FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Water Resource Management, Bureau of Watershed Management

SOUTHWEST DISTRICT • SARASOTA BAY–PEACE–MYAKKA BASINS

TMDL Report

Nutrient TMDL for the Winter Haven Southern Chain of Lakes

(WBIDs 1521, 1521D, 1521E, 1521F, 1521G, 1521H, 1521J, 1521K)

Kevin Petrus

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For additional information on the watershed management approach and impaired waters in the Sarasota Bay, Peace River, and Myakka River (Sarasota Bay–Peace–Myakka) Basins, contact

Tom Singleton
Florida Department of Environmental Protection
Bureau of Watershed Management
Watershed Planning and Coordination Section
2600 Blair Stone Road, Mail Station 3565
Tallahassee, FL 32399-2400
E-mail: thomas.singleton@dep.state.fl.us
Phone: (850) 245-8561; Suncom: 205-8461
Fax: (850) 245-8434

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

Kevin Petrus
Florida Department of Environmental Protection
Bureau of Watershed Management
Watershed Assessment Section
2600 Blair Stone Road, Mail Station 3555
Tallahassee, FL 32399-2400
E-mail: kevin.petrus@dep.state.fl.us
Phone: (850) 245-8459; Suncom: 205-8459
Fax: (850) 245-8536

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Chapter 1: INTRODUCTION

1.1 Purpose of Report

This report presents the Total Maximum Daily Load (TMDL) for total phosphorus to address the nutrient impairment for the Southern Chain of Lakes in the Winter Haven Chain of Lakes, including Lakes Cannon, Howard, Idylwild, Jessie, Lulu, May, Mirror, and Shipp. These eight lakes were verified as impaired for nutrients, using the methodology described in the Identification of Impaired Surface Waters Rule (IWR), Rule 62-303, Florida Administrative Code (F.A.C.), and were included on the Verified List of impaired waters for the Peace River Basin that was adopted by Secretarial Order in June 2005. This TMDL report establishes the allowable loadings to the watershed that would restore the lakes so that they meet the applicable water quality standards for 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 ambient water quality conditions.

The Winter Haven Chain of Lakes is one of 10 priority Surface Water Improvement and Management (SWIM) waterbodies designated by the Southwest Florida Water Management District (SWFWMD). For SWIM waterbodies, Florida water policy requires the water management districts to set and adopt pollutant load reduction goals (PLRGs) for pollutants of concern. In the Water Resource Implementation Rule (Rule 62-40, F.A.C.), PLRGs are defined as estimated numeric reductions in pollutant loadings needed to preserve or restore the designated uses of receiving bodies of water and maintain water quality consistent with applicable state standards. In 2005, the SWFWMD developed a revised PLRG for phosphorus to address the eutrophication of lakes throughout the watershed (McCary and Ross, 2005). The PLRG identified the phosphorus load reductions needed to achieve the Trophic State Index (TSI) target for the lakes in the Southern Chain, and the load reductions are the basis for the nutrient TMDLs for these 8 impaired lakes.

1.2 Identification of Waterbodies

The Winter Haven Chain of Lakes watershed is located in north-central Polk County, within and around the city of Winter Haven **(Figure 1.1).** The Winter Haven Chain of Lakes system is generally divided into the Northern Chain, consisting of 5 lakes, and the Southern Chain, consisting of 16 lakes **(Figure 1.2)**. The watershed draining to the lakes is almost 32 square miles, and almost half of this area comprises water and wetlands. The Northern Chain lakes include Conine, Rochelle, Haines, Smart and Fannie. The Southern Chain lakes consist of Winterset, Eloise, Summit, Lulu, Roy, Shipp, May, Howard, Cannon, Blue, Mirror, Spring, Idylwild, Jessie, Mariana, and Hartridge. Lakes Blue and Mariana are only connected to the other lakes in the Southern Chain when seasonal high waters exceed the lake operational levels.

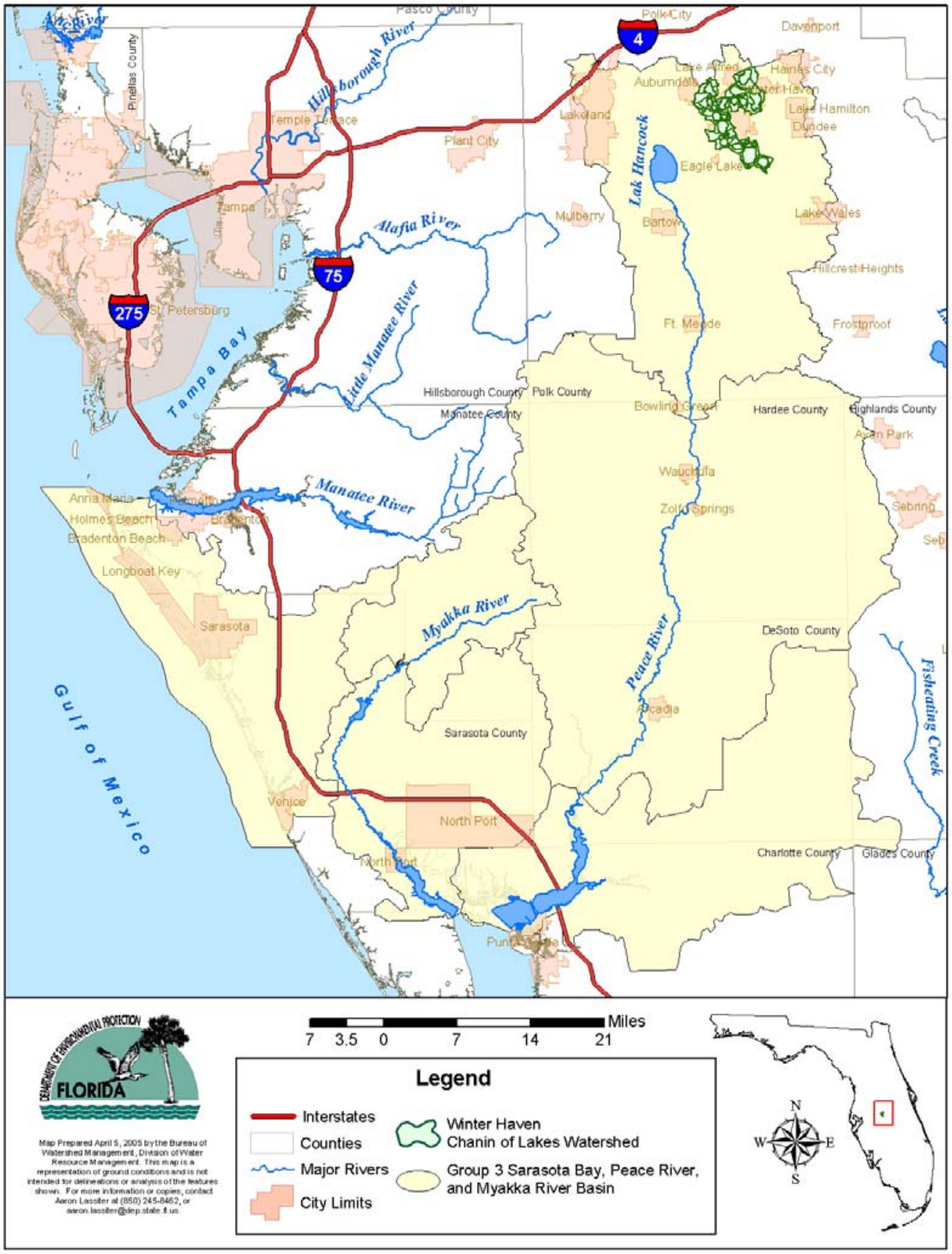

Figure 1.1. Location of the Winter Haven Chain of Lakes Waterbody Segments, and Major Geopolitical Features in the Sarasota Bay–Peace–Myakka Basins

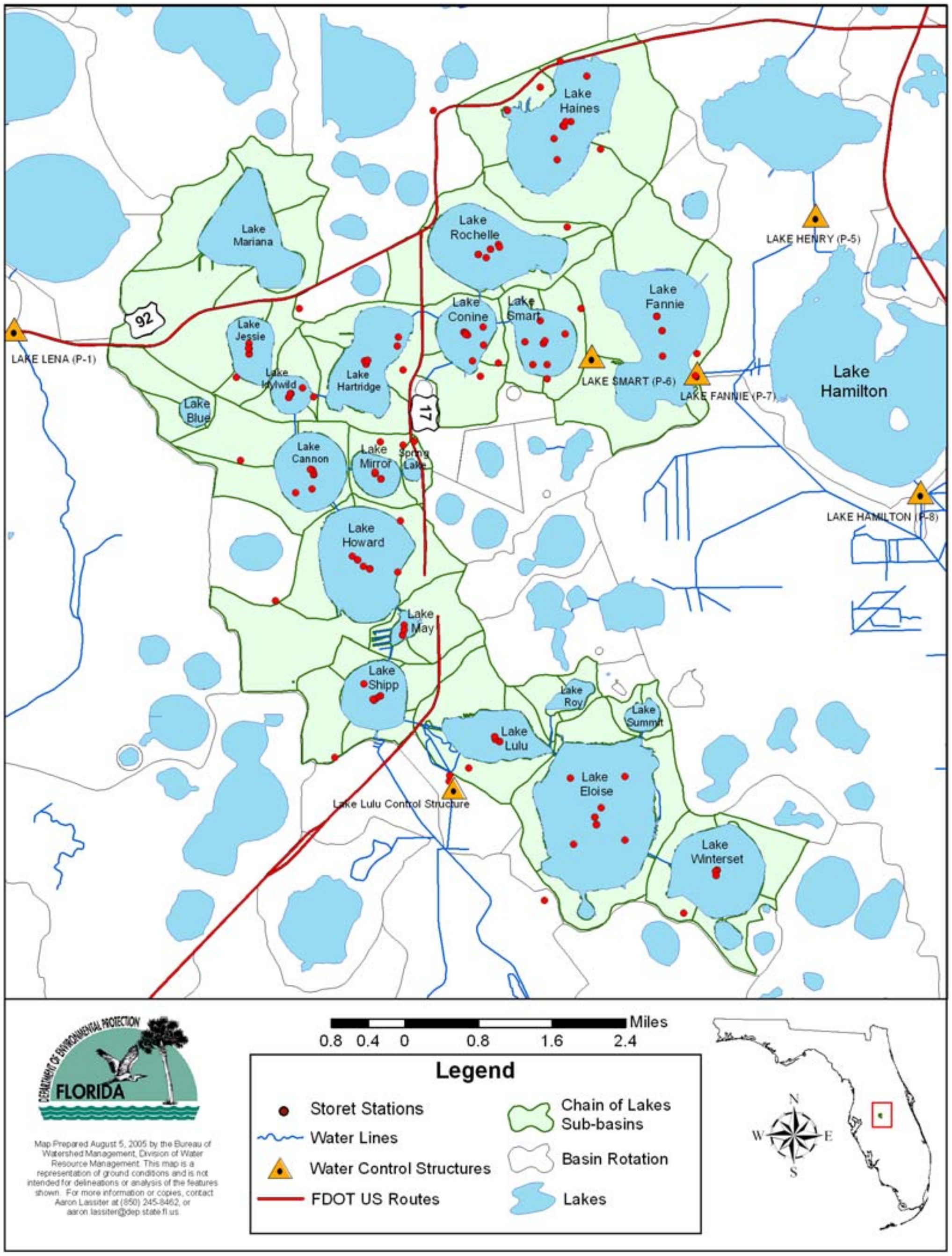

Figure 1.2. Winter Haven Chain of Lakes Waterbody Segments and Monitoring Locations

In the Northern Chain, water levels in Lakes Haines, Rochelle, Conine, and Smart fluctuate at the same level, since they are interconnected via man-made canals. Structure P-6, between Lakes Smart and Fannie, controls these lake levels. Lake Fannie is downstream of Structure P-6, and its elevation is controlled by Structure P-7. When water passes through Structure P-7, it eventually flows into the Peace Creek Drainage Canal. At high water levels, water from the Southern Chain can enter the Northern Chain via a weir structure that allows flow from the east side of Lake Hartridge to the west side of Lake Conine.

In the Southern Chain, water levels are related via a series of interconnecting canals. As mentioned above, Lakes Blue and Mariana are connected to the other lakes only during wet periods. The Southern Chain discharges from a structure on the southern side of Lake Lulu that controls the water levels of all the lakes in the Southern Chain (except Blue and Mariana). Discharge from this structure can be controlled to regulate lake levels in the Southern Chain. Flows out of Lake Lulu enter the Wahneta Farms Drainage Canal, which eventually flows into the Peace Creek Drainage Canal just north of Lake Garfield.

For assessment purposes, the Florida Department of Environmental Protection (Department) has divided the Upper Peace River Planning Unit into water assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each waterbody or waterbody segment. The Winter Haven Chain of Lakes watershed includes the 21 lake WBIDs in the Northern and Southern Chain. The 8 lake segments in the Southern Chain, which were placed on the Verified List for nutrient impairment, are the primary subjects of this TMDL report. **Figure 1.2** shows the watershed, as well as the locations of the water quality monitoring stations and control structures discussed in this report.

1.3 Background

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

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

This TMDL report will be followed by the development and implementation of a Basin Management Action Plan, or BMAP, to reduce the amount of nutrients that caused the verified impairment of lakes in the watershed. These activities will depend heavily on the active participation of the SWFWMD, Polk County, local governments, local 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.

Work has already begun to identify and implement projects that would be components of a BMAP. The SWFWMD, in cooperation with the city of Winter Haven, has begun to implement projects designed to reduce nutrient loadings to the lakes. The SWFWMD has funded several stormwater management projects, a sediment removal feasibility study through the SWIM Program, and a water quality management plan. Stormwater management projects include the construction of stormwater treatment systems along Lakes May, Lulu, Hartridge, and Howard. The sediment removal feasibility study will predict the water quality benefits of removing sediments from Lakes May, Shipp, and Lulu, where sediment accumulation has occurred due to historical point and nonpoint source pollutant discharges, and estimate the costs of implementing the project. The water quality management plan would identify action plans to improve water quality and provide specific recommendations for projects that could be used to meet the TMDLs and PLRGs.

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.]), and the list is amended annually to include updates for each basin statewide.

Florida's 1998 303(d) list included 84 waterbodies in the Sarasota Bay–Peace–Myakka Basins . 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 rulemaking process, the Environmental Regulation Commission adopted the new methodology as Rule 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 the Winter Haven Chain of Lakes and verified the impairments for nutrients in the 12 lakes shown in **Table 2.1.** **Table 2.2** summarizes the nutrient assessment results, based on annual average TSI values, for all the Winter Haven Chain of Lakes using data collected during the verification period (January 1997 to June 2004) and planning period (January 1992 to December 2001). The TSI, a calculation based on nutrient and chlorophyll *a* concentrations, is the primary means of assessing nutrient impairment in lakes.

