Southeast District • Lake Worth Lagoon – Palm Beach Coast

Final Report

Nutrient TMDLs for Pine Lake and (WBIDs 3245C4) and Documentation in Support of the Development of Site-Specific Numeric Interpretations of the Narrative Nutrient Criterion

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September 2021

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Executive Summary

This report details the total maximum daily loads (TMDLs) for Pine Lake, located in the Palm Beach County Chain of Lakes. Pine Lake was identified as impaired for nutrients based on chlorophyll *a*. The lake was added to the 303(d) list by Secretarial Order on October 21, 2016, as the segment with waterbody identification (WBID) numbers 3245C4. TMDLs for total nitrogen (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 Pine Lake

Type of Information	Description
Waterbody name/ WBID number	Pine Lake/WBID 3245C4
Hydrologic Unit Code (HUC) 8	03090206
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 (Lake Worth Lagoon) adopted via Secretarial Order dated October 21, 2016
TMDL pollutants	TN and TP
TMDLs and site-specific interpretations of the narrative nutrient criterion	**Pine Lake (WBID 3245C4)** **TN:** 9,749 kilograms per year (kg/yr), expressed as a 3-year average of annual loads not to be exceeded. **TP:** 611 kg/yr, expressed as a 3-year average of annual loads not to be exceeded.
Load reductions required to meet the TMDLs	**WBID 3245C4**: A 45 % TN reduction and a 44 % TP reduction to achieve a chlorophyll *a* target of 20 micrograms per liter (µg/L).
Concentration-based lake restoration targets	**WBID 3245C4**: The nutrient concentrations corresponding to the chlorophyll *a* criterion and the loading-based criteria are a TN annual geometric mean (AGM) of 0.69 milligrams per liter (mg/L) and a TP AGM of 0.04 mg/L, not to be exceeded more than once in any consecutive 3-yr period.

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, Southeast Florida Regional Operations Center, and Watershed Evaluation and TMDL Section.

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° C.	Degrees Celsius
µg/L	Micrograms Per Liter
ac-ft/yr	Acre-Feet Per Year
AGM	Annual Geometric Mean
BMAP	Basin Management Action Plan
BMP	Best Management Practice
$CaCO_3$	Calcium Carbonate
CFR	Code of Federal Regulations
Chla	Chlorophyll *a*
CWA	Clean Water Act
DEP	Florida Department of Environmental Protection
DO	Dissolved Oxygen
EMC	Event Mean Concentration
EPA	U.S. Environmental Protection Agency
ERD	Environmental Research and Design
F.A.C.	Florida Administrative Code
FDOH	Florida Department of Health
FDOT	Florida Department of Transportation
FL	Florida
F.S.	Florida Statutes
FWRA	Florida Watershed Restoration Act
FWS	U.S. Fish and Wildlife Service
hm^3/yr	Cubic Hectometers Per Year
HUC	Hydrologic Unit Code
ICWW	Intracoastal Waterway
IPaC	Information for Planning and Conservation
IWR	Impaired Surface Waters Rule
kg	Kilogram
kg/yr	Kilograms Per Year
km	Kilometers
km^2	Square Kilometers
LA	Load Allocation
lbs	Pounds
lbs/yr	Pounds Per Year
LVI	Lake Vegetation Index
m	Meter
m^2	Square meters
MDL	Minimum detection limit

mgd	Million Gallons Per Day
mg/L	Milligrams Per Liter
$mg/m^2/yr$	Milligrams Per Square Meter Per Year
$mg/m^3/yr$	Milligrams Per Cubic Meter Per Year
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer System
MSSW	Management and Storage of Surface Waters
m/yr	Meters Per Year
NA	Not Applicable
NADP	National Atmospheric Deposition Program
NMFS	National Marine Fisheries Service
NNC	Numeric Nutrient Criteria
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
OSTDS	Onsite Sewage Treatment and Disposal System
PCU	Platinum Cobalt Units
PHF	Peak Hour Flow
PLRG	Pollutant Load Reduction Goal
PLSM	Pollutant Load Screening Model
POR	Period of Record
ROC	Runoff Coefficient
SFWMD	South Florida Water Management District
SWIM	Surface Water Improvement and Management
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TSI	Trophic State Index
U.S.	United States
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
WBID	Waterbody Identification
WLA	Wasteload Allocation
WQS	Water Quality Standards
WWTF	Wastewater Treatment Facility

Chapter 1: Introduction

1.1 Purpose of Report

This report presents the total maximum daily loads (TMDLs) developed to address the nutrient impairment of Pine Lake, located in the Lake Worth Lagoon Basin. Pursuant to Paragraph 62-302.531(2)(a), F.A.C., these TMDLs will also constitute the site-specific numeric interpretations of the narrative nutrient criterion set forth in Paragraph 62-302.530(48)(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 particular waterbodies, 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 most recent Verified List of Impaired Waters for the Lake Worth Lagoon 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 TMDL establishes the allowable loadings to Pine Lake that would restore this waterbody 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 Lake Worth Lagoon Basin (Hydrologic Unit Code [HUC] 8 – 03090206) into watershed assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or surface water segment. Pine Lake is WBID 3245C4. **Figure 1.1** shows the location of the WBID in the basin and major geopolitical and hydrologic features in context of the region, and **Figure 1.2** is a more detailed map for the immediate Pine Lake watershed.

Pine Lake is a small lake with 0.14 square kilometers (km^2) in surface area and 1.1 kilometers (km) in length with a mean depth of 2.3 meters (Environmental Research and Design [ERD] 2002). Pine Lake is located in Palm Beach County southwest of the city limits of West Palm Beach and north of the Town of Cloud Lake. The lake is bordered immediately to the west by the Palm Beach International Airport and to the east by Interstate 95.

1.3 Watershed Information

1.3.1 Population and Geopolitical Setting

The Pine Lake Watershed is located entirely within Palm Beach County, which has a population of 1,320,134 (U.S. Census Bureau 2010). Pine Lake has a small, heavily urbanized watershed of

11 km^2 that includes portions of West Palm Beach and unincorporated Palm Beach County. As of the 2010 Census, the total population of the City of West Palm Beach was 99,919 (U.S. Census Bureau 2010).

1.3.2 Topography

Pine Lake is part of a chain of 5 hydrologically interconnected lakes running 23 km in a north–south axis in Palm Beach County. From north to south, the chain comprises Pine Lake, Lake Clarke, Lake Osborne, Lake Eden, and Lake Ida. Historically these waterbodies were shallow freshwater lakes connected by a series of wetland sloughs. The lakes were deepened by dredging to make them navigable and connected to the south Florida drainage canal system for flood control and water management.

The physiography and ecology of the chain-of-lakes watersheds reflect their location in the Miami Ridge/Atlantic Coastal Strip of the Southern Florida Coastal Plains ecoregion. The lakes are located immediately west of the Atlantic Coastal Ridge, a low ridge of sand over limestone that runs parallel to the coast and achieves an elevation of up to 15 meters (m) above sea level in places, although elevations average 10 m above sea level. The coastal ridge is a barrier to surface water flow from the east, meaning that the watersheds of all 3 lakes are primarily located in the areas west of the ridge and west of the lakes. These watersheds are largely flat and extend 4.5 m above sea level, rising to 10 m above sea level in the portions of the watersheds extending up the coastal ridge. The ridge is pierced by a series of east-west canals that convey water east to discharge to coastal waters.

