.

Onsite sewage treatment and disposal systems (OSTDSs), including septic tanks, are commonly used where providing central sewer is not cost-effective or practical. When properly sited, designed, constructed, maintained, and operated, OSTDSs are a safe means of disposing of domestic waste. The effluent from a well-functioning OSTDS is comparable to secondarily treated wastewater from a sewage treatment plant. When not functioning properly, however, OSTDSs can be a source of nutrients (nitrogen and phosphorus), pathogens, and other pollutants to both ground water and surface water. As of 2001, Hillsborough County has roughly 100,483 septic systems (Florida Department of Health, 2003). This total does not reflect systems removed from service going back to 1970. The Department does not have information on the percentage the of population using septic systems in Hillsborough County, nor does it have estimates of countywide failure rates to determine the daily discharge of wastewater from septic tanks.

The nonpoint sources addressed in this report primarily include loadings from surface runoff. TN loadings from nonpoint sources were estimated using the loadings calculated at the SWFWMD gage, shown in **Figure 1.2**, and the Watershed Management Model (WMM), which is based on the imperviousness and event mean concentrations (EMCs) from different land use types in the watershed. The spatial distribution and acreage of different land use categories were identified using the SWFWMD's 1999 land use coverage (scale 1:40,000) contained in the Department's geographic information system (GIS) library (Florida Department of Environmental Protection, 2004).

4.3.1 Land Uses

The McKay Bay watershed drains about 33,670 acres (52 square miles) into McKay Bay. Land use categories in the watershed were aggregated using the Level 1 1999 Florida Land Use and Cover Classification System (FLUCCS) and are tabulated in **Table 4.2**. The predominant land use in the watershed is urban and built-up, which comprises 60 percent of the area. The next largest land use, transportation, communication, and utilities, makes up 11 percent of the watershed area.

Table 4.2. Classification and Percent Distribution of Land Use Categories in the McKay Bay Watershed, WBID 1584B (1999)

Level 1 Code	Land Use	Acreage	Percent Distribution
1000	Urban open	11,370	46.80%
	Low-density residential	1,132	4.66%
	Medium-density residential	2,810	11.57%
	High-density residential	201	0.83%
2000	Agriculture	4,562	18.78%
3000/7000	Rangeland	17	0.07%
8000	Transportation, communication, and utilities	164	0.68%
4000	Forest/rural open	3,131	12.89%
5000/6000	Water/wetland	906	3.73%

4.3.2 Estimating Nonpoint Loadings

The nonpoint source loading of TN generated in the McKay Bay watershed was calculated using two methods. First, the loadings at the SWFWMD S-160 control structure, formerly a U.S. Geological Survey (USGS) gaging station (USGS 02301802, Tampa Bypass Canal at S-160, at Tampa, Florida, Latitude 27°57'21", Longitude: 82°22'15"), were calculated based on flow data collected at the existing gage and water quality data collected upstream of the gage. Second, the loadings from the ungaged portion of the watershed were estimated using the WMM. The sum of the loads from these two methods was the estimate of the total nonpoint load generated in the watershed. The loads were calculated for the 1995 to 2003 period. The 2003 loads are considered the best estimate of existing conditions, because the 2003 rainfall total best represents the long-term average rainfall in the watershed compared with the previous six years **(Figure 4.1).** The long-term average annual total rainfall is 47 inches, and the rainfall total was 52 inches in 2003.

Estimating TN Loadings at SWFWMD Gage S-160

For the 1995 to 2003 period, monthly loads were calculated using the TN data collected at HCEPC Station 147, located in the Tampa Bypass Canal, and the monthly average flow at Gage S-160, which was provided by the SWFWMD. The monthly loads in each year were then summed to obtain annual TN loadings, which are shown in **Table 4.6.**

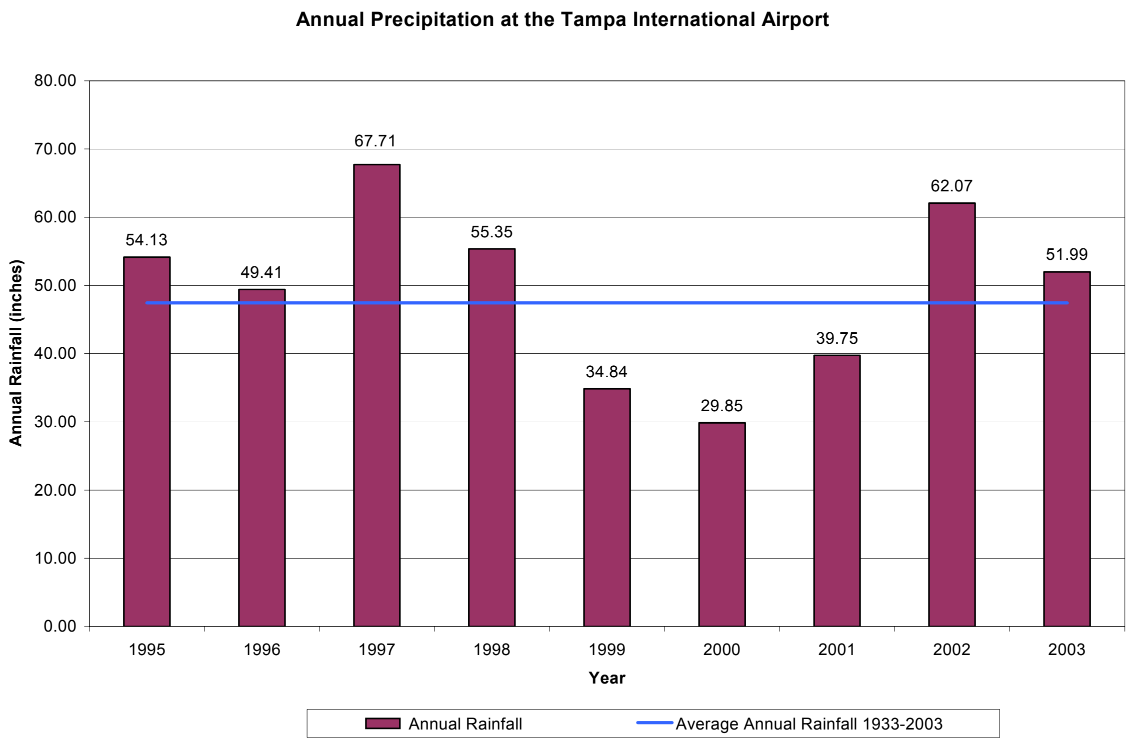

Figure 4.1. Annual Total Precipitation in the McKay Bay Watershed, WBID 1584B

Estimating TN Loadings Using the WMM

The WMM was used to estimate the nonpoint source loadings below SWFWMD Gage S-160. The WMM is designed to estimate annual or seasonal pollutant loadings from a given watershed and to evaluate the effect of watershed management strategies on water quality (User's Manual: Watershed Management Model, 1998). The Department originally funded the WMM development under contract to Camp Dresser and McKee (CDM), and CDM has subsequently refined the model. The strength of the model is its ability to characterize pollutant loadings from nonpoint sources (such as those from stormwater runoff, stream baseflow, and leakage of septic tanks). While the model also handles point sources such as discharges from wastewater treatment facilities and the estimation of pollution load reduction from partial or full-scale implementation of on-site or regional best management practices (BMPs), the model was only used to estimate the ungaged nonpoint nutrient load to the bay.

The fundamental assumption of the model is that the amount of stormwater runoff from any given land use is in direct proportion to annual rainfall. The quantity of runoff is controlled by the fraction of the land use category that is characterized as impervious and the runoff coefficients of both pervious and impervious area. The governing equation is as follows:

$$(1)\ R_L = [C_p + (C_I - C_p)\, IMP_L] * I$$

Where:

R_L = total average annual surface runoff from land use L (inches/year),
IMP_L = fractional imperviousness of land use L,
I = long-term average annual precipitation (inches/year),
C_P = pervious area runoff coefficient, and
C_I = impervious area runoff coefficient.

The model estimates pollutant loadings based on nonpoint pollution loading factors (expressed as pounds/acre/year) that vary by land use and the percent imperviousness associated with each land use. The pollution loading factor, M_L, is computed for each land use L by the following equation:

(2) $M_L = EMC_L * R_L * K$

Where:

M_L = loading factor for land use L (pounds/acre/year),
EMC_L = event mean concentration of runoff from land use L (mg/L); EMC varies by land use and pollutant,
R_L = total average annual surface runoff from land use L computed from Equation (1) (inches/year), and
K = 0.2266, a unit conversion constant.

The data required for applying the WMM include the following:

- Area of all the land use categories and the area served by septic tanks,
- Percent impervious area of each land use category,
- EMC for each pollutant type and land use category,
- Percent EMC of each pollutant type that is in suspended form, and
- Annual precipitation,

Data Required for Estimating TN Loadings. To estimate TN loadings from the McKay Bay watershed using the WMM, the following data were obtained:

A. Rain precipitation data were obtained from the weather station located at Tampa International Airport (NWS Station 88788). The total annual rainfall amounts from 1995 to 2003 were retrieved from the Climate Interactive Rapid Retrieval User System (CIRRUS) hosted by the Southeast Regional Climate Center.