The IWR listing methodology has two TSI thresholds that are typically applied, depending on the annual mean color in lake water. Lakes or lake segments are placed on the Verified List if the annual mean TSI in any one year exceeds 60 when the mean annual color is greater than 40 platinum cobalt units (PCUs), or if the TSI exceeds 40 when the mean annual color is less than or equal to 40 PCUs. Additionally, the IWR allows for alternative, site-specific thresholds that more accurately reflect conditions beyond which an imbalance in flora or fauna occurs, to be used in place of the default threshold values in the rule. As explained in Chapter 3, the TSI threshold of 60 is used as the target to develop the nutrient TMDL for each lake. This alternative threshold is based on paleolimnological research performed on lakes in the Winter Haven Chain, indicating that the natural background condition of the lakes is a TSI above 40, even though mean annual color values are frequently less than 40 PCUs. The initial Verified List also included Lakes Winterset, Eloise, Hartridge, and Fannie because at least one annual average TSI exceeded the default threshold value of 40 in the verified period. These 4 lakes were subsequently removed from the Verified List because none of the annual average TSI values exceeded the alternative threshold of 60 during the verification period.

Table 2.1. Verified Impairments in the Winter Haven Chain of Lakes Waterbody Segments

WBID	Waterbody Segment	Chain	Parameter Causing Impairment	Priority for TMDL Development	Projected Year for TMDL Development
1521H	Lake Cannon	Southern	Nutrients (TSI)	High	2004
1521F	Lake Howard	Southern	Nutrients (TSI)	High	2004
1521K	Lake Jessie	Southern	Nutrients (TSI)	High	2004
1521	Lake Lulu	Southern	Nutrients (TSI)	High	2004
1521E	Lake May	Southern	Nutrients (TSI)	High	2004
1521G	Lake Mirror	Southern	Nutrients (TSI)	High	2004
1521D	Lake Shipp	Southern	Nutrients (TSI)	High	2004
1488C	Lake Haines	Northern	Nutrients (TSI)	High	2004
1488A	Lake Smart	Northern	Nutrients (TSI)	High	2004
1521J	Lake Idylwild	Southern	Nutrients (TSI)	Medium	2009
1488U	Lake Conine	Northern	Nutrients (TSI)	Medium	2009
1488B	Lake Rochelle	Northern	Nutrients (TSI)	Medium	2009

The Polk County Natural Resources Division, Florida LakeWatch, and SWFWMD collected most of the lake data used in the assessment. **Appendix A** presents graphs of the individual chlorophyll *a*, total nitrogen, and total phosphorus sampling results for each of the eight Southern Chain of Lakes impaired for nutrients.

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 algal and 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.

Table 2.2. Summary of Nutrient Assessment Results for the Winter Haven Chain of Lakes

WBID	Waterbody Segment	Chain	IWR Assessment Status Based on TSI for Nutrients	TMDL Year[a]	TN/TP Ratio Median	Annual Average TSI												Average TSI, 1992–2003
						1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	
1521Q	Lake Blue	Southern	Planning List		20.0	68.5	64.3	64.2	-	-	-	-	-	-	-	-	-	65.7
1521H	Lake Cannon	Southern	Impaired	2004	22.0	63.0	62.2	59.5	66.7	65.1	62.3	62.7	56.9	60.8	62.2	59.0	-	61.9
1521B	Lake Eloise	Southern	Not Impaired	2004	38.3	-	-	-	63.7	-	55.6	-	-	-	-	-	-	59.7
1521I	Lake Hartridge	Southern	Not Impaired	2009	26.6	-	-	-	-	-	51.4	-	45.5	-	-	-	-	48.5
1521F	Lake Howard	Southern	Impaired	2004	45.6	67.5	63.4	62.5	65.2	63.3	65.5	-	57.3	-	-	-	-	63.5
1521J	Lake Idylwild	Southern	Impaired	2009	22.4	-	-	-	-	-	58.9	61.8	58.8	-	-	-	-	59.8
1521K	Lake Jessie	Southern	Impaired	2004	19.4	63.6	-	-	64.6	62.2	61.1	62.9	59.0	-	-	-	-	62.2
1521	Lake Lulu	Southern	Impaired	2004	24.0	64.1	61.4	65.4	63.3	64.6	63.0	63.3	57.2	65.0	66.2	64.8	-	63.5
1521L	Lake Marianna	Southern	Not Impaired		35.5	-	55.5	-	-	-	-	-	-	-	-	-	-	55.5
1521E	Lake May	Southern	Impaired	2004	23.0	-	-	-	-	-	64.1	67.0	59.1	-	-	-	-	63.4
1521G	Lake Mirror	Southern	Impaired	2004	43.0	-	-	-	-	-	-	-	-	-	-	-	69.4	69.4
1521O	Lake Roy	Southern	Insufficient Data		38.7	-	-	-	-	-	-	-	-	-	-	-	-	-
1521D	Lake Shipp	Southern	Impaired	2004	40.2	-	-	-	-	-	70.4	-	64.9	75.6	72.0	71.1	68.2	70.4
1521M	Lake Summit	Southern	Insufficient Data		23.1	-	-	-	-	-	-	-	-	-	-	-	-	-
1521A	Lake Winterset	Southern	Not Impaired	2009	36.9	-	-	-	-	-	-	-	45.9	-	-	-	-	45.9
1521G1	Spring Lake	Southern	Insufficient Data		25.8	-	-	-	-	-	-	-	-	-	-	-	-	-
1488U	Lake Conine	Northern	Impaired	2009	16.9	-	75.6	78.6	68.3	71.0	66.5	63.3	58.4	58.6	63.8	-	-	67.1
14882	Lake Fannie	Northern	Not Impaired	2009	25.7	58.4	-	-	-	59.1	-	-	49.0	-	-	-	-	55.5
1488C	Lake Haines	Northern	Impaired	2004	21.5	71.0	75.5	76.3	69.1	75.4	70.2	65.8	65.5	62.2	59.9	-	68.1	69.0
1488B	Lake Rochelle	Northern	Impaired	2009	24.0	62.5	-	-	62.2	63.4	61.6	62.3	58.1	58.5	-	-	63.1	61.5
1488A	Lake Smart	Northern	Impaired	2004	24.7	-	-	-	-	-	64.9	66.6	59.3	60.0	-	-	-	62.7

[a] The year for TMDL development is based on the schedule from the 1998 303(d) list.
- – Insufficient data available to calculate an annual average TSI value.

Determining the limiting nutrient in a waterbody can be accomplished by calculating the ratio of nitrogen-to-phosphorus concentrations in the waterbody. Water column ratios of total nitrogen (TN) to total phosphorus (TP) of less than 10 indicate nitrogen limitation, TN to TP ratios between 10 and 30 indicate colimitation by nitrogen and phosphorus, and TN to TP ratios greater than 30 indicate phosphorus limitation. Based on the data collected during the verified period, the Winter Haven Chain of Lakes median values of the individual TN to TP ratios for each lake indicate that the lakes are either phosphorus limited or colimited **(Table 2.2)**. Of the lakes on the Verified List, Lakes Mirror, Howard, and Shipp in the Southern Chain are phosphorus limited, and the rest of the lakes are colimited by nitrogen and phosphorus. While many of the lakes in the watershed are colimited by nitrogen and phosphorus, the Department agrees with the PLRG study that the existing evidence suggests that the Winter Haven Chain of Lakes are mostly phosphorus-limited systems, and this document only establishes TMDLs for phosphorus.

In addition to causing the excessive growth of algae, the nutrient enrichment of a waterbody can lead to widely varying dissolved oxygen (DO) levels and low DO concentrations in bottom waters. Algal populations produce oxygen as a result of photosynthesis during daylight hours and consume oxygen due to respiration at night and at water depths where light does not penetrate. Additionally, a portion of the dead algal population becomes part of the organic material that will be broken down by microbes and in the process consumes DO in the water column and sediments. Reductions in algal biomass through the control of nutrient loads are expected to result in higher average DO concentrations and smaller DO variation in surface waters.

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 Winter Haven Chain of Lakes are Class III fresh waterbodies, with a designated use of recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife. The Class III water quality criterion applicable to the observed impairment addressed in this TMDL is the narrative nutrient criterion.

3.2 Applicable Water Quality Standards and Numeric Water Quality Targets

3.2.1 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 lakes based on annual average TSI 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 a waterbody.

In translating the narrative nutrient criterion for this TMDL, the TSI target set by the SWFWMD, which is derived from the conclusions of a paleolimnological study of lakes in the Winter Haven Chain, was used as the site-specific threshold to address the lakes' nutrient impairment. Researchers from the University of Florida conducted a paleolimnological investigation of sediment cores from five lakes (Lakes Conine, Haines, Hartridge, Howard, and May) in the Winter Haven Chain of Lakes (Whitmore and Brenner, 1995). The researchers indicated that qualitative interpretations show similar patterns of historical change in all five lakes. The deepest, predisturbance samples (nominally 1860) in all the lakes studied showed the dominance of planktonic species that are distinctive indicators of mesotrophic to eutrophic conditions. The study concluded that, given the predisturbance conditions in the lakes, the maximum improvement in current water quality that is feasible would result in mesotrophic to eutrophic conditions, the elimination of cyanobacterial blooms, and the re-establishment of summer populations of planktonic diatoms. Mesotrophic to eutrophic conditions are typically associated with TSI values in the range of 50 to 60. Based on the study results, the SWFWMD set a TSI target of 60 for the lakes for PLRG development (SWFWMD, 1998), and the Department used this target as the target for the TMDLs.

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 five acres, and a wide variety of industries (see **Appendix B** 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 no NPDES-permitted wastewater treatment facilities that discharge to surface waters in the Winter Haven Chain of Lakes watershed.

4.2.2 Municipal Separate Storm Sewer System Permittees

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

The stormwater collection systems in the Winter Haven Chain of Lakes watershed, which are owned and operated by Polk County in conjunction with the Florida Department of

Transportation (FDOT), District 1, are covered by a Phase I MS4 permit. The watershed falls under the Polk County Phase I MS4 Permit (Number FLS000015). The cities of Winter Haven and Lake Alfred are copermittees and own and operate many of the MS4 areas for the portions of their jurisdictions located within the watershed.

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 the improper disposal of waste materials, leaking septic systems, and domestic animals. Part of the surface runoff loads come from atmospheric deposition that falls directly onto the land surface and then is washed off into surface waters during rain events.

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 2004, Polk County has approximately 112,848 septic systems (Florida Department of Health, 2005). This total does not reflect systems removed from service going back to 1970. The Department does not have information on the percentage of the population using septic systems in Polk County, nor does it have estimates of countywide failure rates to determine the daily discharge of wastewater from septic tanks.

4.3.1 Land Uses

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 (Department, June 2004). The Winter Haven Chain of Lakes watershed covers 20,257 acres, or approximately 32 square miles. Land use categories in the watershed, aggregated using the Level 1 1999 Florida Land Use and Cover Classification System (FLUCCS), are tabulated in **Table 4.1**. The predominant Level I land use in the watershed is urban and built-up, which comprises 38 percent of the area. The next largest area is water, which makes up 37 percent of the watershed area. **Figure 4.1** shows the principal land uses in the watershed.

4.3.2 Estimating Nonpoint Loadings

The PLRG study report, which is the basis for this TMDL, included loading estimates from surface runoff and ground water (McCary and Ross, 2005). The study estimated total phosphorus loads from watershed runoff using the Storm Water Management Model (SWMM) and from ground water using the U.S. Geological Survey MODFLOW Program (McCary and Ross, 2005). **Table 4.2** presents the 10-year average (1990 to 1999) model load results for each lake. The loading estimates show that watershed runoff contributes about 2,800 kilograms (kg)/year of total phosphorus in the Southern Chain and almost 500 kg/year in the Northern Chain. Ground water contributes another 123 kg/year of total phosphorus in the Southern Chain and 135 kg/year in the Northern Chain. A larger proportion of the load to the Northern Chain of Lakes is derived from ground water, which makes up 29 percent of the total load, compared with only 4 percent of the total load to the Southern Chain of Lakes.

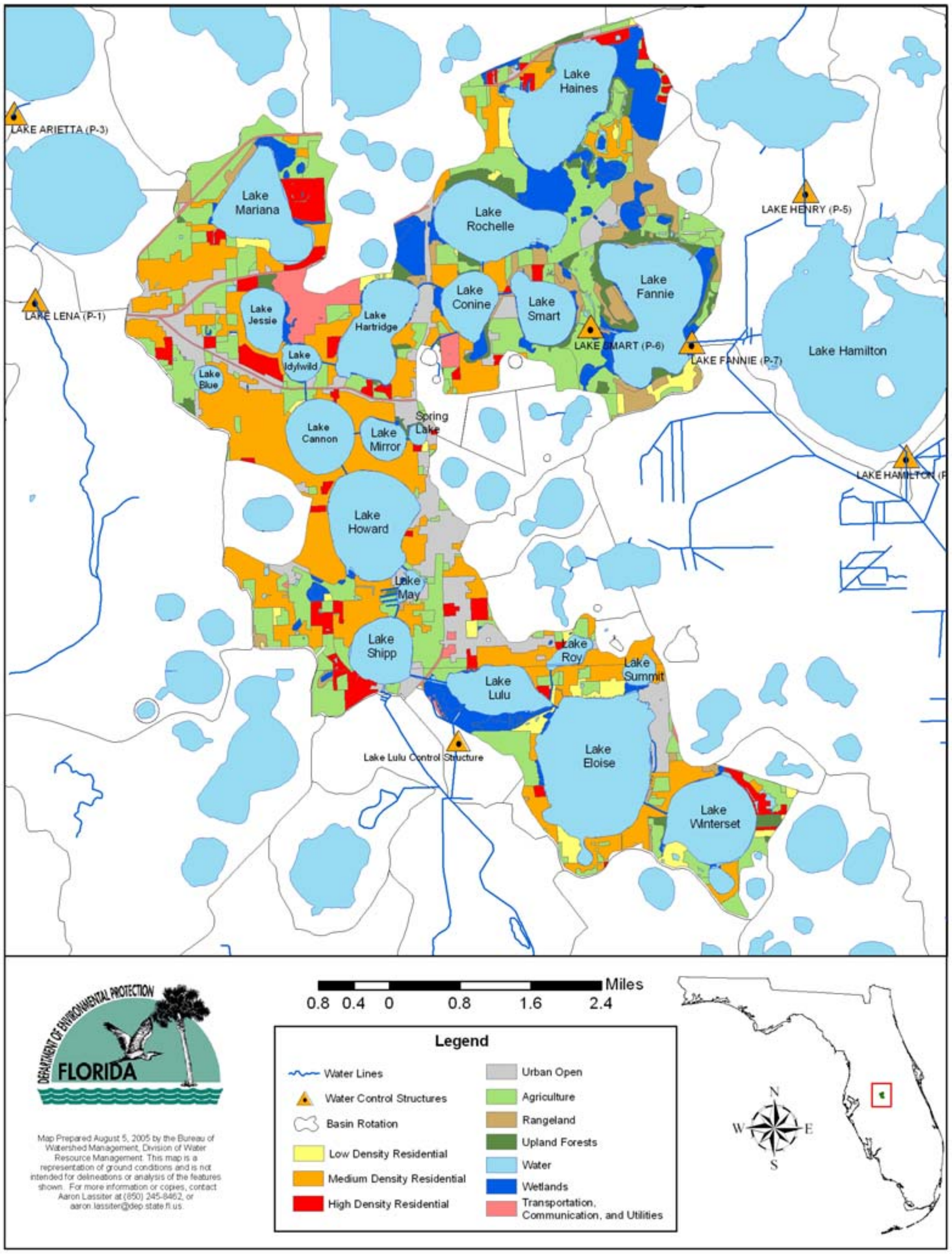

Figure 4.1. Principal Land Uses in the Winter Haven Chain of Lakes Watershed

Table 4.1. Classification of Land Use Categories in the Winter Haven Chain of Lakes Watershed

