**Southwest District • Peace River Basin**

# *Final Report*

# *Nutrient TMDLs for Lake Haines (WBID 1488C), Lake Rochelle (WBID 1488B), and Lake Conine (WBID 1488U)*

# *and Documentation in Support of the Development of Site-Specific Numeric Interpretations of the Narrative Nutrient Criterion*

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# Executive Summary

Lake Haines, Lake Rochelle, and Lake Conine are part of the Winter Haven Northern Chain of Lakes, located in north-central Polk County. The lakes were identified as impaired for nutrients based on exceedances of the applicable chlorophyll *a*, total nitrogen (TN), and total phosphorus (TP) criteria for Florida lakes (Subparagraph 62-302.531[2][b]1., Florida Administrative Code) and were added to the 303(d) list by Secretarial Order in October 2016. Total maximum daily loads (TMDLs) for TN and TP have been developed, and **Table EX-1** lists supporting information for the TMDLs. The TMDLs were developed in accordance with Section 303(d) of the federal Clean Water Act and guidance developed by the U.S. Environmental Protection Agency.

## Table EX-1. Summary of TMDL supporting information for Lake Haines, Lake Rochelle, and Lake Conine

| Type of Information | Description |
|---|---|
| **Waterbody name/ WBID number** | Lake Haines (WBID 1488C), Lake Rochelle (WBID 1488B), and Lake Conine (WBID 1488U) |
| **Hydrologic Unit Code (HUC) 8** | 03100101 |
| **Use classification/ Waterbody designation** | Class III Freshwater |
| **Targeted beneficial uses** | Fish consumption, recreation, and propagation and maintenance of a healthy, well-balanced population of fish and wildlife |
| **303(d) listing status** | Verified List of Impaired Waters for the Group 3 basins (Sarasota Bay–Peace River–Myakka River) adopted via Secretarial Order dated October 2016. |
| **TMDL pollutants** | TN and TP |
| **TMDLs and site-specific interpretations of the narrative nutrient criterion** | **Lake Haines (WBID 1488C)**<br>**Chlorophyll *a*:** 20 micrograms per liter (µg/L), expressed as an annual geometric mean (AGM) concentration not to be exceeded more than once in any consecutive 3-year period.<br><br>**TN:** 1.05 milligrams per liter (mg/L), expressed as an AGM not to be exceeded.<br><br>**TP:** 0.03 mg/L, expressed as an AGM not to be exceeded.<br><br>**Lake Rochelle (WBID 1488B)**<br>**Chlorophyll *a*:** 20 µg/L, expressed as an AGM concentration not to be exceeded more than once in any consecutive 3-year period.<br><br>**TN:** 1.05 mg/L, expressed as an AGM not to be exceeded.<br><br>**TP:** 0.03 mg/L, expressed as an AGM not to be exceeded.<br><br>**Lake Conine (WBID 1488U)**<br>**Chlorophyll *a*:** 20 µg/L, expressed as an AGM concentration not to be exceeded more than once in any consecutive 3-year period.<br><br>**TN:** 1.05 mg/L, expressed as an AGM not to be exceeded.<br><br>**TP:** 0.03 mg/L, expressed as an AGM not to be exceeded. |
| **Load reductions required to meet the TMDLs** | **WBID 1488C:** 33 % TN reduction to achieve a chlorophyll *a* target of 20 µg/L<br><br>**WBID 1488B:** 32 % TN reduction to achieve a chlorophyll *a* target of 20 µg/L.<br><br>**WBID 1488U:** 36 % TN reduction and 57 % TP reduction to achieve a chlorophyll *a* target of 20 µg/L. |

# Acknowledgments

This analysis was accomplished thanks to significant contributions from staff in the Florida Department of Environmental Protection (DEP) Division of Environmental Assessment and Restoration, specifically, the Office of Watershed Services, Watershed Assessment Section, Standards Development Section, Water Quality Restoration Program, Regional Operations Center, and Watershed Evaluation and TMDL Section. DEP also recognizes the City of Winter Haven and Polk County Natural Resource Division for their contributions towards understanding the issues, history, and processes at work in the Winter Haven Chain of Lakes watershed.

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# Chapter 1: Introduction

## 1.1 Purpose of Report

This report presents the total maximum daily loads (TMDLs) developed to address the nutrient impairments of Lake Haines, Lake Rochelle, and Lake Conine, located in the Peace River Basin. The TMDLs will also constitute the site-specific numeric interpretations of the narrative nutrient criterion set forth in Paragraph 62-302.530(90)(b), Florida Administrative Code (F.A.C.), that will replace the otherwise applicable numeric nutrient criteria (NNC) in Subsection 62-302.531(2), F.A.C., for these waterbodies, pursuant to Paragraph 62-302.531(2)(a), F.A.C. The waterbodies were verified as impaired for nutrients using the methodology in the Identification of Impaired Surface Waters Rule (IWR) (Chapter 62-303, F.A.C.), and were included on the Verified List of Impaired Waters for the Sarasota Bay–Peace River–Myakka River Group 3 Basin in assessment Cycle 3 adopted by Secretarial Order in October 2016.

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and provides water quality targets needed to achieve compliance with applicable water quality criteria based on the relationship between pollutant sources and water quality in the receiving waterbody. The TMDLs establish the allowable loadings to Lake Haines, Lake Rochelle, and Lake Conine that would restore the waterbodies so that they meet their applicable water quality criteria for nutrients.

## 1.2 Identification of Waterbodies

For assessment purposes, the Florida Department of Environmental Protection (DEP) divided the Peace River Basin (Hydrologic Unit Code [HUC] 03100101) into watershed assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or surface water segment. Lake Haines is WBID 1488C; Lake Rochelle is WBID 1488B; and Lake Conine is WBID 1488U. **Figure 1.1** shows the location of the WBIDs in the basin and major geopolitical and hydrologic features in the region, and **Figure 1.2** contains a more detailed map of the WBIDs.

The three lakes are located in north-central Polk County around the Cities of Lake Alfred and Winter Haven (**Figure 1.2**). Part of the Winter Haven Northern Chain of Lakes, they are located at the headwaters of the Northern Chain. Lakes Haines, Rochelle, Conine, and Smart are interconnected by navigable canals. and water levels are maintained at the same elevation by a control structure located on the east side of Lake Smart. Lake Smart is situated directly east of Lake Conine (**Figure 1.2**). The lake watersheds are part of the Peace Creek Subbasin in the headwaters of the Peace River Watershed.

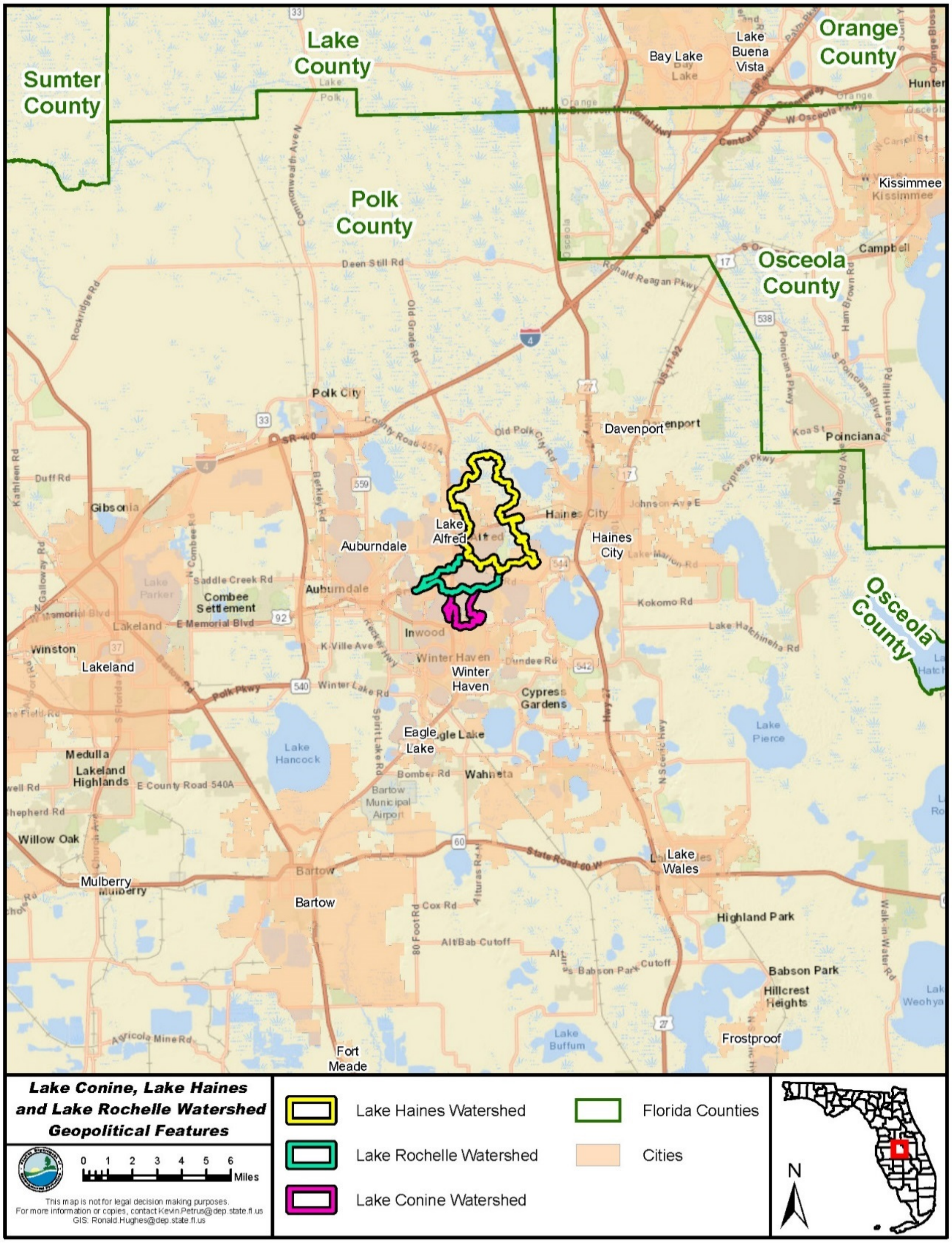


**Figure 1.1. Location of Lake Haines (WBID 1488C), Lake Rochelle (WBID 1488B), and Lake Conine (WBID 1488U) in the Peace River Basin and major hydrologic and geopolitical features in the area**

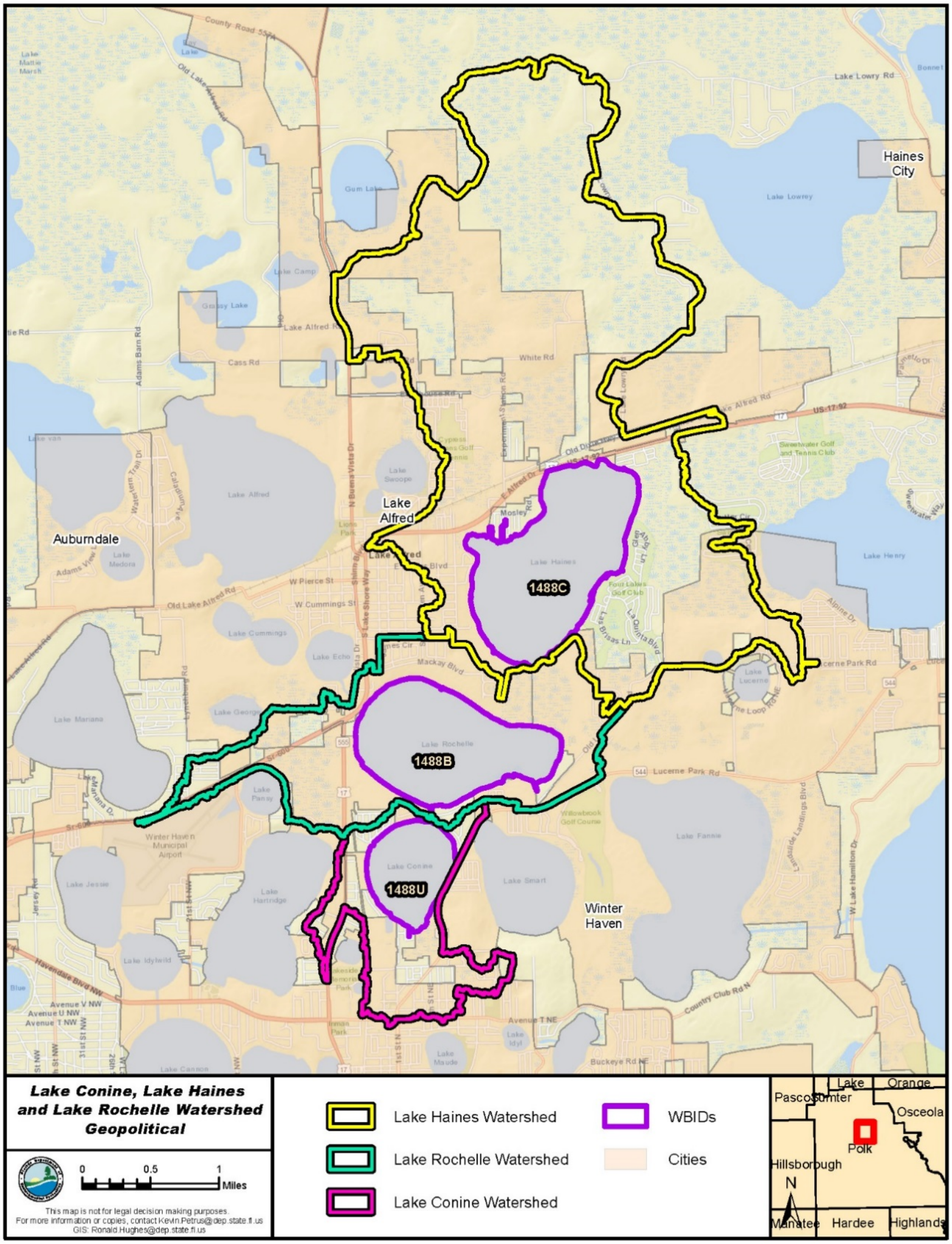


**Figure 1.2. Watershed areas for Lake Haines (WBID 1488C), Lake Rochelle (WBID 1488B), and Lake Conine (WBID 1488U)**

## 1.3 Watershed Information

The Lake Haines Watershed encompasses 4,589 acres. The lake outlet connects to Lake Rochelle via a canal. The lake has a surface area of 718 acres, and the lake volume is 7,104 acre-feet (ac-ft). The average depth of the lake is 7.8 feet (ft) (2.0 meters [m]), with a maximum depth of 19.2 ft (5.9 m).

The Lake Rochelle Watershed comprises 1,205 acres. The lake outlet is connected by a canal to Lake Conine. The lake has a surface area of 523 acres, and the lake volume is 6,758 ac-ft. The average depth of the lake is 11 ft (3.4 m), with a maximum depth of 22.5 ft (6.9 m).

The Lake Conine Watershed covers an area of 589 acres. The lake outlet connects to Lake Smart by a canal. The lake has a surface area of 213 acres, and the lake volume is 1,928 ac-ft. The average depth of the lake is 9.9 ft (3.0 m), with a maximum depth of 20.0 ft (6.1 m).

The lakes in the Northern Chain and other lakes in the vicinity lie in the Trail Ridge–Lake Wales Ridge system, which runs north-south through Polk County. This system is the oldest and highest of a series of sand ridges (relict beaches of ancient sea levels) that parallel the present coastlines. Ridge soils are for the most part composed of various sands and sandy clay, which are typically well drained, with the water table at least 6 ft below the surface.

The climate of the watershed area is generally subtropical, with an annual average temperature of 73° F. Annual rainfall in or near the Peace River Basin averages 50 to 56 inches, and 60 % of the rainfall occurs from June through September (Southwest Florida Water Management District [SWFWMD] 2004). The long-term average annual rainfall for Polk County, based on SWFWMD records from 1915 to 2016, is 52 inches/year (in/yr).

The greater hydrogeological context in which these lakes function is determined in part by the topography, but also by soil geology, aquifer/groundwater interactions, and climate.

Soils are classified by the National Cooperative Soil Survey into four hydrologic soil groups (HSGs)—Types A, B, C, and or D—based on their runoff potential. "A" type soils are typically well-drained, have deep water tables, and consist of sandy textured soils with relatively low runoff potential. "B" type soils are typically loamy with some silt component, a moderately coarse texture, and a lower infiltration rate than Type A soils and are therefore classed as moderately well-drained. "C" type soils are sand, clay, and loam with more fine textures and lower infiltration rates, especially when wet. "D" type soils are variable in texture but generally have a greater clay component and are often found at lower topography with higher water tables that generate a higher hydrologic runoff response. Multiclassed soils vary in their hydrologic response depending on in situ drainage improvements.

**Figure 1.3** displays the distribution of soil types within the watersheds of Lakes Haines, Rochelle, and Conine. The majority of soils in the watershed areas for the three lakes consists of a mix of well drained and variable soil with larger clay content (“A/D” soils) and Type A soils (**Table 1.1**), which by virtue of their infiltration characteristics and the watershed elevation are principally recharge areas for the Floridan aquifer.