Table 4.3. Classification and Percent Distribution of Ungaged Land Use Categories below SWFWMD Gage S-160 (1999)

Code	Land Use	Acreage	Percent Distribution
1000	Urban open	6,590	40.43%
5000/6000	Water/wetland	2,887	17.71%
1300	High-density residential	2,811	17.24%
8000	Highways	2,430	14.91%
1200	Medium-density residential	547	3.36%
4000	Forest/rural open	441	2.71%
1100	Low-density residential	346	2.12%
2000	Agriculture	207	1.27%
3000/7000	Rangeland	41	0.25%

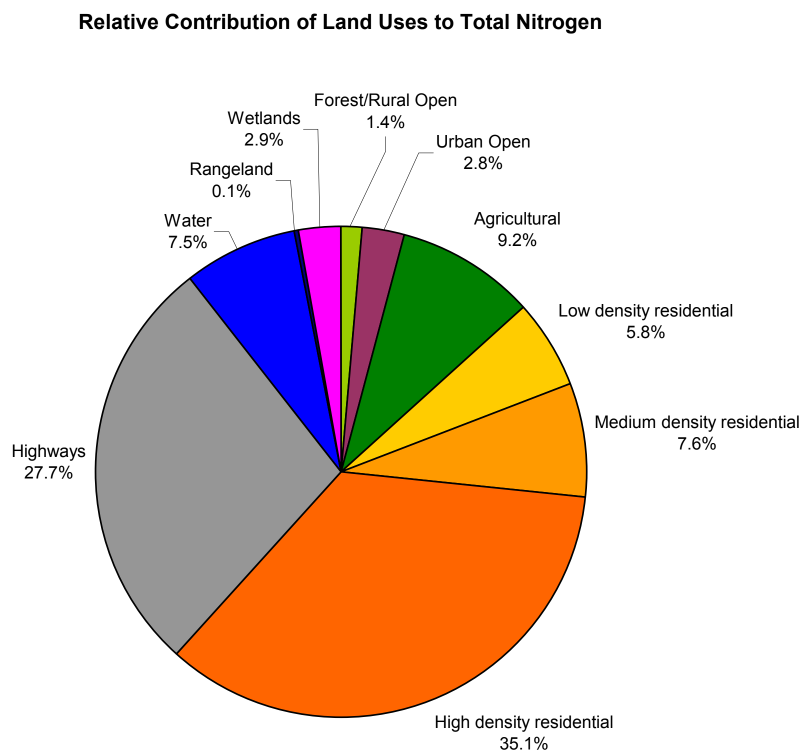

Figure 4.2. Percent Contribution of TN Loads from Different Land Use Categories below SWFWMD Gage S-160

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B. Areas of different land use categories were obtained by aggregating GIS land use coverage based on the simplified Level 1 code. The land use coverage was delineated at the SWFWMD's permanent flow gaging site located on the Tampa Bypass Canal (S-160). The drainage area below the gage encompasses 25.2 square miles, or about half of the total watershed area. **Table 4.3** lists these areas and the percent of each land use category. The dominant land use category for the McKay Bay watershed below SWFWMD Gage S-160 is urban open, which accounts for about 40 percent of the watershed's total area. Water/wetland accounts for another 17.7 percent of the total area. In total, human land use categories cover 55 percent of the total watershed area below the SWFWMD gage **(Figure 4.2).**

C. Percent impervious area of each land use category is a very important parameter in estimating surface runoff using the WMM. Nonpoint pollution monitoring studies throughout the United States over the past 15 years have shown that annual per-acre discharges of urban stormwater pollution are positively related to the amount of imperviousness in land use (User's Manual: Watershed Management Model, 1998). Ideally, the *impervious area* is the area that does not retain water; therefore, 100 percent of the precipitation falling on the impervious area should become surface runoff. In practice, however, the runoff coefficient for impervious area typically ranges between 95 and 100 percent. Impervious runoff coefficients lower than this range were observed in the literature, but usually the number should not be lower than 80 percent.

For pervious area, the runoff coefficient usually ranges between 10 and 20 percent. However, values lower than this range were also observed (User's Manual: Watershed Management Model, 1998). In this report, the values for impervious and pervious runoff coefficients were obtained from the Watershed Management Model User's Manual (Camp Dresser McKee, 1998; Brown).

D. Local event mean concentrations (EMCs) of TN for different land use categories were obtained from the report, *Evaluation of Alternative Stormwater Regulations for Southwest Florida* (Harvey and Baker, 2003), and are presented in **Table 4.4**.

Table 4.4. Land Use Runoff Concentrations (Event Mean Concentrations) in Southwest Florida

FLUCCS ID	Land Use	BOD (mg/L)	Total N (mg/L)	Total P (mg/L)
4000	Forest/rural open	1.23	1.09	0.046
1000-(1100+1200+1300)	Urban open	7.4	1.12	0.18
2000	Agriculture	3.8	2.32	0.344
1100	Low-density residential	4.3	1.64	0.191
1200	Medium-density residential	7.4	2.18	0.335
1300	High-density residential	11.0	2.42	0.49
8000	Communication and transportation	6.7	2.23	0.27
3000+7000	Rangeland	3.8	2.32	0.344
5000	Water	1.6	1.60	0.067
6000	Wetlands	2.63	1.01	0.09

[1] Source: Harper and Baker, 2003.

Estimated Surface Runoff and TN Loading Using the WMM. **Table 4.5** lists the predicted runoff using the WMM and the TN loading from different land use categories. **Figure 4.2** displays the relative contribution of nitrogen loading from each land use category below the gage at the S-160 control structure. High-density residential land use contributes the largest percentage of TN loading (43 percent), followed by communication and transportation, which makes up 35 percent of the TN load.

Table 4.5. Surface Runoff and EstimatedTN Loadings below SWFWMD Gage S-160

Land Use	Area (acres)	Runoff (acre-feet)	Percent Runoff	TN (lbs)	Percent TN load
Forest/rural open	441	312	1.31%	924	0.74%
Urban open	6,590	1313	5.54%	4,000	3.19%
Agricultural	207	288	1.21%	1,815	1.45%
Low-density residential	346	402	1.69%	1,791	1.43%
Medium-density residential	547	782	3.30%	4,638	3.69%
High-density residential	2,811	8233	34.71%	54,182	43.15%
Communication and transportation	2,430	7261	30.61%	44,034	35.07%
Rangeland	41	29	0.12%	183	0.15%
Water	1,902	4117	17.36%	11,307	9.00%
Wetlands	985	982	4.14%	2,697	2.15%

Summary of TN Load into the McKay Bay Watershed. The total pollutant loading into the McKay Bay watershed can be expressed as follows:

(3) $\mathbf{TN_L = \sum TN_{PSu} + \sum TN_{Sg} + + \sum TN_{NPSu}}$

Where:

TN_L = TN loading (pounds/year) for the McKay Bay watershed,

$\sum TN_{PSu}$ = sum of the point source TN loadings (pounds/year) located within the ungaged portion of the watershed,

$\sum TN_{Sg}$ = sum of all source TN loadings (pounds/year) in the gaged portion of the McKay Bay watershed determined by the gaged flow and water quality monitoring results, and

$\sum TN_{NPSu}$ = sum of nonpoint source TN loadings (pounds/year) in the ungaged portion of the McKay Bay watershed determined by the WMM.

It should be noted that the outfalls for Trademark Nitrogen Corporation and Falkenburg Road are below the SWFWMD gage, so that their load is not double-counted in the load measured at the SWFWMD gage. **Table 4.6** summarizes the annual average TN loadings to McKay Bay (from 1995 through 2003) from the gaged area, ungaged area, and point sources in the watershed. Annual TN loadings from all sources varied from a low of 97,279 pounds in 2000 to a high of almost 1.2 million pounds in 1998. The year 2000 was also the year with the lowest rainfall (30 inches), while rainfall in 1998 was above average at 55 inches **(Figure 4.1).** The annual TN load in 2003 was 542,602 pounds, when the total rainfall amount was 52 inches.

Table 4.6. TN Estimates for the McKay Bay Watershed, WBID 1584B

Year	Nonpoint Source Loadings (lbs)			Point Source Loadings (lbs)			TN Loadings (lbs)
	Gaged	Ungaged	Percent Nonpoint Source	Trademark Nitrogen Corporation	Falkenburg Road	Percent Point Source	
1995	261,971	130,740	96.6%	548	13,224	3.4%	406,483
1996	131,461	119,340	93.5%	1,173	16,363	6.5%	268,337
1997	706,102	163,540	97.0%	9,812	17,274	3.0%	896,728
1998	1,034,946	133,687	97.7%	928	26,238	2.3%	1,195,799
1999	136,961	84,149	93.5%	147	15,270	6.5%	236,526
2000	11,453	72,097	85.9%	203	13,526	14.1%	97,279
2001	243,962	96,008	93.9%	193	21,972	6.1%	362,135
2002	291,149	149,918	94.1%	72	27,451	5.9%	468,590
2003	390,930	125,571	95.2%	118	25,982	4.8%	542,602

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Determination of Loading Capacity

The goal of the TMDL development process is to identify the maximum allowable TN loading to the McKay Bay watershed, so that the bay will meet DO and nutrient water quality criteria and maintain its function and designated use as a Class III water. The Department initially attempted to determine the bay's assimilative capacity through a statistical evaluation of available nutrient loading and chlorophyll *a* data, but these efforts were not successful (see the next section). Because a statistically significant relationship between loading and chlorophyll *a* levels was not found, the assimilative capacity for TN loading to the bay was based on the observation that the annual average chlorophyll *a* values in 2003 (based on data from the two long-term HCEPC stations) were less than the IWR estuarine threshold of 11 μg/L for nutrient impairment. The annual average chlorophyll *a* values at Stations 21FLHILL054 and 21FLHILL058 in 2003 were 5.7 μg/L and 8.4 μg/L, respectively. Maintaining the TN loading at 2003 levels is expected to prevent annual average chlorophyll *a* values from exceeding 11 μg/L and provide a margin of safety (MOS) for meeting the target. Specifically, the allowable TN loading is the TN annual loading estimated for 2003 of 542,602 pounds, as presented in **Table 4.6.**

It should be noted that the TN loading estimates for 1999 through 2002 were actually lower than those estimated for 2003 **(Table 4.6),** and that the estuary had higher annual average chlorophyll *a* values for these years. However, the lower TN loading in 1999, 2000, and 2001 was largely due to lower-than-average rainfall in these years. Because the nutrient impairment is expected to be due primarily to stormwater loading, the Department concluded that the assimilative capacity should be based on the estimated load for a year, approximating average rainfall conditions. Additionally, the loading estimates (both from the WMM and gage information) do not take into account any reductions in nutrient loading from stormwater management activities that have been implemented in the watershed over the last few years. For these reasons, the Department concluded that the loading for 2003 is a reasonable estimate of the assimilative capacity for McKay Bay.