Code	Land Use	Acreage	% of Total
1000	Urban Open	3,003	15
1100	Residential Low Density < 2 Dwelling Units/Acre	412	2
1200	Residential Med Density 2 – 5 Dwelling Units/Acre	3,489	17
1300	Residential High Density 6 or more Dwelling Units/Acre	794	4
2000	Agriculture	2,382	12
3000	Rangeland	180	1
4000	Upland Forests	509	3
5000	Water	7,459	37
6000	Wetlands	1,556	8
8000	Transportation, Communication, and Utilities	473	2
Totals		**20,257**	**100**

Table 4.2. Total Phosphorus Loading Estimates to the Winter Haven Chain of Lakes[a]

		Total P (kg/year)		
Lake	Chain	Surface Runoff	Ground Water Inflow	Total Existing Load
Winterset	Southern	87.0	7.8	94.8
Eloise	Southern	181.6	10.1	191.7
Summit	Southern	40.3	1.9	42.2
Lulu	Southern	158.3	9.0	167.3
Roy	Southern	69.6	3.1	72.7
Shipp	Southern	228.5	12.9	241.4
May	Southern	180.3	4.5	184.8
Howard	Southern	322.1	14.3	336.4
Cannon	Southern	272.2	8.0	280.2
Blue	Southern	152.0	3.4	155.4
Mirror	Southern	68.4	2.2	70.6
Spring	Southern	36.8	1.4	38.2
Idylwild	Southern	100.1	3.8	103.9
Jessie	Southern	239.5	14.6	254.1
Marianna	Southern	440.4	17.0	457.4
Hartridge	Southern	214.7	9.2	223.9
	Total	2,792	123	2,915
Conine	Northern	154.1	15.0	169.1
Rochelle	Northern	69.9	22.3	92.2
Haines	Northern	154.7	41.6	196.3
Smart	Northern	35.6	13.9	49.5
Fannie	Northern	56.3	42.1	98.4
	Total	471	135	606

[a] Loads obtained from model simulations in McCary and Ross, 2005.

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Determination of Loading Capacity

The TMDL development process identifies the maximum allowable TP loading to the Southern Chain of Lakes watershed, so that the lakes will meet nutrient water quality criteria and maintain their function and designated use as Class III waters. The Winter Haven Chain of Lakes is one of the 10 priority SWIM waterbodies designated by the SWFWMD. For SWIM waterbodies, Florida water policy requires the water management districts to set and adopt PLRGs for pollutants of concern. In the Water Resource Implementation Rule (Rule 62-40, F.A.C.), PLRGs are defined as estimated numeric reductions in pollutant loadings needed to preserve or restore designated uses of receiving bodies of water and maintain water quality consistent with applicable state standards. In 2005, the SWFWMD developed a revised PLRG for total phosphorus to address lake eutrophication throughout the watershed, and this PLRG serves as the basis for the nutrient TMDLs for the verified impaired lakes in the Southern Chain. This chapter summarizes the process used to develop the revised PLRG; the details of the study can be found in McCary and Ross (2005).

The PLRG study entailed gathering data and information to develop a watershed runoff and ground water model that was then linked to a surface water model to simulate surface water quality for each of the 21 lakes in the Winter Haven Chain of Lakes watershed. A spreadsheet model was also developed to account for channel flows between the lakes. Model simulation was performed for the period from 1990 to 1999. The modeling included the setup of the SWMM to account for surface runoff volume and nutrient loadings, and the MODFLOW Program to account for ground water volume and nutrient loadings. The loads generated from the SWMM and MODFLOW model simulations, as well as the transport between lakes obtained from the spreadsheet model, were then entered into the Water Quality Analysis Simulation Program (WASP) model that simulated water quality in each lake. Two WASP models were developed, one for the Northern Chain and one for the Southern Chain, as there are limitations in the number of segments (i.e., lakes) that can be entered into WASP.

Since this study is based on nutrient loading, the eutrophication module (EUTRO) in WASP was used to simulate the eutrophication processes in the lakes. For this study, simple eutrophication kinetics were used to model lake water quality. These simulate the growth and decay of phytoplankton interacting with one of the nutrient cycles. Growth can be limited by the availability of inorganic nitrogen or inorganic phosphorus, and light. For this study, growth would be limited by inorganic phosphorus and light. The lakes in the watershed are either limited by phosphorus or colimited by nitrogen and phosphorus. For the PLRG study, it was assumed that the lakes as a whole are phosphorus limited.

Water quantity calibration included comparing model results with the observed lake stage. Phosphorus and chlorophyll *a* concentration values were used for water quality calibration. A spreadsheet model was developed to simulate flows between the lakes and to calibrate model lake stage to measured lake stage. Calibration was accomplished by adjusting leakage values from the lakes to the Floridan aquifer, so that modeled lake stages were calibrated to measured lake stages. For the water quality calibration, once all known flows, loads, and parameter values were entered, system constants were chosen within the range of recommended values, as specified by WASP, that gave the best overall performance and match to measured data. In most cases, phosphorus was used for calibration; however, for Lakes Howard and Jessie, chlorophyll *a* data were used because of concerns over the measured phosphorus values. Final calibration was accomplished by adjusting the phosphorus settling rate for each individual lake.

Once the models were calibrated, a series of design scenarios was simulated to determine the effect of phosphorus load reductions on the lakes' trophic level, measured by the TSI. The scenarios were based on total phosphorus load reductions of 10, 20, 30, 50, and 70 percent throughout the watershed over the 10-year period from 1990 to 1999. The model results show that less than a 70 percent reduction in the total load is needed to meet the TSI target of 60 for the lakes in the Southern Chain, except for Lake Blue **(Table 5.1)**. However, Lake Blue was not assessed for nutrients during the verified period because there were insufficient data to assess for nutrient impairment following the IWR methodology.

To derive a TMDL for each impaired lake in the Southern Chain, the TSI model results from the design scenarios were plotted with the phosphorus load reduction increments to generate a line fitted to the model results for each lake, as presented in **Figure 5.1**. The load reductions necessary to meet a TSI of 60 for each lake were obtained from the location where the percent reductions met the TSI threshold on the graph. The load reductions needed to achieve a TSI of 60 in each lake varied between 22.5 percent for Lake Mirror to 60 percent for Lake Shipp. **Table 5.2** presents the existing total phosphorus loads, as well as the percent reduction and associated loadings for each impaired lake to achieve the TSI threshold of 60.

For 3 of the 5 lakes in the Northern Chain (Lakes Conine, Haines, and Smart), phosphorus load reductions greater than 70 percent are needed to achieve a TSI of 60 **(Table 5.1)**. The PLRG study report indicates that the lack of significant improvements in TSI values for Northern Chain lakes is most likely due to the dependence of the Northern Chain on ground water inflows. Additionally, since all the lakes in the Northern Chain are colimited, reductions in nitrogen loads may also be needed to effect lake eutrophication. The 70 percent load reduction for the Northern Chain shows the lake TSIs would be reduced by at least 6 TSI units, compared with the existing condition. As the PLRG study does not identify the phosphorus load reduction needed to meet a TSI of 60 for all the verified impaired lakes in the Northern Chain, TMDLs are not proposed for the Northern Chain of Lakes.

The Department identified the following additional studies that are needed to better define the relationship between nutrient loadings and lake eutrophication:

- *Estimate loadings from atmospheric deposition directly on the lake surfaces, since water covers a considerable area of the watershed,*
- *Determine the area of households not connected to wastewater treatment plants and estimate the septic system loading to the watershed,*
- *Include sediment nutrient exchanges rates in the modeling, as there are some lakes where the internal loading from sediments is expected to be considerable, and*
- *Account for the effects of nitrogen limitation on phytoplankton growth, as the nitrogen-to-phosphorus ratios indicate many of the lakes are colimited.*

Table 5.1. Winter Haven Chain of Lakes TSI Values under Existing and 70 Percent Total Phosphorus Load Reduction[a]

Lake	Chain	Existing Total P Load			Total P Load Reduced by 70%		
		Total P TSI	Chlorophyll *a* TSI	Average TSI	Total P TSI	Chlorophyll *a* TSI	Average TSI
Winterset	Southern	59.2	50.4	54.8	37.1	32.5	34.8
Eloise	Southern	69.1	58.5	63.8	45.4	41.8	43.6
Summit	Southern	62.4	55.2	58.8	38.4	37.4	37.9
Lulu	Southern	76.8	68.4	72.6	49.4	51.1	50.3
Roy	Southern	66.2	58.0	62.1	38.9	38.4	38.7
Shipp	Southern	83.0	72.3	77.7	54.8	54.7	54.8
May	Southern	78.7	69.8	74.3	50.5	52.4	51.5
Howard	Southern	82.0	71.3	76.7	53.8	53.4	53.6
Cannon	Southern	78.2	67.3	72.8	50.0	49.1	49.6
Blue	Southern	94.2	78.7	86.5	65.8	61.2	63.5
Mirror	Southern	68.2	61.8	65.0	40.2	42.8	41.5
Spring	Southern	59.5	54.5	57.0	31.8	33.8	32.8
Idylwild	Southern	72.8	66.0	69.4	44.6	48.1	46.4
Jessie	Southern	75.5	67.5	71.5	47.3	49.4	48.4
Marianna	Southern	64.8	60.9	62.9	36.7	42.7	39.7
Hartridge	Southern	65.7	60.2	63.0	37.8	40.9	39.4
Conine	Northern	79.0	68.9	74.0	70.8	63.8	67.3
Rochelle	Northern	70.9	62.5	66.7	57.4	53.9	55.7
Haines	Northern	80.7	68.4	74.6	65.7	59.3	62.5
Smart	Northern	73.5	64.8	69.2	65.9	60.1	63.0
Fannie	Northern	70.5	61.6	66.1	60.9	55.5	58.2

[a] TSI values from model simulations in McCary and Ross, 2005.

Table 5.2. Total Phosphorus Loadings to the Southern Chain's Impaired Lakes Needed To Meet the TSI Threshold of 60 Units[a]

Lake	Existing Total P Surface Runoff (kg/year)	Existing Total P Ground Water Inflow (kg/year)	Existing Total P Load (kg/year)	% Reduction to Meet TSI Threshold	Total P Load to Meet TSI Threshold (kg/year)
Cannon	272.2	8.0	280.2	49.0	142.9
Howard	322.1	14.3	336.4	57.5	143.0
Idylwild	100.1	3.8	103.9	38.0	64.4
Jessie	239.5	14.6	254.1	45.0	139.8
Lulu	158.3	9.0	167.3	50.0	83.7
May	180.3	4.5	184.8	52.5	87.8
Mirror	68.4	2.2	70.6	22.5	54.7
Shipp	228.5	12.9	241.4	60.0	96.6

[a] Loads obtained from model simulations in McCary and Ross, 2005.

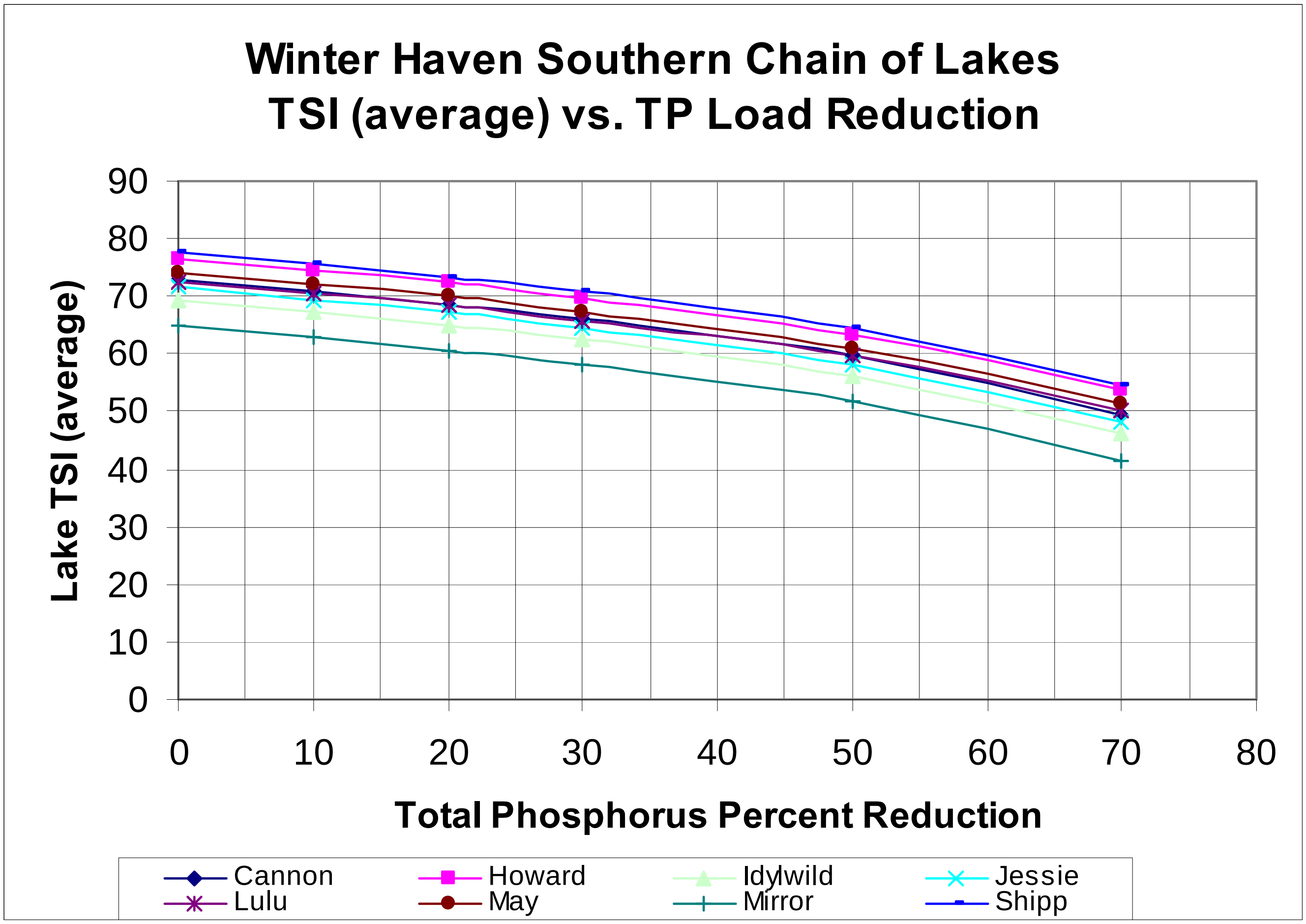

Figure 5.1. PLRG Study Model Results for the TSI for Each Load Reduction Scenario Tested

The city of Winter Haven and the SWFWMD are funding a project to perform additional work to better understand the relationships between pollutant loads and lake water quality. This effort will address all sources of pollution, including stormwater, point sources, sediments, ground water, dry fall, and septic tanks. The project involves incorporating existing information, obtaining additional data, and using the previously developed nutrient budget and Linked Watershed/Waterbody Model to model the lakes. It is anticipated that the project will be completed by the end of 2008 and may result in revisions to the existing TMDLs and the establishment of TMDLs to meet the TSI target of 60 for the impaired lakes in the Northern Chain.