**Table 1.1. Soil type acreage in the watersheds of Lakes Haines, Rochelle, and Conine**

N/A = Not applicable because the area is unclassified lake bottom. Hybrid soil types are A/D, B/D, and C/D.

| Soil Type | Lake Haines Acres | Lake Haines % | Lake Rochelle Acres | Lake Rochelle % | Lake Conine Acres | Lake Conine % |
|---|---|---|---|---|---|---|
| N/A | 722.7 | 13.6 | 612.0 | 35.4 | 292.9 | 36.5 |
| A | 1645.5 | 31.0 | 362.7 | 21.0 | 351.6 | 43.9 |
| A/D | 2444.8 | 46.1 | 670.4 | 38.8 | 143.9 | 17.9 |
| B | 64.0 | 1.2 | 20.8 | 1.2 | 0.0 | 0.0 |
| B/D | 107.0 | 2.0 | 57.7 | 3.3 | 13.2 | 1.6 |
| C | 59.9 | 1.1 | 4.2 | 0.2 | 0.0 | 0.0 |
| C/D | 262.8 | 5.0 | 0.0 | 0.0 | 0.0 | 0.0 |

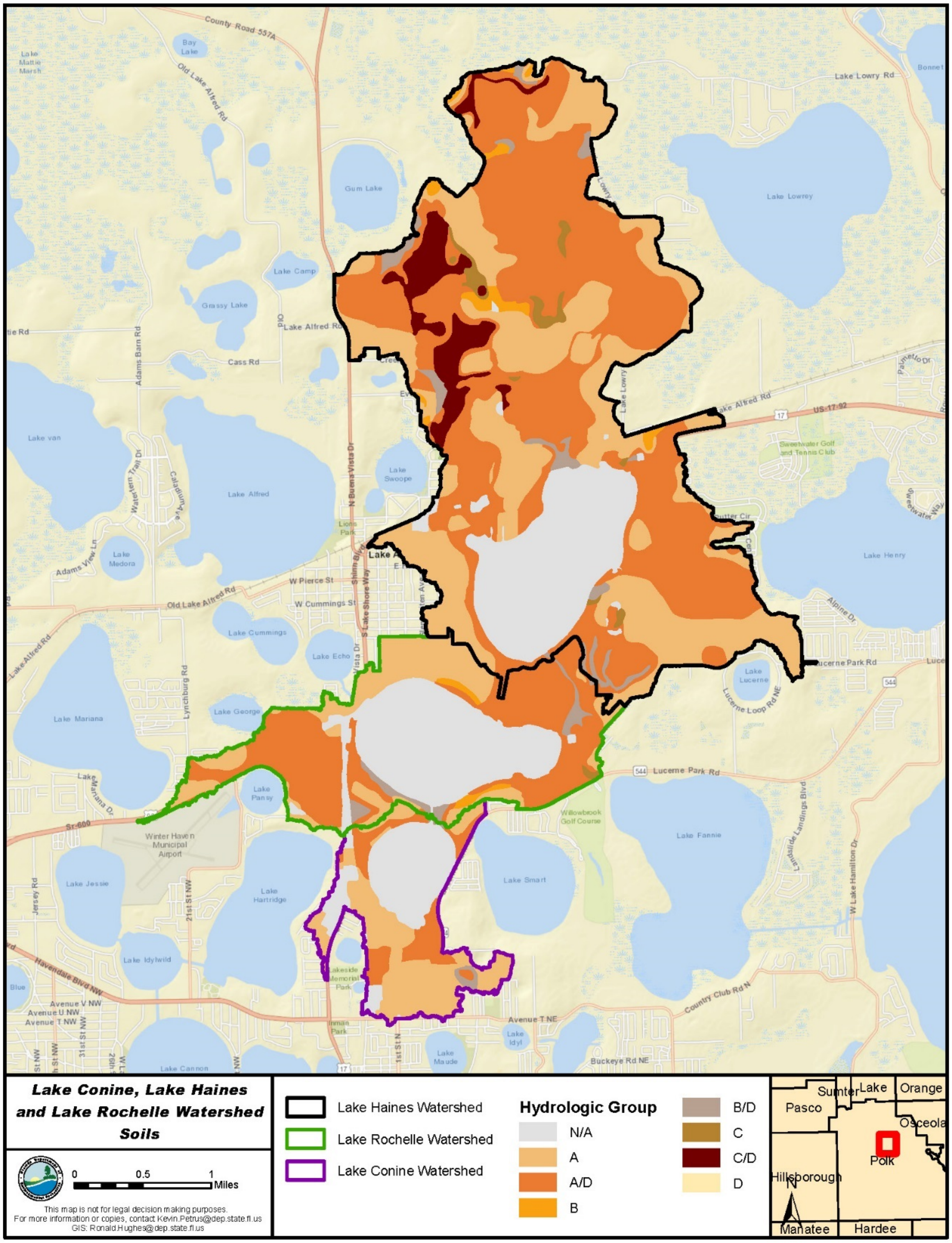


**Figure 1.3. Hydrologic soil groups in the watersheds of Lakes Haines, Rochelle, and Conine**

# Chapter 2: Water Quality Assessment and Identification of Pollutants of Concern

## 2.1 Statutory Requirements and Rulemaking History

Section 303(d) of the federal Clean Water Act (CWA) requires states to submit to the U.S. Environmental Protection Agency (EPA) lists of surface waters that do not meet applicable water quality standards (impaired waters) and establish a TMDL for each pollutant causing the impairment of listed waters on a schedule. DEP has developed such lists, commonly referred to as 303(d) lists, since 1992.

The Florida Watershed Restoration Act (FWRA) (Section 403.067, Florida Statutes [F.S.]) directed DEP to develop, and adopt by rule, a science-based methodology to identify impaired waters. The Environmental Regulation Commission adopted the methodology as Chapter 62-303, F.A.C. (the IWR), in 2001. The rule was amended in 2006, 2007, 2012, 2013, and 2016.

The list of impaired waters in each basin, referred to as the Verified List, is also required by the FWRA (Subsection 403.067[4], F.S.). The state's 303(d) list is amended annually to include basin updates.

## 2.2 Classification of the Waterbody and Applicable Water Quality Standards

Lake Haines, Lake Rochelle, and Lake Conine are Class III (fresh) waterbodies, with a designated use of fish consumption, recreation, and propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The Class III water quality criterion applicable to the verified impairment (nutrients) for these waterbodies is Florida's nutrient criterion in Paragraph 62-302.530(90)(b), F.A.C. Florida adopted NNC for lakes, spring vents, and streams in 2011. These were approved by the EPA in 2012 and became effective in 2014.

The applicable lake NNC are dependent on alkalinity, measured in milligrams per liter as calcium carbonate (mg/L $CaCO_3$) and true color (color), measured in platinum cobalt units (PCU), based on long-term period of record (POR) geometric means (**Table 2.1**). The POR alkalinity geometric means are 51 mg/L $CaCO_3$ in Lake Haines, 64 mg/L $CaCO_3$ in Lake Rochelle, and 55 mg/L $CaCO_3$ in Lake Conine. The POR geometric means for color in Lakes Haines, Rochelle, and Conine are 57 PCU, 33 PCU, and 29 PCU, respectively. The geometric means were calculated based on the results in the IWR Run 53 Database. Using this methodology, Lake Haines is classified as a high-color (>40 PCU) lake, and Lakes Rochelle and Conine are classified as low-color (<40 PCU), high-alkalinity (> 20 mg/L $CaCO_3$) lakes.

The chlorophyll *a* NNC for high-color lakes is an annual geometric mean (AGM) value of 20 micrograms per liter (µg/L), not to be exceeded more than once in any consecutive 3-year period. The associated total nitrogen (TN) and total phosphorus (TP) criteria for a lake can vary annually, depending on the availability of data for chlorophyll *a* and the concentrations of chlorophyll *a* in the lake. If there are sufficient data to calculate an AGM for chlorophyll *a* and the mean does not exceed the chlorophyll *a* criterion for the lake type in **Table 2.1**, then the TN and TP numeric interpretations for that calendar year are the AGMs of lake TN and TP samples, subject to the minimum and maximum TN and TP limits in the table. If there are insufficient data to calculate the AGM for chlorophyll *a* for a given year, or the AGM for chlorophyll *a* exceeds the values in the table for the lake type, then the applicable numeric interpretations for TN and TP are the minimum values in the table. **Table 2.1** lists the NNC for Florida lakes specified in Subparagraph 62-302.531(2)(b)1., F.A.C.

**Table 2.1. Chlorophyll *a*, TN, and TP criteria for Florida lakes (Subparagraph 62-302.531[2][b]1., F.A.C.)**

[1] For lakes with color > 40 PCU in the West Central Nutrient Watershed Region, the maximum TP limit is the 0.49 mg/L TP streams threshold for the region.

| Long-Term Geometric Mean Lake Color and Alkalinity | AGM Chlorophyll *a* | Minimum Calculated AGM TP NNC | Minimum Calculated AGM TN NNC | Maximum Calculated AGM TP NNC | Maximum Calculated AGM TN NNC |
|---|---|---|---|---|---|
| **>40 PCU** | 20 µg/L | 0.05 mg/L | 1.27 mg/L | 0.16 mg/L[1] | 2.23 mg/L |
| **≤ 40 PCU and > 20 mg/L $CaCO_3$** | 20 µg/L | 0.03 mg/L | 1.05 mg/L | 0.09 mg/L | 1.91 mg/L |
| **≤ 40 PCU and ≤ 20 mg/L $CaCO_3$** | 6 µg/L | 0.01 mg/L | 0.51 mg/L | 0.03 mg/L | 0.93 mg/L |

## 2.3 Determination of the Pollutant of Concern

### 2.3.1 Data Providers

The sources of nutrient data for the lakes are stations sampled by Polk County (21FLPOLK…), SWFWMD (21FLSWFD…), and DEP's Southwest District (21FLTPA…). The majority of the available nutrient data come from the monitoring conducted by Polk County. The county sampled at the center of each lake from the mid-1980s to the early 1990s: Lake Haines at Station 21FLPOLKHAINES1 since 1985, Lake Rochelle at Station 21FLPOLKROCHELLE1 since 1993, and Lake Conine at Station 21FLPOLKCONNINE1 since 1987. In 1999, the county began sampling for corrected chlorophyll *a*, the more common form of chlorophyll *a* used in assessing surface water quality. The other sampling organizations conduct monitoring intermittently. **Figure 2.1** shows the sampling locations in the lake WBIDs.

The individual water quality measurements discussed in this report are available in the IWR Run 53 Database and are available on request.

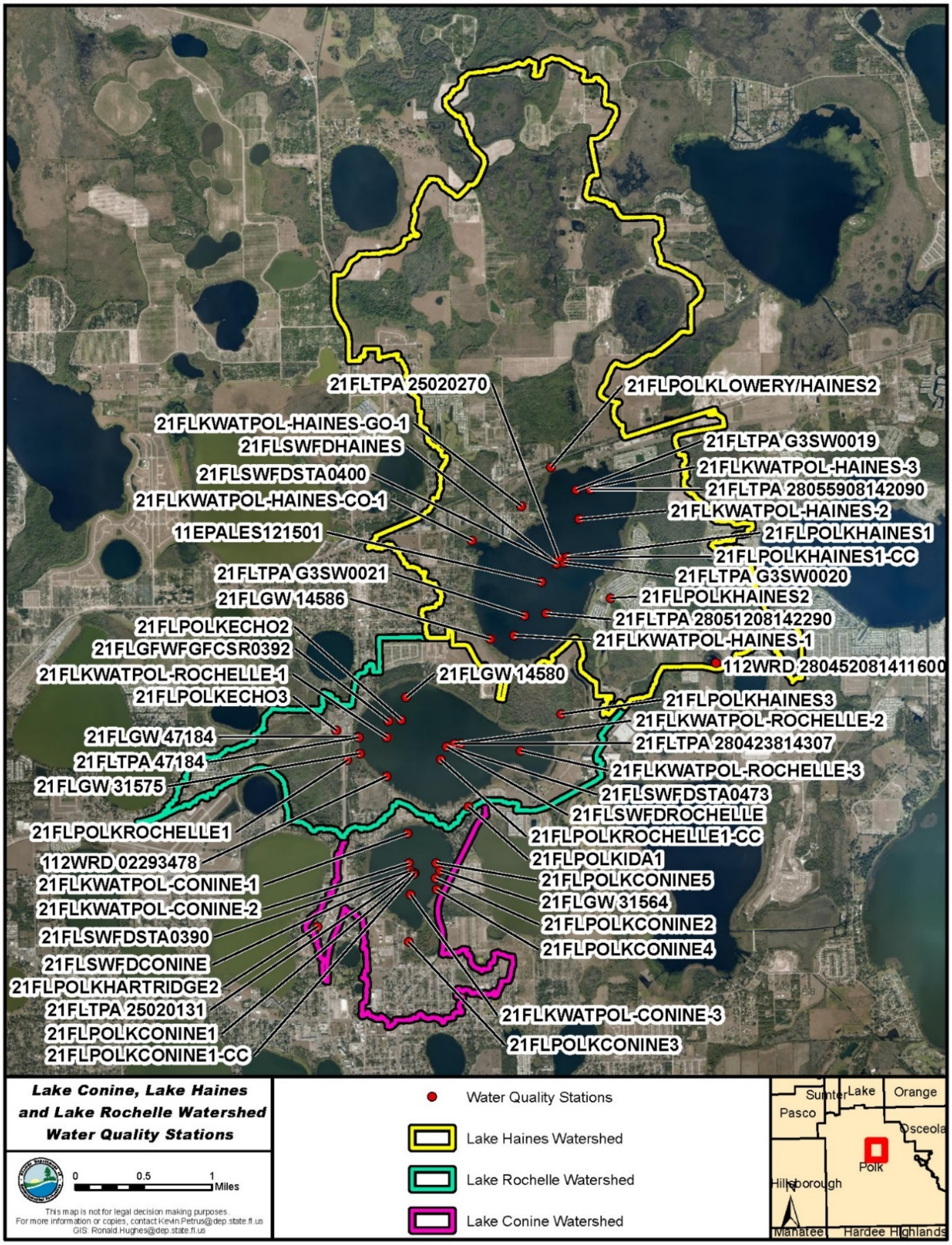


**Figure 2.1. Monitoring stations in the Lake Haines, Lake Rochelle, and Lake Conine Watersheds**

### 2.3.2 Information on Verified Impairment

During the Cycle 3 assessment, the NNC were used to assess the lakes during the verified period (January 1, 2008–June 30, 2015) based on data from IWR Database Run 52. Lake Haines was assessed as impaired for chlorophyll *a* and TN (Category 5) because the AGMs exceeded the NNC more than once in a three-year period, and the waterbody was added to the 303(d) list for chlorophyll *a* and TN. It was found not to be impaired for TP (Category 2). **Table 2.2** lists the Lake Haines AGM values, calculated using the most recent water quality results per the IWR methodology, for chlorophyll *a*, TN, and TP for the Cycle 3 planning and verified periods and 2016. **Figures 2.2 to 2.4** present the Lake Haines water quality results measured in the 1990 to 2016 period for chlorophyll a, TN, and TP, respectively.

Lake Rochelle was assessed as impaired for chlorophyll *a* and TN (Category 5) because the AGMs exceeded the NNC more than once in a three-year period (2008 and 2014), and the waterbody was added to the 303(d) list for chlorophyll *a* and TN. It was found not to be impaired for TP (Category 2). **Table 2.3** lists the Lake Rochelle AGM values calculated using the most recent water quality results per the IWR methodology for chlorophyll *a*, TN, and TP for the Cycle 3 planning and verified periods and 2016. Lake Rochelle water quality results measured in the 1990 to 2016 period for chlorophyll a, TN, and TP are shown in **Figures 2.5 to 2.7**, respectively.

Lake Conine was assessed as impaired for chlorophyll *a*, TN, and TP (Category 5) because the AGMs exceeded the NNC more than once in a three-year period (2008 and 2015), and the waterbody was added to the 303(d) list for chlorophyll *a*, TN, and TP. **Table 2.4** lists the Lake Conine AGM values calculated using the most recent water quality results per the IWR methodology for chlorophyll *a*, TN, and TP for the Cycle 3 planning and verified periods and 2016. The chlorophyll a, TN, and TP results measured in Lake Conine from 1990 to 2016 are displayed in **Figures 2.8 to 2.10**, respectively.

The total phosphorus concentrations in all three lakes have decreased considerably since the early 1990's as shown in the time series graphs. Prior to 1993, Lake Haines and Lake Conine received discharges from wastewater treatment facilities (WWTF). In 1992, the point source discharge to Lake Haines from the Lake Alfred WWTF was eliminated. In the past Lake Conine was the receiving water for point source discharges from four WWTFs (Birds Eye, Pipping Packing Company, Florida Citrus Salads, and the City of Winter Haven). In 1992, the discharge to the lake from the City of Winter Haven WWTF was removed. Sediment inactivation by alum treatment in Lake Conine was completed in the mid-1990s to address the legacy internal phosphorus loads. The improved water quality resulted from a combination of the elimination of point source discharges from the lakes and alum treatment of Lake Conine, which was completed in 1995 (PBS&J 2010).

## Table 2.2. Lake Haines AGM values (2003–16)]

ID = Insufficient data

**Note:** Values shown in boldface type and shaded are greater than the NNC for lakes. Rule 62-302.531, F.A.C., states that the applicable numeric interpretations for TN, TP, and chlorophyll *a* shall not be exceeded more than once in any consecutive three-year period.

| Year | Chlorophyll *a* (µg/L) | TN (mg/L) | TP (mg/L) |
|---|---|---|---|
| **2003** | **39** | **1.56** | **0.06** |
| **2004** | ID | ID | ID |
| **2005** | **35** | **1.46** | ID |
| **2006** | **45** | **1.46** | ID |
| **2007** | **28** | **1.29** | ID |
| **2008** | **30** | **1.36** | 0.02 |
| **2009** | **26** | **1.40** | 0.02 |
| **2010** | **23** | **1.35** | 0.02 |
| **2011** | 20 | 1.29 | 0.03 |
| **2012** | **35** | **1.51** | 0.03 |
| **2013** | **29** | **1.50** | ID |
| **2014** | 19 | 1.27 | 0.02 |
| **2015** | **22** | 1.26 | 0.03 |
| **2016** | **26** | 1.20 | 0.03 |

## Table 2.3. Lake Rochelle AGM values (2003–16)

ID = Insufficient data

**Note:** Values shown in boldface type and shaded are greater than the NNC for lakes. Rule 62-302.531, F.A.C., states that the applicable numeric interpretations for TN, TP, and chlorophyll *a* shall not be exceeded more than once in any consecutive three-year period.

| Year | Chlorophyll *a* (µg/L) | TN (mg/L) | TP (mg/L) |
|---|---|---|---|
| **2003** | **26** | **1.37** | ID |
| **2004** | ID | ID | ID |
| **2005** | **30** | **1.32** | ID |
| **2006** | 13 | 1.05 | ID |
| **2007** | **27** | **1.19** | 0.03 |
| **2008** | **27** | **1.25** | **0.04** |
| **2009** | **31** | **1.54** | 0.02 |
| **2010** | **29** | **1.37** | ID |
| **2011** | 20 | 1.21 | 0.02 |
| **2012** | **30** | **1.39** | 0.02 |
| **2013** | **26** | **1.32** | ID |
| **2014** | **24** | **1.43** | 0.02 |
| **2015** | 20 | 1.16 | 0.02 |
| **2016** | 13 | 0.95 | 0.02 |

## Table 2.4. Lake Conine AGM values (2003–16)

ID = Insufficient data

**Note:** Values shown in boldface type and shaded are greater than the NNC for lakes. Rule 62-302.531, F.A.C., states that the applicable numeric interpretations for TN, TP, and chlorophyll *a* shall not be exceeded more than once in any consecutive three-year period.

| Year | Chlorophyll *a* (µg/L) | TN (mg/L) | TP (mg/L) |
|---|---|---|---|
| **2003** | **28** | **1.25** | **0.06** |
| **2004** | ID | ID | ID |
| **2005** | **40** | **1.46** | ID |
| **2006** | 16 | 1.16 | 0.06 |
| **2007** | **46** | **1.46** | **0.07** |
| **2008** | **36** | **1.36** | **0.04** |
| **2009** | **36** | **1.48** | **0.04** |
| **2010** | **38** | **1.43** | ID |
| **2011** | **44** | **1.65** | **0.06** |
| **2012** | **35** | **1.36** | **0.05** |
| **2013** | **28** | **1.31** | **0.04** |
| **2014** | **23** | **1.19** | 0.02 |
| **2015** | **23** | **1.14** | 0.02 |
| **2016** | 19 | 1.04 | 0.02 |