5.2 Attempts to Develop Empirical Relationships

Attempts were made to identify relationships between the watershed TN loading and the chlorophyll *a* values measured at Stations HCEPC 54 and HCEPC 58. No strong correlation between loadings and receiving water quality was found. This lack of a relationship is at least partially due to the limited information used to derive the loading estimates. For example, the freshwater monitoring site available for calculating the gaged load to the estuary was located at HCEPC Station 147 (Latitude: 27°58'54", Longitude: 82°21'16"), approximately 2 miles upstream of the SWFWMD Gage S-160. Additionally, the gage site is located at a control structure on a portion of the Tampa Bypass Canal that is influenced by surface water withdrawals. The city of Tampa and Tampa Bay Water have permits to withdraw surface water from the Tampa Bypass Canal for potable water use. As a result, flow measurements at the gage inaccurately mimic ambient conditions.

Additional monitoring and evaluation must be continued and will be addressed in the development of the Basin Management Action Plan for the LSC watershed TMDL.

5.3 Relationship Between Nutrients and DO

Reductions in TN loading are also expected to result in additional benefits for other parameters of concern, including DO and BOD. As described in Chapter 2, reduced algal biomass, as measured by chlorophyll *a*, should result in lower BOD levels in McKay Bay. During daylight hours, algal photosynthesis consumes nutrients and organic matter. The organic matter acts as an energy reserve, and oxygen is released. The reverse process, respiration, may occur simultaneously and dominate during dark periods of the day. During respiration, algae consume oxygen and their energy reserve to produce carbon dioxide and water. Because photosynthesis creates oxygen and respiration depletes oxygen, the algae affect the estuary's oxygen sources. Swings in oxygen can be induced by diurnal light patterns where oxygen levels rise during daylight and become depleted at night.

A fraction of the increased biomass will also become part of the organic material that is broken down by microbes or settles to the bottom. The introduction of dissolved and solid organic material from nonpoint and point sources also creates an oxygen demand during decomposition. Measuring the biological oxygen demand (BOD) within the water column quantifies how much oxygen is consumed during decomposition and plant growth.

By meeting the TN loading for 2003, chlorophyll *a* values should remain below 11 μg/L, reducing the algal biomass from levels in previous years. This lower algal biomass should, in turn, lower the BOD levels in McKay Bay. Further sediment oxygen demand (SOD) in the bay should also decrease over time as algal biomass reduction reduces the accumulation of organic matter in the sediments. Sediment processes play an important role in regulating water quality and are particularly important in a shallow estuary like McKay Bay. A portion of the organic matter produced in the water column settles to the sediment surface. Sediment processes influence DO in the water column by serving as a long-term repository of oxygen demand, which is evident in the DO depth profile data at the two long-term HCEPC stations. **Figures 5.1** and **5.2** show that DO concentrations at the two stations are typically highest near the water surface and lowest at the bottom near the sediment-water interface. A reduction of both algal BOD and SOD will have a positive impact on DO concentrations in the water column.

5.4 Current Restoration and Management Projects

At least four stormwater projects that have been implemented in the McKay Bay watershed in recent years have already reduced the TN loading to the bay. The SWFWMD funded several stormwater retrofit projects through the Surface Water Improvement and Management (SWIM) Program. The primary goal of these projects was to reduce pollutant loadings to McKay Bay and ultimately to Tampa Bay, improving or maintaining estuarine water quality. **Table 5.1** lists the projects and the estimated load reductions. As shown in **Table 5.1,** these projects are estimated to reduce annual TN loadings to the bay by over 12,105 pounds.

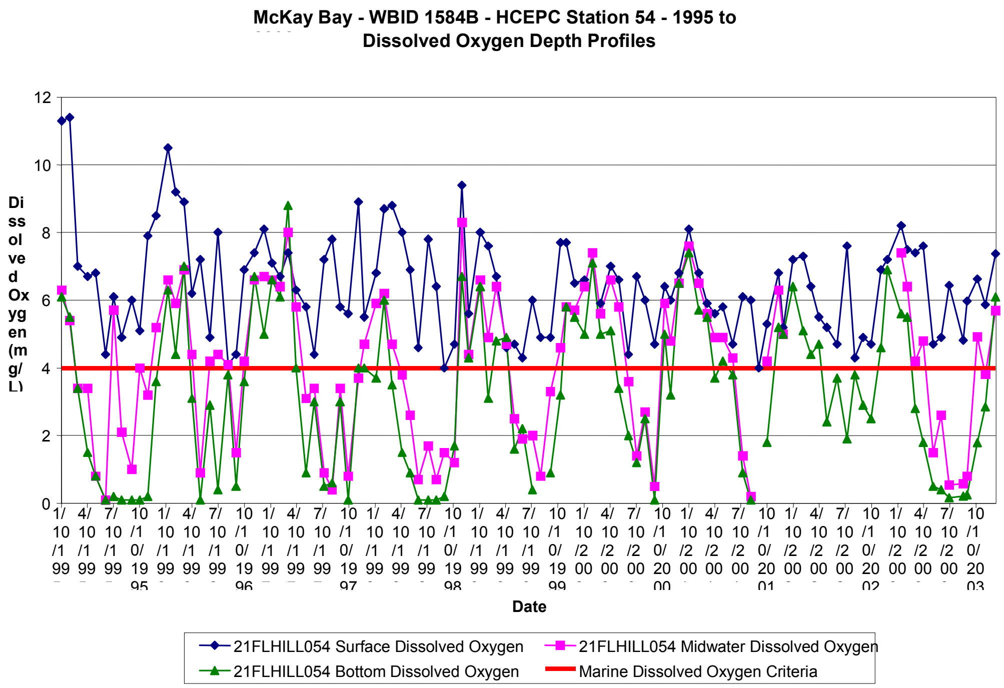

Figure 5.1. HCEPC Station 54 DO Depth Profiles

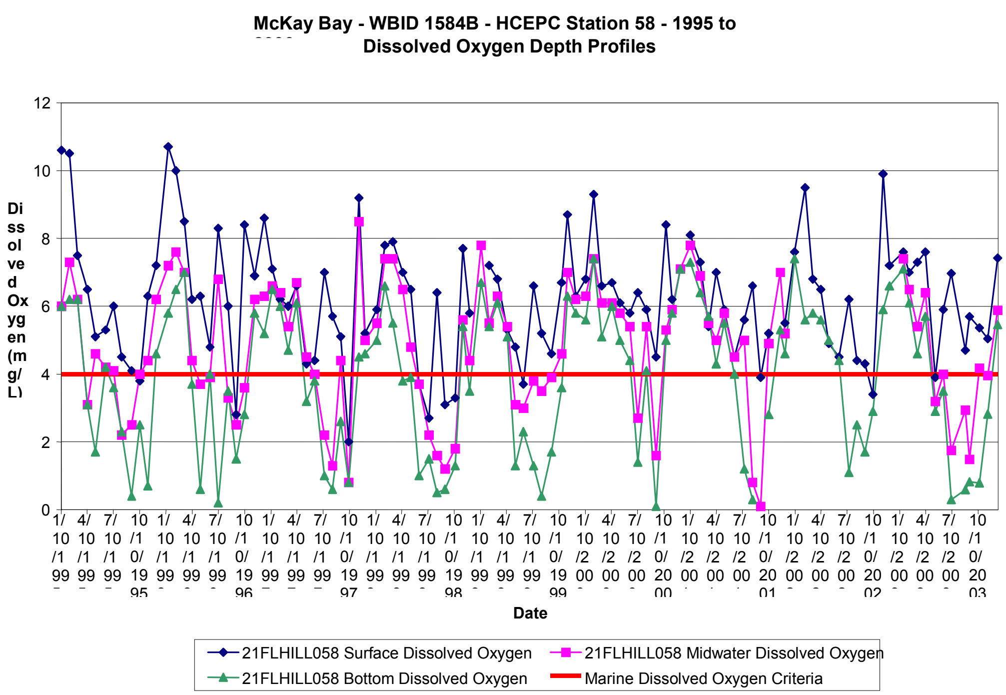

Figure 5.2. HCEPC Station 58 DO Depth Profiles

Table 5.1. SWIM Stormwater Retrofit Projects in the McKay Bay Watershed, WBID 1584B

Project	WBID	Basin Acreage	Estimated Load Reduction (lbs/year))			Completed	Cooperator
			TN	TP	TSS		
30th Street Baffle Box*	1584A	14	-	-	-	April 1998	City of Tampa
Pond 56	1584A	190	300	368	14,354	September 1998	City of Tampa
Melburne Pond	1584B	600	944	317	69,697	September 2002	Florida Department of Transportation
East Lake Outfall**	1579	1,200	9,982	809	256,157	December 2000	Hillsborough County
Eastshore Commerce Park Stormwater Retrofit	1536A	1,000	880	586	27,591	Ongoing	Tampa Bay Water, Hillsborough County

* Load reductions not estimated for this project.
** System operational from December 2000 to December 2002; expected to be back on line in June 2004
- No estimate provided.

5.5 Critical Conditions

The McKay Bay TMDL was based on annual average conditions (i.e., values from all four seasons in a calendar year, 2003) rather than critical/seasonal conditions because of the following:

a) The methodology used to determine assimilative capacity does not lend itself very well to short-term assessments,

b) The net change in overall primary productivity, which is better addressed on an annual basis, is generally a better indicator of an imbalance in flora or fauna, and

c) The methodology used to determine impairment is based on an annual average and requires data from all four quarters of a calendar year.

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 among 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 regulations (40 CFR § 130.2[I]), which state that TMDLs can be expressed in terms of mass per time (e.g., pounds per day), toxicity, or **other appropriate measure**. The TMDL for McKay Bay is expressed in terms of pounds/year and percent reduction, and represents the maximum annual TN load the estuary can assimilate to maintain the chlorophyll *a* threshold and achieve the DO criterion of 4.0 mg/L **(Table 6.1).**

Table 6.1. TMDL Components for McKay Bay Watershed, WBID 1584B

Parameter	WLA		LA (lbs/year)	MOS (lbs/year	TMDL (lbs/year)	Percent Reduction
	Wastewater[1] (lbs/year)	NPDES Stormwater (percent reduction)				
TN	55,616	5.7	486,986	Implicit	542,602	5.7

[1] The allowable annual load for Falkenburg Road is 54,794 pounds and for Trademark Nitrogen Corporation, 822 pounds.