5.2 Critical Conditions

The Winter Haven Chain of Lakes TMDL was based on annual average conditions 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 (wasteload 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 best management practices (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 TMDLs for the Southern Chain of Lakes are expressed in terms of kg/year, kg/day and percent reduction, and represent the long-term average annual TP load the lakes can assimilate to maintain the TSI threshold of 60 **(Tables 6.1a** and **6.1b).** The TMDLs to be implemented are those expressed on a mass per year basis, and the expression of the TMDL on a mass per day basis is for information purposes only.

Table 6.1a. TMDL Components by Year for Total Phosphorus in the Southern Chain of Lakes

Lake	WBID	WLA		LA (kg/year)	MOS (kg/year)	TMDL (kg/year)	% Reduction
		Wastewater (kg/year)	NPDES Stormwater[a] (% reduction)				
Cannon	1521H	N/A	54	129	14	143	54
Howard	1521F	N/A	62.5	126	17	143	62.5
Idylwild	1521J	N/A	43	59	5	64	43
Jessie	1521K	N/A	50	127	13	140	50
Lulu	1521	N/A	55	75	9	84	55
May	1521E	N/A	57.5	79	9	88	57.5
Mirror	1521G	N/A	27.5	51	4	55	27.5
Shipp	1521D	N/A	65	84	13	97	65

[a] The NPDES stormwater WLA is established based on the same percent reduction used for the LA.
N/A – Not applicable

Table 6.1b. TMDL Components by Day for Total Phosphorus in the Southern Chain of Lakes

Lake	WBID	WLA		LA (kg/day)	MOS (kg/day)	TMDL (kg/day)	% Reduction
		Wastewater (kg/day)	NPDES Stormwater[a] (% reduction)				
Cannon	1521H	N/A	54	0.35	0.04	0.39	54
Howard	1521F	N/A	62.5	0.35	0.05	0.39	62.5
Idylwild	1521J	N/A	43	0.16	0.01	0.18	43
Jessie	1521K	N/A	50	0.35	0.04	0.38	50
Lulu	1521	N/A	55	0.21	0.02	0.23	55
May	1521E	N/A	57.5	0.22	0.02	0.24	57.5
Mirror	1521G	N/A	27.5	0.14	0.01	0.15	27.5
Shipp	1521D	N/A	65	0.23	0.03	0.26	65

[a] The NPDES stormwater WLA is established based on the same percent reduction used for the LA.
N/A – Not applicable

6.2 Load Allocation

The LA to each lake is the sum of the existing TP ground water load and stormwater runoff load, shown in Table 5.2, multiplied by the percent load reduction needed to achieve the TSI threshold, minus an additional 5 percent of the load to provide an explicit MOS. The LAs for the impaired lakes in the Southern Chain varied from 51 kg/year for Lake Mirror to 129 kg/year for Lake Cannon. The LA to each lake represents the allocation to all nonpoint sources, which will be partitioned between all parties responsible for nonpoint source loadings when the specific source information becomes available. It should be noted that the LAs include loading from stormwater discharges regulated by the Department and the SWFWMD that are not part of the NPDES stormwater program (see **Appendix B**).

6.3 Wasteload Allocation

6.3.1 NPDES Wastewater Discharges

There are no NPDES-permitted wastewater treatment facilities that discharge to surface waters in the Winter Haven Chain of Lakes watershed. Thus, the WLA for wastewater facilities is not applicable.

6.3.2 NPDES Stormwater Discharges

As noted in Chapter 4, loadings from stormwater discharges permitted under the NPDES stormwater program (i.e. MS4 areas) are placed in the WLA, rather than the LA. The WLA is expressed as a percent reduction and was set at the same percent reduction needed for nonpoint sources to meet the LA. The actual load from NPDES permitted stormwater discharges are included in the LA, and the LA will be portioned between all parties responsible for nonpoint source loadings when the specific source information becomes available. It should be noted that any MS4 permittee is only responsible for reducing the loads associated with stormwater outfalls that it owns or otherwise has responsible control over, and it is not responsible for reducing other nonpoint source loads in its jurisdiction.

6.4 Margin of Safety

TMDLs must address uncertainty issues by incorporating an MOS into the analysis. The MOS is a required component of a TMDL and accounts for the uncertainty about the relationship between pollutant loads and the quality of the receiving waterbody (Clean Water Act, Section 303[d][1][c]). Considerable uncertainty is usually inherent in estimating nutrient loading from nonpoint sources, as well as predicting water quality response. The MOS can either be implicitly accounted for by choosing conservative assumptions about loading or water quality response, or explicitly accounted for during the allocation of loadings. While the Department usually uses an implicit MOS based on conservative assumptions in the models used to determine the assimilative capacity, an explicit MOS was used because there are no defined conservative assumptions used in the PLRG development. Five percent of the existing load, estimated for the 1990-1999 period, to each lake has been reserved as the MOS.

Chapter 7: NEXT STEPS: IMPLEMENTATION PLAN DEVELOPMENT AND BEYOND

7.1 Basin Management Action Plan

Following the adoption of these TMDLs by rule, the next step in the TMDL process is to develop an implementation plan for the TMDLs, referred to as the BMAP. This document will be developed over the next two years in cooperation with local stakeholders, who will attempt to reach consensus on detailed allocations and on how load reductions will be accomplished. The BMAP will include, among other things:

- Appropriate load reduction allocations among the affected parties,
- A description of the load reduction activities to be undertaken, including structural projects, nonstructural BMPs, and public education and outreach,
- A description of further research, data collection, or source identification needed in order to achieve the TMDLs,
- Timetables for implementation,
- Confirmed and potential funding mechanisms,
- Any applicable signed agreement(s),
- Local ordinances defining actions to be taken or prohibited,
- Any applicable local water quality standards, permits, or load limitation agreements,
- Milestones for implementation and water quality improvement, and
- Implementation tracking, water quality monitoring, and follow-up measures.

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

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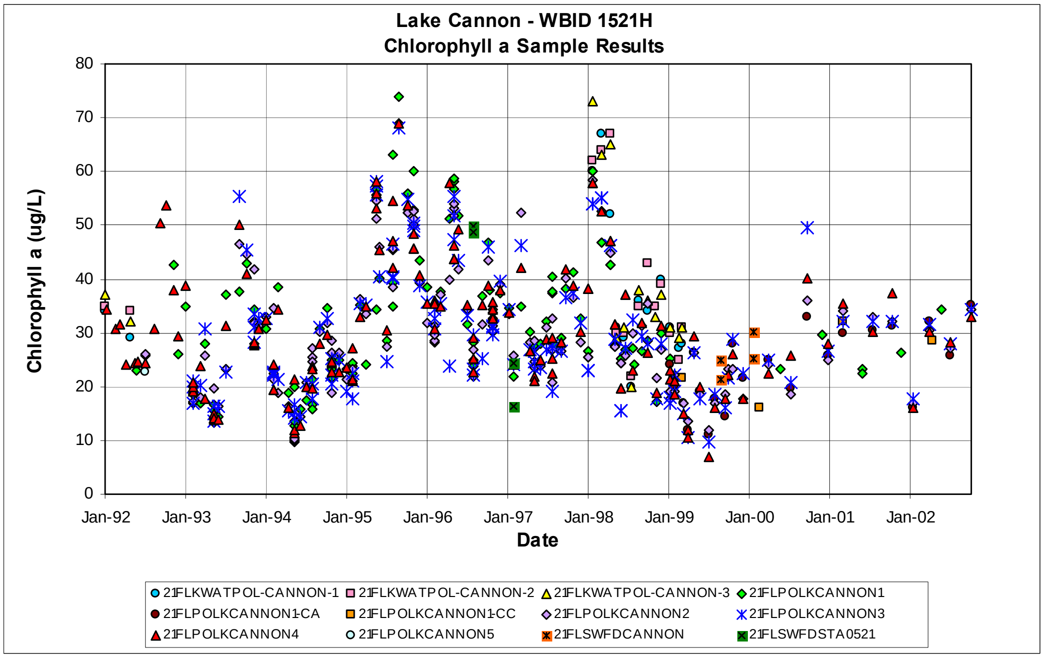
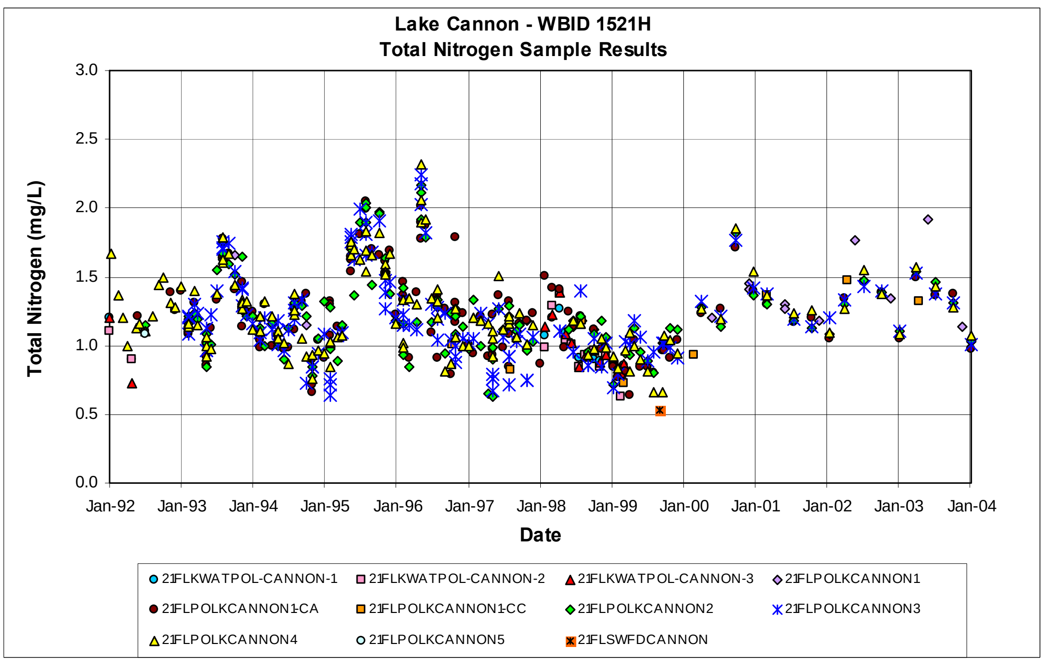
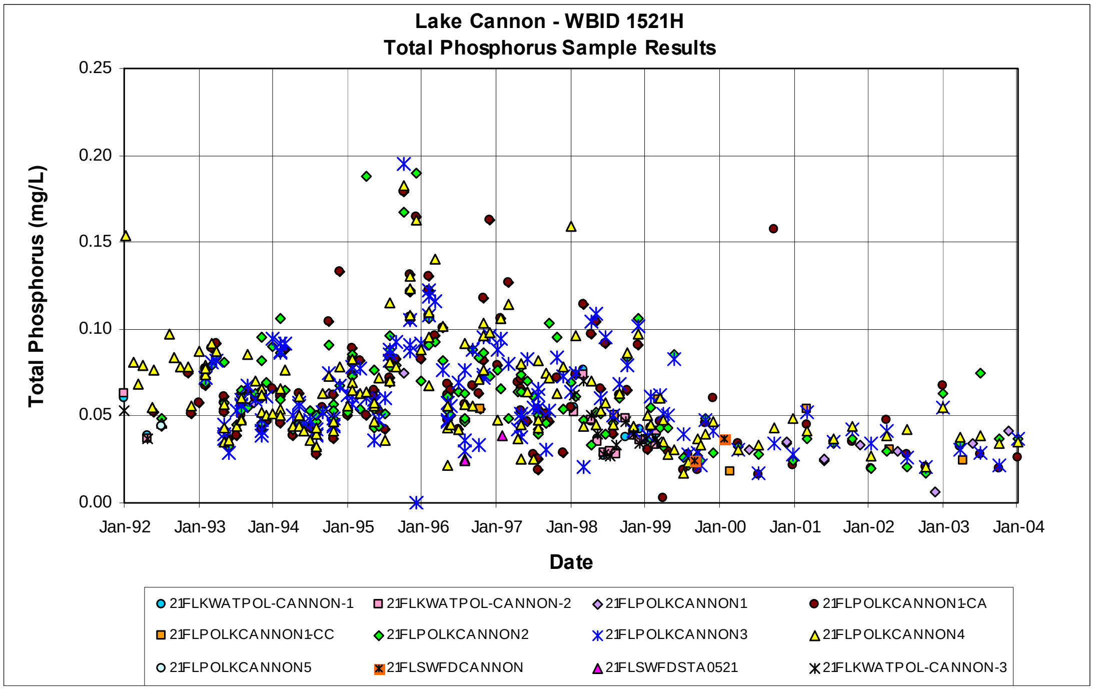
Appendices

Appendix A: Graphs of Chlorophyll *a*, Total Nitrogen, and Total Phosphorus Sampling Results for the Southern Chain's Impaired Lakes