1.3.3 Hydrogeological Setting

The Palm Beach County Chain of Lakes is connected via the Stub, C-51, and E-4 Canals. The lakes are divided into individual watersheds, each with a different ultimate discharge point. The north-south E-4 Canal connects every lake in the series, but flows are normally directed out to coastal waters via the major east-west canals (C-51/West Palm Beach Canal, C-16/Boynton/Stanley-Weaver Canal, and the C-15 Canal). Pine Lake (along with unimpaired Lake Clarke) is located in the C-51 Basin. Water collected in the C-51 Canal typically is discharged east to the Lake Worth Lagoon through Structure S-155. Lake Osborne is in the C-16 Basin. The C-16 typically discharges to the Lake Worth Lagoon via Structure S-41. Lakes Ida and Eden are in the C-15 Basin. The C-15 Canal discharges to the Intracoastal Waterway (ICWW) through the S-40 structure. The timing, magnitude, duration, and direction of water movement are regulated by the operational schedules of water control structures in each drainage basin. Individual lake watershed delineation is based on typical conditions under the normal operation of the canal and control structure system. **Figure 1.3** shows the major canals discussed here along with arrows indicating the typical flow in the canal network during normal operation.

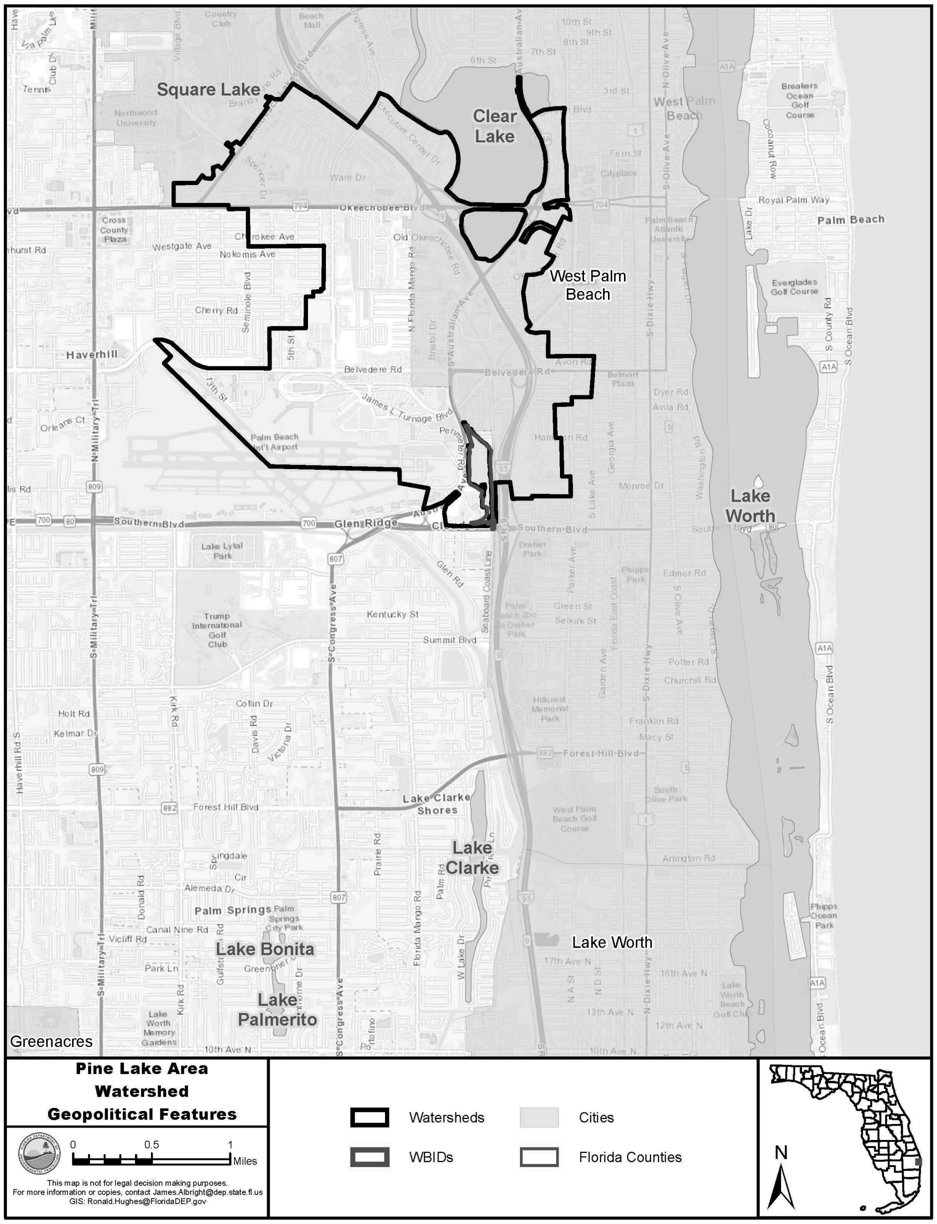


Figure 1.1. Location of Pine Lake and its watershed in the Lake Worth Lagoon Basin and major hydrologic and geopolitical features in the area