6.2 Wasteload Allocation

6.2.1 NPDES Wastewater Discharges

The final WLA was established according to recommendations in *A Report to the Governor and the Legislature on the Allocation of Total Maximum Daily Loads in Florida* (Florida Department of Environmental Protection, February 1, 2001). Because both facilities have made significant reductions in their permitted discharge (see **Section 4.2.1**) and have provided treatment beyond technology-based effluent treatment levels for TN, each facility was given their current maximum permittable load (based on permit concentration and flow limitations). Falkenburg Road, an advanced wastewater treatment plant (AWTP), has effluent limits that are greater than the technology-based treatment levels for domestic wastewater facilities (secondary treatment). Trademark Nitrogen Corporation also has effluent limits that are greater than the recommended limits for industrial facilities. The nitrogen TMDL is based on existing measured loads from these facilities. To allocate the maximum permitted load to each facility and still meet the TMDL limit, the nonpoint source load allocation was reduced to offset the allowable point source load increase.

The WLA was determined by calculating the permitted TN load for each facility and combining the permitted loads. Falkenburg Road's AWTP load was determined by using the permitted surface water discharge limit of 6.0 mgd and the annual average effluent limit of 3 mg/L for TN. The maximum allowed TN loading is 54,794 pounds/year. Trademark Nitrogen Corporation has a permitted discharge limit based on the annual average flow of 0.09 mgd and a monthly effluent limit of 3 mg/L. The WLA was determined to be 822 pounds/year of TN. Although Trademark has a design capacity of 25.0 mgd, the effluent limit for TN was based on the average flow of the existing discharge. The allowable WLA is 55,616 pounds/year of TN.

6.2.2 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. Since 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 5.7 percent, this percent reduction is 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.

6.3 Load Allocation

The LA was determined by subtracting the WLA from the total maximum load allowed. As discussed in Chapter 4, the estimated TN loading was the summation of point source loads and nonpoint source loads for 2003. The total maximum loading was calculated to be 542,602 pounds/year. Subtracting the WLA of 55,616 pounds/year gives a LA of 486,986 pounds/year. The estimated nonpoint source load for 2003 was 516,501 pounds/year. To meet the LA of 486,986 pounds/year, the existing nonpoint source loading will need to be reduced by 5.7 percent.

6.4 Margin of Safety

Consistent with the recommendations of the Allocation Technical Advisory Committee Report (Florida Department of Environmental Protection, February 1, 2001), an implicit margin of safety (MOS) was used in the development of this TMDL. An implicit MOS was provided by the conservative decision associated with the TMDL development approach, which established the TMDL at a load that is expected to maintain the annual average chlorophyll *a* value below the estuarine threshold of 11 μg/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 McKay Bay. 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 allocations among the affected parties,
- A description of the load reduction activities to be undertaken,
- Timetables for project implementation and completion,
- Funding mechanisms that may be utilized,
- Any applicable signed agreement,
- Local ordinances defining actions to be taken or prohibited,
- Local water quality standards, permits, or load limitation agreements, and
- Monitoring and follow-up measures.

References

Baker, D., and H. Harper, H. 1994. *Evaluation of Alternative Stormwater Regulations for Southwest Florida, Final Report.* Orlando, Florida: Environmental Research and Design, Inc.

Baker, D., and H. Harper. 2003. *Evaluation of Alternative Stormwater Regulations for Southwest Florida, Final Report.* Orlando, Florida: Environmental Research and Design, Inc.

Brown, M.T. (Add date.) *The South Dade Watershed Project.* Miami, Florida: Center for Urban and Community Design.

Camp Dresser and McKee. 1998. *The Watershed Management Model User's Manual.*

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

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

Florida Department of Environmental Protection. February 1, 2001. *A Report to the Governor and the Legislature on the Allocation of Total Maximum Daily Loads in Florida.* Tallahassee, Florida: Bureau of Watershed Management.

—. 2003. *Total Maximum Daily Load for Total Phosphorus for Lake Eustis and Haines Creek Reach, Lake County, Florida.* Tallahassee, Florida: Bureau of Watershed Management.

—. 2003. *Total Maximum Daily Load for Dissolved Oxygen Impairment for the Palatlakaha River, Lake County, Florida.* Tallahassee, Florida: Bureau of Watershed Management.

—. September 2003. *Tampa Bay Basin Status Report.* Tallahassee, Florida. Available at http://www.dep.state.fl.us/water/tmdl/stat_rep.htm.

—. 2004. (Add rest of citation)

Florida Department of Health. 2003. (Add rest of citation)

Florida LakeWatch. Available at http://lakewatch.ifas.ufl.edu/. Florida Watershed Restoration Act. *Chapter 99-223, Laws of Florida.*

McKay Bay Water Quality Management Plan. December 1998. (Add rest of citation)

National Research Council. 1993. (Add rest of citation)

Roehl, J. W. 1962. *Sediment Source Areas, Delivery Ratios, and Influencing Morphological Factors.* International association of Scientific Hydrology. 59: 202-213. Symposium of Bari, October 1-8, 1962.

Stoker, Y.E., V.A. Levesque, and E.M. Fritz. 1996. *Discharge, Water Quality Characteristics, and Nutrient Loads from McKay Bay, Delaney Creek, and East Bay, Tampa, Florida, 1991 – 1993.* U.S. Geological Survey Water Resources Investigations Report 95-4167.

Southwest Florida Water Management District. 20__. *Tampa Bay/Anclote River Watershed Comprhensive Watershed Management Report.* Brooksville, Florida.

—. 1998. *Tampa Bay Surface Water Improvement and Management Plan.* Brooksville, Florida.

Tampa Bay Estuary Program. 1999. *Progress Report, Partners for Progress, The Tampa Bay Nitrogen Management Consortium Action Plan, 1995 – 1999.* Tampa, Florida.

U. S. Environmental Protection Agency. 1999. *Protocol for Developing Nutrient TMDLs.* Washington, D.C.: Office of Water. EPA841-B-99-007.

User's Manual: Watershed Management Model, Version 4.1. 1998. Rouge River National Wet Weather Demonstration Project. Wayne County, Michigan. PRO-NPS-TM27.02.

Appendices

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 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 has been developed for Newnans Lake at the time this study was conducted.

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 municipal separate storm sewer systems (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 Florida Department of Transportation 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 II 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.

Appendix B: DO and Chlorophyll *a* Raw Data

EPC Station 54, DO Data

WBID	Station	Date	Surface DO	Midwater DO	Bottom DO	Calculated DO
1584B	21FLHILL24030702	1/10/1995	11.3	6.3	6.1	6.3
1584B	21FLHILL24030702	2/7/1995	11.4	5.4	5.5	5.5
1584B	21FLHILL24030702	3/7/1995	7	3.4	3.4	3.4
1584B	21FLHILL24030702	4/11/1995	6.7	3.4	1.5	1.88
1584B	21FLHILL24030702	5/9/1995	6.8	0.8	0.8	0.8
1584B	21FLHILL24030702	6/13/1995	4.4	0.1	0.1	0.1
1584B	21FLHILL24030702	7/11/1995	6.1	5.7	0.2	1.3
1584B	21FLHILL24030702	8/8/1995	4.9	2.1	0.1	0.5
1584B	21FLHILL24030702	9/12/1995	6	1	0.1	0.28
1584B	21FLHILL24030702	10/10/1995	5.1	4	0.1	0.88
1584B	21FLHILL24030702	11/7/1995	7.9	3.2	0.2	0.8
1584B	21FLHILL24030702	12/6/1995	8.5	5.2	3.6	5.2
1584B	21FLHILL24030702	1/17/1996	10.5	6.6	6.3	6.6
1584B	21FLHILL24030702	2/13/1996	9.2	5.9	4.4	5.9
1584B	21FLHILL24030702	3/13/1996	8.9	6.9	7	7
1584B	21FLHILL24030702	4/9/1996	6.2	4.4	3.1	4.4
1584B	21FLHILL24030702	5/8/1996	7.2	0.9	0.1	0.26
1584B	21FLHILL24030702	6/11/1996	4.9	4.2	2.9	4.2
1584B	21FLHILL24030702	7/9/1996	8	4.4	0.4	1.2
1584B	21FLHILL24030702	8/13/1996	4.1	4.1	3.8	4.1
1584B	21FLHILL24030702	9/10/1996	4.4	1.5	0.5	0.7
1584B	21FLHILL24030702	10/9/1996	6.9	4.2	3.6	4.2
1584B	21FLHILL24030702	11/13/1996	7.4	6.6	6.7	6.7
1584B	21FLHILL24030702	12/17/1996	8.1	6.7	5	6.7
1584B	21FLHILL24030702	1/14/1997	7.1	6.6	6.6	6.6
1584B	21FLHILL24030702	2/11/1997	6.7	6.4	6.1	6.4
1584B	21FLHILL24030702	3/11/1997	7.4	8	8.8	8
1584B	21FLHILL24030702	4/8/1997	6.3	5.8	4	5.8
1584B	21FLHILL24030702	5/13/1997	5.8	3.1	0.9	1.34
1584B	21FLHILL24030702	6/10/1997	4.4	3.4	3	3.4
1584B	21FLHILL24030702	7/15/1997	7.2	0.9	0.5	0.58
1584B	21FLHILL24030702	8/12/1997	7.8	0.4	0.6	0.44
1584B	21FLHILL24030702	9/9/1997	5.8	3.4	3	3.4
1584B	21FLHILL24030702	10/7/1997	5.6	0.8	0.1	0.24
1584B	21FLHILL24030702	11/12/1997	8.9	3.7	4	4
1584B	21FLHILL24030702	12/3/1997	5.5	4.7	4	4.7
1584B	21FLHILL24030702	1/13/1998	6.8	5.9	3.7	5.9
1584B	21FLHILL24030702	2/10/1998	8.7	6.2	6	6.2
1584B	21FLHILL24030702	3/10/1998	8.8	4.7	3.5	4.7
1584B	21FLHILL24030702	4/14/1998	8	3.8	1.5	1.96
1584B	21FLHILL24030702	5/12/1998	6.9	2.6	0.9	1.24
1584B	21FLHILL24030702	6/9/1998	4.6	0.7	0.1	0.22
1584B	21FLHILL24030702	7/14/1998	7.8	1.7	0.1	0.42
1584B	21FLHILL24030702	8/11/1998	6.4	0.7	0.1	0.22