Lake Cannon - WBID 1521H
Total Phosphorus Sample Results
Total Phosphorus (mg/L)
0.25
0.20
0.15
0.10
0.05
0.00
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Date
21FLKWATPOL-CANNON-1
21FLKWATPOL-CANNON-2
21FLPOLKCANNON1
21FLPOLKCANNON1-CA
21FLPOLKCANNON1-CC
21FLPOLKCANNON2
21FLPOLKCANNON3
21FLPOLKCANNON4
21FLPOLKCANNON5
21FLSWFDCANNON
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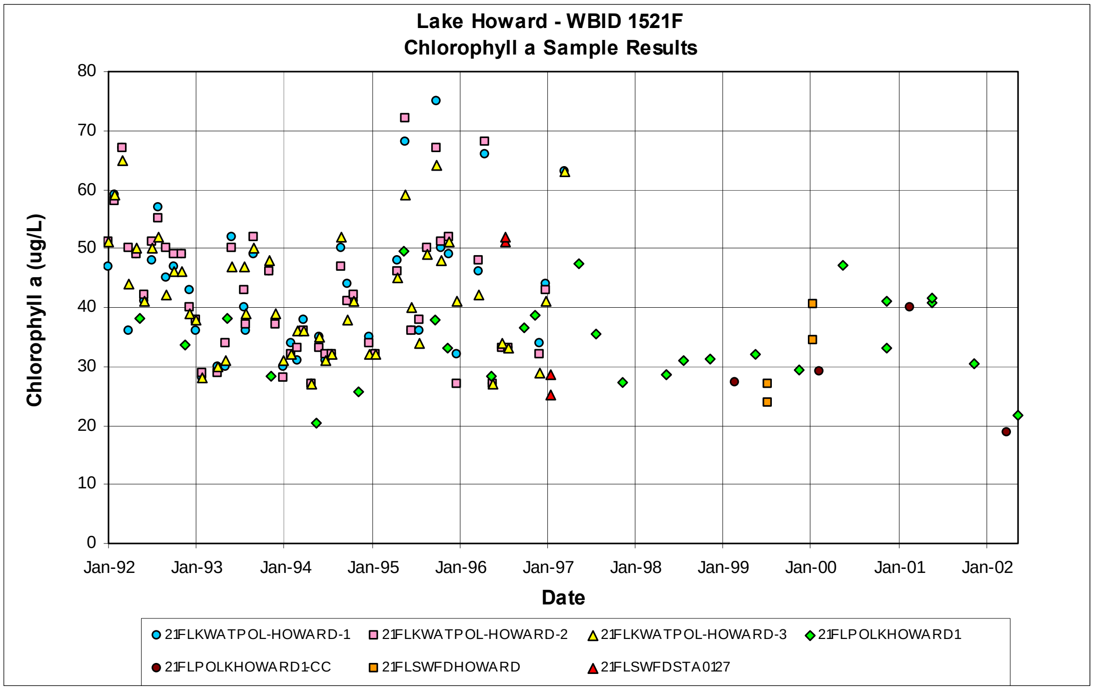
Lake Howard - WBID 1521F
Chlorophyll a Sample Results
Chlorophyll a (ug/L)
80
70
60
50
40
30
20
10
0
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Date
21FLKWATPOL-HOWARD-1
21FLKWATPOL-HOWARD-2
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21FLSWFDHOWARD
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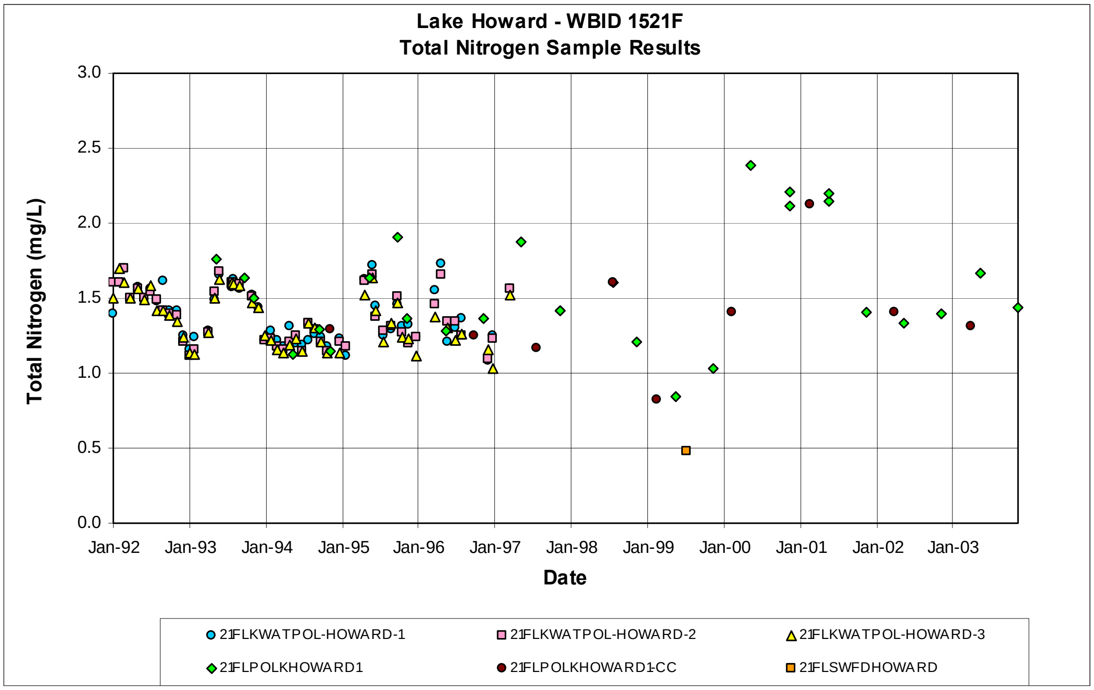
Lake Howard - WBID 1521F
Total Nitrogen Sample Results
Total Nitrogen (mg/L)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Date
21FLKWATPOL-HOWARD-1
21FLKWATPOL-HOWARD-2
21FLKWATPOL-HOWARD-3
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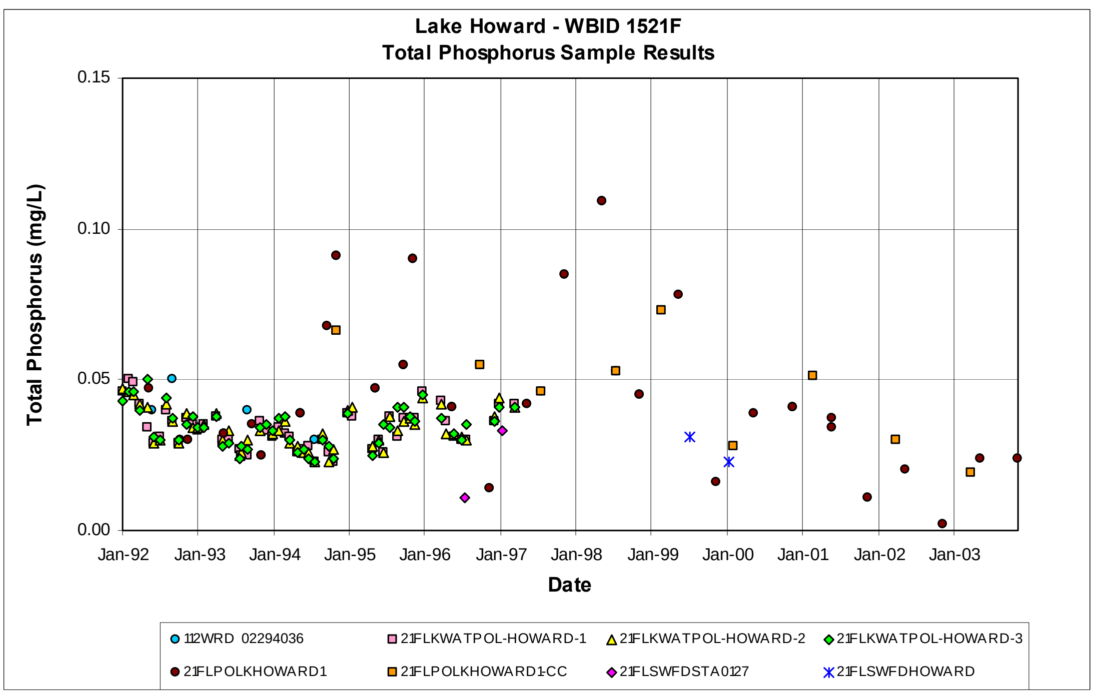
21FLPOLKHOWARD1-CC
21FLSWFDHOWARD


Lake Howard - WBID 1521F
Total Phosphorus Sample Results
Total Phosphorus (mg/L)
0.15
0.10
0.05
0.00
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Date
112WRD 02294036
21FLKWATPOL-HOWARD-1
21FLKWATPOL-HOWARD-2
21FLKWATPOL-HOWARD-3
21FLPOLKHOWARD1
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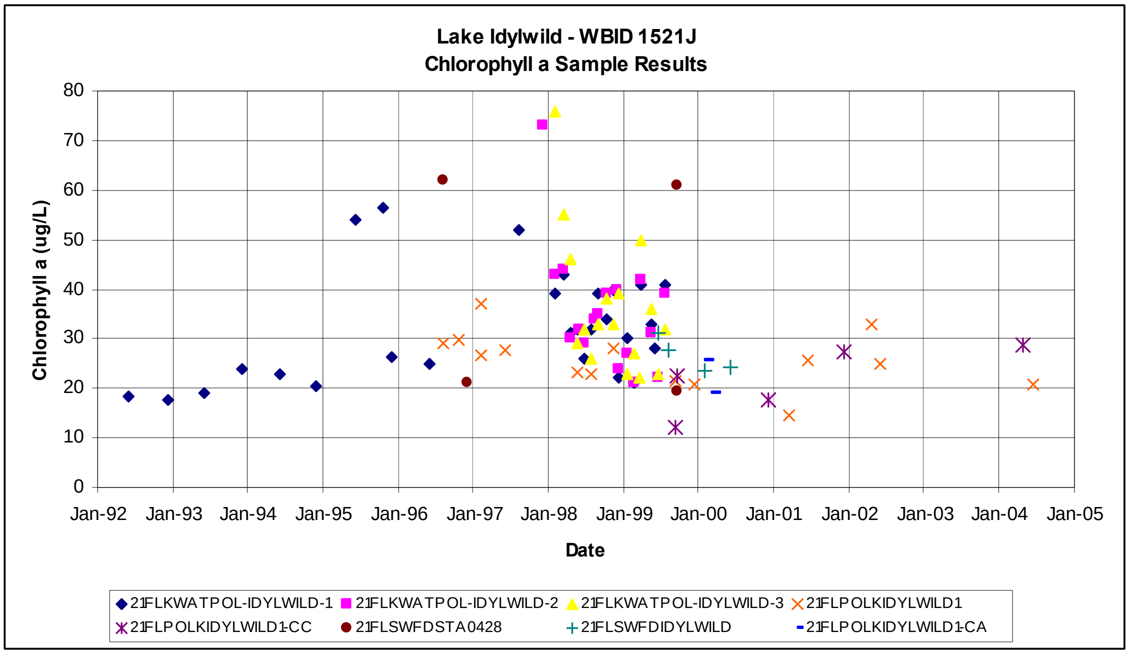
Lake Idylwild - WBID 1521J
Chlorophyll a Sample Results
Chlorophyll a (ug/L)
80
70
60
50
40
30
20
10
0
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Date
21FLKWATPOL-IDYLWILD-1
21FLKWATPOL-IDYLWILD-2
21FLKWATPOL-IDYLWILD-3
21FLPOLKIDYLWILD1
21FLPOLKIDYLWILD1-CC
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21FLSWFDIDYLWILD
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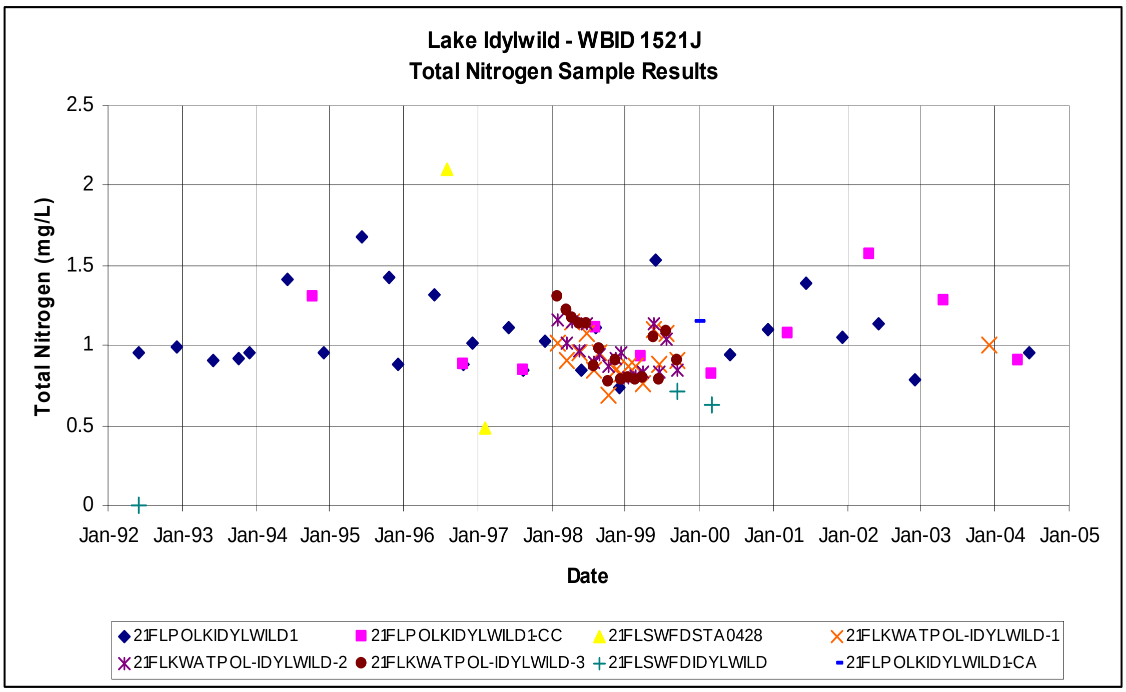
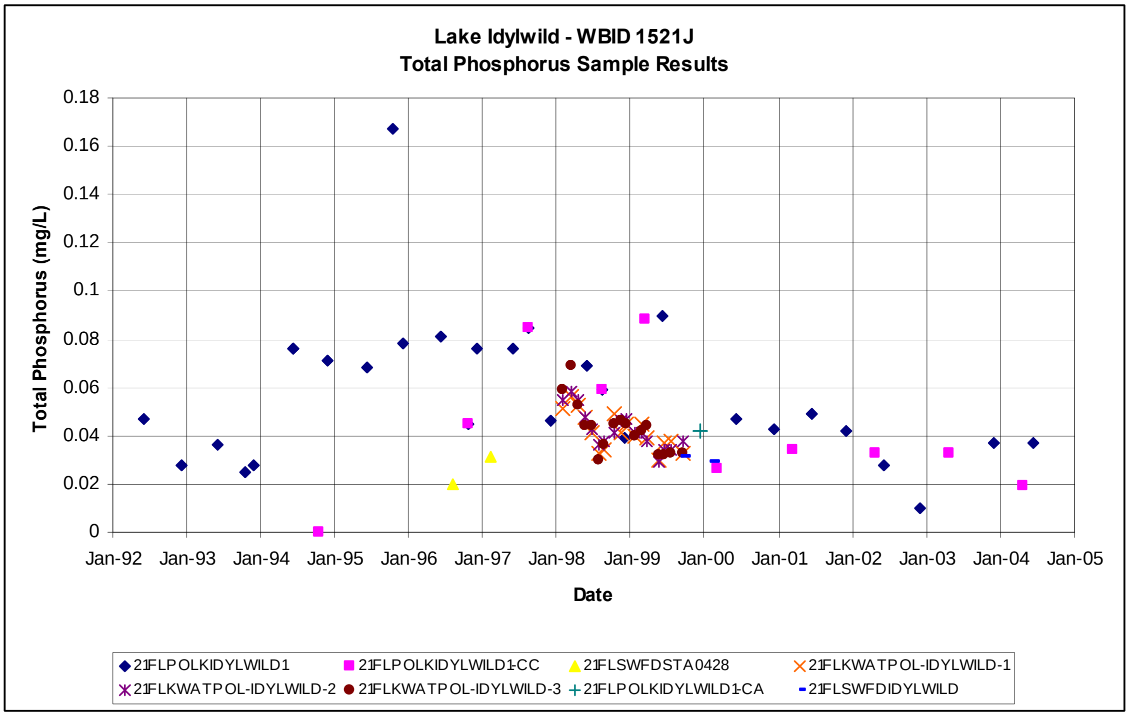

Lake Idylwild - WBID 1521J
Total Nitrogen Sample Results
Total Nitrogen (mg/L)
2.5
2
1.5
1
0.5
0
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Date
21FLPOLKIDYLWILD1
21FLPOLKIDYLWILD1-CC
21FLSWFDSTA0428
21FLKWATPOL-IDYLWILD-1
21FLKWATPOL-IDYLWILD-2
21FLKWATPOL-IDYLWILD-3
21FLSWFDIDYLWILD
21FLPOLKIDYLWILD1-CA