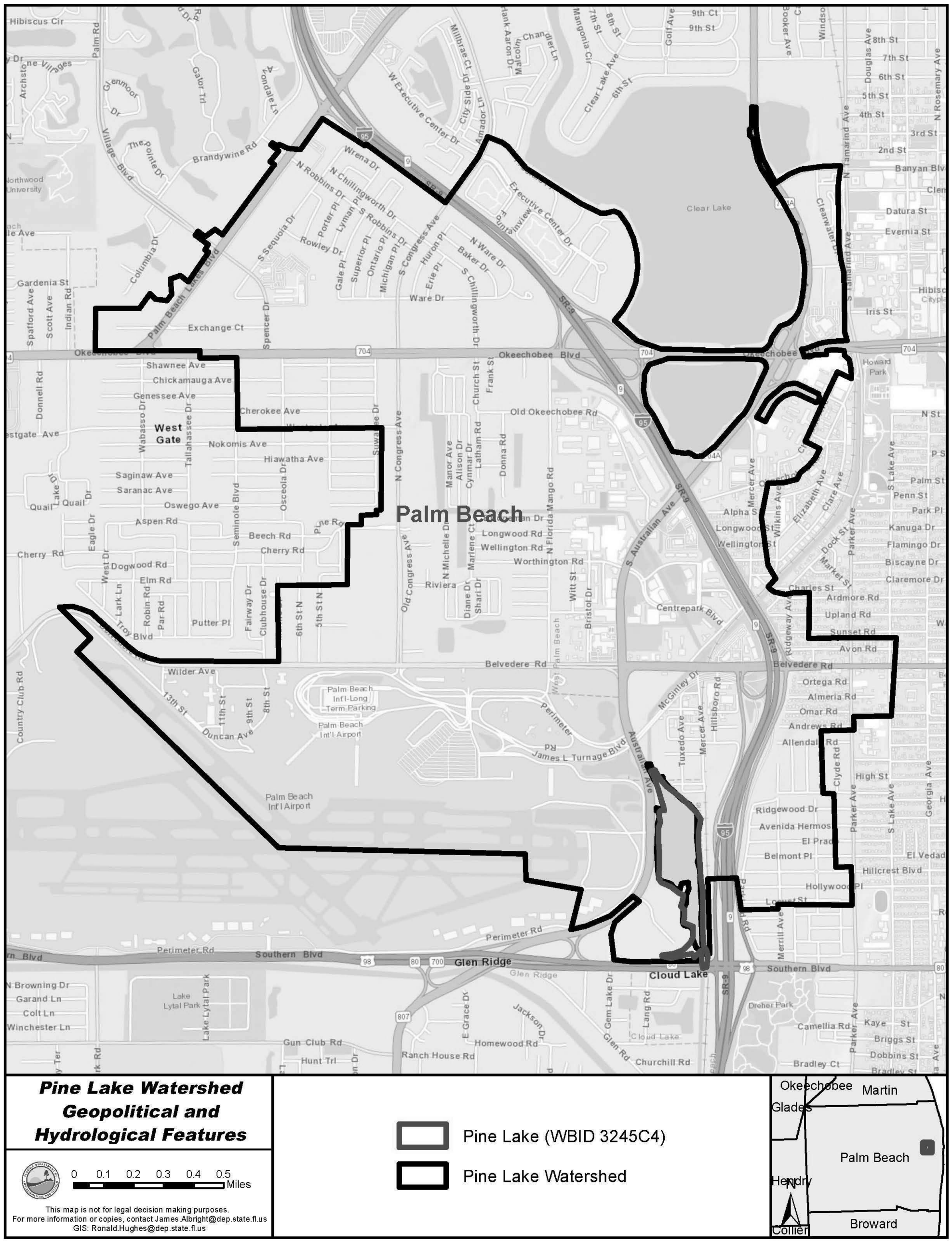


Figure 1.2. Pine Lake (WBID 3245C4) and its watershed

Refer to **Figure 1.2** for a detailed look at the Pine Lake watershed. Inflows to Pine Lake occur primarily through the Stub Canal, which enters the lake from the northwest, and the lake discharges through the continuation of the Stub Canal down to the C-51 Canal (ERD 2015). Water from the C-51 Canal is discharged into the Lake Worth Lagoon just east of Lake Clarke.

The primary soils in the Pine Lake Watershed, based on the National Cooperative Soil Survey, are in Hydrologic Soil Groups A and A/D. Group A soils are sandy to loamy and are associated with a low runoff potential and high infiltration rates. Group B soils are silty to loamy and are moderately drained. Soils in Group D are often greater than 40 % clay and have a high runoff potential. Soils classified in dual hydrologic groups (A/D and B/D) have Type A and B soil characteristics when unsaturated but behave like Type D soil when saturated.

Table 1.1 lists the soil hydrologic groups and their corresponding areas in the Pine Lake Watershed. Based on the soil characteristics shown in **Figure 1.4**, soils in these watershed are mostly well drained. The hydrologic characteristics of soil can significantly influence the capability of a watershed to hold rainfall or produce surface runoff, and these characteristics are factors in the calculation of background conditions described in **Section 5.4**.

The climate of the Pine Lake Watersheds is subtropical. The average monthly temperature in West Palm Beach ranges from 19° C in January to 28° C in August, according to the 1981–2010 climate normal calculated by Florida State University (Florida Climate Center 2010). Annual rainfall in Palm Beach County averaged 158 centimeters (cm) for the period of 1981–2010 and 157 cm for the period of 1991–2020, based on NOAA/NWS data (NWS 2020).

Table 1.1. Soil type areas in the Pine Lake Watershed

m^2 = Square meters

Soil	Pine Lake Watershed (m^2)
Water	1,965,150
A	5,278,818
A/D	3,722,215
B/D	Not Present

Figure 1.3. Hydrogeological setting for the lakes including arrows indicating flow direction for the main canals of the local canal network

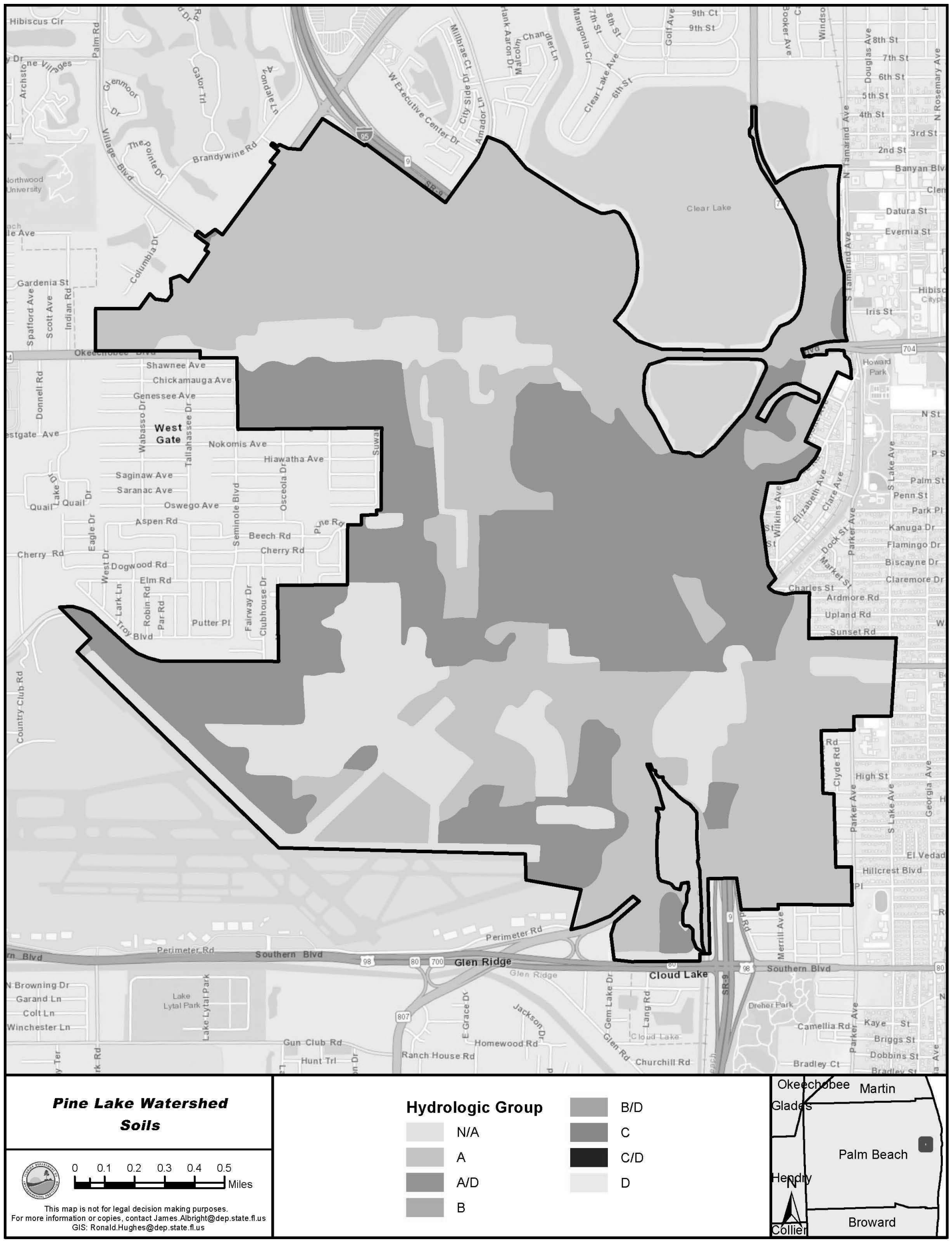


Figure 1.4. Hydrologic soil groups in the Pine Lake Watershed

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

Pine Lake is a Class III (fresh) waterbody, 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 this waterbody is Florida's nutrient criterion in Paragraph 62-302.530(48)(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 geometric means (**Table 2.1**). The lake classifications for the NNC are high-color lakes, low-color/high-alkalinity lakes (>20 mg/L $CaCO_3$), and low-color/low-alkalinity lakes (>20 mg/L $CaCO_3$).