WBID	Station	Date	Surface DO	Midwater DO	Bottom DO	Calculated DO
1584B	21FLHILL24030702	9/8/1998	4	1.5	0.2	0.46
1584B	21FLHILL24030702	10/13/1998	4.7	1.2	1.7	1.3
1584B	21FLHILL24030702	11/9/1998	9.4	8.3	6.7	8.3
1584B	21FLHILL24030702	12/2/1998	5.6	4.4	4.3	4.4
1584B	21FLHILL054	1/12/1999	8	6.6	6.4	6.6
1584B	21FLHILL054	2/9/1999	7.6	4.9	3.1	4.9
1584B	21FLHILL054	3/9/1999	6.7	6.4	4.8	6.4
1584B	21FLHILL054	4/13/1999	4.6	4.7	4.9	4.7
1584B	21FLHILL054	5/11/1999	4.7	2.5	1.6	2.5
1584B	21FLHILL054	6/8/1999	4.3	1.9	2.2	2.2
1584B	21FLHILL054	7/13/1999	6	2	0.4	0.72
1584B	21FLHILL054	8/10/1999	4.9	0.8	nd	1.21
1584B	21FLHILL054	9/14/1999	4.9	3.3	0.9	1.38
1584B	21FLHILL054	10/19/1999	7.7	4.6	3.2	4.6
1584B	21FLHILL054	11/8/1999	7.7	5.8	5.8	5.8
1584B	21FLHILL054	12/7/1999	6.5	5.7	5.5	5.7
1584B	21FLHILL054	1/11/2000	6.6	6.4	5	6.4
1584B	21FLHILL054	2/8/2000	nd	7.4	7.1	7.25
1584B	21FLHILL054	3/7/2000	5.9	5.6	5	5.6
1584B	21FLHILL054	4/11/2000	7	6.6	5.1	6.6
1584B	21FLHILL054	5/9/2000	6.6	5.8	3.4	5.8
1584B	21FLHILL054	6/13/2000	4.4	3.6	2	3.6
1584B	21FLHILL054	7/11/2000	6.7	1.4	1.2	1.24
1584B	21FLHILL054	8/9/2000	6	2.7	2.5	2.7
1584B	21FLHILL054	9/12/2000	4.7	0.5	0.1	0.18
1584B	21FLHILL054	10/17/2000	6.4	5.9	5	5.9
1584B	21FLHILL054	11/7/2000	6	4.8	3.2	4.8
1584B	21FLHILL054	12/6/2000	6.8	6.5	6.5	6.5
1584B	21FLHILL054	1/9/2001	8.1	7.6	7.4	7.6
1584B	21FLHILL054	2/13/2001	6.8	6.5	5.7	6.5
1584B	21FLHILL054	3/14/2001	5.9	5.6	5.5	5.6
1584B	21FLHILL054	4/10/2001	5.6	4.9	3.7	4.9
1584B	21FLHILL054	5/8/2001	5.8	4.9	4.2	4.9
1584B	21FLHILL054	6/12/2001	4.7	4.3	3.8	4.3
1584B	21FLHILL054	7/17/2001	6.1	1.4	0.9	1
1584B	21FLHILL054	8/14/2001	6	0.2	0.1	0.12
1584B	21FLHILL054	9/11/2001	4	nd	nd	4
1584B	21FLHILL054	10/10/2001	5.3	4.2	1.8	4.2
1584B	21FLHILL054	11/19/2001	6.8	6.3	5.2	6.3
1584B	21FLHILL054	12/5/2001	5.2	5	5	5
1584B	21FLHILL054	1/8/2002	7.2	nd	6.4	6.8
1584B	21FLHILL054	2/13/2002	7.3	nd	5.1	6.2
1584B	21FLHILL054	3/12/2002	6.4	nd	4.4	5.4
1584B	21FLHILL054	4/9/2002	5.5	nd	4.7	5.1
1584B	21FLHILL054	5/7/2002	5.2	nd	2.4	3.8
1584B	21FLHILL054	6/11/2002	4.7	nd	3.7	4.2
1584B	21FLHILL054	7/16/2002	7.6	nd	1.9	4.75
1584B	21FLHILL054	8/13/2002	4.3	nd	3.8	4.05

WBID	Station	Date	Surface DO	Midwater DO	Bottom DO	Calculated DO
1584B	21FLHILL054	9/10/2002	4.9	nd	2.9	3.9
1584B	21FLHILL054	10/8/2002	4.7	nd	2.5	3.6
1584B	21FLHILL054	11/12/2002	6.9	nd	4.6	5.75
1584B	21FLHILL054	12/4/2002	7.2	nd	6.9	7.05
1584B	21FLHILL054	1/22/2003	8.2	7.4	5.6	7.4
1584B	21FLHILL054	2/11/2003	7.5	6.4	5.5	6.4
1584B	21FLHILL054	3/11/2003	7.4	4.2	2.8	4.2
1584B	21FLHILL054	4/8/2003	7.6	4.8	1.8	4.8
1584B	21FLHILL054	5/13/2003	4.7	1.5	0.5	0.7
1584B	21FLHILL054	6/10/2003	4.9	2.6	0.4	0.84
1584B	21FLHILL054	7/8/2003	6.44	0.54	0.16	0.236
1584B	21FLHILL054	8/26/2003	4.82	0.58	0.21	0.284
1584B	21FLHILL054	9/9/2003	5.97	0.8	0.25	0.36
1584B	21FLHILL054	10/14/2003	6.63	4.92	1.79	4.92
1584B	21FLHILL054	11/12/2003	5.87	3.81	2.85	3.81
1584B	21FLHILL054	12/17/2003	7.37	5.69	6.09	6.09

EPC Station 58, DO Data

WBID	Station	Date	Surface DO	Midwater DO	Bottom DO	Calculated DO
1584B	21FLHILL24030704	1/10/1995	10.6	6	6	6
1584B	21FLHILL24030704	2/7/1995	10.5	7.3	6.2	7.3
1584B	21FLHILL24030704	3/7/1995	7.5	6.2	6.2	6.2
1584B	21FLHILL24030704	4/11/1995	6.5	3.1	3.1	3.1
1584B	21FLHILL24030704	5/9/1995	5.1	4.6	1.7	4.6
1584B	21FLHILL24030704	6/13/1995	5.3	4.2	4.2	4.2
1584B	21FLHILL24030704	7/11/1995	6	4.1	3.6	4.1
1584B	21FLHILL24030704	8/8/1995	4.5	2.2	2.3	2.3
1584B	21FLHILL24030704	9/12/1995	4.1	2.5	0.4	0.82
1584B	21FLHILL24030704	10/10/1995	3.8	4	2.5	3.8
1584B	21FLHILL24030704	11/7/1995	6.3	4.4	0.7	1.44
1584B	21FLHILL24030704	12/6/1995	7.2	6.2	4.6	6.2
1584B	21FLHILL24030704	1/17/1996	10.7	7.2	5.8	7.2
1584B	21FLHILL24030704	2/13/1996	10	7.6	6.5	7.6
1584B	21FLHILL24030704	3/13/1996	8.5	7	7	7
1584B	21FLHILL24030704	4/9/1996	6.2	4.4	3.7	4.4
1584B	21FLHILL24030704	5/8/1996	6.3	3.7	0.6	1.22
1584B	21FLHILL24030704	6/11/1996	4.8	3.9	4	4
1584B	21FLHILL24030704	7/9/1996	8.3	6.8	0.2	1.52
1584B	21FLHILL24030704	8/13/1996	6	3.3	3.5	3.5
1584B	21FLHILL24030704	9/10/1996	2.8	2.5	1.5	1.7
1584B	21FLHILL24030704	10/9/1996	8.4	3.6	2.8	3.6
1584B	21FLHILL24030704	11/13/1996	6.9	6.2	5.8	6.2
1584B	21FLHILL24030704	12/17/1996	8.6	6.3	5.2	6.3
1584B	21FLHILL24030704	1/14/1997	7.1	6.6	6.5	6.6

WBID	Station	Date	Surface DO	Midwater DO	Bottom DO	Calculated DO
1584B	21FLHILL24030704	2/11/1997	6.2	6.4	6	6.2
1584B	21FLHILL24030704	3/11/1997	6	5.4	4.7	5.4
1584B	21FLHILL24030704	4/8/1997	6.6	6.7	6.1	6.6
1584B	21FLHILL24030704	5/13/1997	4.3	4.5	3.2	4.3
1584B	21FLHILL24030704	6/10/1997	4.4	4	3.8	4
1584B	21FLHILL24030704	7/15/1997	7	2.2	1	1.24
1584B	21FLHILL24030704	8/12/1997	5.7	1.3	0.6	0.74
1584B	21FLHILL24030704	9/9/1997	5.1	4.4	2.6	4.4
1584B	21FLHILL24030704	10/7/1997	2	0.8	0.8	0.8
1584B	21FLHILL24030704	11/12/1997	9.2	8.5	4.5	8.5
1584B	21FLHILL24030704	12/3/1997	5.2	5	4.6	5
1584B	21FLHILL24030704	1/13/1998	5.9	5.5	5	5.5
1584B	21FLHILL24030704	2/10/1998	7.8	7.4	6.6	7.4
1584B	21FLHILL24030704	3/10/1998	7.9	7.4	5.5	7.4
1584B	21FLHILL24030704	4/14/1998	7	6.5	3.8	6.5
1584B	21FLHILL24030704	5/12/1998	6.5	4.8	3.9	4.8
1584B	21FLHILL24030704	6/9/1998	3.7	3.7	1	1.54
1584B	21FLHILL24030704	7/14/1998	2.7	2.2	1.5	1.64
1584B	21FLHILL24030704	8/11/1998	6.4	1.6	0.5	0.72
1584B	21FLHILL24030704	9/8/1998	3.1	1.2	0.6	0.72
1584B	21FLHILL24030704	10/13/1998	3.3	1.8	1.3	1.4
1584B	21FLHILL24030704	11/9/1998	7.7	5.6	5.4	5.6
1584B	21FLHILL24030704	12/2/1998	5.8	4.4	3.5	4.4
1584B	21FLHILL058	1/12/1999	nd	7.8	6.7	7.25
1584B	21FLHILL058	2/9/1999	7.2	5.5	5.4	5.5
1584B	21FLHILL058	3/9/1999	6.8	6.3	6.1	6.3
1584B	21FLHILL058	4/13/1999	5.3	5.4	5.1	5.3
1584B	21FLHILL058	5/11/1999	4.8	3.1	1.3	1.66
1584B	21FLHILL058	6/8/1999	3.7	3	2.3	3
1584B	21FLHILL058	7/13/1999	6.6	3.8	1.3	1.8
1584B	21FLHILL058	8/10/1999	5.2	3.5	0.4	1.02
1584B	21FLHILL058	9/14/1999	4.6	3.9	1.7	3.9
1584B	21FLHILL058	10/19/1999	6.7	4.6	3.6	4.6
1584B	21FLHILL058	11/8/1999	8.7	7	6.3	7
1584B	21FLHILL058	12/7/1999	6.3	6.2	5.8	6.2
1584B	21FLHILL058	1/11/2000	6.8	6.3	5.6	6.3
1584B	21FLHILL058	2/8/2000	9.3	7.4	7.4	7.4
1584B	21FLHILL058	3/7/2000	6.6	6.1	5.1	6.1
1584B	21FLHILL058	4/11/2000	6.7	6.1	6	6.1
1584B	21FLHILL058	5/9/2000	6.1	5.8	5	5.8
1584B	21FLHILL058	6/13/2000	5.8	5.4	4.4	5.4
1584B	21FLHILL058	7/11/2000	6.4	2.7	1.4	1.66
1584B	21FLHILL058	8/9/2000	5.9	5.4	4.1	5.4
1584B	21FLHILL058	9/12/2000	4.5	1.6	0.1	0.4
1584B	21FLHILL058	10/17/2000	8.4	5.3	5	5.3
1584B	21FLHILL058	11/7/2000	6.2	5.9	5.8	5.9
1584B	21FLHILL058	12/6/2000	nd	7.1	7.1	7.1
1584B	21FLHILL058	1/9/2001	8.1	7.8	7.3	7.8