Lake Idylwild - WBID 1521J
Total Phosphorus Sample Results
Total Phosphorus (mg/L)
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Date
21FLPOLKIDYLWILD1
21FLPOLKIDYLWILD1-CC
21FLSWFDSTA0428
21FLKWATPOL-IDYLWILD-1
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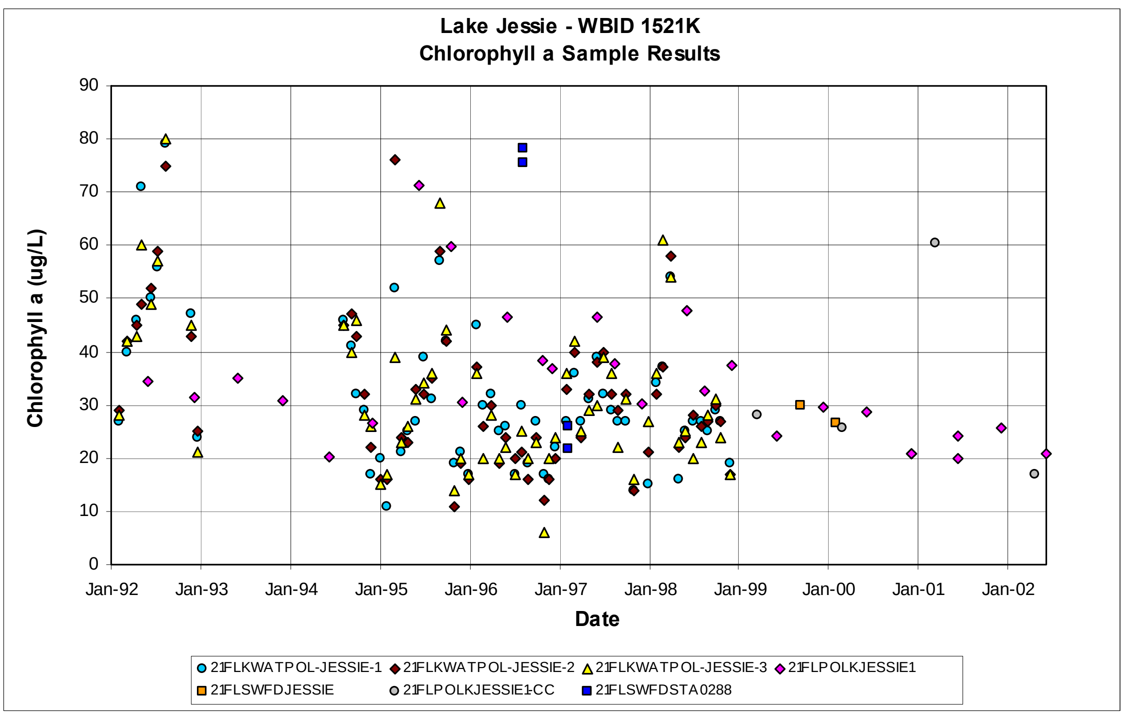
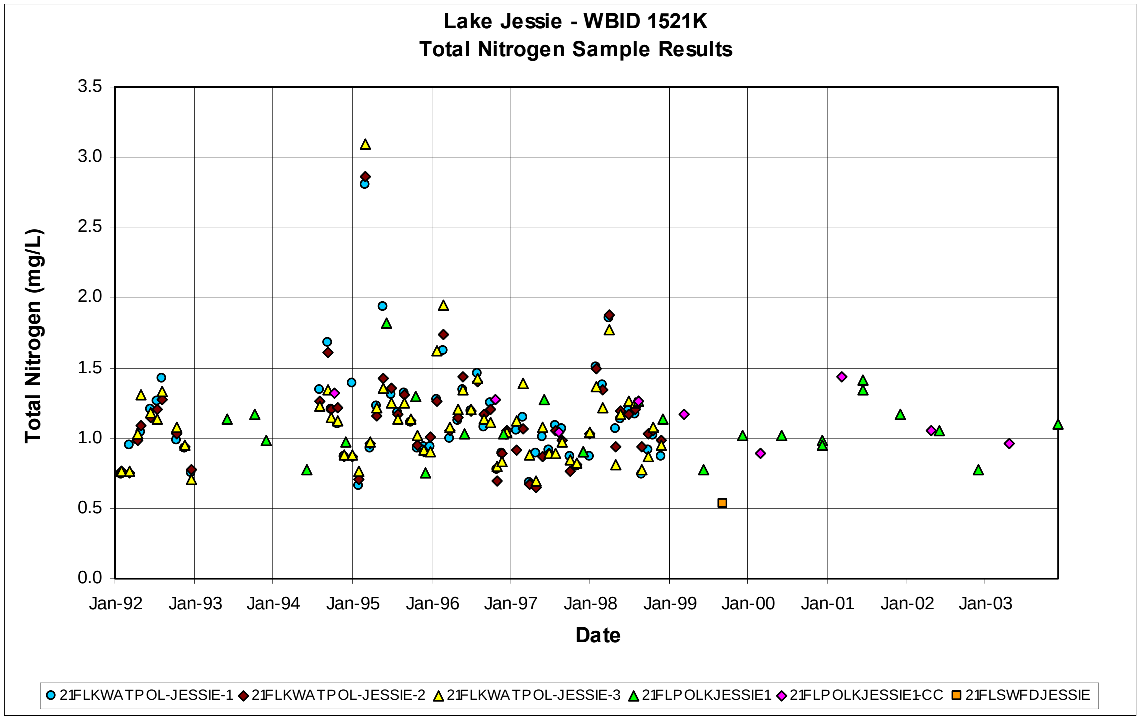
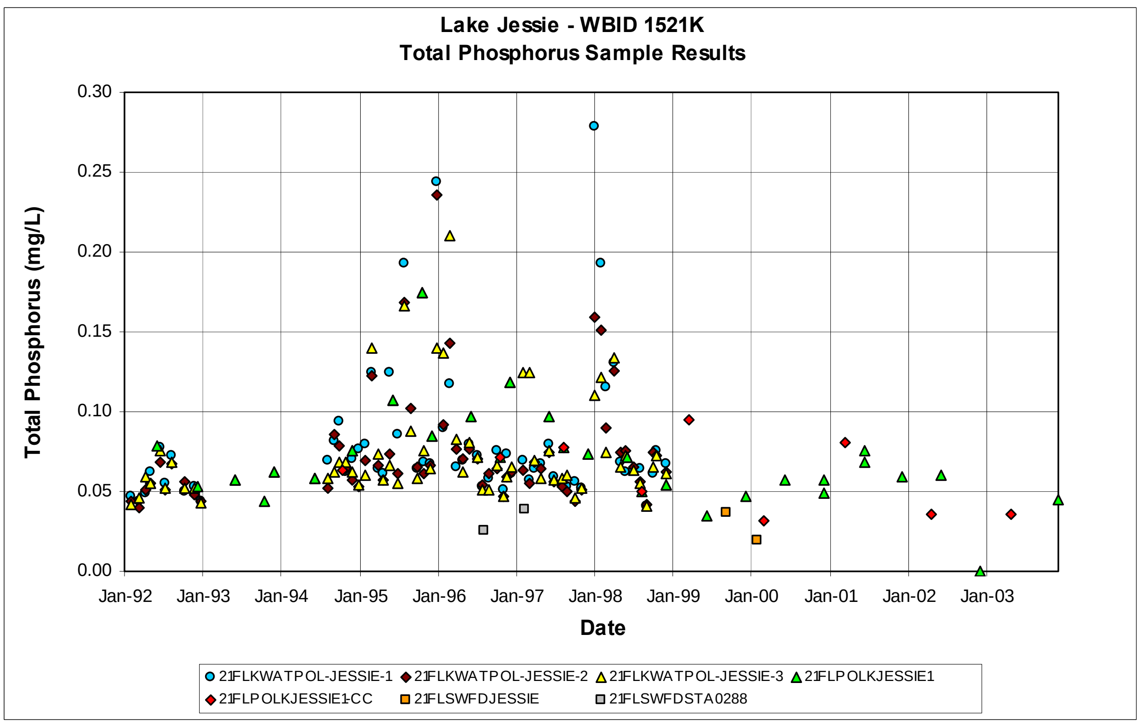
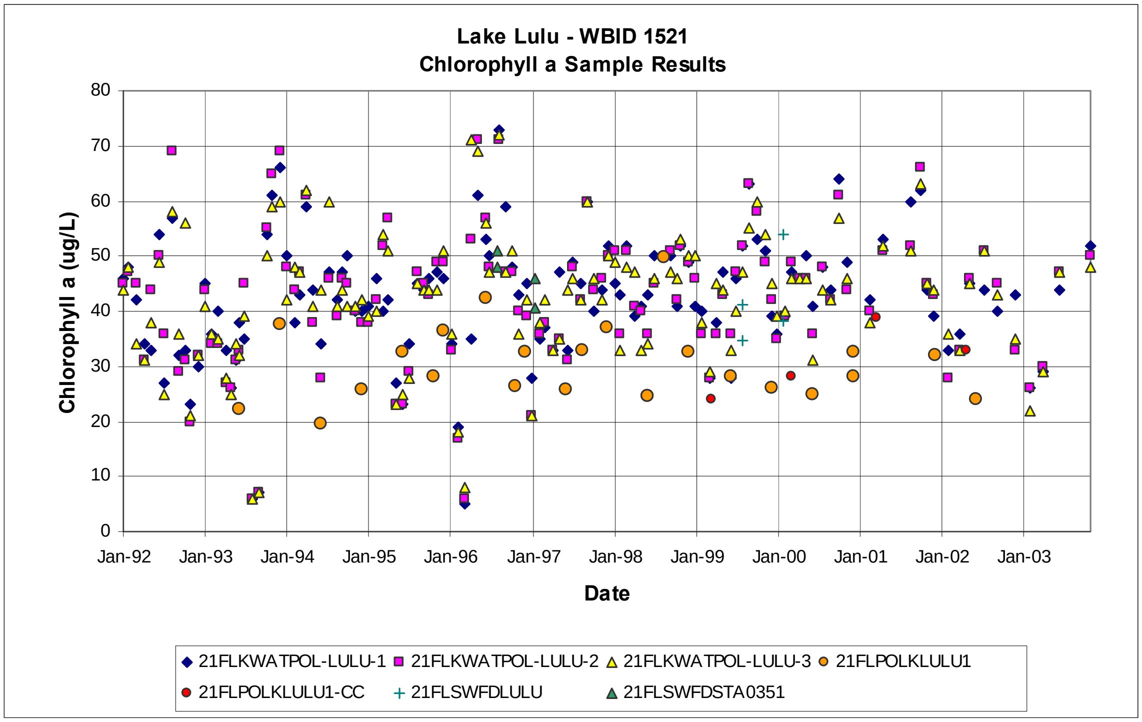
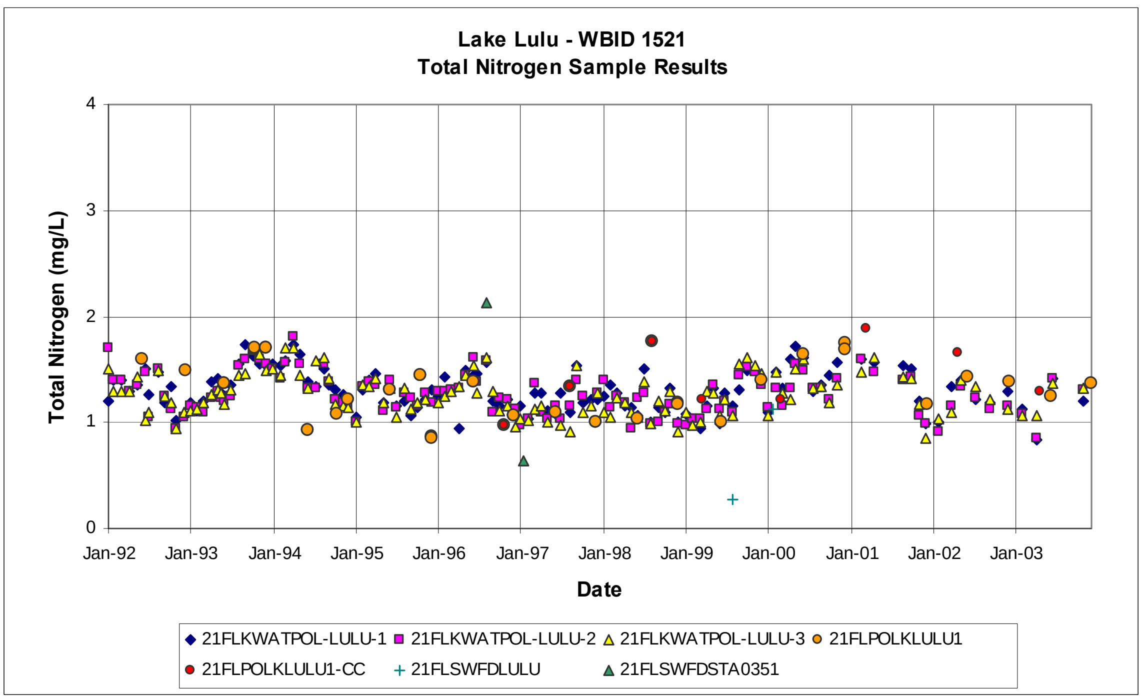
21FLKWATPOL-IDYLWILD-3
21FLPOLKIDYLWILD1-CA
21FLSWFDIDYLWILD

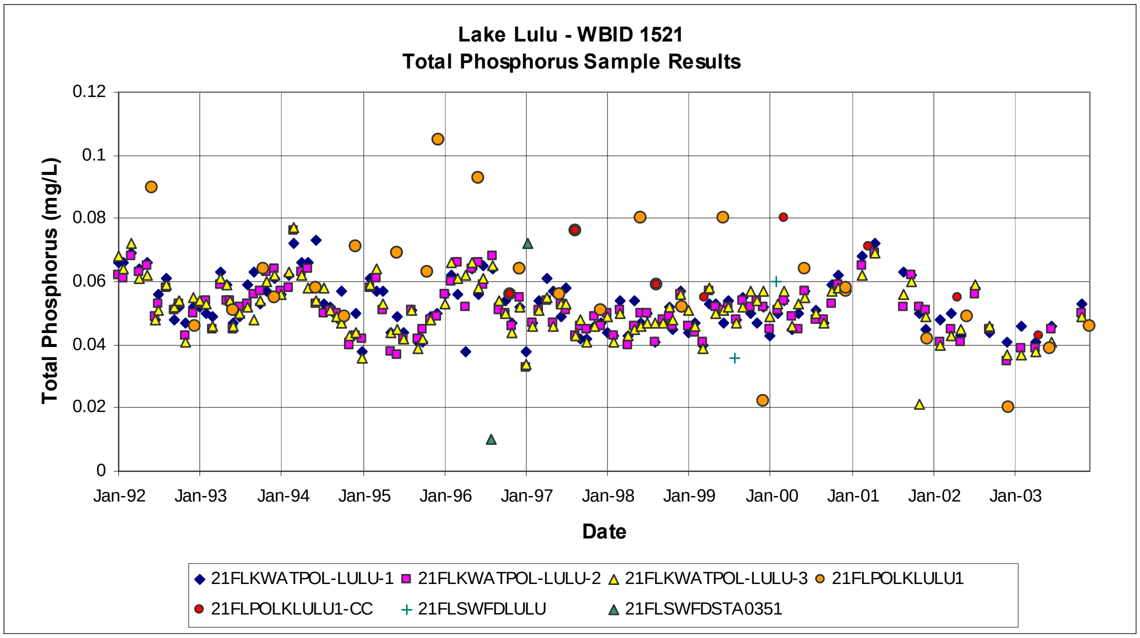

Lake Jessie - WBID 1521K
Chlorophyll a Sample Results
Chlorophyll a (ug/L)
90
80
70
60
50
40
30
20
10
0
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Date
21FLKWATPOL-JESSIE-1
21FLKWATPOL-JESSIE-2
21FLKWATPOL-JESSIE-3
21FLPOLKJESSIE1
21FLSWFDJESSIE
21FLPOLKJESSIE1-CC
21FLSWFDSTA0288