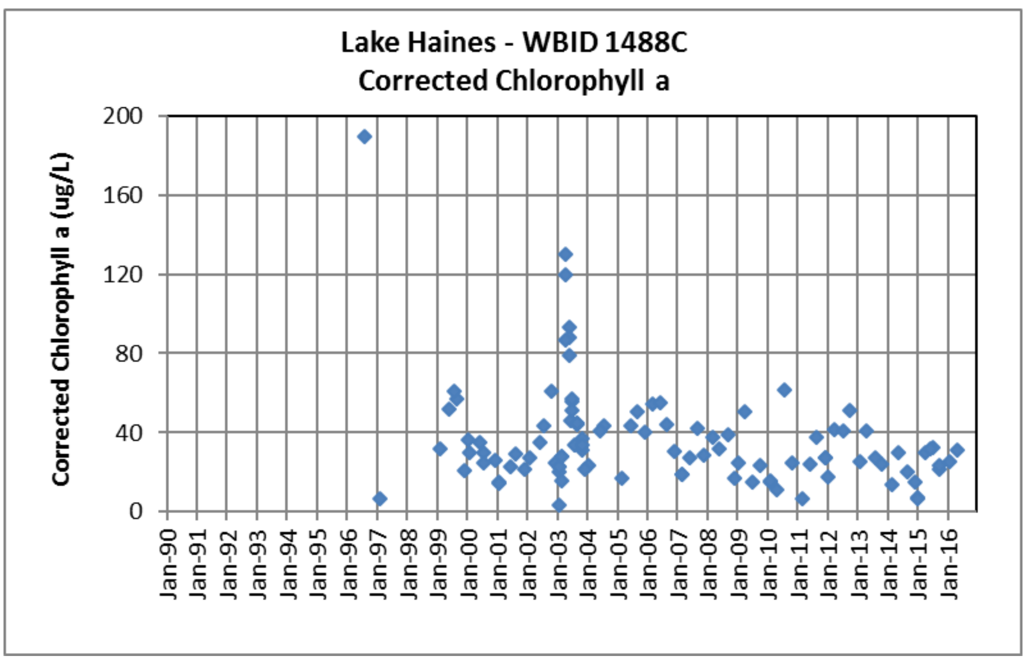


**Figure 2.2. Lake Haines Corrected Chlorophyll a Results (1990 to 2016)**

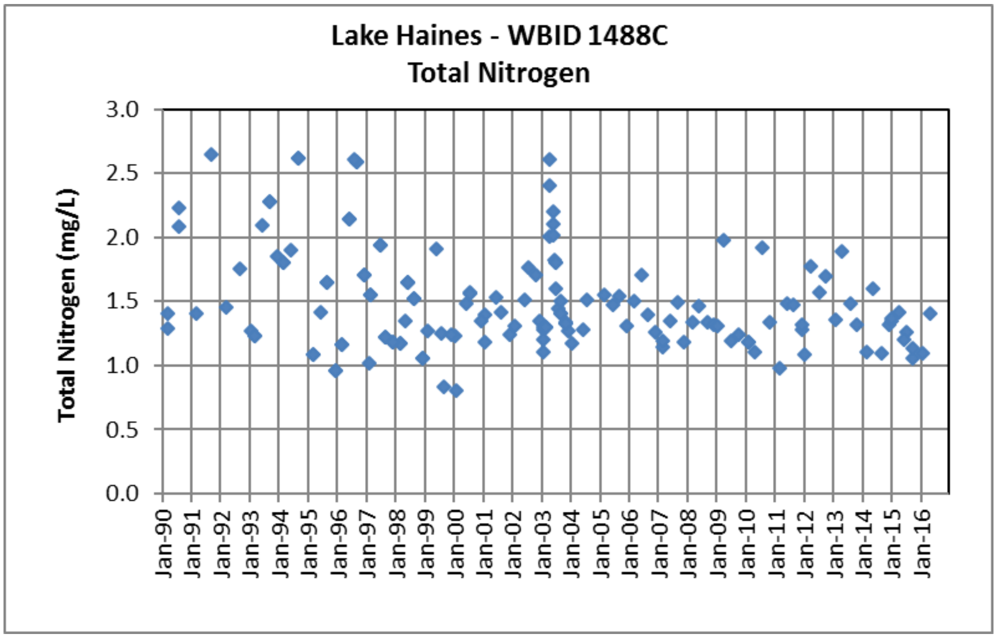


**Figure 2.3. Lake Haines TN Results (1990 to 2016)**

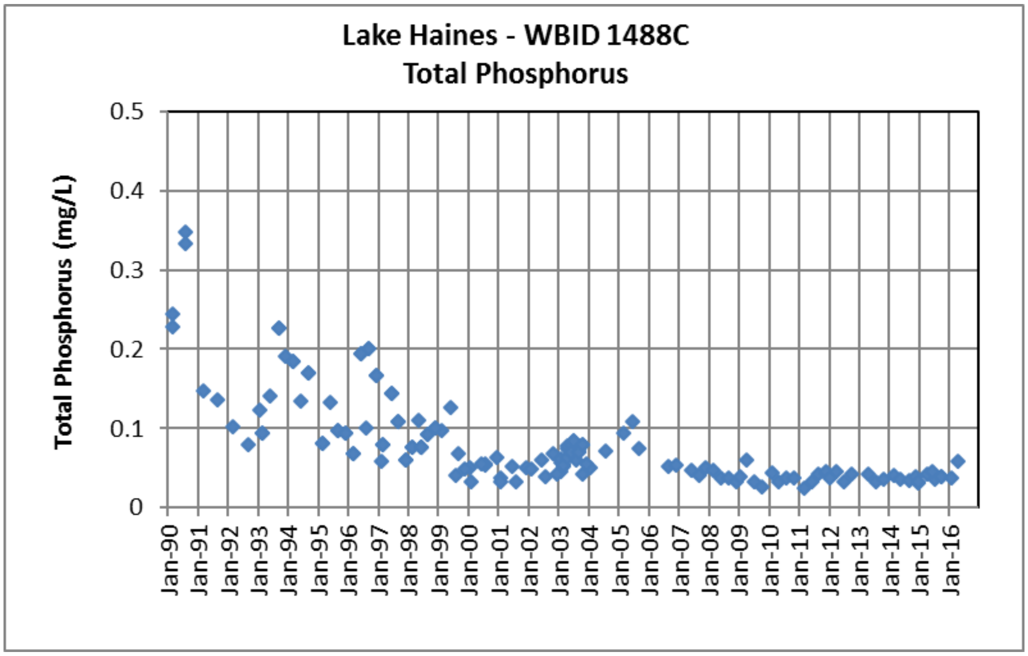


**Figure 2.4. Lake Haines TP Results (1990 to 2016)**

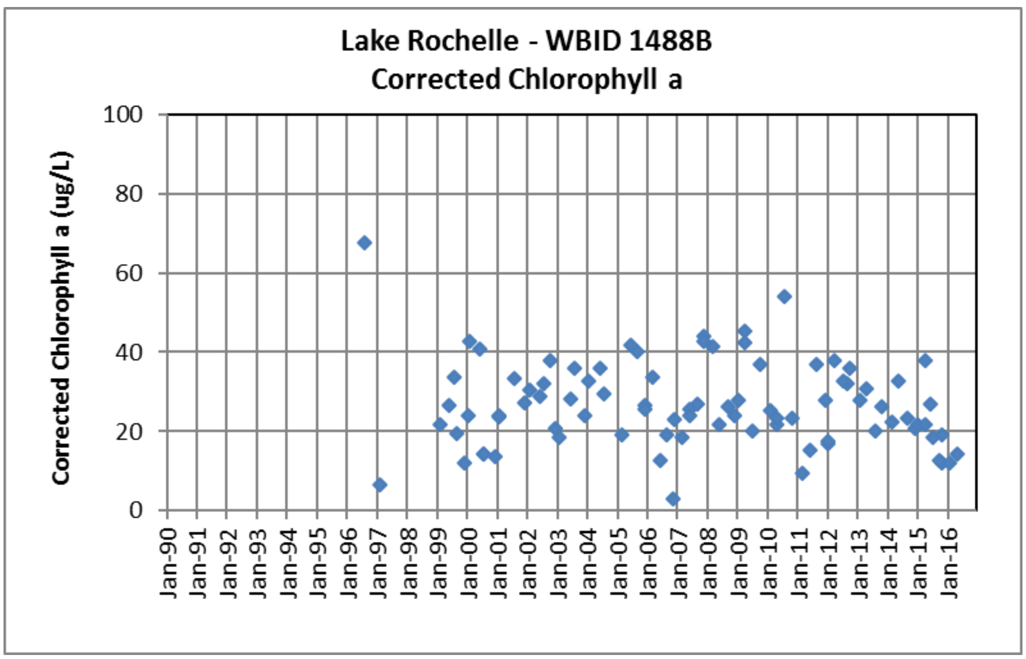


**Figure 2.5. Lake Rochelle Corrected Chlorophyll a Results (1990 to 2016)**

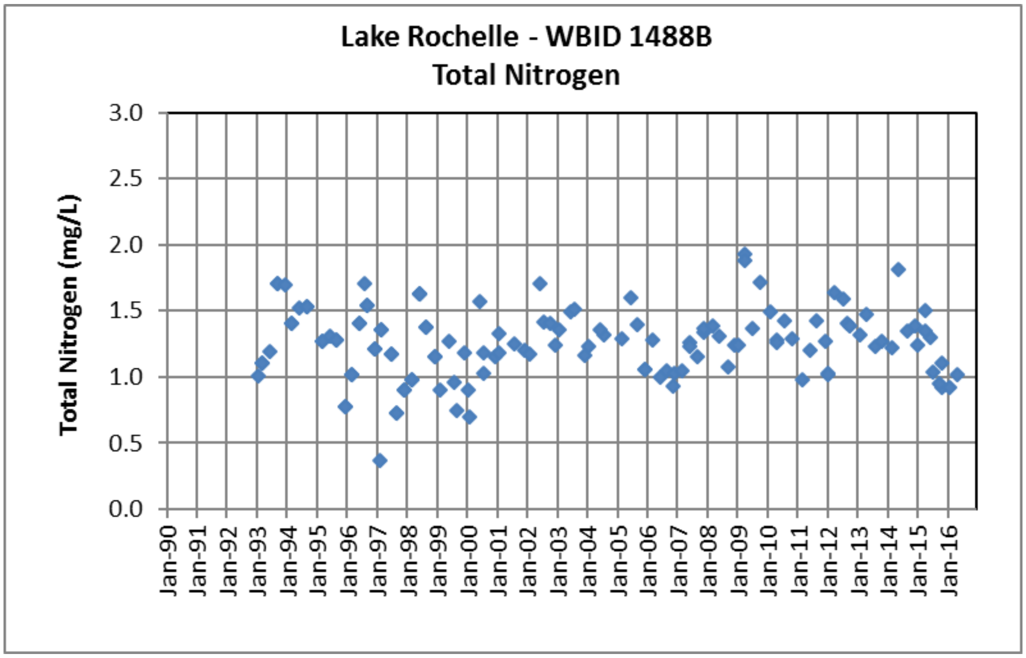


**Figure 2.6. Lake Rochelle TN Results (1990 to 2016)**

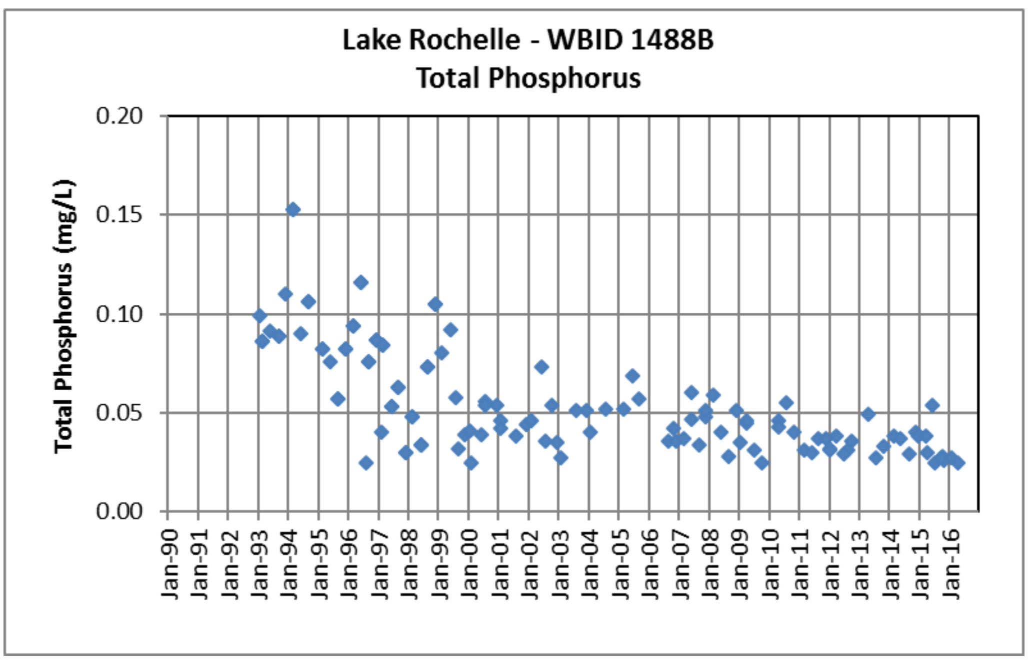


**Figure 2.7. Lake Rochelle TP Results (1990 to 2016)**

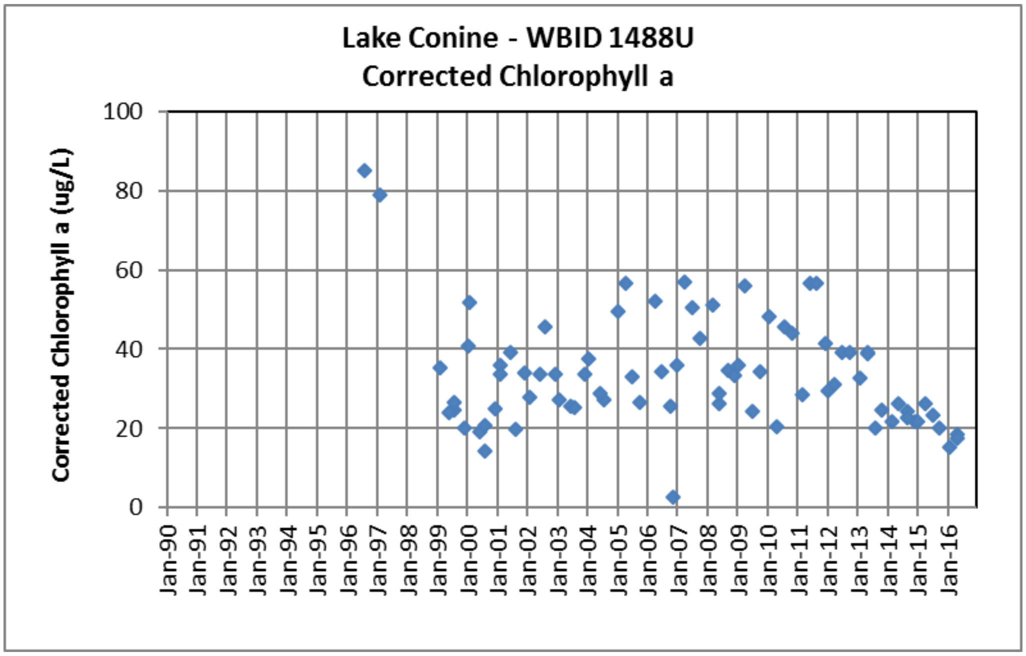


**Figure 2.8. Lake Conine Corrected Chlorophyll a Results (1990 to 2016)**

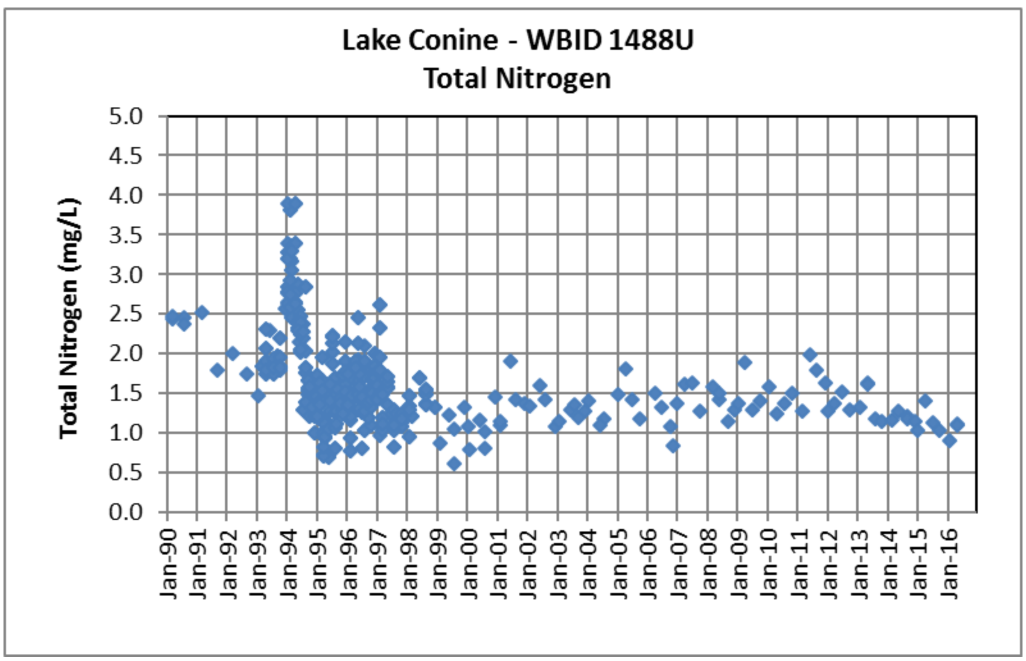


**Figure 2.9. Lake Conine TN Results (1990 to 2016)**

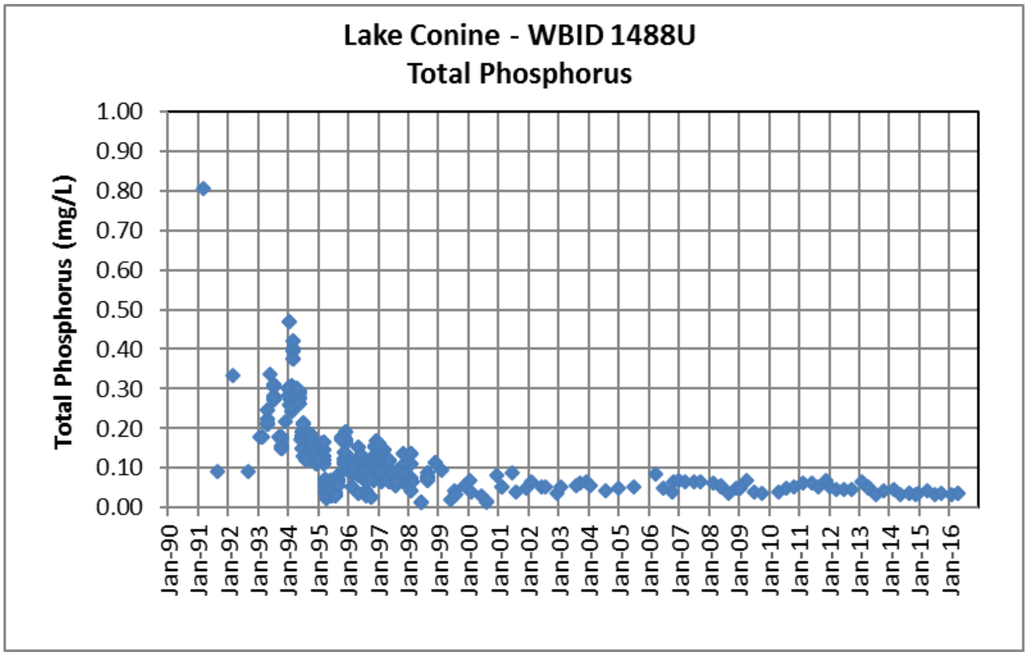


**Figure 2.10. Lake Conine TP Results (1990 to 2016)**

# Chapter 3: Site-Specific Numeric Interpretation of the Narrative Nutrient Criterion

## 3.1 Establishing the Site-Specific Interpretation

The nutrient TMDLs presented in this report, upon adoption into Chapter 62-304.625, F.A.C., will constitute the site-specific numeric interpretations of the narrative nutrient criterion set forth in Paragraph 62-302.530(90)(b), F.A.C., that will replace the otherwise applicable NNC in Subsection 62-302.531(2), F.A.C., for these particular waterbodies, pursuant to Paragraph 62-302.531(2)(a), F.A.C. **Table 3.1** lists the elements of the nutrient TMDLs that constitute the site-specific numeric interpretation of the narrative nutrient criterion. **Appendix B** summarizes the relevant details to support the determination that the TMDLs provide for the protection of Lake Haines, Lake Rochelle, and Lake Conine and for the attainment and maintenance of water quality standards in downstream waters (pursuant to Subsection 62-302.531[4], F.A.C.), and to support using the nutrient TMDLs as the site-specific numeric interpretations of the narrative nutrient criterion.