WBID	Station	Date	Surface DO	Midwater DO	Bottom DO	Calculated DO
1584B	21FLHILL058	2/13/2001	7.3	6.9	6.4	6.9
1584B	21FLHILL058	3/14/2001	5.4	5.5	5.7	5.5
1584B	21FLHILL058	4/10/2001	7	5	4.3	5
1584B	21FLHILL058	5/8/2001	5.9	5.8	5.5	5.8
1584B	21FLHILL058	6/12/2001	4.5	4.5	4	4.5
1584B	21FLHILL058	7/17/2001	5.6	5	1.2	1.96
1584B	21FLHILL058	8/14/2001	6.6	0.8	0.3	0.4
1584B	21FLHILL058	9/11/2001	3.9	0.1	nd	0.48
1584B	21FLHILL058	10/10/2001	5.2	4.9	2.8	4.9
1584B	21FLHILL058	11/19/2001	nd	7	5.3	6.15
1584B	21FLHILL058	12/5/2001	5.5	5.2	4.6	5.2
1584B	21FLHILL058	1/8/2002	7.6	nd	7.4	7.5
1584B	21FLHILL058	2/13/2002	9.5	nd	5.6	7.55
1584B	21FLHILL058	3/12/2002	6.8	nd	5.8	6.3
1584B	21FLHILL058	4/9/2002	6.5	nd	5.6	6.05
1584B	21FLHILL058	5/7/2002	4.9	nd	5	4.95
1584B	21FLHILL058	6/11/2002	4.5	nd	4.4	4.45
1584B	21FLHILL058	7/16/2002	6.2	nd	1.1	1.61
1584B	21FLHILL058	8/13/2002	4.4	nd	2.5	3.45
1584B	21FLHILL058	9/10/2002	4.3	nd	1.7	3
1584B	21FLHILL058	10/8/2002	3.4	nd	2.9	3.15
1584B	21FLHILL058	11/12/2002	9.9	nd	5.9	7.9
1584B	21FLHILL058	12/4/2002	7.2	nd	6.6	6.9
1584B	21FLHILL058	1/22/2003	7.6	7.4	7.1	7.4
1584B	21FLHILL058	2/11/2003	7	6.5	6.1	6.5
1584B	21FLHILL058	3/11/2003	7.3	5.4	4.6	5.4
1584B	21FLHILL058	4/8/2003	7.6	6.4	5.7	6.4
1584B	21FLHILL058	5/13/2003	3.9	3.2	2.9	3.2
1584B	21FLHILL058	6/10/2003	5.9	4	3.5	4
1584B	21FLHILL058	7/8/2003	6.97	1.75	0.3	0.59
1584B	21FLHILL058	8/26/2003	4.7	2.94	0.59	1.06
1584B	21FLHILL058	9/9/2003	5.69	1.49	0.82	0.954
1584B	21FLHILL058	10/14/2003	5.36	4.17	0.79	1.466
1584B	21FLHILL058	11/12/2003	5.04	3.96	2.82	3.96
1584B	21FLHILL058	12/17/2003	7.42	5.88	5.46	5.88

EPC Station 54, Chlorophyll *a* Data

WBID	Station	Date	Chlorophyll *a*
1584B	21FLHILL24030702	1/10/1995	3.13925
1584B	21FLHILL24030702	2/7/1995	9.475725
1584B	21FLHILL24030702	3/7/1995	4.6893
1584B	21FLHILL24030702	4/11/1995	2.840292
1584B	21FLHILL24030702	5/9/1995	5.231564
1584B	21FLHILL24030702	6/13/1995	23.980446
1584B	21FLHILL24030702	7/11/1995	18.734254
1584B	21FLHILL24030702	8/8/1995	5.02425
1584B	21FLHILL24030702	9/12/1995	35.529984
1584B	21FLHILL24030702	10/10/1995	14.8672
1584B	21FLHILL24030702	11/7/1995	65.886244
1584B	21FLHILL24030702	12/6/1995	21.148068
1584B	21FLHILL24030702	1/17/1996	15.19812
1584B	21FLHILL24030702	2/13/1996	16.438401
1584B	21FLHILL24030702	3/13/1996	12.832315
1584B	21FLHILL24030702	4/9/1996	7.27832
1584B	21FLHILL24030702	5/8/1996	2.54866
1584B	21FLHILL24030702	6/11/1996	20.639551
1584B	21FLHILL24030702	7/9/1996	14.351926
1584B	21FLHILL24030702	8/13/1996	32.304049
1584B	21FLHILL24030702	9/10/1996	8.937289
1584B	21FLHILL24030702	10/9/1996	3.759432
1584B	21FLHILL24030702	11/13/1996	11.89761
1584B	21FLHILL24030702	12/17/1996	10.321365
1584B	21FLHILL24030702	1/14/1997	5.05408
1584B	21FLHILL24030702	2/11/1997	10.576379
1584B	21FLHILL24030702	3/11/1997	10.74338833
1584B	21FLHILL24030702	4/8/1997	12.90778
1584B	21FLHILL24030702	5/13/1997	6.2599
1584B	21FLHILL24030702	6/10/1997	5.943168
1584B	21FLHILL24030702	7/15/1997	0.44992
1584B	21FLHILL24030702	8/12/1997	5.765425
1584B	21FLHILL24030702	9/9/1997	7.73575
1584B	21FLHILL24030702	10/7/1997	2.545472
1584B	21FLHILL24030702	11/12/1997	6.885153
1584B	21FLHILL24030702	12/3/1997	4.024032
1584B	21FLHILL24030702	1/13/1998	1.2403
1584B	21FLHILL24030702	2/10/1998	9.313054
1584B	21FLHILL24030702	3/10/1998	11.975517
1584B	21FLHILL24030702	4/14/1998	6.663284
1584B	21FLHILL24030702	5/12/1998	15.401369
1584B	21FLHILL24030702	6/9/1998	4.56114
1584B	21FLHILL24030702	7/14/1998	7.116768
1584B	21FLHILL24030702	8/11/1998	33.529815
1584B	21FLHILL24030702	9/8/1998	9.96132
1584B	21FLHILL24030702	10/13/1998	2.428036

WBID	Station	Date	Chlorophyll *a*
1584B	21FLHILL24030702	11/9/1998	12.122306
1584B	21FLHILL24030702	12/2/1998	6.151158
1584B	21FLHILL054	1/12/1999	1.646178
1584B	21FLHILL054	2/9/1999	7.635699
1584B	21FLHILL054	3/9/1999	13.39576
1584B	21FLHILL054	4/13/1999	11.075463
1584B	21FLHILL054	5/11/1999	1.425424
1584B	21FLHILL054	6/8/1999	2.352933
1584B	21FLHILL054	7/13/1999	11.9897
1584B	21FLHILL054	8/10/1999	4.416489
1584B	21FLHILL054	9/14/1999	7.975338
1584B	21FLHILL054	10/19/1999	15.019696
1584B	21FLHILL054	11/8/1999	9.231552
1584B	21FLHILL054	12/7/1999	5.246422
1584B	21FLHILL054	1/11/2000	7.924992
1584B	21FLHILL054	2/8/2000	5.658048
1584B	21FLHILL054	3/7/2000	8.12518
1584B	21FLHILL054	4/11/2000	10.973952
1584B	21FLHILL054	5/9/2000	11.19399556
1584B	21FLHILL054	6/13/2000	8.6844
1584B	21FLHILL054	7/11/2000	5.03769
1584B	21FLHILL054	8/9/2000	13.296112
1584B	21FLHILL054	9/12/2000	5.3767
1584B	21FLHILL054	10/17/2000	7.39008
1584B	21FLHILL054	11/7/2000	9.491872
1584B	21FLHILL054	12/6/2000	6.2769
1584B	21FLHILL054	1/9/2001	6.62847
1584B	21FLHILL054	2/13/2001	9.294444
1584B	21FLHILL054	3/14/2001	7.604799
1584B	21FLHILL054	4/10/2001	5.802972
1584B	21FLHILL054	5/8/2001	8.579591
1584B	21FLHILL054	6/12/2001	17.6236
1584B	21FLHILL054	7/17/2001	7.3102
1584B	21FLHILL054	8/14/2001	2.676772
1584B	21FLHILL054	9/11/2001	2.682498
1584B	21FLHILL054	10/10/2001	3.8694
1584B	21FLHILL054	11/19/2001	14.9321
1584B	21FLHILL054	12/5/2001	7.105329
1584B	21FLHILL054	1/8/2002	3.2
1584B	21FLHILL054	2/13/2002	3.1
1584B	21FLHILL054	3/12/2002	6
1584B	21FLHILL054	4/9/2002	4.8
1584B	21FLHILL054	5/7/2002	2.5
1584B	21FLHILL054	6/11/2002	9.8
1584B	21FLHILL054	7/16/2002	3.5
1584B	21FLHILL054	8/13/2002	9.9
1584B	21FLHILL054	9/10/2002	22
1584B	21FLHILL054	10/8/2002	17.8