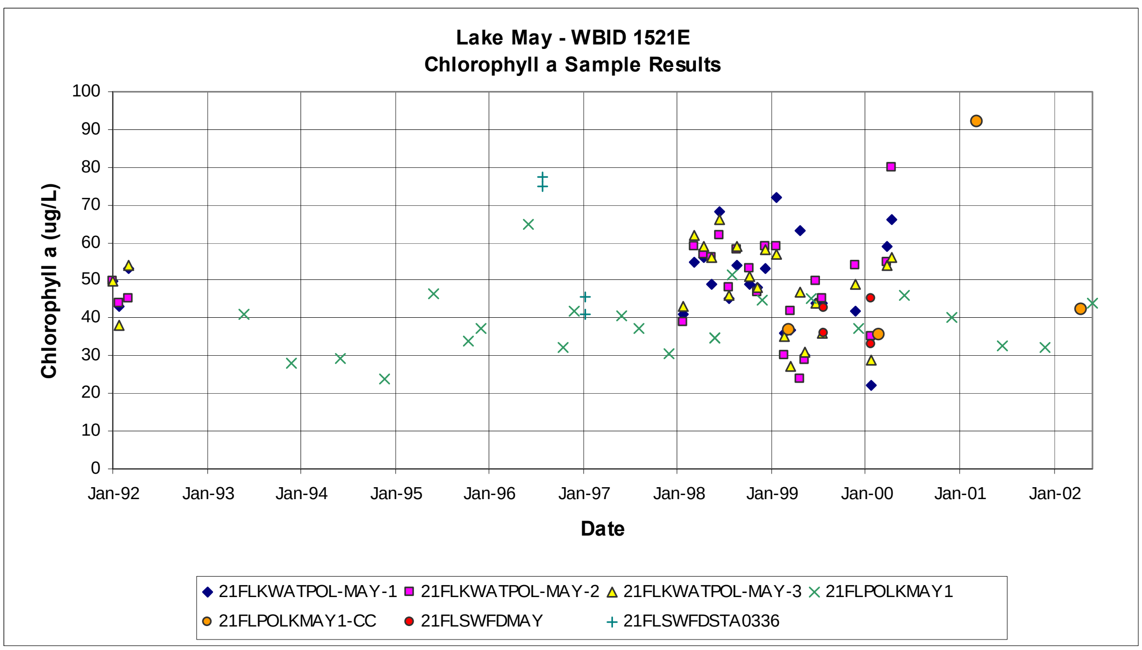

Lake Jessie - WBID 1521K
Total Nitrogen Sample Results
Total Nitrogen (mg/L)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Date
21FLKWATPOL-JESSIE-1
21FLKWATPOL-JESSIE-2
21FLKWATPOL-JESSIE-3
21FLPOLKJESSIE1
21FLPOLKJESSIE1-CC
21FLSWFDJESSIE

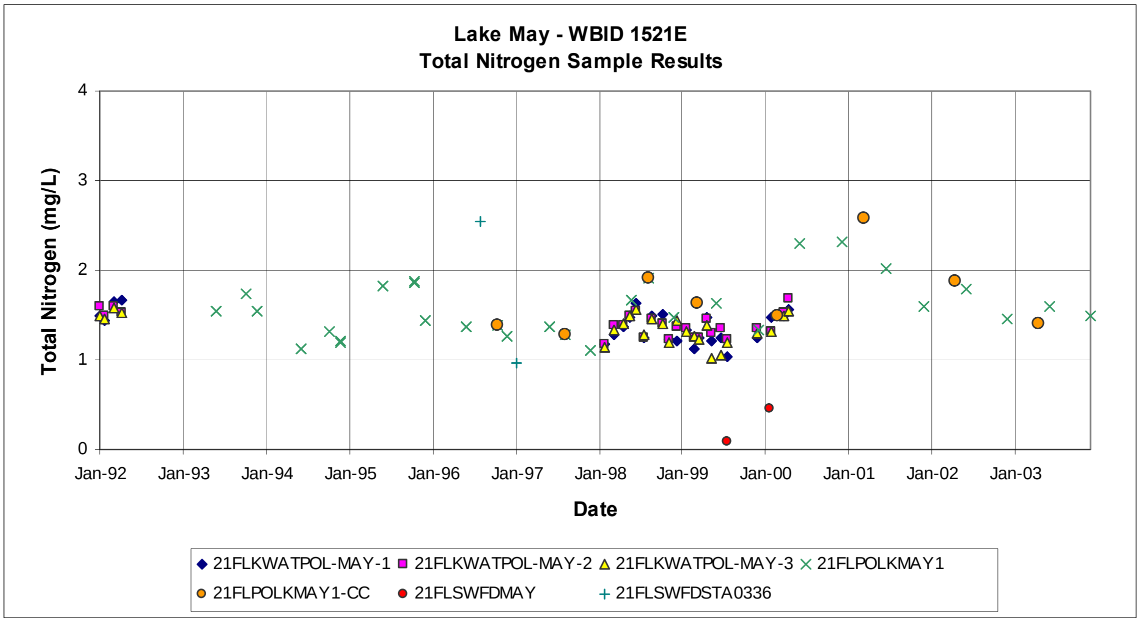

Lake Jessie - WBID 1521K
Total Phosphorus Sample Results
Total Phosphorus (mg/L)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Date
21FLKWATPOL-JESSIE-1
21FLKWATPOL-JESSIE-2
21FLKWATPOL-JESSIE-3
21FLPOLKJESSIE1
21FLPOLKJESSIE1-CC
21FLSWFDJESSIE
21FLSWFDSTA0288

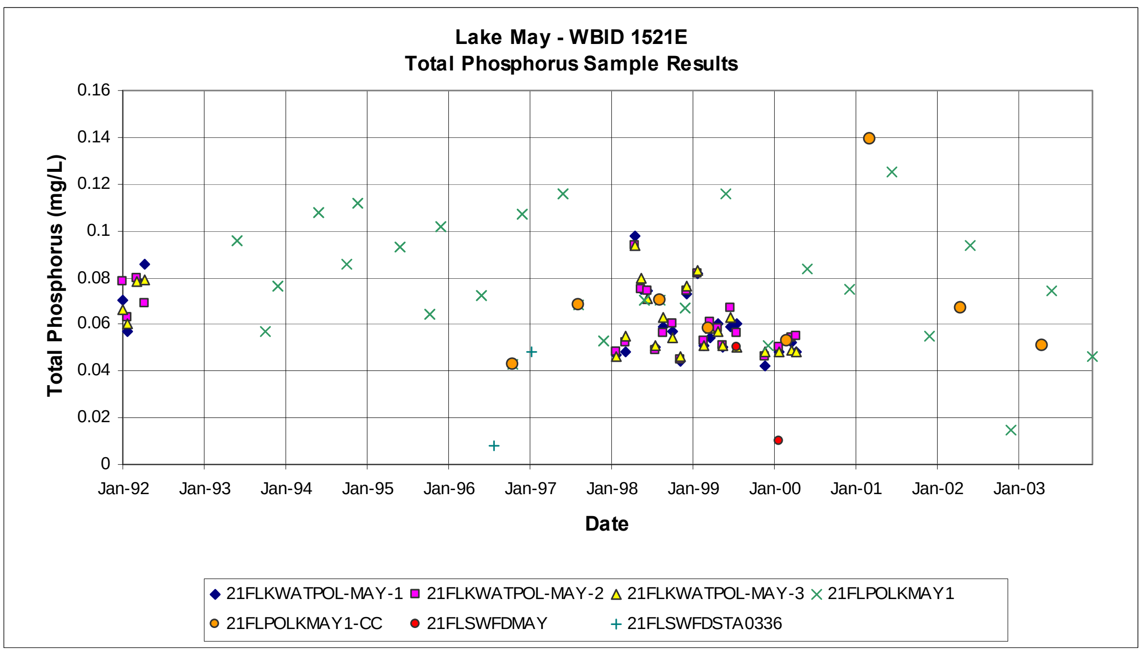

Lake Lulu - WBID 1521
Chlorophyll a Sample Results
Chlorophyll a (ug/L)
80
70
60
50
40
30
20
10
0
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Date
21FLKWATPOL-LULU-1
21FLKWATPOL-LULU-2
21FLKWATPOL-LULU-3
21FLPOLKLULU1
21FLPOLKLULU1-CC
21FLSWFDLULU
21FLSWFDSTA0351

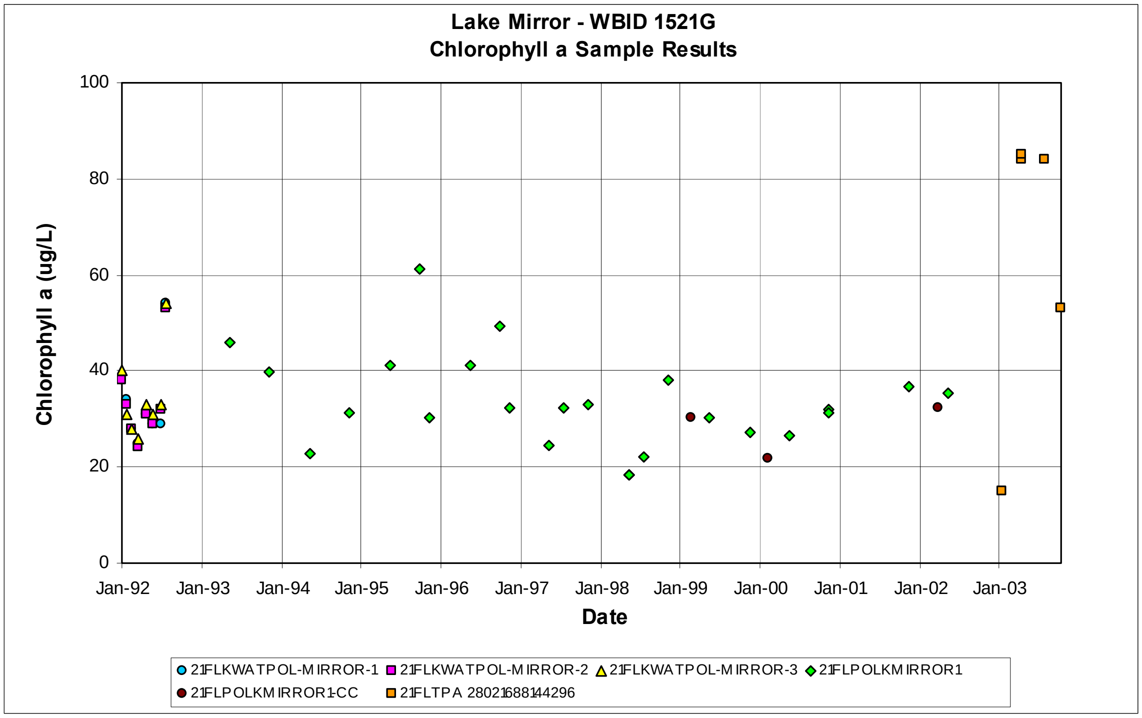

Lake Lulu - WBID 1521
Total Nitrogen Sample Results
Total Nitrogen (mg/L)
4
3
2
1
0
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Date
21FLKWATPOL-LULU-1
21FLKWATPOL-LULU-2
21FLKWATPOL-LULU-3
21FLPOLKLULU1
21FLPOLKLULU1-CC
21FLSWFDLULU
21FLSWFDSTA0351

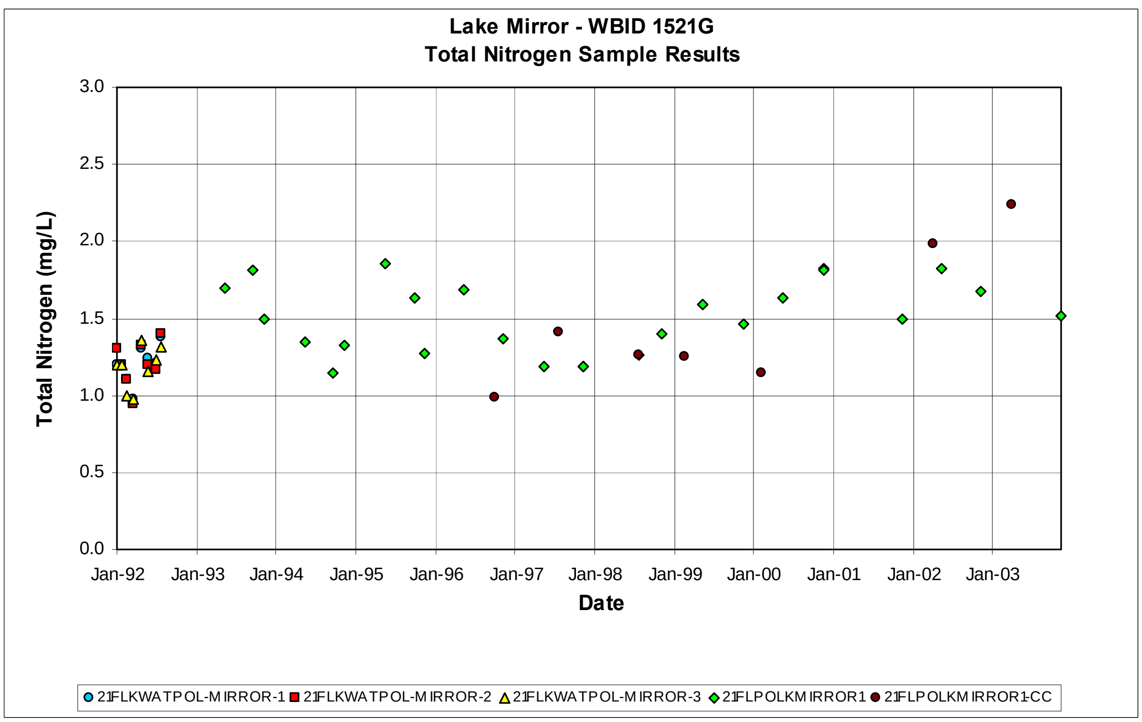

Lake Lulu - WBID 1521
Total Phosphorus Sample Results
Total Phosphorus (mg/L)
0.12
0.1
0.08
0.06
0.04
0.02
0
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Date
21FLKWATPOL-LULU-1
21FLKWATPOL-LULU-2
21FLKWATPOL-LULU-3
21FLPOLKLULU1
21FLPOLKLULU1-CC
21FLSWFDLULU
21FLSWFDSTA0351