When developing TMDLs to address nutrient impairment, it is essential to address those nutrients that typically contribute to excessive plant growth. In Florida waterbodies, nitrogen and phosphorus are most often the limiting nutrients. The limiting nutrient is defined as the nutrient(s) that limit plant growth (both macrophytes and algae) 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. In the past, management activities to control lake eutrophication focused on phosphorus reduction as phosphorus was generally recognized as the limiting nutrient in freshwater systems. Recent studies, however, have supported that the reduction of both nitrogen and phosphorus is necessary to control algal growth in aquatic systems (Conley et al. 2009, Paerl 2009, Lewis et al. 2011, Paerl and Otten 2013). Furthermore, the analysis used in the development of the Florida lake NNC support this idea as statistically significant relationships were found between chlorophyll *a* values and both nitrogen and phosphorus concentrations (DEP 2012).

## 3.2 Site-Specific Response Variable Target Selection

The generally applicable chlorophyll *a* criteria for lakes were established by taking into consideration multiple lines of evidence, including; an analysis of lake chlorophyll a concentrations statewide, comparisons to a smaller population of select reference lakes, paleolimnological studies, expert opinions, user perceptions, and biological responses. Based upon these lines of evidence, DEP concluded that an annual average chlorophyll *a* of 20 µg/L in colored or high alkalinity lakes is protective of the designated uses of recreation and aquatic life support (DEP 2012). Color and alkalinity were used as morphoedaphic factors to predict the natural trophic status of lakes. Colored (≥40 PCU), and high alkalinity lakes (≥ 20 mg $CaCO_3$/L) are mesotrophic or eutrophic. The generally applicable chlorophyll *a* criteria are assumed to be protective of individual Florida lakes absent information that shows either 1) more sensitive aquatic life use (*i.e*., more responsive floral community); or, 2) a significant historic change in trophic status (*i.e*., significant increasing trend in color and/or alkalinity). Long-term datasets of color, alkalinity, and nutrients in these lakes suggest that they do not differ from the population of lakes used in the development of the NNC, and therefore DEP has determined that the generally applicable NNC criteria are the most appropriate site-specific chlorophyll *a* criteria.

In the assessment using statewide NNC, DEP allows for an acceptable range of AGMs of TN and TP, up to the values shown in the "maximum calculated numeric interpretation" column, as long as the applicable chlorophyll *a* criterion is achieved in that same year. These numeric interpretations for TN, TP, and chlorophyll *a* cannot be exceeded more than once in any consecutive calendar three-year period and apply statewide. If there are insufficient data to calculate the AGM chlorophyll *a* for a given year or the AGM chlorophyll *a* exceeds the values for the lake type, then the applicable numeric interpretations for TN and TP are the minimum values in the table. If there are sufficient data to calculate the AGM chlorophyll *a* and the mean does not exceed the chlorophyll *a* value for the lake type, then the TN and TP numeric interpretations for that calendar year are the AGMs of ambient TN and TP samples for that lake, subject to the minimum and maximum TN and TP.

The TN and TP concentrations identified as the site-specific criteria were in part determined by using a regression approach to achieve the applicable chlorophyll *a* criterion (explained in **Chapter 5**).

## 3.3 Numeric Expression of the Site-Specific Numeric Interpretation

An empirical equation describing the relationships between chlorophyll *a* and nutrient concentrations (TN and TP), using the AGM values for all three lakes, was used in the TMDL development approach, explained in detail in **Chapter 5**. This approach uses the regression relationships between nutrients and chlorophyll *a*, based on the sampling location in each lake with the most comprehensive dataset, to assist in setting restoration target concentrations. Additionally, the selection of nutrient targets takes into consideration downstream protection and site-specific paleolimnological results for TP, documented in **Chapter 5**. The target concentrations are then used to determine percent reductions in the in-lake concentrations for the period from 2003 to 2016.

The nutrient criteria are all expressed as AGM concentrations in these three lakes. The chlorophyll *a* concentration is expressed as an AGM concentration not to be exceeded more than once in any consecutive three-year period. The TN and TP concentrations are expressed as AGM concentrations never to be exceeded. **Table 3.1** summarizes the nutrient concentration targets for the three lakes.

### Table 3.1. Site-specific interpretations of the narrative nutrient criterion

**Note:** Frequency refers to the time interval not to be exceeded. Chlorophyll *a* shall not be exceeded more than once in any consecutive three-year period. TN and TP are never to be exceeded.

| Waterbody/ WBID | AGM Chlorophyll *a* (µg/L) | Chlorophyll *a* Frequency | AGM TN (mg/L) | TN Frequency | AGM TP (mg/L) | TP Frequency |
|---|---|---|---|---|---|---|
| **Lake Conine/ 1488U** | 20 | Once in a three-year period | 1.05 | No exceedance | 0.03 | No exceedance |
| **Lake Rochelle/ 1488B** | 20 | Once in a three-year period | 1.05 | No exceedance | 0.03 | No exceedance |
| **Lake Haines/ 1488C** | 20 | Once in a three-year period | 1.05 | No exceedance | 0.03 | No exceedance |

## 3.4 Downstream Protection

The general direction of flow is from the northernmost lake, Lake Haines, to Lake Conine in the south. The outlet for Lake Conine conveys water to Lake Smart, which is classified as a low-color (<40 PCU), high-alkalinity (> 20 mg/L $CaCO_3$) lake. The regression analysis indicates that a TN AGM of 1.17 mg/L and a TP AGM of 0.03 mg/L (based on paleolimnological results) will achieve the chlorophyll *a* criterion of 20 µg/L in Lake Haines, Lake Rochelle, and Lake Conine. However, the generally applicable NNC for Lake Smart immediately downstream are a TN concentration of 1.05 mg/L and a TP concentration of 0.03 mg/L. To protect water quality in Lake Smart, the TN target is 1.05 mg/L.

In the cycle 3 assessment period, Lake Smart had sufficient nutrient data to determine that designated uses might not be attained according to the IWR planning list methodology (based on chlorophyll *a*, total nitrogen, and total phosphorus exceedances of the NNC), however, there were insufficient nutrient data available to include the lake on the verified list of impaired waters. A multiple regression model was developed using Lake Smart AGM results in the 1999 to 2015 period. To identify a potential TN water quality target, the regression model equation explaining the relationship of chlorophyll *a* to TN and TP was applied. Using the equation, a TN AGM of 1.21 mg/L, associated with a TP target of 0.03 mg/L, results in achieving a chlorophyll *a* AGM of 20 µg/L. This method shows the selected TN target is protective of Lake Smart water quality.

## 3.5 Endangered Species Consideration

Section 7(a)(2) of the Endangered Species Act (ESA) requires each federal agency, in consultation with the services (i.e., the U.S. Fish and Wildlife Service [FWS] and the U.S. National Oceanic and/or Atmospheric Administration [NOAA], National Marine Fisheries Service [NMFS]), to ensure that any action authorized, funded, or carried out is not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of designated critical habitat. The EPA must review and approve changes in water quality standards (WQS), such as setting site-specific criteria. Prior to approving WQS changes for aquatic life criteria, the EPA will prepare an Effect Determination summarizing the direct or indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action. The EPA categorizes potential effect outcomes as either (1) "no effect," (2) "may affect, not likely to adversely affect," or (3) "may affect: likely to adversely affect."

The service(s) must concur on the Effect Determination before the EPA approves a WQS change. A finding and concurrence by the service(s) of "no effect" will allow the EPA to approve an otherwise approvable WQS change. However, findings of either "may affect, not likely to adversely affect" or "may affect: likely to adversely affect" will result in a longer consultation process between the federal agencies and may result in a disapproval or a required modification to the WQS change.

DEP is not aware of any endangered species present in the Northern Chain of Lakes. Furthermore, it is expected that water quality improvements resulting from these restoration efforts will positively affect aquatic species living in the lakes and their respective watersheds.

# 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 target 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 septic systems; and atmospheric deposition.

However, the 1987 amendments to the CWA 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, such as those from local government master drainage systems, construction sites over five acres, and a wide variety of industries (see **Appendix A** for background information on the federal and state stormwater programs).

To be consistent with CWA 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 (see **Section 6.1** on **Expression and Allocation of the TMDL**). However, the methodologies used to estimate nonpoint source loads do not distinguish between NPDES and non-NPDES stormwater discharges, and as such, this source assessment section does not make any distinction between the two types of stormwater.

## 4.2 Point Sources

### 4.2.1 Wastewater Point Sources

There are no NPDES-permitted domestic or industrial wastewater facilities discharging in the watersheds of the three lakes.

### 4.2.2 Municipal Separate Storm Sewer System (MS4) Permittees

The Lake Haines, Lake Rochelle, and Lake Conine Watersheds are covered by a Polk County NPDES MS4 Phase I permit (FLS000015). The Florida Department of Transportation (FDOT) District 1 and the Cities of Winter Haven and Lake Alfred are co-permittees in the MS4 permit. For additional information on MS4 facilities in the watersheds, email NPDES-stormwater@dep.state.fl.us. **Table 4.1** lists the permittees/co-permittees and their MS4 permit numbers.

**Table 4.1. NPDES MS4 permits with jurisdiction in the Lake Haines, Lake Rochelle, and Lake Conine Watersheds**

| Permit Number | Permittee/Co-Permittees | Phase |
|---|---|---|
| **FLS000015** | Polk County | I |
| **FLS266701** | City of Lake Alfred | I |
| **FLS266761** | City of Winter Haven | I |
| **FLS266779** | FDOT District 1 – Polk | I |

## 4.3 Nonpoint Sources

Pollutant sources that are not NPDES wastewater or stormwater dischargers are generally considered nonpoint sources. Nutrient loadings to Lakes Haines, Rochelle, and Conine are primarily generated from nonpoint sources. Nonpoint sources addressed in this analysis primarily include loadings from surface runoff, groundwater seepage entering the lakes, and precipitation directly onto the lake surface (atmospheric deposition).

### 4.3.1 Land Uses

Land use is one of the most important factors in determining the level of nutrient loadings from a watershed. Nutrients can be flushed into a receiving water through surface runoff and stormwater conveyance systems during stormwater events. Both human land use areas and natural land areas generate nutrients. However, human land uses typically generate more nutrient loads per unit of land surface area than natural lands can produce. **Tables 4.2** through **4.4** list 2011 land use in the Lake Haines, Lake Rochelle, and Lake Conine Watersheds, respectively, based on data from the SWFWMD, and **Figure 4.1** shows the information graphically.

In the Lake Haines and Lake Rochelle Watersheds, the largest anthropogenic land use is agriculture, making up 25 % and 11 % of the watershed areas, respectively. Wetlands make up 38 % and 29 % of each watershed area, respectively. In the Lake Conine Watershed, the dominant land use is medium-density residential, which comprises one-third of the watershed area.

**Table 4.2. SWFWMD land use in the Lake Haines Watershed in 2011**

| Land Use Code | Land Use Classification | Acres | % of Watershed |
|---|---|---|---|
| **1100** | Low-Density Residential | 224 | 4.2 |
| **1200** | Medium-Density Residential | 152 | 2.9 |
| **1300** | High-Density Residential | 321 | 6.0 |
| **1400** | Commercial | 43 | 0.8 |
| **1500** | Light Industrial | 49 | 0.9 |
| **1700** | Institutional | 27 | 0.5 |
| **1800** | Recreational | 115 | 2.2 |
| **1900** | Open Land | 125 | 2.4 |
| **2000** | Agriculture | 1,343 | 25.3 |
| **4000** | Forest/Rural Open | 80 | 1.5 |
| **5000** | Water | 718 | 13.5 |
| **6000** | Wetlands | 2,037 | 38.4 |
| **8000** | Communication and Transportation | 72 | 1.4 |
| **Total** | | **5,307** | **100** |

**Table 4.3. SWFWMD land use in the Lake Rochelle Watershed in 2011**

| Land Use Code | Land Use Classification | Acres | % of Watershed |
|---|---|---|---|
| **1100** | Low-Density Residential | 42 | 2.4 |
| **1200** | Medium-Density Residential | 179 | 10.3 |
| **1300** | High-Density Residential | 7 | 0.4 |
| **1400** | Commercial | 34 | 2.0 |
| **1500** | Light Industrial | 26 | 1.5 |
| **1700** | Institutional | 9 | 0.5 |
| **1800** | Recreational | 0 | 0.0 |
| **1900** | Open Land | 149 | 8.6 |
| **2000** | Agriculture | 187 | 10.8 |
| **4000** | Forest/Rural Open | 41 | 2.4 |
| **5000** | Water | 523 | 30.2 |
| **6000** | Wetlands | 501 | 29.0 |
| **8000** | Communication and Transportation | 30 | 1.7 |
| **Total** | | **1,728** | **100** |

**Table 4.4. SWFWMD land use in the Lake Conine Watershed in 2011**

| Land Use Code | Land Use Classification | Acres | % of Watershed |
|---|---|---|---|
| **1100** | Low-Density Residential | 15 | 1.8 |
| **1200** | Medium-Density Residential | 266 | 33.2 |
| **1300** | High-Density Residential | 10 | 1.2 |
| **1400** | Commercial | 52 | 6.5 |
| **1500** | Light Industrial | 19 | 2.4 |
| **1700** | Institutional | 58 | 7.3 |
| **1800** | Recreational | 2 | 0.2 |
| **1900** | Open Land | 19 | 2.4 |
| **2000** | Agriculture | 11 | 1.3 |
| **4000** | Forest/Rural Open | 1 | 0.1 |
| **5000** | Water | 213 | 26.6 |
| **6000** | Wetlands | 89 | 11.0 |
| **8000** | Communication and Transportation | 47 | 5.9 |
| **Total** | | **802** | **100** |

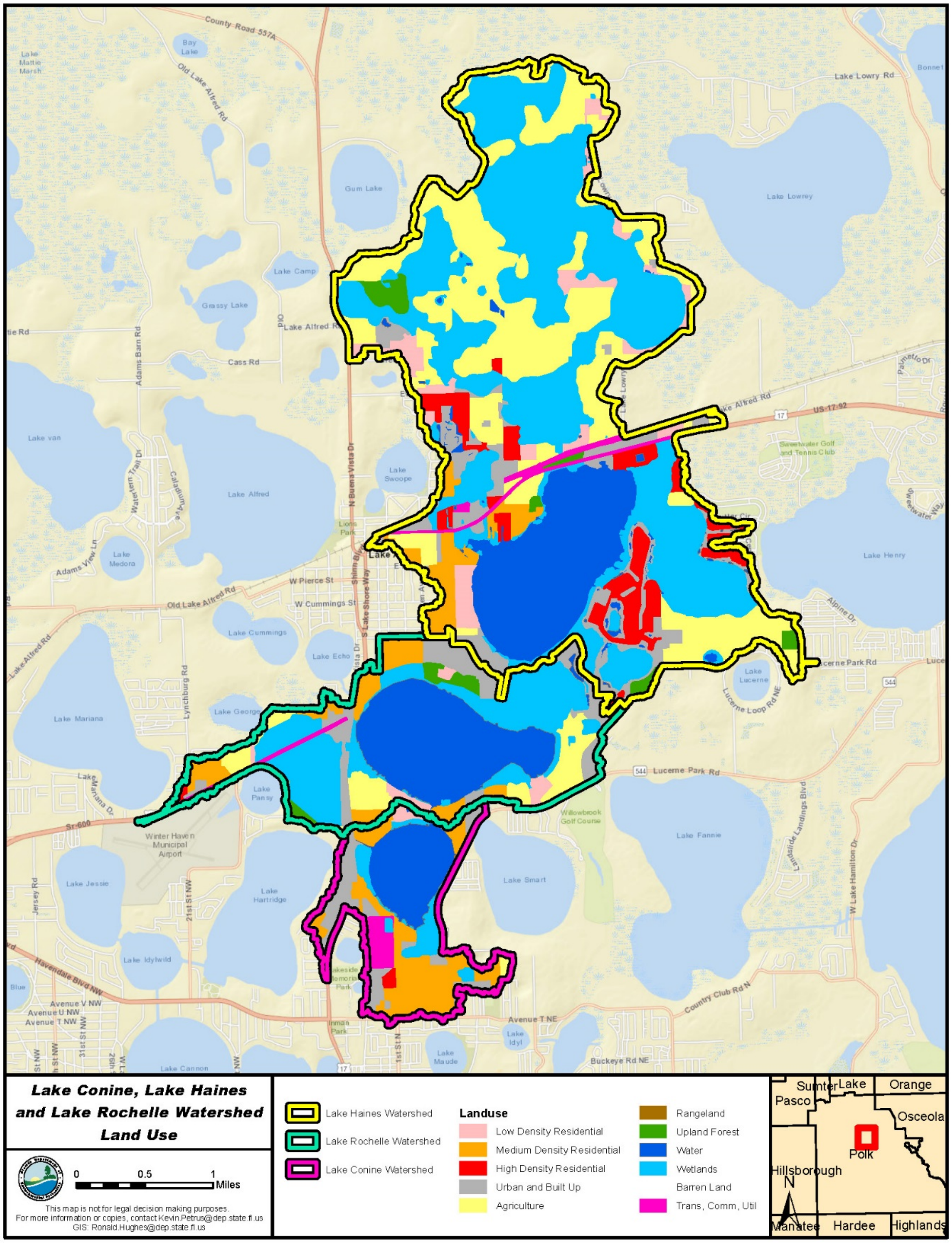


**Figure 4.1. Land use in the Lake Haines, Lake Rochelle, and Lake Conine Watersheds in 2011**

### 4.3.2 Onsite Sewage Treatment and Disposal Systems (OSTDS)

OSTDS, including septic tanks, are commonly used where providing central sewer service is not cost-effective or practical. When properly sited, designed, constructed, maintained, and operated, OSTDS 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. OSTDS can be a source of nutrients (nitrogen and phosphorus), pathogens, and other pollutants to both groundwater and surface water. **Figure 4.2** shows the locations of OSTDS in the Lake Haines, Rochelle, and Conine Watersheds.