WBID	Station	Date	Chlorophyll *a*
1584B	21FLHILL054	11/12/2002	2.8
1584B	21FLHILL054	12/4/2002	5.1

EPC Station 58, Chlorophyll *a* Data

WBID	Station	Date	Chlorophyll α
1584B	21FLHILL24030704	1/10/1995	15.60128
1584B	21FLHILL24030704	2/7/1995	12.362592
1584B	21FLHILL24030704	3/7/1995	6.716292
1584B	21FLHILL24030704	4/11/1995	5.4054
1584B	21FLHILL24030704	5/9/1995	12.984192
1584B	21FLHILL24030704	6/13/1995	20.445399
1584B	21FLHILL24030704	7/11/1995	20.088405
1584B	21FLHILL24030704	8/8/1995	12.442815
1584B	21FLHILL24030704	9/12/1995	78.56088
1584B	21FLHILL24030704	10/10/1995	17.196696
1584B	21FLHILL24030704	11/7/1995	44.715448
1584B	21FLHILL24030704	12/6/1995	21.574255
1584B	21FLHILL24030704	1/17/1996	29.147388
1584B	21FLHILL24030704	2/13/1996	16.66471
1584B	21FLHILL24030704	3/13/1996	13.433356
1584B	21FLHILL24030704	4/9/1996	6.691965
1584B	21FLHILL24030704	5/8/1996	16.337541
1584B	21FLHILL24030704	6/11/1996	5.98647
1584B	21FLHILL24030704	7/9/1996	15.915886
1584B	21FLHILL24030704	8/13/1996	13.852257
1584B	21FLHILL24030704	9/10/1996	12.617808
1584B	21FLHILL24030704	10/9/1996	17.663573
1584B	21FLHILL24030704	11/13/1996	9.72619
1584B	21FLHILL24030704	12/17/1996	13.19184
1584B	21FLHILL24030704	1/14/1997	5.731044
1584B	21FLHILL24030704	2/11/1997	7.552702
1584B	21FLHILL24030704	3/11/1997	16.676946
1584B	21FLHILL24030704	4/8/1997	13.08475
1584B	21FLHILL24030704	5/13/1997	12.757477
1584B	21FLHILL24030704	6/10/1997	13.253436
1584B	21FLHILL24030704	7/15/1997	25.031448
1584B	21FLHILL24030704	8/12/1997	13.058199
1584B	21FLHILL24030704	9/9/1997	13.775045
1584B	21FLHILL24030704	10/7/1997	4.35062
1584B	21FLHILL24030704	11/12/1997	17.500527
1584B	21FLHILL24030704	12/3/1997	7.101276
1584B	21FLHILL24030704	1/13/1998	1.595462
1584B	21FLHILL24030704	2/10/1998	14.257848
1584B	21FLHILL24030704	3/10/1998	14.07064
1584B	21FLHILL24030704	4/14/1998	40.427535
1584B	21FLHILL24030704	5/12/1998	18.972
1584B	21FLHILL24030704	6/9/1998	11.899742
1584B	21FLHILL24030704	7/14/1998	19.213882

WBID	Station	Date	Chlorophyll α
1584B	21FLHILL24030704	8/11/1998	26.702936
1584B	21FLHILL24030704	9/8/1998	27.00383
1584B	21FLHILL24030704	10/13/1998	10.88784
1584B	21FLHILL24030704	11/9/1998	12.49704
1584B	21FLHILL24030704	12/2/1998	62.290152
1584B	21FLHILL058	1/12/1999	2.99523
1584B	21FLHILL058	2/9/1999	14.154535
1584B	21FLHILL058	3/9/1999	9.96575
1584B	21FLHILL058	4/13/1999	17.550582
1584B	21FLHILL058	5/11/1999	10.44446
1584B	21FLHILL058	6/8/1999	4.911864
1584B	21FLHILL058	7/13/1999	20.195828
1584B	21FLHILL058	8/10/1999	6.563485
1584B	21FLHILL058	9/14/1999	17.9451
1584B	21FLHILL058	10/19/1999	23.594571
1584B	21FLHILL058	11/8/1999	11.517392
1584B	21FLHILL058	12/7/1999	7.858098
1584B	21FLHILL058	1/11/2000	12.463011
1584B	21FLHILL058	2/8/2000	6.96318
1584B	21FLHILL058	3/7/2000	10.82186667
1584B	21FLHILL058	4/11/2000	6.220792
1584B	21FLHILL058	5/9/2000	12.776
1584B	21FLHILL058	6/13/2000	12.90086471
1584B	21FLHILL058	7/11/2000	17.268273
1584B	21FLHILL058	8/9/2000	16.98855733
1584B	21FLHILL058	9/12/2000	14.436675
1584B	21FLHILL058	10/17/2000	9.58848
1584B	21FLHILL058	11/7/2000	9.186432
1584B	21FLHILL058	12/6/2000	7.980578
1584B	21FLHILL058	1/9/2001	10.589648
1584B	21FLHILL058	2/13/2001	7.280787
1584B	21FLHILL058	3/14/2001	8.4916
1584B	21FLHILL058	4/10/2001	9.776292
1584B	21FLHILL058	5/8/2001	9.783769
1584B	21FLHILL058	6/12/2001	12.80233
1584B	21FLHILL058	7/17/2001	18.585624
1584B	21FLHILL058	8/14/2001	10.056368
1584B	21FLHILL058	9/11/2001	10.709013
1584B	21FLHILL058	10/10/2001	3.55408
1584B	21FLHILL058	11/19/2001	26.349543
1584B	21FLHILL058	12/5/2001	14.08527
1584B	21FLHILL058	1/8/2002	2.9
1584B	21FLHILL058	2/13/2002	4.6
1584B	21FLHILL058	3/12/2002	3.5
1584B	21FLHILL058	4/9/2002	5.6
1584B	21FLHILL058	5/7/2002	18
1584B	21FLHILL058	6/11/2002	15.7
1584B	21FLHILL058	7/16/2002	8

WBID	Station	Date	Chlorophyll α
1584B	21FLHILL058	8/13/2002	24.1
1584B	21FLHILL058	9/10/2002	51.5
1584B	21FLHILL058	10/8/2002	24.6
1584B	21FLHILL058	11/12/2002	17.8
1584B	21FLHILL058	12/4/2002	28.7
1584B	21FLHILL058	1/22/2003	2.92
1584B	21FLHILL058	2/11/2003	2.51
1584B	21FLHILL058	3/11/2003	5.47
1584B	21FLHILL058	4/8/2003	17.8
1584B	21FLHILL058	5/13/2003	6.39
1584B	21FLHILL058	6/10/2003	16.28
1584B	21FLHILL058	7/8/2003	18.27
1584B	21FLHILL058	8/26/2003	6.36
1584B	21FLHILL058	9/9/2003	4.04
1584B	21FLHILL058	10/14/2003	10.06
1584B	21FLHILL058	11/12/2003	0.99
1584B	21FLHILL058	12/17/2003	10.13

Appendix C: Total Nitrogen to Total Phosphorus Ratios at Long-Term Hillsborough County Stations

EPC Station 54

WBID	Station	Date	Total Nitrogen	Total Phosphorus	Nitrogen: Phosphorus Ratio
1584B	21FLHILL24030702	1/17/1996	0.574	0.22	2.609090909
1584B	21FLHILL24030702	2/13/1996	0.62	0.17	3.647058824
1584B	21FLHILL24030702	2/13/1996	0.621	0.17	3.652941176
1584B	21FLHILL24030702	3/13/1996	0.97	0.24	4.041666667
1584B	21FLHILL24030702	4/9/1996	0.9	0.3	3
1584B	21FLHILL24030702	5/8/1996	0.665	0.34	1.955882353
1584B	21FLHILL24030702	6/11/1996	0.861	0.35	2.46
1584B	21FLHILL24030702	7/9/1996	0.85	0.45	1.888888889
1584B	21FLHILL24030702	8/13/1996	1.06	0.33	3.212121212
1584B	21FLHILL24030702	9/10/1996	0.82	0.28	2.928571429
1584B	21FLHILL24030702	10/9/1996	0.71	0.3	2.366666667
1584B	21FLHILL24030702	11/13/1996	0.72	0.31	2.322580645
1584B	21FLHILL24030702	12/17/1996	0.48	0.09	5.333333333
1584B	21FLHILL24030702	1/14/1997	0.58	0.11	5.272727273
1584B	21FLHILL24030702	2/11/1997	0.67	0.25	2.68
1584B	21FLHILL24030702	3/11/1997	0.76	0.29	2.620689655
1584B	21FLHILL24030702	4/8/1997	0.62	0.28	2.214285714
1584B	21FLHILL24030702	5/13/1997	0.7	0.26	2.692307692
1584B	21FLHILL24030702	6/10/1997	0.68	0.25	2.72
1584B	21FLHILL24030702	7/15/1997	0.692	0.29	2.386206897
1584B	21FLHILL24030702	8/12/1997	0.692	0.31	2.232258065
1584B	21FLHILL24030702	9/9/1997	0.87	0.35	2.485714286
1584B	21FLHILL24030702	10/7/1997	0.89	0.33	2.696969697
1584B	21FLHILL24030702	11/12/1997	0.8	0.42	1.904761905
1584B	21FLHILL24030702	12/3/1997	0.831	0.35	2.374285714
1584B	21FLHILL24030702	1/13/1998	0.99	0.44	2.25
1584B	21FLHILL24030702	2/10/1998	0.77	0.37	2.081081081
1584B	21FLHILL24030702	3/10/1998	0.98	0.45	2.177777778
1584B	21FLHILL24030702	4/14/1998	0.75	0.4	1.875
1584B	21FLHILL24030702	5/12/1998	0.86	0.53	1.622641509
1584B	21FLHILL24030702	6/9/1998	0.47	0.52	0.903846154
1584B	21FLHILL24030702	7/14/1998	0.73	0.42	1.738095238
1584B	21FLHILL24030702	8/11/1998	0.82	0.46	1.782608696
1584B	21FLHILL24030702	9/8/1998	0.94	0.38	2.473684211
1584B	21FLHILL24030702	10/13/1998	0.78	0.34	2.294117647
1584B	21FLHILL24030702	11/9/1998	0.8	0.23	3.47826087
1584B	21FLHILL24030702	12/2/1998	0.62	0.22	2.818181818
1584B	21FLHILL054	1/12/1999	0.61	0.14	4.357142857
1584B	21FLHILL054	2/9/1999	0.67	0.26	2.576923077
1584B	21FLHILL054	3/9/1999	0.67	0.23	2.913043478
1584B	21FLHILL054	4/13/1999	0.69	0.29	2.379310345
1584B	21FLHILL054	5/11/1999	0.72	0.16	4.5