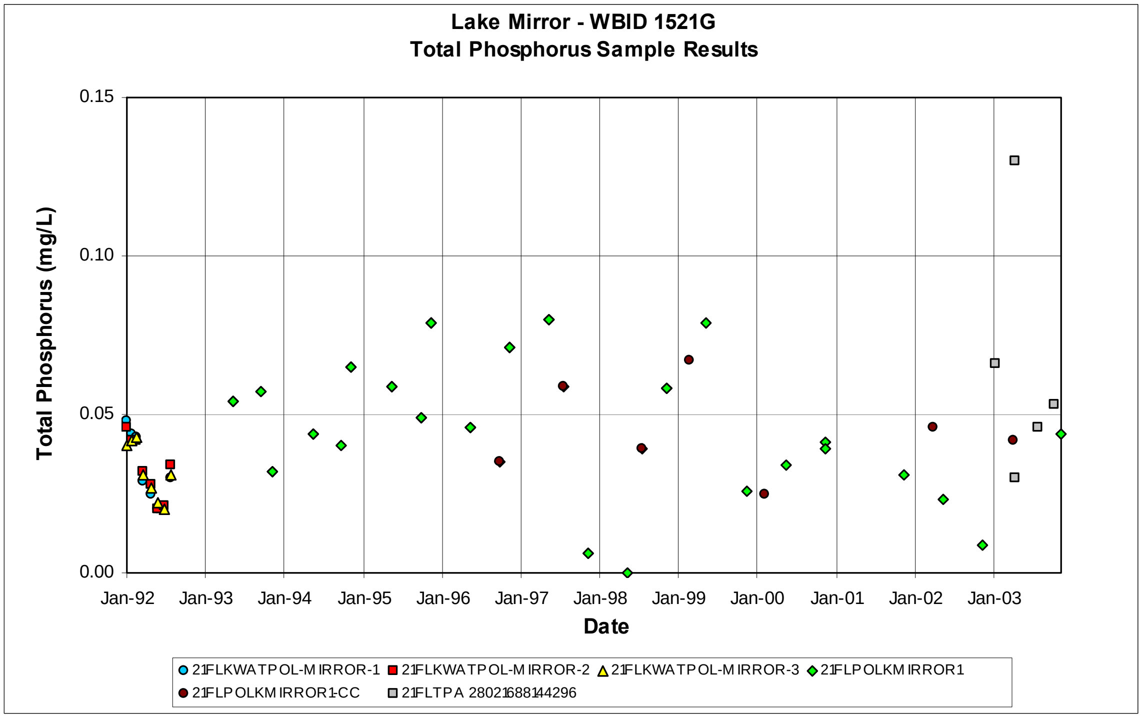

Lake May - WBID 1521E
Chlorophyll a Sample Results
Chlorophyll a (ug/L)
100
90
80
70
60
50
40
30
20
10
0
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Date
21FLKWATPOL-MAY-1
21FLKWATPOL-MAY-2
21FLKWATPOL-MAY-3
21FLPOLKMAY1
21FLPOLKMAY1-CC
21FLSWFDMAY
21FLSWFDSTA0336

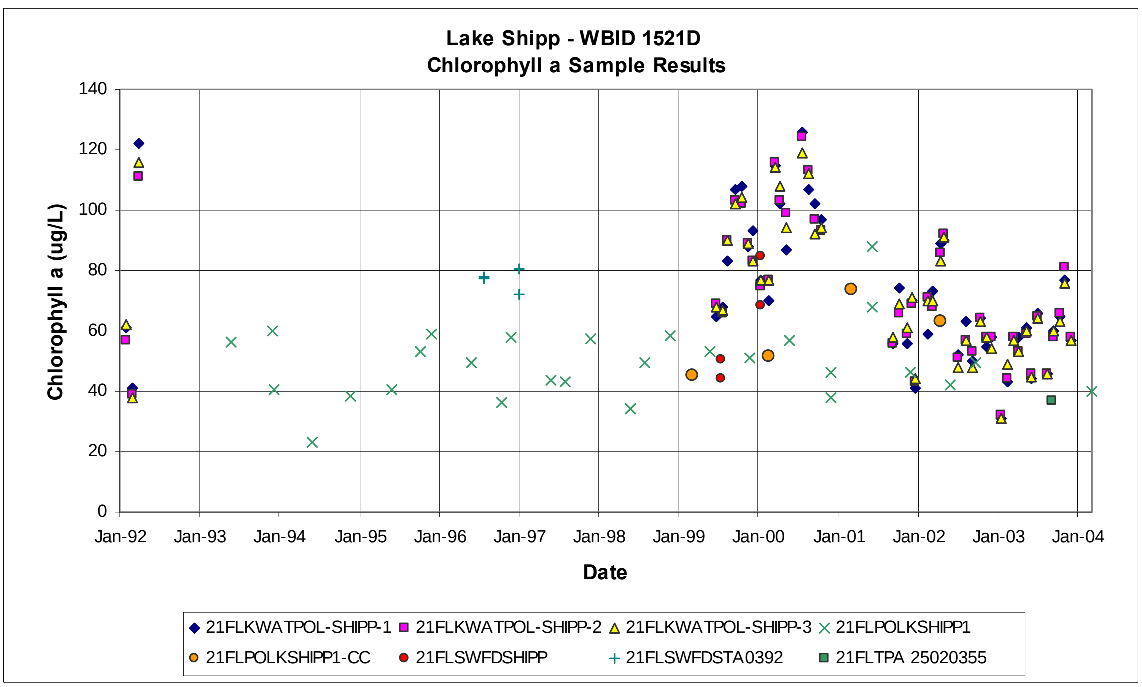

Lake May - WBID 1521E
Total Nitrogen Sample Results
Total Nitrogen (mg/L)
0
1
2
3
4
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Date
21FLKWATPOL-MAY-1
21FLKWATPOL-MAY-2
21FLKWATPOL-MAY-3
21FLPOLKMAY1
21FLPOLKMAY1-CC
21FLSWFDMAY
21FLSWFDSTA0336

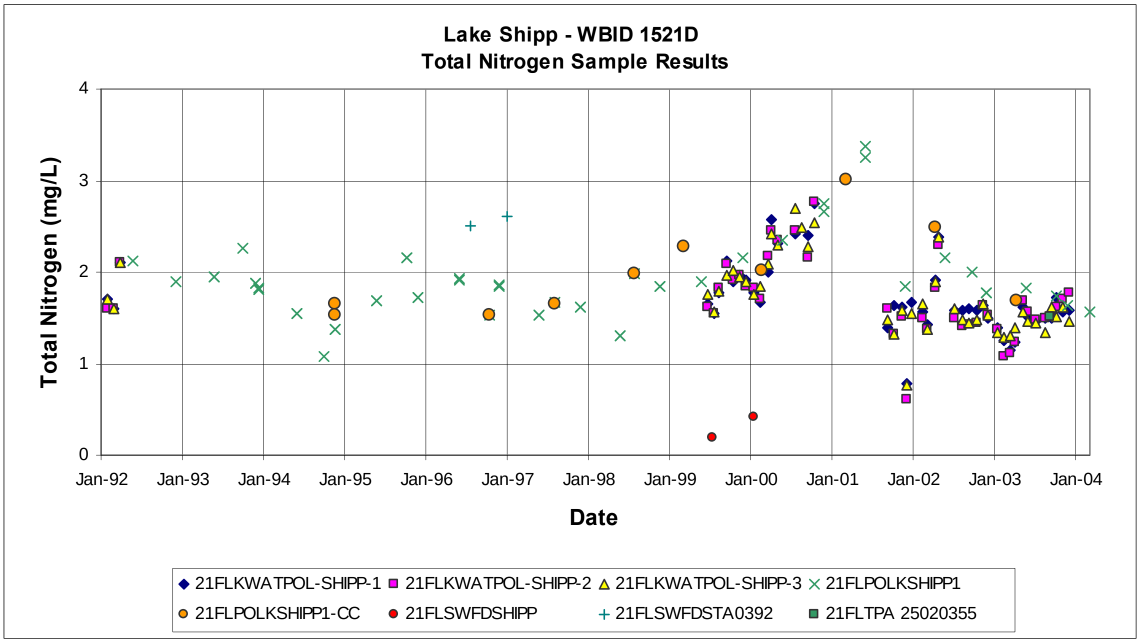

Lake May - WBID 1521E
Total Phosphorus Sample Results
Total Phosphorus (mg/L)
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Date
21FLKWATPOL-MAY-1
21FLKWATPOL-MAY-2
21FLKWATPOL-MAY-3
21FLPOLKMAY1
21FLPOLKMAY1-CC
21FLSWFDMAY
21FLSWFDSTA0336

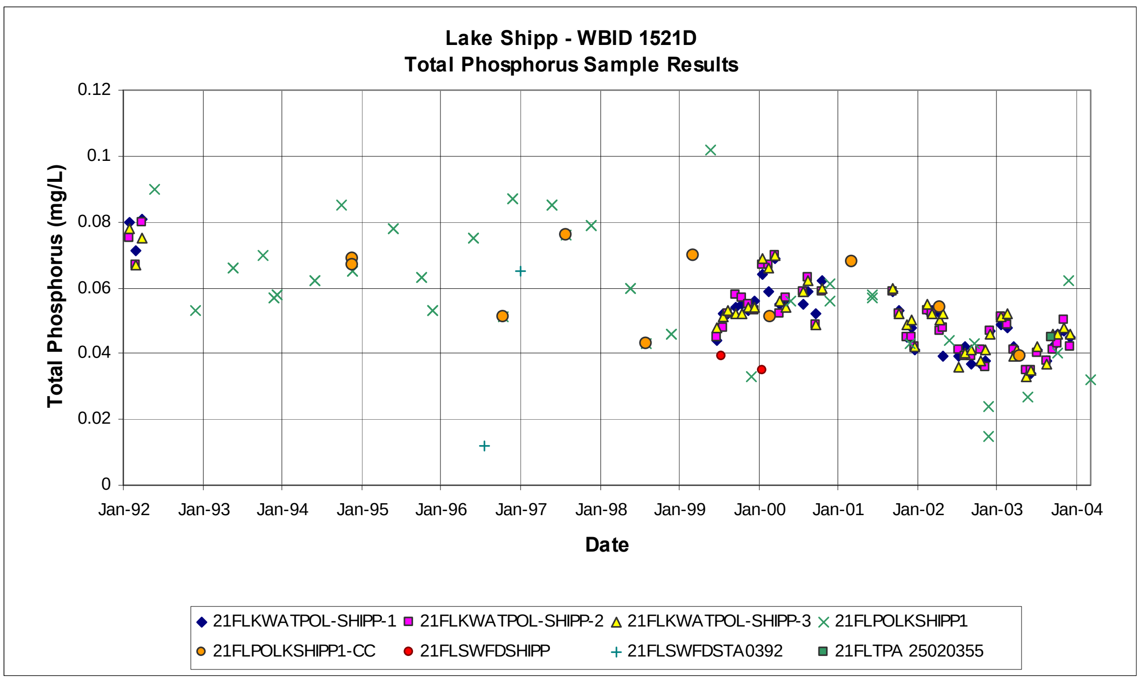

Lake Mirror - WBID 1521G
Chlorophyll a Sample Results
Chlorophyll a (ug/L)
100
80
60
40
20
0
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Date
21FLKWATPOL-MIRROR-1
21FLKWATPOL-MIRROR-2
21FLKWATPOL-MIRROR-3
21FLPOLKMIRROR1
21FLPOLKMIRROR1-CC
21FLTPA 28021688144296


Lake Mirror - WBID 1521G
Total Nitrogen Sample Results
Total Nitrogen (mg/L)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Date
21FLKWATPOL-MIRROR-1
21FLKWATPOL-MIRROR-2
21FLKWATPOL-MIRROR-3
21FLPOLKMIRROR1
21FLPOLKMIRROR1-CC


Lake Mirror - WBID 1521G
Total Phosphorus Sample Results
Total Phosphorus (mg/L)
0.15
0.10
0.05
0.00
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Date
21FLKWATPOL-MIRROR-1
21FLKWATPOL-MIRROR-2
21FLKWATPOL-MIRROR-3
21FLPOLKMIRROR1
21FLPOLKMIRROR1-CC
21FLTPA 28021688144296


Lake Shipp - WBID 1521D
Chlorophyll a Sample Results
Chlorophyll a (ug/L)
140
120
100
80
60
40
20
0
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Date
21FLKWATPOL-SHIPP-1
21FLKWATPOL-SHIPP-2
21FLKWATPOL-SHIPP-3
21FLPOLKSHIPP1
21FLPOLKSHIPP1-CC
21FLSWFDSHIPP
21FLSWFDSTA0392
21FLTPA 25020355


Lake Shipp - WBID 1521D
Total Nitrogen Sample Results
Total Nitrogen (mg/L)
0
1
2
3
4
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Date
21FLKWATPOL-SHIPP-1
21FLKWATPOL-SHIPP-2
21FLKWATPOL-SHIPP-3
21FLPOLKSHIPP1
21FLPOLKSHIPP1-CC
21FLSWFDSHIPP
21FLSWFDSTA0392
21FLTPA 25020355


Lake Shipp - WBID 1521D
Total Phosphorus Sample Results
Total Phosphorus (mg/L)
0
0.02
0.04
0.06
0.08
0.1
0.12
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Date
21FLKWATPOL-SHIPP-1
21FLKWATPOL-SHIPP-2
21FLKWATPOL-SHIPP-3
21FLPOLKSHIPP1
21FLPOLKSHIPP1-CC
21FLSWFDSHIPP
21FLSWFDSTA0392
21FLTPA 25020355

Appendix B: 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 Rule 62-40, F.A.C.

The rule requires the state's water management districts (WMDs) to establish stormwater PLRGs and adopt them as part of a SWIM plan, other watershed plan, or rule. These 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.

In 1987, the U.S. Congress established Section 402(p) as part of the federal Clean Water Act Reauthorization. This section of the law amended the scope of the federal NPDES stormwater permitting program to designate certain stormwater discharges as "point sources" of pollution. These stormwater discharges include certain discharges that are associated with industrial activities designated by specific standard industrial classification (SIC) codes, construction sites disturbing 5 or more acres of land, and master drainage systems of local governments with a population above 100,000, which are better known as MS4s. However, because the master drainage systems of most local governments in Florida are interconnected, the EPA has implemented Phase I of the MS4 permitting program on a countywide basis, which brings in all cities (incorporated areas), Chapter 298 urban water control districts, and the FDOT throughout the 15 counties meeting the population criteria. The Department received authorization to implement the NPDES stormwater program in 2000.

An important difference between the NPDES program and other state stormwater permitting programs is that the former covers both new and existing discharges, while the state program focuses on new discharges. Additionally, Phase II of the NPDES Program, implemented in 2003, expands the need for these permits to construction sites between 1 and 5 acres, and to local governments with as few as 1,000 people. - 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 all MS4 permits issued in Florida include a reopener clause that allows permit revisions to implement TMDLs when the implementation plan is formally adopted.

Florida Department of Environmental Protection
Division of Water Resource Management
Bureau of Watershed Management
2600 Blair Stone Road, Mail Station 3565
Tallahassee, Florida 32399-2400
(850) 245-8561
www2.dep.state.fl.us/water/