Currently, the number of septic tanks in the Lake Haines, Rochelle, and Conine Watersheds are calculated at 318, 301, and 301, respectively.

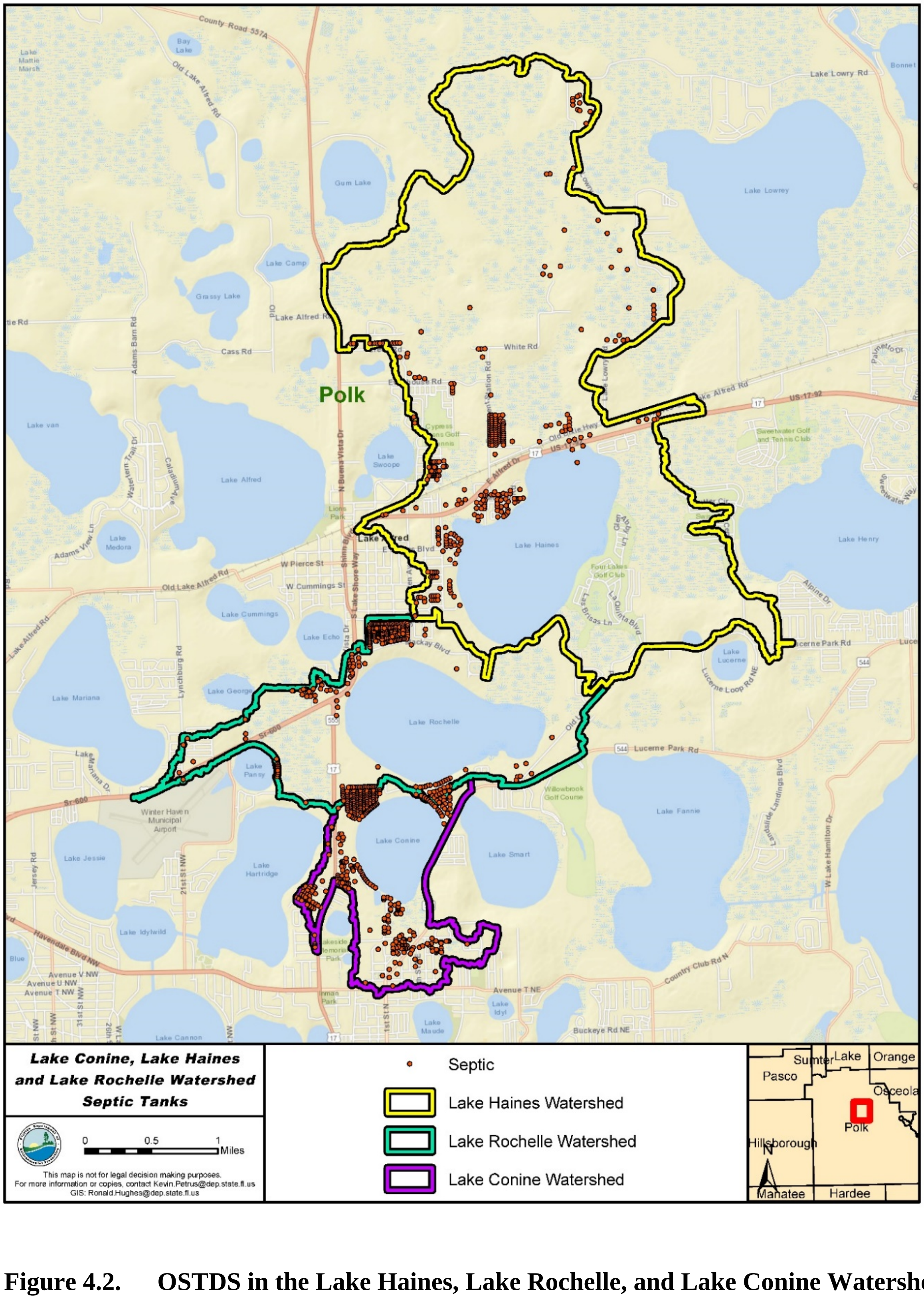


**Figure 4.2. OSTDS in the Lake Haines, Lake Rochelle, and Lake Conine Watersheds**

# Chapter 5: Determination of Assimilative Capacity

## 5.1 Determination of Loading Capacity

Nutrient enrichment and the resulting problems related to eutrophication tend to be widespread and are frequently manifested far (in both time and space) from their sources. Addressing eutrophication involves relating water quality and biological effects such as photosynthesis, decomposition, and nutrient recycling as acted on by environmental factors (rainfall, point source discharge, etc.) to the timing and magnitude of constituent loads supplied from various categories of pollution sources. Assimilative capacity should be related to some specific hydrometeorological condition during a selected period or to some range of expected variation in these conditions.

The goal of this TMDL analysis is to determine the assimilative capacity of Lakes Haines, Rochelle, and Conine and to identify the maximum allowable TN and TP lake concentrations and the associated nutrient source reductions, so that the lakes will meet the TMDL targets and thus maintain their function and designated use as Class III freshwaters.

## 5.2 Evaluation of Water Quality Conditions

Water quality monitoring for nutrients in the three lakes in recent years has been performed primarily by three organizations: Polk County (21FLPOLK…), SWFWMD (21FLSWFD…), and DEP Southwest District (21FLTPA…). The majority of the available nutrient data come from the monitoring conducted by Polk County. The county has routinely sampled at the center of each lake since 1993: Lake Haines at Station 21FLPOLKHAINES1, Lake Rochelle at Station 21FLPOLKROCHELLE1, and Lake Conine at Station 21FLPOLKCONNINE1. The other sampling organizations have conducted monitoring intermittently for short periods.

The results collected at the Polk County sampling locations near the center of each lake were evaluated to determine if relationships exist between nutrient concentrations and chlorophyll *a* levels. The county monitoring near the lake center provides a consistent dataset for evaluating surface water quality. The county is the only organization that has routinely sampled the lakes over an extended period. The nutrient and corrected chlorophyll *a* AGMs were used in this evaluation to be consistent with the expression of the adopted NNC for lakes. In 1999, the county began sampling for corrected chlorophyll *a*, which is the more common form of chlorophyll *a* used in assessing surface water quality. For this analysis, the geometric means for each year were calculated using a minimum of two Polk County sample results per year, collected in different quarters, with at least one of the results collected in the May to September time frame. From 1999 to 2015, sufficient results were collected in each year to calculate AGM values for corrected chlorophyll *a* and nutrients for all three lakes.

**Figure 5.1** shows the corrected chlorophyll a AGM values from 1999 to 2015. Overall, Lake Conine exhibited the highest chlorophyll *a* results, which varied from 23 to 46 μg/L. The chlorophyll *a* values for Lake Rochelle ranged from 18 to 33 μg/L, and for Lake Haines, from 17 to 38 μg/L.

**Figure 5.2** displays the TN AGM results from 1999 to 2015. Generally, the AGMs for all 3 lakes were within 0.1 to 0.4 mg/L of each other on an annual basis. Over the period, Lakes Conine and Haines had slightly higher TN values than Lake Rochelle. The results varied from 1.09 to 1.65 mg/L in Lake Conine, 1.04 to 1.60 mg/L in Lake Rochelle, and 1.26 to 1.55 mg/L in Lake Haines.

**Figure 5.3** shows the TP AGM values from 1999 to 2015. Lake Conine had slightly higher AGMs in this period compared with the other lakes. Values ranged from 0.03 to 0.07 mg/L in Lake Conine, 0.03 to 0.06 mg/L in Lake Rochelle, and 0.04 to 0.09 mg/L in Lake Haines.

**Figure 5.4** presents the color AGM results. Lake Haines exhibited higher color values than the other lakes, which ranged from 23 to 170 PCU. The color results ranged from 22 to 57 PCU in Lake Conine, and from 18 to 78 PCU in Lake Rochelle. The Lake Haines Watershed had the highest percentage of wetlands at 38 %, compared with the watersheds of Lakes Rochelle and Conine.

Using the AGM results, the relationships between water quality and lake levels were evaluated. **Figure 5.5** shows the results of a comparison of lake color AGM values and average annual lake levels. Color in all 3 lakes generally increased when the water level exceeded 128 ft. Above this level, the increase in color in Lake Haines was more pronounced than in Lakes Rochelle and Conine. **Figure 5.6** shows chlorophyll a AGM values and lake levels. There is no apparent relationship between chlorophyll a AGM values and water levels in all three lakes.

The AGM results for chlorophyll a, TN, and TP (**Figures 5.1** through **5.3**, respectively) indicate that the nutrient conditions in the lakes are similar. The navigable canals connecting these lakes allows for the exchange of water between them. Additionally, the relationships of chlorophyll *a* and TP (**Figure 5.7**) and chlorophyll *a* and TN (**Figure 5.8**) show a significant positive response of chlorophyll *a* to nutrient concentrations when the results for all three lakes are combined ($p$ values $< 0.05$).

As nutrient conditions are similar in the lakes and the applicable chlorophyll a target criteria appropriate for these lakes is the same (20 μg/L), the water quality results for the lakes were combined to derive a nutrient target. Additionally, paleolimnological results for Lakes Haines and Conine indicate that phosphorus levels prior to disturbance by human development were similar in this group of lakes. The paleolimnological study TP results were applied to establish a water quality target for TP. The method used to address the nutrient impairment included the development of a multiple regression equation that relates lake nutrient concentrations to the AGM chlorophyll *a* levels, using the results from all three lakes.