WBID	Station	Date	Total Nitrogen	Total Phosphorus	Nitrogen: Phosphorus Ratio
1584B	21FLHILL054	6/8/1999	0.69	0.18	3.833333333
1584B	21FLHILL054	7/13/1999	0.84	0.25	3.36
1584B	21FLHILL054	8/10/1999	0.72	0.33	2.181818182
1584B	21FLHILL054	9/14/1999	0.68	0.22	3.090909091
1584B	21FLHILL054	10/19/1999	0.62	0.19	3.263157895
1584B	21FLHILL054	11/8/1999	0.53	0.18	2.944444444
1584B	21FLHILL054	12/7/1999	0.56	0.12	4.666666667
1584B	21FLHILL054	1/11/2000	0.58	0.08	7.25
1584B	21FLHILL054	2/8/2000	0.46	0.18	2.555555556
1584B	21FLHILL054	3/7/2000	0.98	0.21	4.666666667
1584B	21FLHILL054	4/11/2000	0.72	0.13	5.538461538
1584B	21FLHILL054	5/9/2000	0.98	0.17	5.764705882
1584B	21FLHILL054	6/13/2000	1.03	0.21	4.904761905
1584B	21FLHILL054	7/11/2000	1.19	0.26	4.576923077
1584B	21FLHILL054	8/9/2000	1.39	0.24	5.791666667
1584B	21FLHILL054	9/12/2000	1.14	0.24	4.75
1584B	21FLHILL054	10/17/2000	1.11	0.19	5.842105263
1584B	21FLHILL054	11/7/2000	1.64	0.16	10.25
1584B	21FLHILL054	12/6/2000	0.86	0.13	6.615384615
1584B	21FLHILL054	1/9/2001	0.69	0.17	4.058823529
1584B	21FLHILL054	2/13/2001	0.8	0.12	6.666666667
1584B	21FLHILL054	3/14/2001	1.01	0.19	5.315789474
1584B	21FLHILL054	4/10/2001	1.12	0.2	5.6
1584B	21FLHILL054	5/8/2001	0.81	0.15	5.4
1584B	21FLHILL054	6/12/2001	0.99	0.23	4.304347826
1584B	21FLHILL054	7/17/2001	1.2	0.21	5.714285714
1584B	21FLHILL054	8/14/2001	0.81	0.19	4.263157895
1584B	21FLHILL054	9/11/2001	0.94	0.33	2.848484848
1584B	21FLHILL054	10/10/2001	0.99	0.27	3.666666667
1584B	21FLHILL054	11/19/2001	0.81	0.19	4.263157895
1584B	21FLHILL054	12/5/2001	0.99	0.22	4.5
1584B	21FLHILL054	1/8/2002	1.438	0.16	8.9875
1584B	21FLHILL054	2/13/2002	0.692	0.15	4.613333333
1584B	21FLHILL054	3/12/2002	0.757	0.17	4.452941176
1584B	21FLHILL054	4/9/2002	1.038	0.19	5.463157895
1584B	21FLHILL054	5/7/2002	1.079	0.22	4.904545455
1584B	21FLHILL054	6/11/2002	1.195	0.25	4.78
1584B	21FLHILL054	7/16/2002	1.222	0.28	4.364285714
1584B	21FLHILL054	8/13/2002	1.097	0.29	3.782758621
1584B	21FLHILL054	9/10/2002	0.988	0.17	5.811764706
1584B	21FLHILL054	10/8/2002	0.597	0.24	2.4875
1584B	21FLHILL054	11/12/2002	0.533	0.2	2.665
1584B	21FLHILL054	12/4/2002	0.42	0.16	2.625

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WBID	Station	Date	Total Nitrogen	Total Phosphorus	Nitrogen: Phosphorus Ratio
1584B	21FLHILL24030704	1/17/1996	0.802	0.24	3.341666667
1584B	21FLHILL24030704	1/17/1996	0.8	0.24	3.333333333
1584B	21FLHILL24030704	4/9/1996	1.02	0.31	3.290322581
1584B	21FLHILL24030704	7/9/1996	0.77	0.43	1.790697674
1584B	21FLHILL24030704	9/10/1996	1	0.29	3.448275862
1584B	21FLHILL24030704	1/14/1997	0.52	0.12	4.333333333
1584B	21FLHILL24030704	2/11/1997	0.68	0.23	2.956521739
1584B	21FLHILL24030704	3/11/1997	0.83	0.31	2.677419355
1584B	21FLHILL24030704	4/8/1997	0.66	0.28	2.357142857
1584B	21FLHILL24030704	5/13/1997	0.84	0.28	3
1584B	21FLHILL24030704	7/15/1997	0.759	0.33	2.3
1584B	21FLHILL24030704	10/7/1997	1.01	0.36	2.805555556
1584B	21FLHILL24030704	1/13/1998	1.06	0.49	2.163265306
1584B	21FLHILL24030704	2/10/1998	0.77	0.4	1.925
1584B	21FLHILL24030704	4/14/1998	1.03	0.44	2.340909091
1584B	21FLHILL24030704	7/14/1998	0.86	0.45	1.911111111
1584B	21FLHILL24030704	10/13/1998	0.91	0.37	2.459459459
1584B	21FLHILL058	1/12/1999	0.68	0.17	4
1584B	21FLHILL058	4/13/1999	0.76	0.44	1.727272727
1584B	21FLHILL058	6/8/1999	0.8	0.2	4
1584B	21FLHILL058	7/13/1999	0.79	0.27	2.925925926
1584B	21FLHILL058	8/10/1999	0.78	0.31	2.516129032
1584B	21FLHILL058	9/14/1999	0.66	0.27	2.444444444
1584B	21FLHILL058	10/19/1999	0.76	0.27	2.814814815
1584B	21FLHILL058	11/8/1999	0.57	0.22	2.590909091
1584B	21FLHILL058	12/7/1999	0.65	0.16	4.0625
1584B	21FLHILL058	1/11/2000	0.57	0.14	4.071428571
1584B	21FLHILL058	2/8/2000	0.41	0.18	2.277777778
1584B	21FLHILL058	3/7/2000	0.76	0.22	3.454545455
1584B	21FLHILL058	4/11/2000	0.78	0.21	3.714285714
1584B	21FLHILL058	5/9/2000	0.98	0.18	5.444444444
1584B	21FLHILL058	6/13/2000	1.22	0.23	5.304347826
1584B	21FLHILL058	7/11/2000	1.47	0.35	4.2
1584B	21FLHILL058	8/9/2000	1.47	0.29	5.068965517
1584B	21FLHILL058	9/12/2000	1.5	0.28	5.357142857
1584B	21FLHILL058	10/17/2000	1.15	0.2	5.75
1584B	21FLHILL058	11/7/2000	1.58	0.16	9.875
1584B	21FLHILL058	12/6/2000	0.93	0.14	6.642857143
1584B	21FLHILL058	1/9/2001	0.66	0.17	3.882352941
1584B	21FLHILL058	2/13/2001	0.74	0.12	6.166666667
1584B	21FLHILL058	3/14/2001	0.92	0.15	6.133333333
1584B	21FLHILL058	4/10/2001	0.94	0.19	4.947368421
1584B	21FLHILL058	5/8/2001	0.66	0.13	5.076923077
1584B	21FLHILL058	6/12/2001	0.92	0.25	3.68
1584B	21FLHILL058	7/17/2001	1.18	0.25	4.72

WBID	Station	Date	Total Nitrogen	Total Phosphorus	Nitrogen: Phosphorus Ratio
1584B	21FLHILL058	8/14/2001	0.86	0.22	3.909090909
1584B	21FLHILL058	9/11/2001	0.96	0.36	2.666666667
1584B	21FLHILL058	10/10/2001	0.93	0.27	3.444444444
1584B	21FLHILL058	11/19/2001	0.62	0.18	3.444444444
1584B	21FLHILL058	12/5/2001	0.76	0.17	4.470588235
1584B	21FLHILL058	1/8/2002	0.646	0.19	3.4
1584B	21FLHILL058	2/13/2002	0.743	0.17	4.370588235
1584B	21FLHILL058	3/12/2002	0.785	0.16	4.90625
1584B	21FLHILL058	4/9/2002	1.013	0.2	5.065
1584B	21FLHILL058	5/7/2002	0.983	0.25	3.932
1584B	21FLHILL058	6/11/2002	1.173	0.28	4.189285714
1584B	21FLHILL058	7/16/2002	1.17	0.31	3.774193548
1584B	21FLHILL058	8/13/2002	1.147	0.33	3.475757576
1584B	21FLHILL058	9/10/2002	1.517	0.27	5.618518519
1584B	21FLHILL058	10/8/2002	0.62	0.25	2.48
1584B	21FLHILL058	11/12/2002	0.529	0.2	2.645
1584B	21FLHILL058	12/4/2002	0.827	0.21	3.938095238

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