The chlorophyll *a* NNC for both high-color and low-color/high-alkalinity 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 TN and TP criteria for a lake can vary annually, depending on the availability of chlorophyll *a* data and the concentrations of chlorophyll *a* in the lake. If there are sufficient data to calculate an AGM for the chlorophyll *a* for a given year, 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 if the AGM for chlorophyll *a* exceeds the values in the table for the lake type, then the applicable numeric criteria for TN and TP are the minimum values in the table. **Table 2.1** lists the NNC for Florida lake types specified in Subparagraph 62-302.530(48)(b), F.A.C.

At the time of assessment, Pine Lake (with a long-term geometric mean color of 40 PCU) and was classified as a high-color lake and therefore the applicable chlorophyll *a* criterion was 20 µg/L, the TN minimum and maximum criteria were 1.27 and 2.23 milligrams per liter (mg/L), respectively, and the TP minimum and maximum criteria were 0.05 and 0.16 mg/L, respectively. This classification corresponds to the first row of **Table 2.1**.

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

Long-Term Geometric Mean Color and Alkalinity	AGM Chlorophyll *a*	Minimum NNC AGM TP	Minimum NNC AGM TN	Maximum NNC AGM TP	Maximum NNC AGM TN
> 40 PCU	20 µg/L	0.05 mg/L	1.27 mg/L	0.16 mg/L	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 lake are stations sampled by the U.S. Geological Survey (USGS) (112WRD…), Palm Beach County Environmental Management (21FLPBCH…), DEP (21FLGW…, and 21FLWPB…), and ERD (21FLERDI…). **Figures 2.1** shows the sampling locations in the Pine Lake Watershed. The individual water quality measurements discussed in this report are available in the IWR Run 52 Database and are available on request.

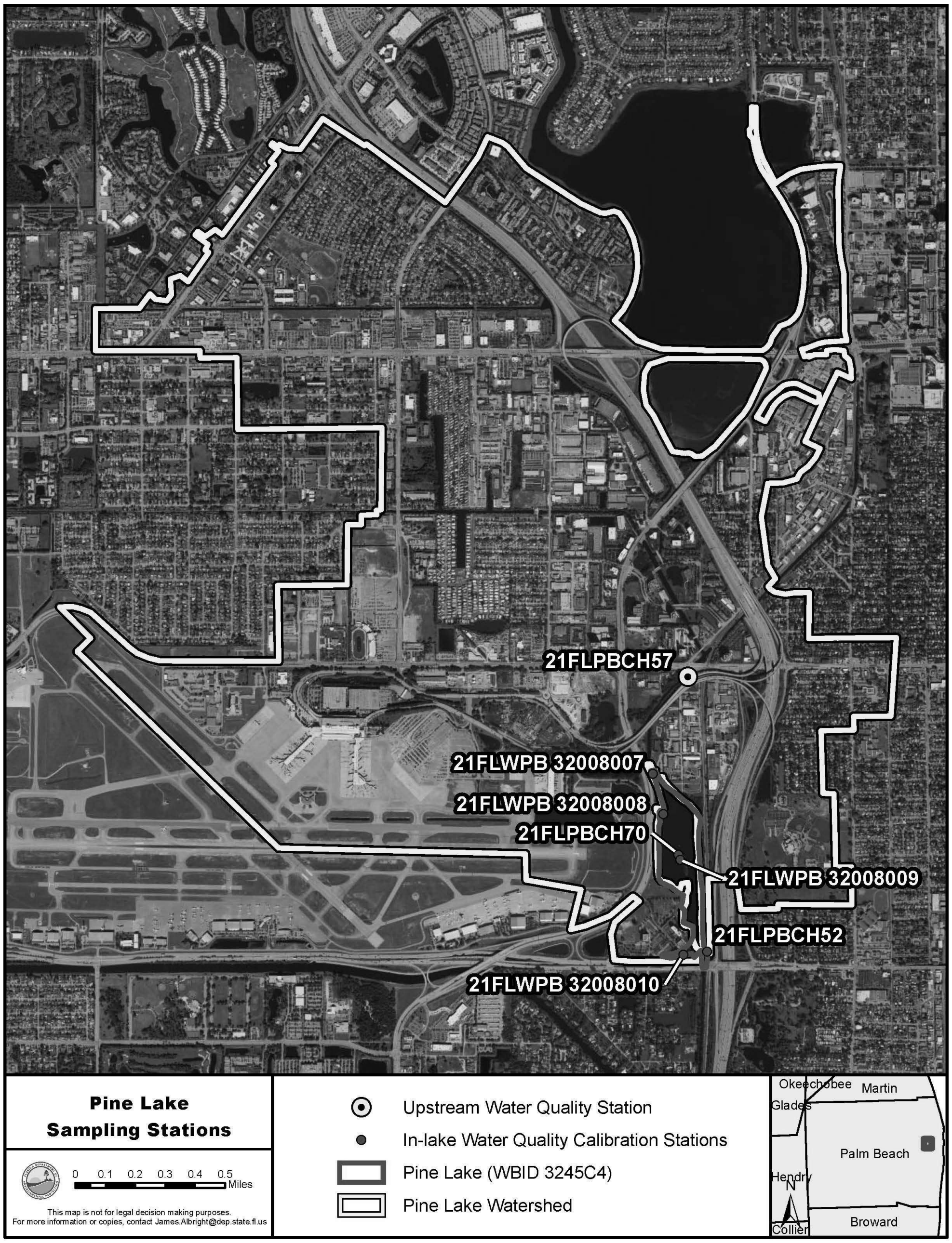


Figure 2.1. Monitoring stations in the Pine Lake Watershed

2.3.2 Information on Verified Impairment

All waterbodies of the state are assigned WBID numbers that in turn are divided into regional basin groups for assessment purposes. Each basin group (numbered 1–5) is assessed in a rotating assessment scheme that is divided into five-year cycles with one group assessed per year. The lakes in this report are located in the Lake Worth Lagoon Basin, which is a Group 3 basin. The Group 3 waterbodies have been assessed three times: the Cycle 1 assessment was performed in 2004 (with data from a verified period of 1997–2004), the Cycle 2 assessment was completed in 2010 (with a verified period of 2002–09), and the Cycle 3 assessment was completed in 2016 (with data from a verified period of 2008-15. Nutrients were assessed using the Trophic State Index (TSI) in Cycles 1 and 2; following these assessments, the state adopted NNC, which were applied in the Cycle 3 assessment. Pine Lake was found to be impaired based on TSI in Cycle 2. Assessments are performed in accordance with the IWR and the data used for these assessments are contained in the IWR database. The IWR database is periodically updated, and these updates are assigned "run" numbers.