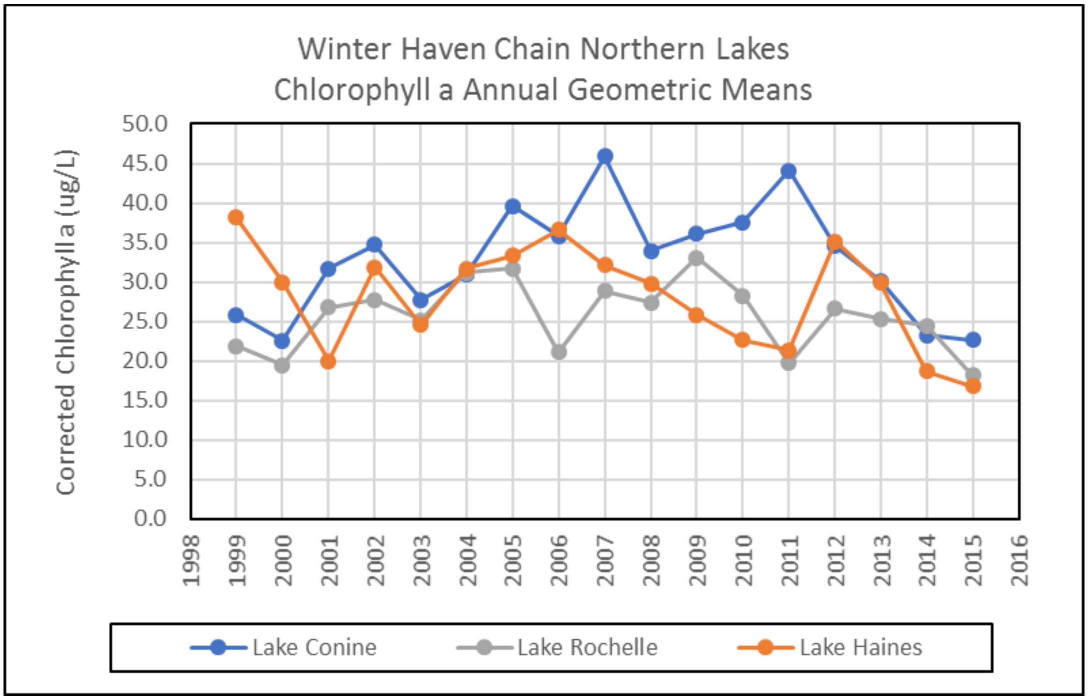


**Figure 5.1. Corrected chlorophyll *a* AGM values in Lake Haines, Lake Rochelle, and Lake Conine**

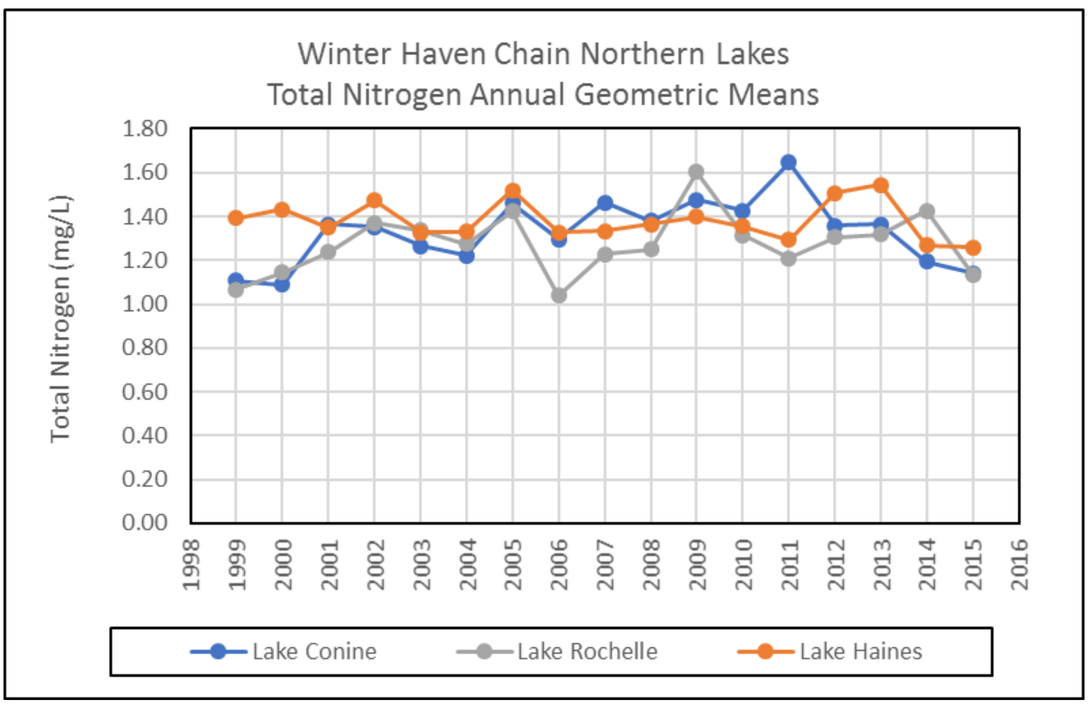


**Figure 5.2. TN AGM values in Lake Haines, Lake Rochelle, and Lake Conine**

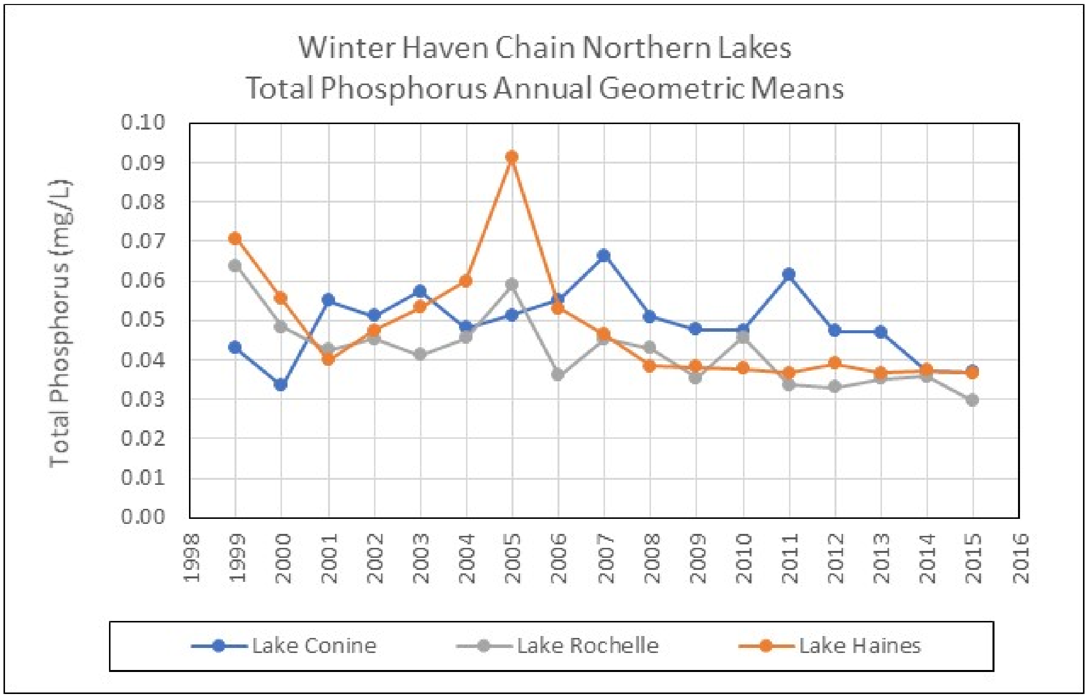


**Figure 5.3. TP AGM values in Lake Haines, Lake Rochelle, and Lake Conine**

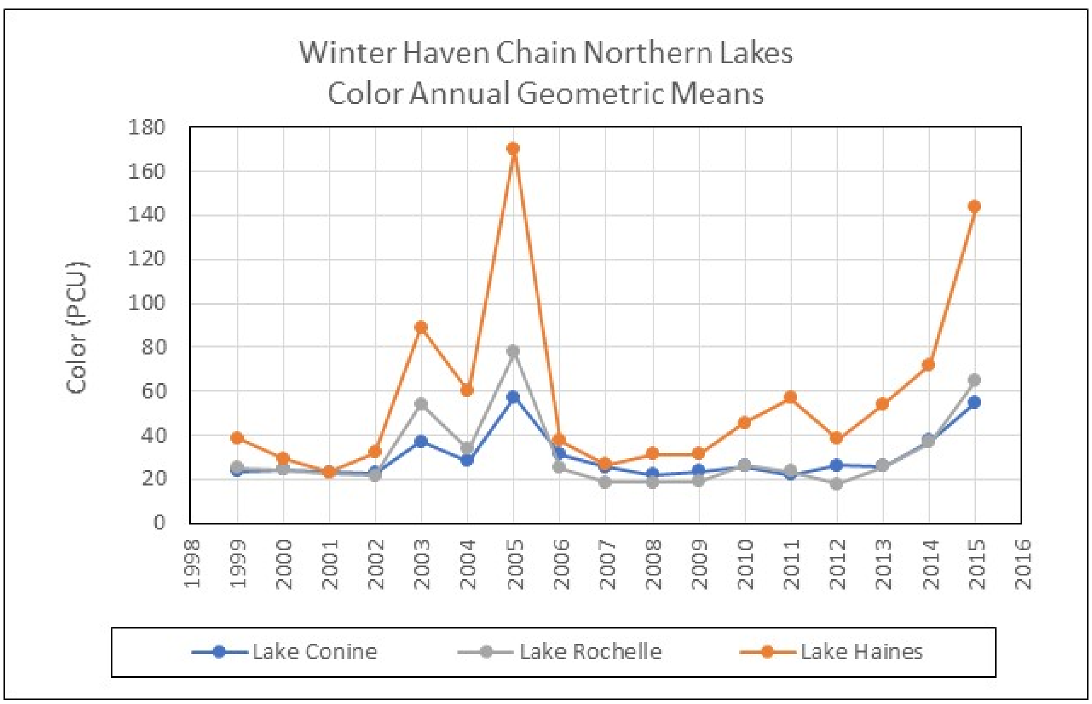


**Figure 5.4. Color AGM results in Lake Haines, Lake Rochelle, and Lake Conine**

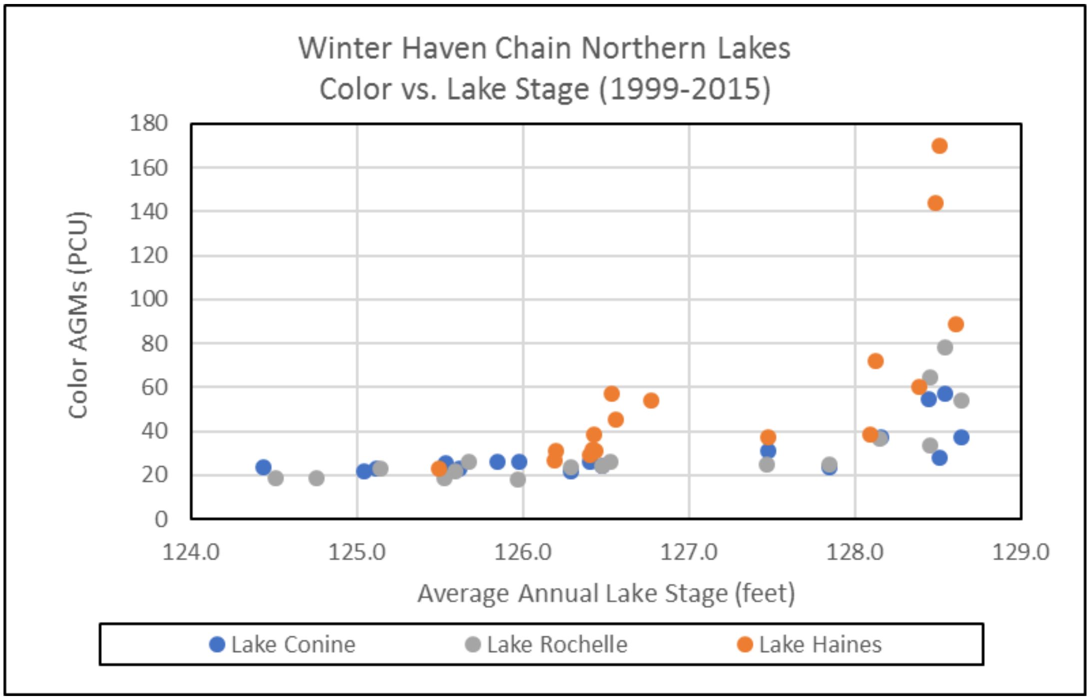


**Figure 5.5. Relationship between color AGM results and lake levels**

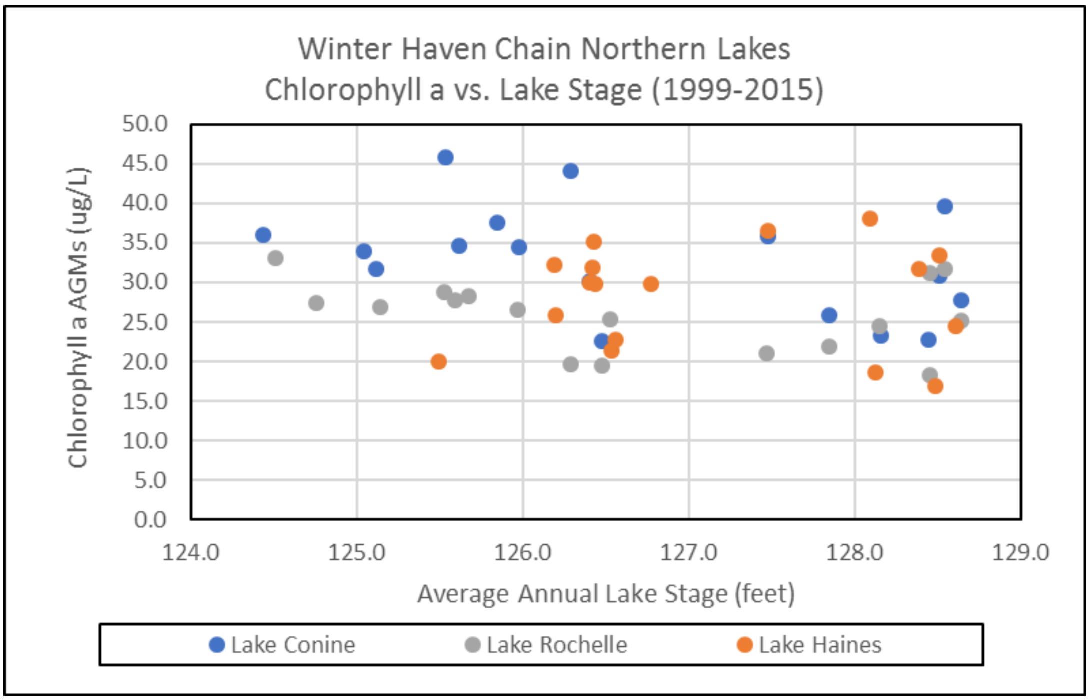


**Figure 5.6. Relationship between chlorophyll *a* AGM results and lake levels**

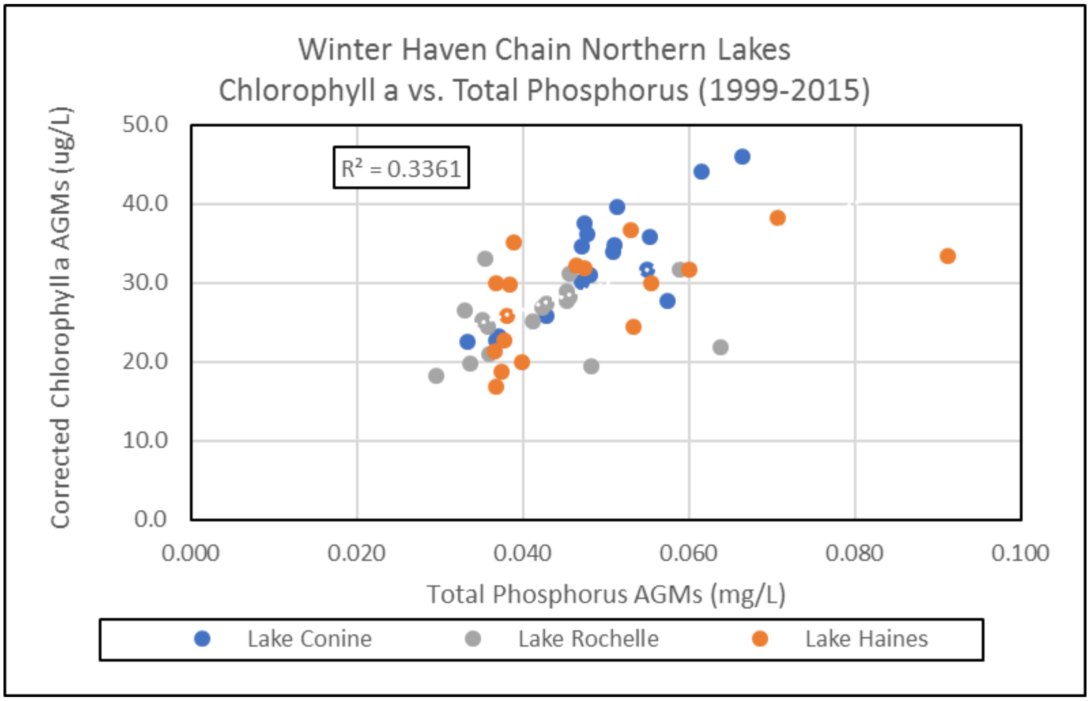


**Figure 5.7. Relationship between AGM results for chlorophyll *a* and TP**

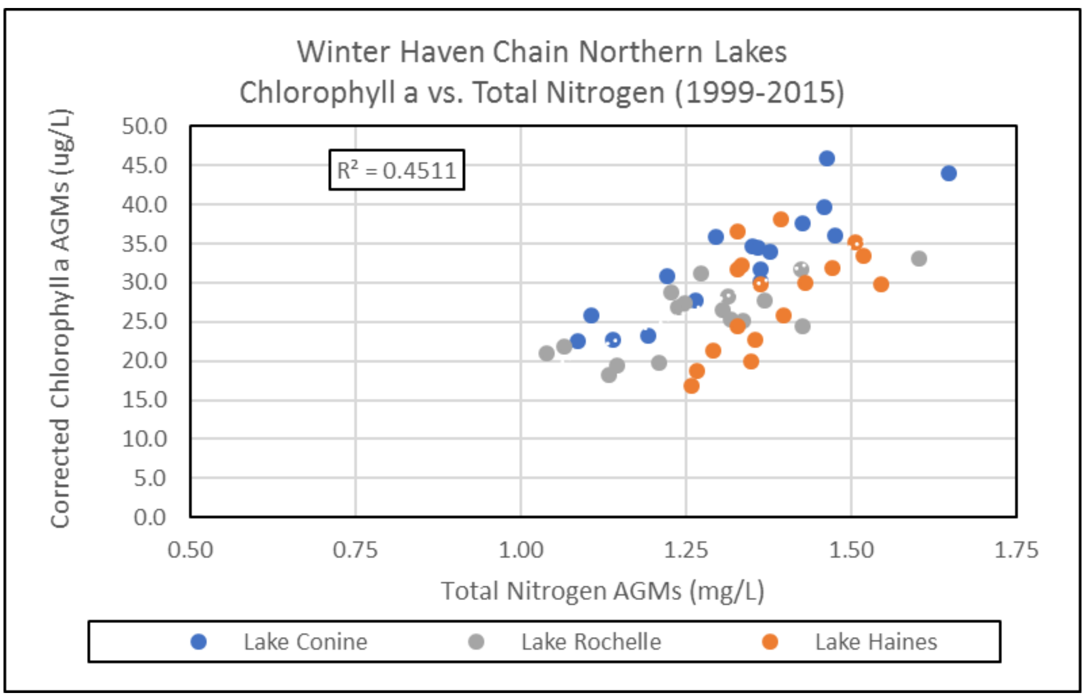


**Figure 5.8. Relationship between AGM results for chlorophyll *a* and TN**

Invasive aquatic plants occur within Lakes Haines, Rochelle, and Conine (most notably hydrilla, water hyacinth, and water lettuce) and herbicide treatment is conducted at times to control the spread of these plants in the lakes. This practice may enhance the cycling of nutrients within the lake, as the decomposition of dead plant material leads to the release of nutrients into the water column which can be a nutrient source for the phytoplankton community. Herbicide treatment information (acres treated and targeted vegetation) performed since 2007 was obtained from the Polk County Parks and Natural Resources Office and compared to the lake chlorophyll *a* results in each lake, **Figures 5.9, 5.10, and 5.11**. Since the year 2007, there have been thirty-six herbicide treatment events in Lake Haines, forty treatment events in Lake Rochelle, and thirty treatment events in Lake Conine. During the 2007 to 2016 period, six of the treatments events in each lake covered more than 10 percent of the lake surface area.

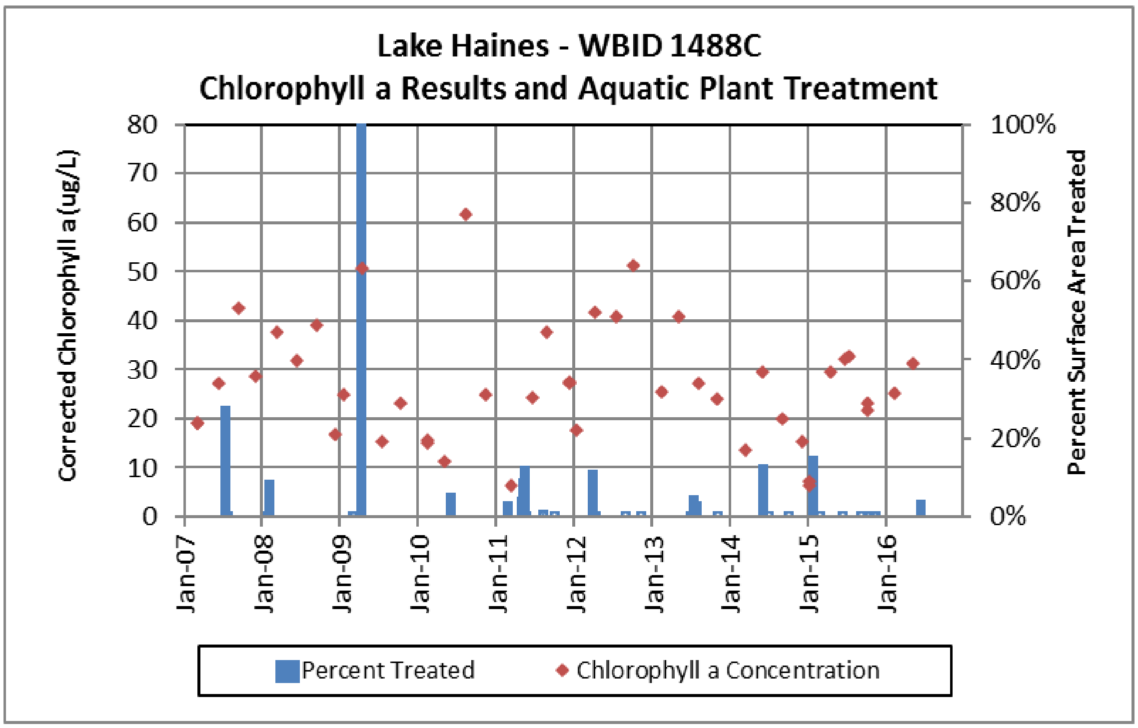


**Figure 5.9 Lake Haines Chlorophyll a Results and Lake Area Treated for Invasive Aquatic Plant Growth.**

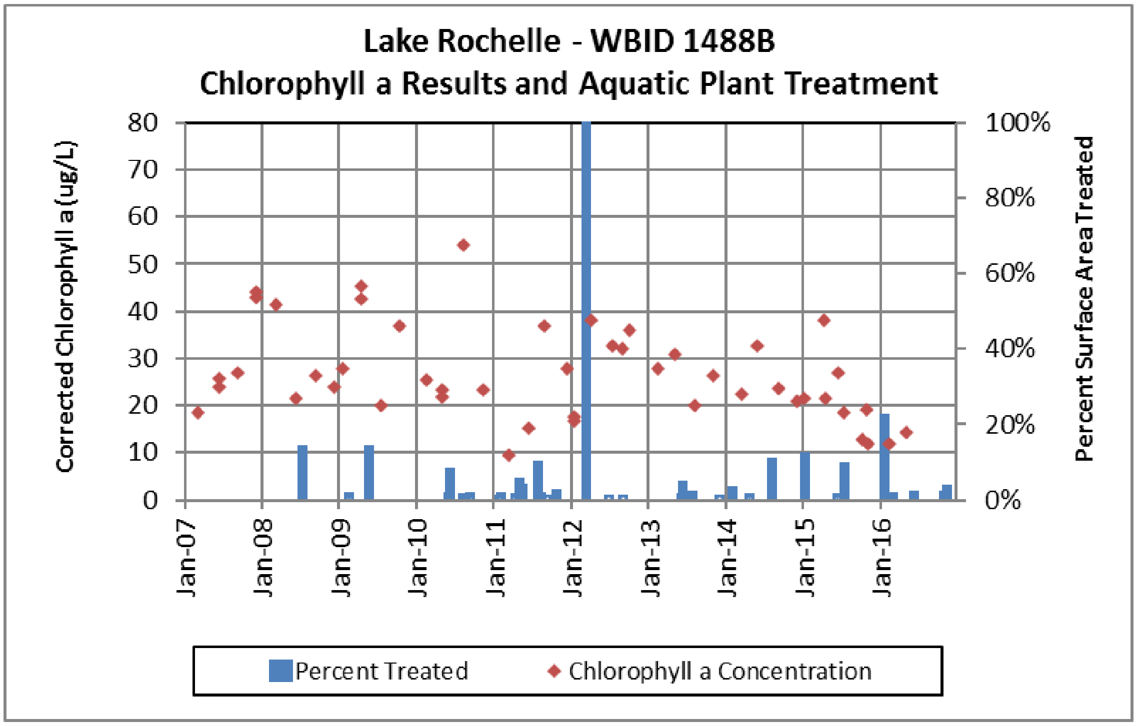


**Figure 5.10** **Lake Rochelle Chlorophyll a Results and Lake Area Treated for Invasive Aquatic Plant Growth.**

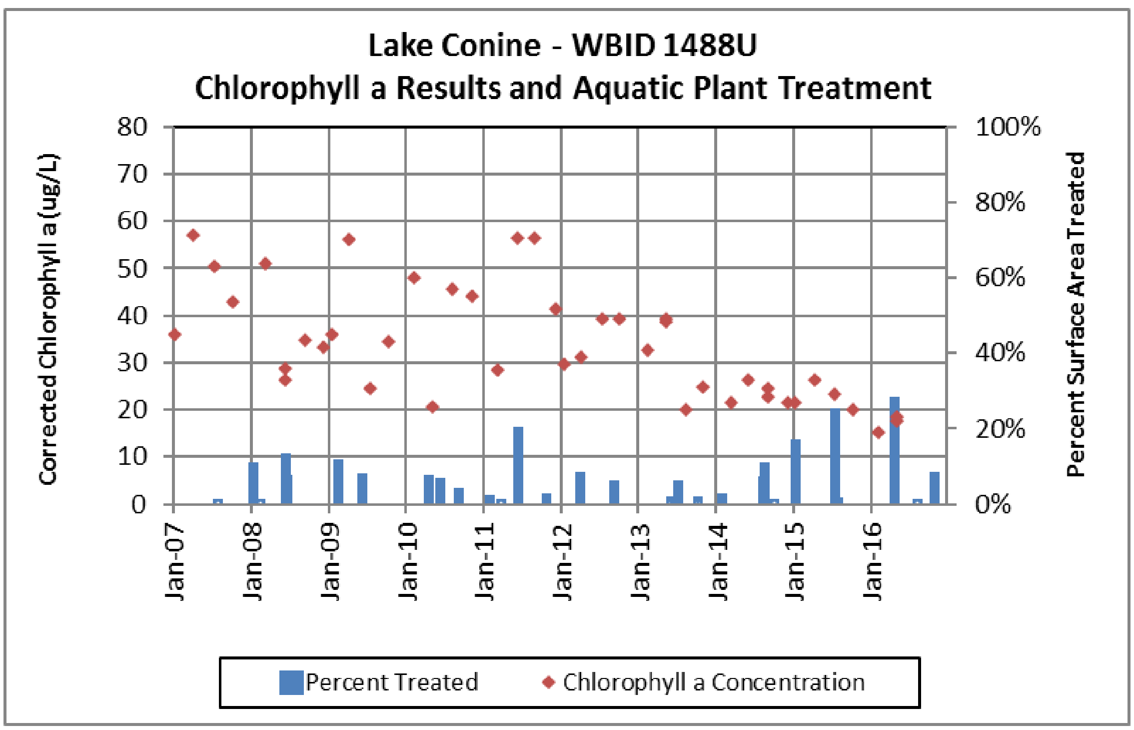


**Figure 5.11** **Lake Conine Chlorophyll a Results and Lake Area Treated for Invasive Aquatic Plant Growth.**

## 5.3 Critical Conditions and Seasonal Variation

The estimated assimilative capacity is based on annual conditions, rather than critical/seasonal conditions, because (1) the methodology used to determine assimilative capacity does not lend itself very well to short-term assessments; (2) DEP is generally more concerned with the net change in overall primary productivity in the waterbody, which is better addressed on an annual basis; and (3) the methodology used to determine impairment is based on annual conditions (AGM values).

## 5.4 Water Quality Analysis to Determine Assimilative Capacity

A multiple regression model was developed, using the nutrient results from all three lakes, to derive an equation that relates TN and TP AGM concentrations to chlorophyll *a* AGM concentrations. The model was developed using the log-transformed corrected chlorophyll *a*, TN, and TP AGM concentrations calculated from Polk County lake measurements recorded from 1999 to 2015. The results of the multiple regression analyses show a significant relationship between in-lake chlorophyll *a* and nutrient concentrations. The results of this relationship are presented in **Appendix C**, and the resultant equation is as follows:

***Log of Chlorophyll a AGM = 1.92 + 1.20 * Log of TN AGM + 0.46 * Log of TP AGM***

The TP water quality target for the three lakes was derived using the pre-disturbance inferred water quality from paleolimnological study results measured in Lake Haines and Lake Conine (Whitmore 2003). The study estimated pre-disturbance average TP levels by applying two statistical models that are based on sedimented diatoms and calibrated using a large number of Florida lakes (Whitmore 1989, Line et al. 1994). The predicted average TP results from the maximum sediment core depth analyzed (95 to 100 centimeter [cm] depth), which equates to pre-disturbance conditions, were 29.8 µg/L (0.0298 mg/L) for Lake Haines and 35.7 µg/L (0.0357 mg/L) for Lake Conine.

Since the pre-disturbance TP results represent an estimate of average conditions, a method was applied to relate averages to geometric means using the lake dataset applied in NNC development. Using all the statewide lake TP data, which were applied in the development of the lake NNC thresholds, (DEP 2012), the comparison of average and geometric mean values shows a strong linear relationship (**Figure 5.9**). The expression of this relationship in the form of an equation is TP geometric mean = TP average * 0.9373. In the case of Lake Haines, the pre-disturbance average TP value is equivalent to a geometric mean of 0.028 mg/L. For Lake Conine, the pre-disturbance TP value, expressed as a geometric mean, is 0.033 mg/L. For TMDL development, a TP value of 0.03 mg/L expressed as a geometric mean is identified as the water quality target.

As discussed in **Chapter 3**, the NNC chlorophyll *a* threshold of 20 µg/L, expressed as an AGM, was selected as the response variable target for TMDL development. The paleolimnological results provided a TP concentration target. To identify a TN water quality target, the regression equation explaining the relationship of chlorophyll *a* to TN and TP was used to determine the TN concentration necessary to meet the chlorophyll *a* target of 20 µg/L. A TN geometric mean of 1.17 mg/L, associated with the TP target of 0.03 mg/L, results in a chlorophyll *a* AGM of 20 µg/L. As indicated in **Chapter 3**, Lake Smart is downstream of the three lakes, and the generally applicable NNC for Lake Smart are a TN concentration of 1.05 mg/L and a TP concentration of 0.03 mg/L. To protect the downstream waters, the TN TMDL target is 1.05 mg/L.

The lakes are expected to meet the applicable nutrient criteria and maintain their function and designated use as Class III freshwater when surface water nutrient concentrations are reduced to the target concentrations, addressing the anthropogenic contributions to the water quality impairment. The approaches used to establish the nutrient target also address meeting the chlorophyll *a* target and take into consideration the estimated pre-disturbance conditions in the lakes.

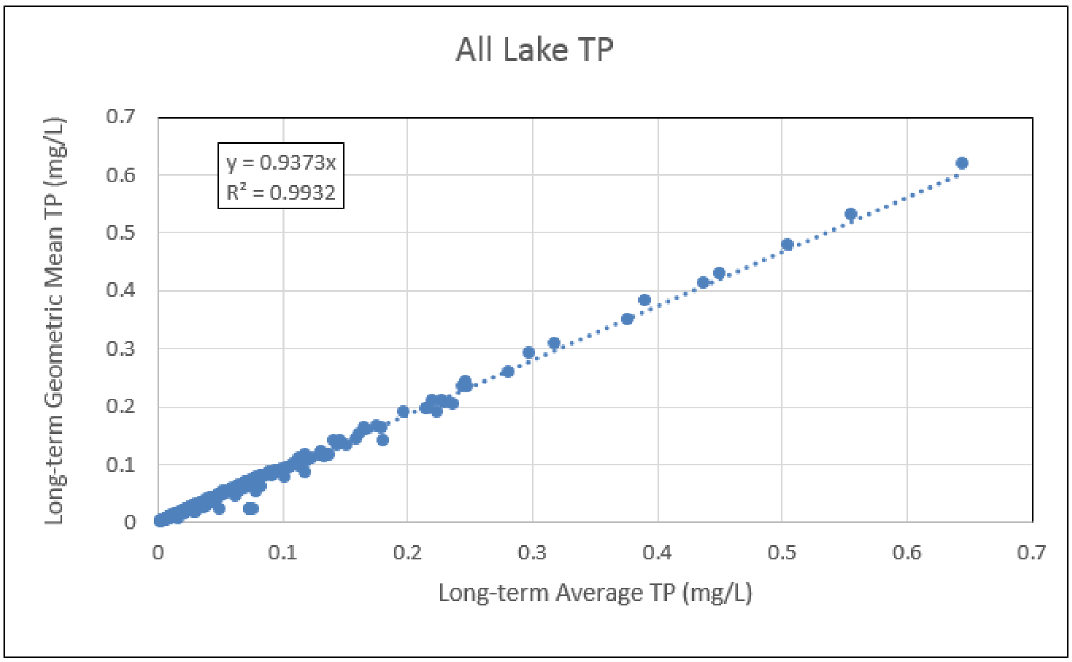


**Figure 5.12. Relationship between TP AGMs and averages (arithmetic means) from lake results used in NNC development**

## 5.5 Calculation of the TMDLs

The method used for developing the nutrient TMDLs is a percent reduction approach, in which the percent reductions in the existing nutrient concentrations in Lake Haines, Lake Rochelle, and Lake Conine are calculated to meet the water quality targets.

Existing lake nutrient conditions used in the percent reduction calculations were selected by considering the nutrient concentrations measured in the 2003–16 period. This period includes the entire Cycle 3 planning and verified periods, as well as the water quality measurements in 2016 following the Cycle 3 assessment period. The existing nutrient conditions used in the percent reduction calculation were the maximum values of the TN and TP AGMs that exceeded the water quality targets. The percent reductions were calculated for each lake's parameter-specific impairments on the adopted Cycle 3 Verified List. The geometric means were calculated from nutrient results available in IWR Database Run 53. **Table 5.1** lists the percent reduction results.

The equation used to calculate the percent reduction is as follows:

$$\frac{\textbf{[measured exceedance – target]}}{\textbf{measured exceedance}} \textbf{ X 100}$$

In Lake Haines, for the existing geometric mean TN concentration of 1.56 mg/L to achieve the target concentration of 1.05 mg/L, a 33 % reduction in the lake TN concentration is necessary. In Lake Rochelle, for the existing geometric mean TN concentration of 1.54 mg/L to achieve the target concentration of 1.05 mg/L, a 32 % reduction in the lake TN concentration is necessary. To achieve the TMDL targets for Lake Conine, a 36 % reduction is required in the existing TN concentration of 1.65 mg/L and a 57 % reduction is needed in the current TP concentration of 0.07 mg/L.

The nutrient AGM TMDL values and the associated percent reductions address the anthropogenic nutrient inputs contributing to the exceedances of the chlorophyll *a* criterion.

**Table 5.1. Reductions required in existing nutrient concentrations to meet water quality targets**

ID = Insufficient data

| Year | Lake Haines TN AGM (mg/L) | Lake Rochelle TN AGM (mg/L) | Lake Conine TN AGM (mg/L) | Lake Conine TP AGM (mg/L) |
|---|---|---|---|---|
| **2003** | 1.56 | 1.37 | 1.25 | 0.06 |
| **2004** | ID | ID | ID | ID |
| **2005** | 1.46 | 1.32 | 1.46 | ID |
| **2006** | 1.46 | 1.05 | 1.16 | 0.06 |
| **2007** | 1.29 | 1.19 | 1.46 | 0.07 |
| **2008** | 1.36 | 1.25 | 1.36 | 0.04 |
| **2009** | 1.40 | 1.54 | 1.48 | 0.04 |
| **2010** | 1.35 | 1.37 | 1.43 | ID |
| **2011** | 1.29 | 1.21 | 1.65 | 0.06 |
| **2012** | 1.51 | 1.39 | 1.36 | 0.05 |
| **2013** | 1.50 | 1.32 | 1.31 | 0.04 |
| **2014** | 1.27 | 1.43 | 1.19 | 0.02 |
| **2015** | 1.26 | 1.16 | 1.14 | 0.02 |
| **2016** | 1.20 | 0.95 | 1.04 | 0.02 |
| **Maximum** | **1.56** | **1.54** | **1.65** | **0.07** |
| **TMDL Target** | **1.05** | **1.05** | **1.05** | **0.03** |
| **% Reduction to Meet Target** | **33** | **32** | **36** | **57** |

# Chapter 6: Determination of Loading Allocations

## 6.1 Expression and Allocation of the TMDL

The objective of a TMDL is to provide a basis for allocating loads to all 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 accounts for uncertainty in the relationship between effluent limitations and water quality:

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

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

$$\mathbf{TMDL \cong \sum WLAs_{wastewater} + \sum WLAs_{NPDES\ Stormwater} + \sum LAs + MOS}$$

It should be noted that the various components of the revised TMDL equation may not sum up to the value of the TMDL because (1) 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 (2) 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 Code of Federal Regulations [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 Lake Conine, Lake Rochelle, and Lake Haines are expressed in terms of nutrient concentration targets and the percent reductions necessary to meet the targets, and represent the lake nutrient concentrations the waterbodies can assimilate while maintaining a balanced aquatic flora and fauna (see **Table 6.1**). These TMDLs are based on the maximum AGM values for TN and TP that are not be exceeded. The restoration goal is to achieve the generally applicable chlorophyll *a* criterion of 20 μg/L, which is expressed as an AGM not to be exceeded more than once in any consecutive 3-year period, thus protecting each lake's designated use.

The TMDLs will constitute the site-specific numeric interpretations of the narrative nutrient criterion set forth in Paragraph 62-302.530(90)(b), F.A.C., that will replace the otherwise applicable NNC in Subsection 62-302.531(2), F.A.C., for these particular waters.

**Table 6.1. TMDL components for nutrients in Lake Conine (WBID 1488U), Lake Rochelle (WBID 1488B), and Lake Haines (WBID 1488C)**

NA = Not applicable
[1] Represents the AGM lake value not to be exceeded.
[2] The required percent reductions listed in this table represent the reduction from all sources.

| Waterbody (WBID) | Parameter | TMDL (mg/L)[1] | WLA Wastewater (% reduction) | WLA NPDES Stormwater (% reduction)[2] | LA (% reduction)[2] | MOS |
|---|---|---|---|---|---|---|
| **1488U** | TN | 1.05 | NA | 36 | 36 | Implicit |
| **1488U** | TP | 0.03 | NA | 57 | 57 | Implicit |
| **1488B** | TN | 1.05 | NA | 32 | 32 | Implicit |
| **1488B** | TP | 0.03 | NA | NA | NA | Implicit |
| **1488C** | TN | 1.05 | NA | 33 | 33 | Implicit |
| **1488C** | TP | 0.03 | NA | NA | NA | Implicit |

## 6.2 Load Allocation

To achieve the TN target, a 36 %, 32 %, and 33 % reduction in current TN sources to Lake Conine, Lake Rochelle, and Lake Haines, respectively, is required. To achieve the TP target, a 57 % reduction in current TP sources to Lake Conine is required. The percent reductions represent the generally needed total nitrogen and total phosphorus reductions from all sources; including stormwater runoff, groundwater contributions, and septic tanks. Although the TMDLs are based on the percent reductions from all sources to the lakes; it is not DEP's intent to abate natural conditions. The needed reduction from anthropogenic inputs will be calculated based on more detailed source information when a restoration plan is developed. The reductions in nonpoint source nutrient loads are expected to result in reduced sediment nutrient flux, which is commonly a factor in lake eutrophication.

It should be noted that the LA includes loadings from stormwater discharges regulated by DEP and the water management district that are not part of the NPDES stormwater program (see **Appendix A**).

## 6.3 Wasteload Allocation

### 6.3.1 NPDES Wastewater Discharges

As noted in **Chapter 4**, no active NPDES-permitted facilities discharge either into the waterbody or the watersheds of each lake. Therefore, a WLA for wastewater discharges is not applicable.

### 6.3.2 NPDES Stormwater Discharges

Polk County and co-permittees (FDOT District 1 and the Cities of Winter Haven and Lake Alfred) are covered by a Phase I NPDES MS4 permit (FLS000015). Areas within these jurisdictions may be responsible for a 36 %, 32 %, and 33 % reduction in current TN loadings to Lake Conine, Lake Rochelle, and Lake Haines, respectively, and a 57 % reduction in current TP loadings to Lake Conine.

It should be noted that any MS4 permittee is only responsible for reducing the anthropogenic 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 (MOS)

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. Consistent with the recommendations of the Allocation Technical Advisory Committee (DEP 2001), an implicit MOS was used in the development of these TMDLs. 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 (CWA, Section 303[d][1][c]). Considerable uncertainty is usually inherent in estimating nutrient loading from nonpoint sources, as well as in predicting water quality response. The effectiveness of management activities (e.g., stormwater management plans) in reducing loading is also subject to uncertainty.

Consistent with the recommendations of the Allocation Technical Advisory Committee (DEP 2001), an implicit MOS was used in the development of the TMDL because of the conservative assumptions that were applied. The TMDLs were developed using the highest TN and TP AGM values to calculate the percent reductions and requiring the TMDL targets not to be exceeded in any one year. Additionally, the TN target of 1.05 mg/L, in conjunction with the TP target, results in a chlorophyll *a* concentration less than the criterion of 20 µg/L.

# Chapter 7: Implementation Plan Development and Beyond

## 7.1 Implementation Mechanisms

Following the adoption of a TMDL, implementation takes place through various measures. The implementation of TMDLs may occur through specific requirements in NPDES wastewater and MS4 permits, and, as appropriate, through local or regional water quality initiatives or basin management action plans (BMAPs).

Facilities with NPDES permits that discharge to the TMDL waterbody must respond to the permit conditions that reflect target concentrations, reductions, or wasteload allocations identified in the TMDL. NPDES permits are required for Phase I and Phase II MS4s as well as domestic and industrial wastewater facilities. MS4 Phase I permits require a permit holder to prioritize and act to address a TMDL unless management actions to achieve that particular TMDL are already defined in a BMAP. MS4 Phase II permit holders must also implement the responsibilities defined in a BMAP or other form of restoration plan (e.g., a reasonable assurance plan).

As outlined in Subsection 403.9337(2), F.S., all county and municipal government located within a waterbody listed as impaired by nutrients pursuant to s. 403.067, shall, at a minimum, adopt DEP's *Model Ordinance for Florida-Friendly Fertilizer Use on Urban Landscapes.* The Model Ordinance contains numerous best management practices (BMPs) addressing setbacks from water bodies, recommended fertilizer blends and slow release application rates, and proper irrigation practices. Municipal governments may adopt additional or more stringent standards if deemed necessary to better address the impairment.

## 7.2 BMAPs

Section 403.067, F.S. (the FWRA), contains information on the development and implementation of BMAPs. DEP or a local entity may initiate and develop a BMAP that addresses some or all of the contributing areas to the TMDL waterbody. BMAPs are adopted by the DEP Secretary and are legally enforceable.

BMAPs describe the fair and equitable allocations of pollution reduction responsibilities to the sources in the watershed, as well as the management strategies that will be implemented to meet those responsibilities, funding strategies, mechanisms to track progress, and water quality monitoring. Local entities usually implement these strategies, such as wastewater facilities, industrial sources, agricultural producers, county and city stormwater systems, military bases, water control districts, state agencies, and individual property owners. BMAPs can also identify mechanisms to address potential pollutant loading from future growth and development.

Additional information about BMAPs is available on the DEP website.

## 7.3 Implementation Considerations for the Waterbody

In addition to addressing reductions in watershed pollutant contributions to impaired waters during the implementation phase, it is also necessary to consider the impacts of internal sources (e.g., sediment nutrient fluxes or the presence of nitrogen-fixing cyanobacteria) and the results of any associated remediation projects on surface water quality. Herbicide treatment is used to control the growth of invasive aquatic plants in Lakes Haines, Rochelle, and Conine, and this management activity can contribute to the cycling of nutrients in the lakes and be a source factor influencing phytoplankton growth. Approaches for addressing both the external and internal nutrient sources should be included in a comprehensive management plan for the lakes. Additionally, the current water quality and water level monitoring of each lake should continue and be expanded, as necessary, during the implementation phase to ensure that adequate information is available for tracking restoration progress.

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# 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 designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Chapter 62-40, F.A.C. In 1994, DEP stormwater treatment requirements were integrated with the stormwater flood control requirements of the water management districts, along with wetland protection requirements, into the Environmental Resource Permit regulations, as authorized under Part IV of Chapter 373, F.S.

Chapter 62-40, F.A.C., also requires the state's water management districts to establish stormwater pollutant load reduction goals (PLRGs) and adopt them as part of a Surface Water Improvement and Management (SWIM) Program plan, other watershed plan, or rule. Stormwater PLRGs are a major component of the load allocation part of a TMDL. To date, they 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 CWA Reauthorization. This section of the law amended the scope of the federal NPDES permitting program to designate certain stormwater discharges as "point sources" of pollution. The EPA promulgated regulations and began implementing the Phase I NPDES stormwater program in 1990 to address stormwater discharges associated with industrial activity, including 11 categories of industrial activity, construction activities disturbing 5 or more acres of land, and large and medium MS4s located in incorporated places and counties with populations of 100,000 or more.

However, because the master drainage systems of most local governments in Florida are physically interconnected, the EPA implemented Phase I of the MS4 permitting program on a countywide basis, which brought in all cities (incorporated areas), Chapter 298 special districts; community development districts, water control districts, and FDOT throughout the 15 counties meeting the population criteria. DEP received authorization to implement the NPDES stormwater program in 2000. The authority to administer the program is set forth in Section 403.0885, F.S.