Pine Lake was assessed using the NNC in the Cycle 3 assessment with IWR Run 52. Pine Lake was determined to be impaired for chlorophyll *a*. The Cycle 3 assessment was adopted by Secretarial Order on October 21, 2016. **Table 2.2** lists the AGM values for chlorophyll a, TN, and TP for Pine Lake.

Table 2.2. Pine Lake AGM values for the 2008–14 verified period

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)
2008	**31**	1.10	0.04
2009	**29**	**1.37**	**0.11**
2010	**29**	1.00	0.05
2011	**21**	1.12	0.05
2012	16	0.98	0.07
2013	**24**	0.81	0.05
2014	**27**	0.69	**0.07**

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

3.1 Establishing the Site-Specific Interpretations

Pursuant to Paragraph 62-302.531(2)(a), F.A.C., the nutrient TMDLs presented in this report, upon adoption into Chapter 62-304.715, F.A.C., will constitute the site-specific numeric interpretations of the narrative nutrient criterion set forth in Paragraph 62-302.530(48)(b), F.A.C., that will replace the otherwise applicable NNC in Subsection 62-302.531(2), F.A.C., for this particular waterbody. **Table 3.1** lists the elements of the nutrient TMDLs that constitute the site-specific numeric interpretations of the narrative nutrient criterion. **Appendix B** summarizes the relevant details to support the determination that the TMDLs provide for the protection of Pine Lake 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. 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 the reduction of both nitrogen and phosphorus is better 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 development of the generally applicable lake NNC was based on the selection of a protective chlorophyll *a* criterion and the subsequent evaluation of the relationship between chlorophyll *a* and TN and TP to develop TN and TP concentrations protective of designated uses (DEP 2012). Based on several lines of evidence, DEP developed a chlorophyll *a* criterion of 20 µg/L for lakes with high color. DEP demonstrated that the chlorophyll *a* criterion of 20 µg/L is protective of designated uses and maintains a healthy well-balanced community of aquatic flora and fauna in high-color lakes. There is no information available suggesting that Pine Lake requires lower chlorophyll *a* levels. Therefore, DEP has determined that the generally applicable chlorophyll *a* NNC for a lake with high color is appropriate, and it will be used as the TMDL target.

3.3 Numeric Expression of the Site-Specific Numeric Interpretations

The site-specific interpretations of the narrative nutrient criterion for TN and TP were determined by using the watershed and waterbody models described in **Chapter 5** to determine the TN and TP loading that would achieve the chlorophyll *a* criterion of 20 µg/L every year. **Section 5.4** discusses in more detail the methods used to derive these loading values.

Three-year rolling average loads were calculated from yearly TN and TP loads that achieved the generally applicable chlorophyll *a* criterion, and the maximum 3-year averages of TN and TP loads were chosen as the site-specific interpretations of the narrative nutrient criterion. The resulting TN and TP target loads for Pine Lake are 9,749 and 611 kilograms per year (kg/yr) respectively (**Table 3.1**). The site-specific interpretations for Pine Lake are expressed as 3-year rolling average loads never to be exceeded.

Table 3.1. Site-specific interpretations of the narrative nutrient criterion for Pine Lake

Note: The rolling average loads listed for TN and TP are intended to achieve the applicable annual geometric mean chlorophyll *a* criterion for high color and high alkalinity lakes.

WBID	3-Year Rolling Average TN Load (kg/yr)	3-Year Rolling Average TP Load (kg/yr)
3245C4	9,749	611

DEP also determined the in-lake TN and TP concentrations corresponding to the conditions that attain the chlorophyll *a* criterion and the TN and TP load-based criteria. These concentration-based restoration targets are presented for informational purposes only. The TN and TP restoration concentrations represent the simulated TN and TP concentrations corresponding to the simulated chlorophyll *a* concentration. A distribution of the yearly simulated nutrient concentrations was derived in the modeling approach, and the 80th percentile of this distribution was selected as the restoration TN and TP concentrations. The statistical derivation of the 80th percentile is consistent with a 1-in-3-year exceedance rate. The TN and TP restoration concentrations for Pine Lake are AGM concentrations of 0.69 and 0.04 mg/L, respectively, not to be exceeded more than once in any consecutive 3-year period.

3.4 Downstream Protection

As discussed in **Section 1.3.3**, the two lakes are part of a chain of lakes, which is in turn connected to the actively managed south Florida canal network (refer to **Figure 1.3**). Although lakes in this area have generally applicable NNC based on their lake characteristics, it should be noted that, as this area is part of the south Florida region, there are no generally applicable TN and TP NNC for streams, and the nutrient impairment threshold of 20 µg/L of chlorophyll *a* applies to these waters.

Outflow from Pine Lake generally flows southward via the continuation of the Stub Canal to its confluence with the larger C-51 Canal. This portion of the C-51 Canal East is assessed as WBID 3245F and is a Class III freshwater flowing stream/canal, which captures drainage from farther west as well as the smaller contributions from Pine Lake and Lake Clarke, which also flows into this portion of the C-51 Canal. The nutrient impairment threshold for chlorophyll *a* in south Florida streams is 20 µg/L, and WBID 3245F is not impaired for chlorophyll *a*. Lake Clarke (WBID 3245B) is a Class III freshwater lake with the applicable NNC for a high color lakes (refer to **Table 2.1** for the applicable criteria). Lake Clarke is not currently verified impaired for TN, TP, or chlorophyll *a*. Based on the healthy existing conditions in the downstream receiving waters, the existing nutrient loads from Pine Lake to the C-51 Canal have not caused downstream waters to fail to achieve their designated uses or to cause an imbalance in aquatic flora and fauna. The reductions in nutrient loads described in this TMDL analysis are not expected to cause nutrient impairment but, rather, to improve water quality in these downstream waters.

3.5 Endangered Species Considerations

Section 7(a)(2) of the Endangered Species Act 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. The FWS online Information for Planning and Conservation (IPaC) tool identifies terrestrial species potentially affected by activities in the Pine Lake Watershed. DEP is not aware of the presence of any endangered species in the three watersheds, Furthermore, it is expected that restoration efforts and subsequent water quality improvements will positively affect 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 watersheds 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**). The methodologies used to estimate loads do not distinguish between NPDES and non-NPDES stormwater discharges. As non-NPDES/non-MS4 stormwater discharges may comprise a significant portion of the overall load, 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 wastewater facilities that discharge to Pine Lake or that discharge to surface waters in the Pine Lake watershed.

4.2.2 Municipal Separate Storm Sewer System (MS4) Permittees

There is an NPDES MS4 Phase I permit (FLS000018) that includes 40 individual co-permittees. Of the multiple entities included in permit FLS000018, only co-permittees whose jurisdictions are included, wholly or in part, within the boundaries of the Pine Lake Watershed are listed here.

Also note that while these permittees are located wholly or partially within the Pine Lake watershed, the permittees do not have jurisdiction over the entire contributing areas for each lake, nor are they responsible for any discharge if they do not have an outfall discharging to the watershed. The Pine Lake Watershed includes four MS4 entities; Palm Beach County, the City of West Palm Beach, the Northern Palm Beach County Improvement District, and Florida Department of Transportation District IV. For more information on MS4s in the watersheds, send an email to NPDES-stormwater@dep.state.fl.us. **Table 4.1** lists the permittees/co-permittees in the watersheds and their MS4 permit numbers.

Table 4.1. NPDES MS4 permits with jurisdictions in the Pine Lake Watershed

Permit Number	Permittee/Co-permittee	Phase
FLS000018 co-permittees	Palm Beach County City of West Palm Beach Florida Department of Transportation District IV Northern Palm Beach County Improvement District	I

4.2.3 Industrial NPDES Permits

The Pine Lake Watershed also includes numerous dischargers covered by industrial NPDES permits. The largest number of industrial permits found in the Pine Lake watershed are associated with the Palm Beach International Airport. **Tables 4.2** shows the Multi-Sector Generic Permits (MSGP) for all industrial facilities and activities.

Table 4.2. NPDES industrial facilities permits within the Pine Lake Watershed

Permit Number	Permittee Facility Name
FLR05B377	American Airlines Inc
FLR05C136	West Palm Beach Layover Facility
FLR05D037	Southwest Airlines at Palm Beach International Airport
FLR05E271	Palm Beach International Airport
FLR05E279	Palm Beach Intl Airport
FLR05E315	UPS - West Palm Beach Gateway
FLR05F516	Centerport Inc.
FLR05F516	Centerport Inc.
FLR05H131	FedEx Express PBIR
FLR05H168	Aircraft Service International Group
FLR05I365	Palm Beach Intl Airport

4.3 Nonpoint Sources

Nonpoint sources addressed in this analysis primarily include loadings from non-MS4 surface runoff, groundwater seepage from septic systems entering the lakes, and precipitation directly onto the lake surface (atmospheric deposition).

Accurately quantifying the nutrient loadings from nonpoint sources requires identifying nonpoint source categories, locating the sources, determining the intensity and frequency at which these sources create high nutrients loadings, and specifying the relative contributions from these sources. Depending on the land use distribution in a given watershed, frequently cited nonpoint sources in urban areas include failed septic tanks, leaking sewer lines, and pet feces. For a watershed dominated also by rangeland land uses, Nutrients loadings can come from the runoff from areas with animal feeding operations or direct animal access to the receiving waters. In addition to the sources associated with the anthropogenic activities, birds and other wildlife forms can also act as nutrient contributors to the receiving waters. While detailed source information is not always available for accurately quantifying the nutrients loadings from different sources, land use information can provide some hints on what the potential sources of observed nutrients impairment might be.

4.3.1 Land Uses

Land use is one of the most important factors in determining nutrient loadings from the Pine Lake 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. **Table 4.3** lists land use in the Pine Lake Watershed. Land use coverages are from 2016 (Florida Land Use and Cover Classiciation System [FLUCCS] Level 1), based on data from the South Florida Water Management District (SFWMD 2020). **Figure 4.1** show the information graphically for Pine Lake. These data were applied in the development of watershed loadings to the lakes, described in **Section 4.4**. The watershed loadings were then used in the development of the lake water quality model documented in **Chapter 5**.

The total watershed area for Pine Lake is 10.97 km^2. The predominant land use is urban, which covers approximately 96 % of the area. Of the urban land, transportation (including both roads and airport runway areas) makes up the largest area, covering 32 % of the area, followed by 24 % commercial and services followed by residential land use covering approximately 21 % of the area. Another 12 % of the area is devoted to industrial land uses, and the remaining area—including water and wetland and all other land uses—covers a little more than 3 % of the total area. There are no agricultural land uses in the Pine Lake Watershed.

Table 4.3. SFWMD 2016 land use in the Pine Lake Watershed

Land Use Code	Land Use Classification	Area (km^2)	% of Watershed
1200	Residential Medium Density	1.54	14.05
1300	Residential High Density	0.69	6.63
1400	Commercial and Services	2.66	24.24
1500	Industrial	1.31	11.96
1700	Institutional	0.20	1.81
1800	Recreational	0.61	5.56
1900	Open Land	0.06	0.51
5000	Water	0.31	2.80
6000	Wetlands	0.01	0.08
8000	Communication and Transportation	3.55	32.37
Total		**10.97**	**100**