The Phase II NPDES stormwater program, promulgated in 1999, addresses additional sources, including small MS4s and small construction activities disturbing between 1 and 5 acres, and urbanized areas serving a minimum resident population of at least 1,000 individuals. While these urban stormwater discharges are 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. It should be noted that Phase I MS4 permits issued in Florida include a reopener clause that allows permit revisions to implement TMDLs when the implementation plan is formally adopted.

# Appendix B: Information in Support of Site-Specific Interpretations of the Narrative Nutrient Criterion

### Table B-1. Spatial extent of the numeric interpretation of the narrative nutrient criterion

| Location | Description |
|---|---|
| **Waterbody name** | Lake Haines, Lake Rochelle, and Lake Conine |
| **Waterbody type(s)** | Lake |
| **WBID** | Lake Haines (WBID 1488C), Lake Rochelle (WBID 1488B), and Lake Conine (WBID 1488U) (see **Figure 1.2** of this report) |
| **Description** | Lake Haines, Lake Rochelle, and Lake Conine are part of the Winter Haven Chain of Lakes system located in north central Polk County. The combined watershed area for these lakes is 6,383 acres. In the Lake Haines and Lake Rochelle Watersheds, the dominant land use is wetlands, which cover 38 % and 29 % of the areas, respectively. Medium-density residential is the dominant land use in the Lake Conine Watershed, comprises 33 % of the watershed area.<br><br>**Chapter 1** of this report provides more detail on the lake system. |
| **Specific location (latitude/longitude or river miles)** | The center of Lake Haines is located at Latitude N: 28°05'32", Longitude W: -81°42'25". The center of Lake Rochelle is located at Latitude N: 28°04'22", Longitude W: -81°43'14". The center of Lake Conine is located at Latitude N: 28°03'34", Longitude W: -81°43'29". The site-specific criteria apply as a spatial average for each lake, as defined by WBIDs 1488C, 1488B, and 1488U. |
| **Map** | **Figure 1.1** shows the general location of the lakes and their watersheds, and **Figure 4.1** shows the land uses in the watersheds. |
| **Classification(s)** | Class III Freshwater |
| **Basin name (Hydrologic Unit Code [HUC]) 8)** | Peace River Basin (03100101) |

**Table B-2. Description of the numeric interpretation of the narrative nutrient criterion**

| Numeric Interpretation of Narrative Nutrient Criterion | Information on Parameters Related to Numeric Interpretation of the Narrative Nutrient Criterion |
|---|---|
| **NNC summary:<br>Generally applicable lake classification (if applicable) and corresponding NNC** | Lake Haines is classified as a high-color (>40 PCU) lake, and the generally applicable NNC, expressed as AGM concentrations not to be exceeded more than once in any 3-year period, are chlorophyll *a* of 20 µg/L, TN of 1.27 to 2.23 mg/L, and TP of 0.05 to 0.16 mg/L. Lakes Rochelle and Conine are classified as low-color (<40 PCU), high-alkalinity (> 20 mg/L $CaCO_3$) lakes, and the generally applicable NNC, expressed as AGM concentrations not to be exceeded more than once in any 3-year period, are chlorophyll *a* of 20 µg/L, TN of 1.05 to 1.91 mg/L, and TP of 0.03 to 0.09 mg/L. |
| **Proposed TN, TP, chlorophyll *a*, and/or nitrate + nitrite concentrations (magnitude, duration, and frequency)** | Numeric interpretations of the narrative nutrient criterion:<br><br>**Lake Haines (WBID 1488C)**<br>**Chlorophyll *a*:** 20 µg/L, expressed as an AGM concentration not to be exceeded more than once in any consecutive 3-year period.<br>**TN:** 1.05 mg/L, expressed as an AGM not to be exceeded.<br>**TP:** 0.03 mg/L, expressed as an AGM not to be exceeded.<br><br>**Lake Rochelle (WBID 1488B)**<br>**Chlorophyll *a*:** 20 µg/L, expressed as an AGM concentration not to be exceeded more than once in any consecutive 3-year period.<br>**TN:** 1.05 mg/L, expressed as an AGM not to be exceeded.<br>**TP:** 0.03 mg/L, expressed as an AGM not to be exceeded.<br><br>**Lake Conine (WBID 1488U)**<br>**Chlorophyll *a*:** 20 µg/L, expressed as an AGM concentration not to be exceeded more than once in any consecutive 3-year period.<br>**TN:** 1.05 mg/L, expressed as an AGM not to be exceeded.<br>**TP:** 0.03 mg/L, expressed as an AGM not to be exceeded. |

| Numeric Interpretation of Narrative Nutrient Criterion | Information on Parameters Related to Numeric Interpretation of the Narrative Nutrient Criterion |
|---|---|
| **Period of record used to develop numeric interpretations of the narrative nutrient criterion for TN and TP** | An empirical equation describing the relationships between chlorophyll *a* and nutrient concentrations (TN and TP), using the AGM values for all three lakes in the period from 1999 to 2015, was applied to assist in setting nutrient concentration targets. The selection of nutrient targets takes into consideration downstream protection to establish the TN target and the results of paleolimnological studies of Lake Haines and Conine to derive the TP concentration target. The paleolimnological results are presented in the following document:<br><br>Whitmore, T. 2003. *Water quality trends associated with algal community changes in Florida lakes: Historic evidence for defining nutrient criteria.* Final Report to the Florida Department of Environmental Protection. Gainesville, FL: University of Florida, Department of Fisheries and Aquatic Sciences. |
| **How the criteria developed are spatially and temporally representative of the waterbody or critical condition** | The water quality results applied in the analysis spanned the 1999–2015 period, which included both wet and dry years. The years 2000, 2006, and 2007 were dry years, 2009 to 2011 were average years, and 2002, 2004, and 2005 were wet years.<br><br>**Figure 2.1** shows the sampling stations in Lakes Haines, Rochelle, and Conine. The Polk County data collected near the center of each lake, where the majority of results were collected, were used to develop the regression equations relating nutrient concentrations to chlorophyll *a* levels. The data collected at the Polk County monitoring stations in the center of each lake are considered representative of the waterbody as a whole.<br><br>**Chapter 5** contains graphs showing water quality results for the variables relevant to TMDL development. |

### Table B-3. Summary of how designated use(s) are protected by the criterion

| Designated Use Requirements | Information Related to Designated Use Requirements |
|---|---|
| **History of assessment of designated use support** | During the Cycle 3 assessment, the NNC were used to assess the lakes during the verified period (January 1, 2008–June 30, 2015) based on data from IWR Database Run 52. Lake Haines was assessed as impaired for chlorophyll *a* and TN because the AGMs exceeded the NNC more than once in a three-year period (2008 and 2015), and the waterbody was added to the 303(d) list for chlorophyll *a* and TN. It was found not to be impaired for TP. Lake Rochelle was assessed as impaired for chlorophyll *a* and TN because the AGMs exceeded the NNC more than once in a three-year period (2008 and 2014), and the waterbody was added to the 303(d) list for chlorophyll *a* and TN. It was found not to be impaired for TP. Lake Conine was assessed as impaired for chlorophyll *a*, TN, and TP because the AGMs exceeded the NNC more than once in a three-year period (2008 and 2015), and the waterbody was added to the 303(d) list for chlorophyll a, TN, and TP. |
| **Basis for use support** | The basis for use support is the NNC chlorophyll *a* concentration of 20 µg/L, which is protective of designated uses for both high-color lakes and low-color, high-alkalinity lakes. Based on the available information, there is nothing unique about the three lakes that would make the use of the chlorophyll *a* threshold of 20 µg/L inappropriate for them. |
| **Approach used to develop criteria and how it protects uses** | The methods used to address the nutrient impairment included (1) the development of a regression equation that relates the lake TN and TP concentrations to the annual geometric mean chlorophyll *a* levels, (2) evaluating downstream protection, and c) the evaluation of paleolimnological results to establish a TP target consistent with pre-disturbance conditions. The criteria are expressed as maximum AGM concentrations not to be exceeded in any year. Establishing the frequency as not to be exceeded in any year ensures that the chlorophyll *a* NNC, which are protective of designated use, is achieved. |
| **How the TMDL analysis will ensure that nutrient-related parameters are attained to demonstrate that the TMDLs will not negatively impact other water quality criteria** | The method indicated that the chlorophyll *a* concentration target for the lake will be attained at the TMDL in-lake TN and TP concentration, frequency and duration, while taking into consideration the estimated pre-disturbance phosphorus condition in the lake. DEP notes that there were no impairments for nutrient-related parameters (such as dissolved oxygen [DO] or un-ionized ammonia). The proposed reductions in nutrient inputs will result in further improvements in water quality. |

## Table B-4. Documentation of the means to attain and maintain water quality standards for downstream waters

| Protection of Downstream Waters and Monitoring Requirements | Information Related to Protection of Downstream Waters and Monitoring Requirements |
|---|---|
| **Identification of downstream waters: List receiving waters and identify technical justification for concluding downstream waters are protected** | The outlet for Lake Conine conveys water to Lake Smart, immediately downstream of the three lakes. Lake Smart is classified as a low-color (<40 PCU), high-alkalinity (> 20 mg/L $CaCO_3$) lake. The regression analysis developed indicates that a TN AGM of 1.17 mg/L and a TP AGM of 0.03 mg/L (based on paleolimnological results) will achieve the chlorophyll *a* criterion of 20 µg/L in Lakes Haines, Rochelle, and Conine. However, the generally applicable NNC for Lake Smart is a TN concentration of 1.05 mg/L and a TP concentration of 0.03 mg/L. To protect the downstream water in Lake Smart, the TN target selected is 1.05 mg/L. |
| **Summary of existing monitoring and assessment related to the implementation of Subsection 62-302.531(4), F.A.C., and trends tests in Chapter 62-303, F.A.C.** | Polk County conducts routine monitoring of Lakes Haines, Rochelle, and Conine. The data collected through these monitoring activities will be used to evaluate the effect of BMPs implemented in the watershed on lake TN and TP concentrations in subsequent water quality assessment periods. |

## Table B-5. Documentation of endangered species consideration

| Administrative Requirements | Information for Administrative Requirements |
|---|---|
| **Endangered species consideration** | DEP is not aware of any endangered species present in the Winter Haven Northern Chain of Lakes. Furthermore, it is expected that improvements in water quality resulting from these restoration efforts will positively impact aquatic species living in the lakes and their respective watersheds. |

## Table B-6. Documentation that administrative requirements are met

| Administrative Requirements | Information for Administrative Requirements |
|---|---|
| **Notice and comment notifications** | DEP published a Notice of Development of Rulemaking on February 21, 2018, to initiate TMDL development for impaired waters in the Peace River Basin. A technical public meeting to present the general TMDL approach for Lakes Haines, Rochelle, and Conine was held on November 8, 2017. A rule development public workshop for the TMDLs was held on March 6, 2018. |
| **Hearing requirements and adoption format used; responsiveness summary** | Following the publication of the Notice of Proposed Rule, DEP will provide a 21-day challenge period and a public hearing that will be noticed no less than 45 days prior. Hearing held June 29, 2018. |
| **Official submittal to EPA for review and General Counsel certification** | If DEP does not receive a rule challenge, the certification package for the rule will be prepared by the DEP program attorney. DEP will prepare the TMDLs and submittal package for the TMDLs to be considered as site-specific interpretations of the narrative nutrient criterion, and will submit these documents to EPA. |

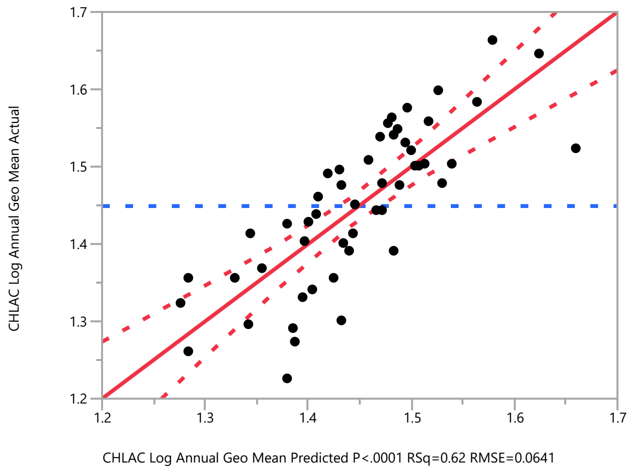
# Appendix C: Multiple Regression Model Results

## Response CHLAC Log AGM: Lake Haines, Lake Rochelle, and Lake Conine 1999–2015

## Results

## Whole Model

## Actual by Predicted Plot




## Summary of Fit

| Calculation | Result |
|---|---:|
| RSquare | 0.619027 |
| RSquare Adj | 0.603153 |
| Root Mean Square Error | 0.064094 |
| Mean of Response | 1.449028 |
| Observations (or Sum Wgts) | 51 |

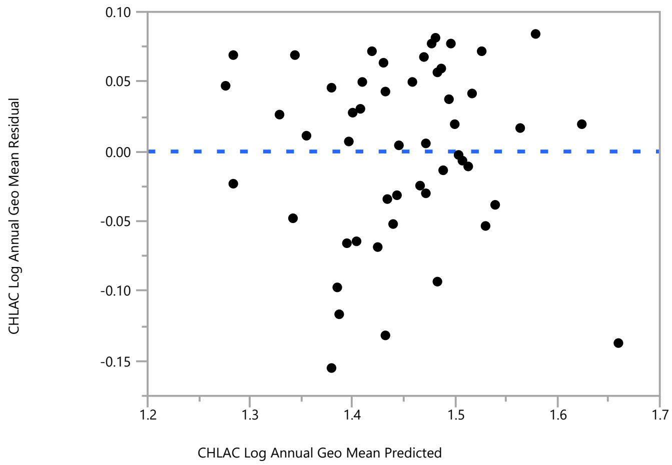
## Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---:|---:|---:|---:|
| Model | 2 | 0.32039948 | 0.160200 | 38.9966 |
| Error | 48 | 0.19718587 | 0.004108 | **Prob > F** |
| C. Total | 50 | 0.51758535 | | <.0001* |

## Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| | VIF |
|---|---:|---:|---:|---:|---:|
| Intercept | 1.9205423 | 0.141374 | 13.58 | <.0001* | . |
| TN Log Annual Geo Mean | 1.2044362 | 0.217255 | 5.54 | <.0001* | 1.1145112 |
| TP Log Annual Geo Mean | 0.4595592 | 0.097062 | 4.73 | <.0001* | 1.1145112 |

## Residual by Predicted Plot




## Prediction Expression

1.9205422599128

+ 1.20443621601207 * TN Log Annual Geo Mean

+ 0.45955919528119 * TP Log Annual Geo Mean

## Annual Geometric Means Used in the Multiple Regression Model

| Waterbody | Year | Polk County Station 1 CHLAC Annual Geometric Mean (µg/L) | Polk County Station 1 TN Annual Geometric Mean (mg/L) | Polk County Station 1 TP Annual Geometric Mean (mg/L) |
|---|---|---|---|---|
| Lake Conine | 1999 | 25.9 | 1.107 | 0.043 |
| Lake Conine | 2000 | 22.6 | 1.087 | 0.033 |
| Lake Conine | 2001 | 31.7 | 1.363 | 0.055 |
| Lake Conine | 2002 | 34.7 | 1.351 | 0.051 |
| Lake Conine | 2003 | 27.8 | 1.265 | 0.057 |
| Lake Conine | 2004 | 30.9 | 1.222 | 0.048 |
| Lake Conine | 2005 | 39.6 | 1.461 | 0.051 |
| Lake Conine | 2006 | 35.8 | 1.295 | 0.055 |
| Lake Conine | 2007 | 45.9 | 1.464 | 0.066 |
| Lake Conine | 2008 | 34.0 | 1.379 | 0.051 |
| Lake Conine | 2009 | 36.1 | 1.476 | 0.048 |
| Lake Conine | 2010 | 37.6 | 1.427 | 0.047 |
| Lake Conine | 2011 | 44.1 | 1.648 | 0.061 |
| Lake Conine | 2012 | 34.5 | 1.359 | 0.047 |
| Lake Conine | 2013 | 30.1 | 1.364 | 0.047 |
| Lake Conine | 2014 | 23.3 | 1.193 | 0.037 |
| Lake Conine | 2015 | 22.7 | 1.140 | 0.037 |
| Lake Haines | 1999 | 38.1 | 1.393 | 0.071 |
| Lake Haines | 2000 | 30.0 | 1.432 | 0.055 |
| Lake Haines | 2001 | 20.0 | 1.348 | 0.040 |
| Lake Haines | 2002 | 31.9 | 1.473 | 0.047 |
| Lake Haines | 2003 | 24.5 | 1.328 | 0.053 |
| Lake Haines | 2004 | 31.7 | 1.329 | 0.060 |
| Lake Haines | 2005 | 33.4 | 1.520 | 0.091 |
| Lake Haines | 2006 | 36.6 | 1.328 | 0.053 |
| Lake Haines | 2007 | 32.2 | 1.334 | 0.046 |
| Lake Haines | 2008 | 29.8 | 1.364 | 0.038 |
| Lake Haines | 2009 | 25.8 | 1.399 | 0.038 |
| Lake Haines | 2010 | 22.7 | 1.355 | 0.038 |
| Lake Haines | 2011 | 21.3 | 1.292 | 0.037 |
| Lake Haines | 2012 | 35.2 | 1.506 | 0.039 |
| Lake Haines | 2013 | 29.9 | 1.546 | 0.037 |
| Lake Haines | 2014 | 18.7 | 1.267 | 0.037 |
| Lake Haines | 2015 | 16.8 | 1.258 | 0.037 |
| Lake Rochelle | 1999 | 21.9 | 1.067 | 0.064 |
| Lake Rochelle | 2000 | 19.4 | 1.146 | 0.048 |
| Lake Rochelle | 2001 | 26.8 | 1.238 | 0.042 |

| Waterbody | Year | Polk County Station 1 CHLAC Annual Geometric Mean (µg/L) | Polk County Station 1 TN Annual Geometric Mean (mg/L) | Polk County Station 1 TP Annual Geometric Mean (mg/L) |
|---|---|---|---|---|
| **Lake Rochelle** | **2002** | **27.7** | **1.370** | **0.045** |
| **Lake Rochelle** | **2003** | **25.2** | **1.336** | **0.041** |
| **Lake Rochelle** | **2004** | **31.2** | **1.274** | **0.046** |
| **Lake Rochelle** | **2005** | **31.7** | **1.424** | **0.059** |
| **Lake Rochelle** | **2006** | **21.1** | **1.040** | **0.036** |
| **Lake Rochelle** | **2007** | **28.8** | **1.228** | **0.045** |
| **Lake Rochelle** | **2008** | **27.4** | **1.250** | **0.043** |
| **Lake Rochelle** | **2009** | **33.1** | **1.604** | **0.035** |
| **Lake Rochelle** | **2010** | **28.2** | **1.313** | **0.046** |
| **Lake Rochelle** | **2011** | **19.7** | **1.209** | **0.034** |
| **Lake Rochelle** | **2012** | **26.6** | **1.307** | **0.033** |
| **Lake Rochelle** | **2013** | **25.3** | **1.319** | **0.035** |
| **Lake Rochelle** | **2014** | **24.5** | **1.427** | **0.036** |
| **Lake Rochelle** | **2015** | **18.2** | **1.134** | **0.030** |