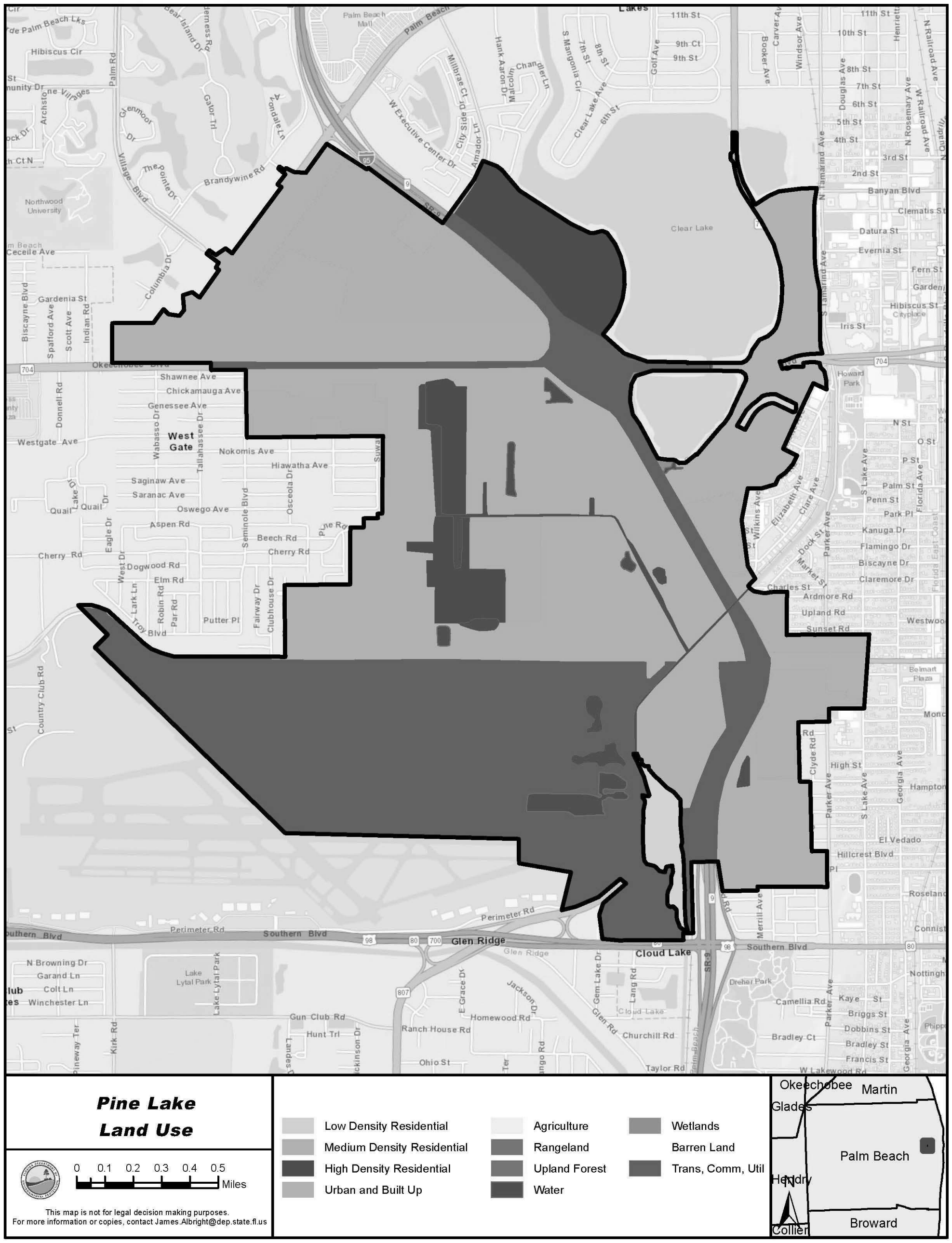


Figure 4.1. SFWMD 2016 land use in the Pine Lake Watershed

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. However, OSTDS can be a source of nutrients (nitrogen and phosphorus), pathogens, and other pollutants to both groundwater and surface water.

The Florida Department of Health (FDOH) maintains a list of septic tanks by county, and the Palm Beach County 2018 database was used to estimate the number of known and likely septic tanks in the lake watersheds. There were an estimated 123 septic tanks in the Pine Lake Watershed. **Figure 4.2** shows the OSTDS locations in the Pine Lake Watershed.

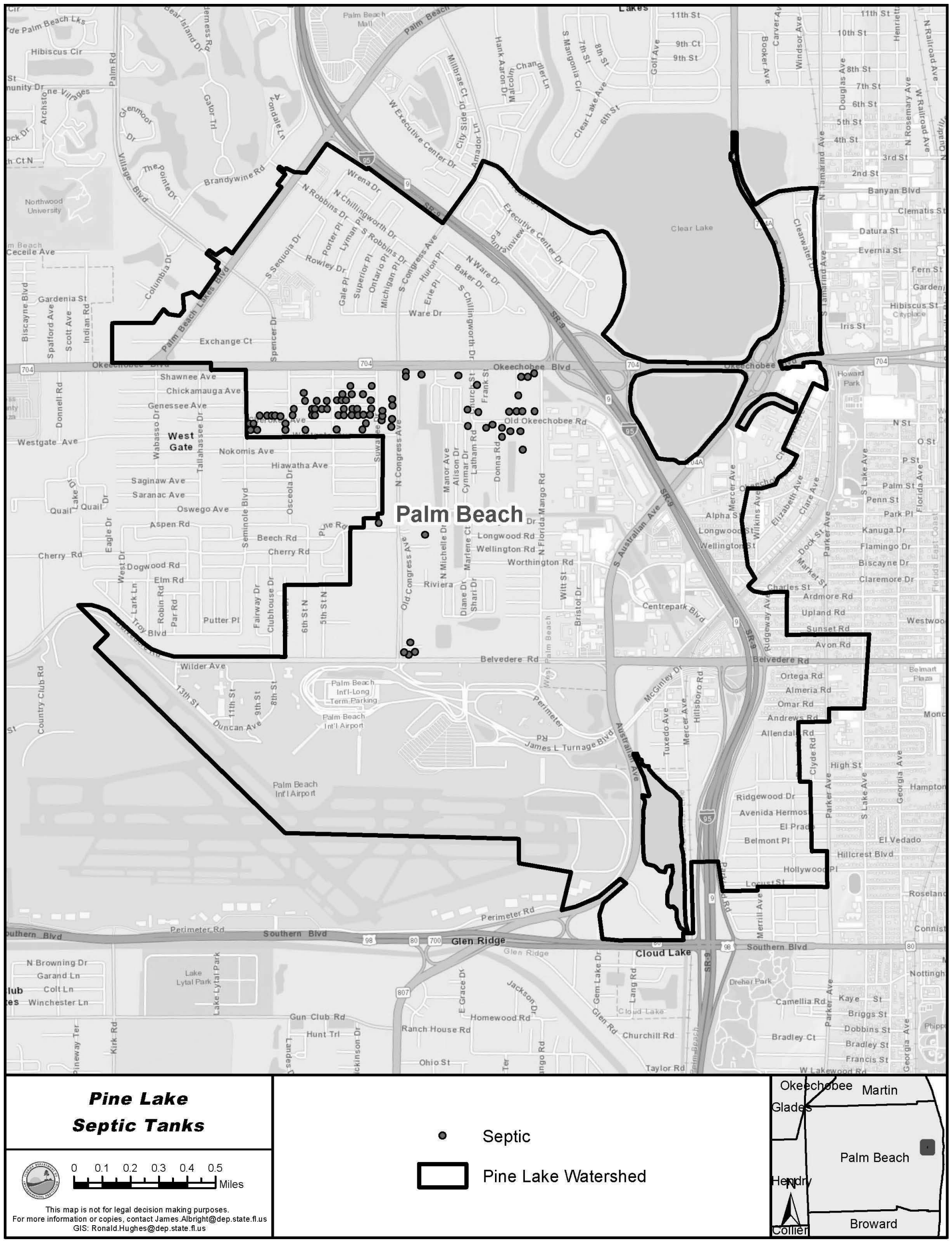


Figure 4.2. OSTDS in the Pine Lake Watershed

4.3.3 Atmospheric Deposition

Nutrient loadings from the atmosphere are an important component of the nutrient budget in many Florida lakes. Nutrients are delivered through two pathways: wet atmospheric deposition with precipitation and dry particulate-driven deposition. Atmospheric deposition to terrestrial portions of the Pine Lake Watershed is assumed to be accounted for in the loading rates used to estimate the watershed loading from land. Loading from atmospheric deposition directly onto the water surface was also considered in the loading estimation.

Direct atmospheric deposition into Pine Lake was calculated using data from the St. Johns River Water Management District (SJRWMD) for Lake Apopka. This site was used because it included data for both TN and TP and the atmospheric deposition dataset statewide is limited. Dry deposition is the component of the overall atmospheric deposition where particles settle onto a surface (solid substrate or waterbody surface) from the atmosphere over time due to the action of gravity. It's expressed as a per area loading rate (areal loading rate) on an annual scale. Wet deposition is the component of atmospheric deposition that is delivered via precipitation onto a surface. This measurement is expressed as a concentration of solutes in precipitation multiplied by the volume of precipitation. The TN and TP atmospheric loading rates obtained were an average of 978 and 46 mg/m^2/yr, respectively. The average atmospheric loads for each lake were derived by multiplying these loading rates by the surface area of each of the lakes. The average atmospheric loads for TN and TP in Pine Lake were 142 and 7 kg/yr, respectively. **Table 4.4** shows the annual atmospheric deposition and atmospheric loads for Pine Lake.

Table 4.4. Estimated atmospheric loads in Pine Lake

Year	TN deposition (mg/m^2/yr)	TP deposition (mg/m^2/yr)	Pine Lake TN Load (kg/yr)	Pine Lake TP Load (kg/yr)
2004	1,280	39	179	5
2005	840	30	118	4
2006	836	25	117	3
2007	1,537	58	215	8
2008	1,018	48	142	7
2009	823	46	115	6
2010	911	54	128	7
2011	644	37	90	5
2012	1,716	97	240	14
2013	826	35	116	5
2014	831	38	116	5
2015	676	51	95	7
2016	777	43	109	6
Average	**978**	**46**	**142**	**7**

4.4 Estimating Watershed Runoff

The Pollutant Loading Screening Model (PLSM) was used to simulate runoff volumes from the Pine Lake Watershed. PLSM-estimated runoff volumes are driven by multiplying rainfall and runoff coefficients (ROCs) which vary over the surface area of the landscape based on empirically estimated land use–specific values. The ROCs used in these PLSM simulations were derived from spatially averaged data in peninsular Florida (Harper 1994; 2012). Precipitation data were obtained from the West Palm Beach International Airport station (WPBAIRP_R). Monthly rain totals were sorted into dry and wet season totals for each year. Land use descriptions were obtained from SFWMD 2016 land use coverage. The model period of 2006–2014 for Pine Lake was chosen to capture the most recent period with uninterrupted continuous data sufficient to calculate AGMs for TN, TP, and chlorophyll *a*. **Tables 4.5** lists the PLSM results for Pine Lake.

Table 4.5. PLSM-simulated runoff volumes to Pine Lake

hm^3/yr = Cubic hectometers per year

Year	Pine Lake	
	Pine Dry Season Runoff Volume (hm^3/yr)	Pine Wet Season Runoff Volume (hm^3/yr)
2004	4.0	10.9
2005	2.2	8.6
2006	3.5	5.3
2007	4.1	10.9
2008	4.1	7.5
2009	1.3	8.7
2010	6.8	5.3
2011	1.4	7.8
2012	3.1	12.6
2013	2.0	9.6
2014	4.3	8.4
2015	3.2	5.5
2016	5.3	6.3

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 Pine Lake and to identify the maximum allowable TN and TP loadings from the watersheds, so that the lakes will meet their TMDL targets and thereby maintain their function and designated use as Class III waters.

5.2 Evaluation of Water Quality Conditions

Figure 5.1 shows the chlorophyll *a* AGM values and annual total rainfall for Pine Lake. No clear direct relationships were seen between rainfall and chlorophyll *a*. The lack of strong relationships between nutrients and rainfall suggests that adjustments for seasonality and rainfall are unlikely to affect the TMDL determination.

For the water quality analysis conducted for TMDL development, AGMs were used to be consistent with the expression of the adopted NNC for lakes. These were calculated using a minimum of 4 sample results per year, with at least 1 of the samples collected in the May to September period and at least 1 sample collected from other months. Values with an "I" qualifier code were used as reported. Values with "U" or "T" qualifier codes were changed to the minimum detection limit (MDL) divided by the square root of 2. Values with "G" or "V" qualifier codes were removed from the analysis for quality control reasons. Multiple sample results collected on the same day were averaged.

The AGM calculation method for this purpose is somewhat different than the one used to calculate AGMs for performing water quality assessments, following the methodology in Chapter 62-303, F.A.C. Also, all currently available data were used to calculate AGMs for modeling, which means that there are more recent AGMs available than those used at the time of the most recent IWR assessment. Therefore, the AGMs presented in **Chapter 2** may not match the AGMs used for TMDL development.

5.3 Critical Conditions and Seasonal Variation

The lakes' 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 segment, which is better addressed on an annual basis, (3) the methodology used to determine impairment is based on annual conditions (AGM values), and (4) the chlorophyll *a* criterion used as the TMDL target is expressed as an AGM.

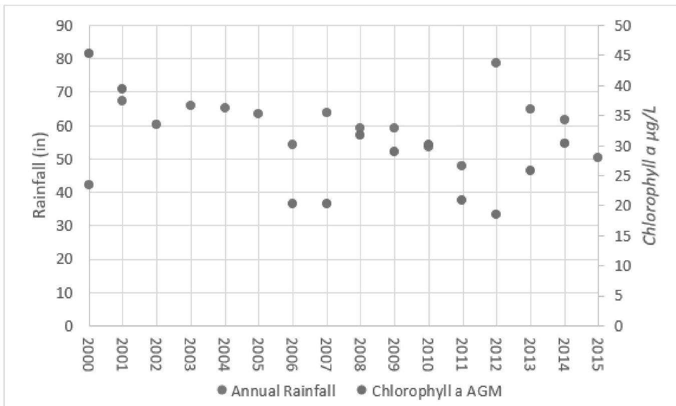


Figure 5.1. Annual rainfall vs. chlorophyll *a* AGMs in Pine Lake

5.4 Water Quality Modeling to Determine Assimilative Capacity

The BATHTUB eutrophication model was used to predict nutrient and chlorophyll *a* conditions for Pine Lake based on physical lake characteristics and watershed flows derived from the PLSM. The model was then calibrated to simulate in-lake water quality in each lake and to calculate the TN and TP loads under the existing conditions. Reductions were then applied to the watershed and septic components of the existing conditions loads until the simulated in-lake chlorophyll *a* concentrations were below the target of 20 µg/L in every year.

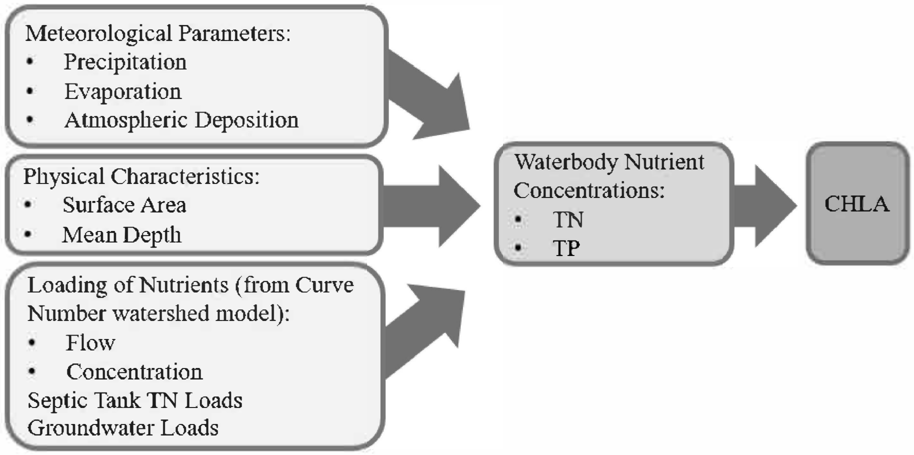
5.4.1 Water Quality Model Description

The BATHTUB eutrophication model is a suite of empirically derived steady-state models developed by the U.S. Army Corps of Engineers (USACE) Waterways Experimental Station. The primary function of these models is to estimate nutrient concentrations and algal biomass resulting from different patterns of nutrient loadings. The procedures for selecting the appropriate model for a particular waterbody are described in the User's Manual (Walker 2004). The empirical prediction of eutrophication with this approach is typically a two-stage procedure using the following two categories of models (Walker 1987):

- The **nutrient balance model** relates the nutrient concentration to the external nutrient loadings, morphometrics, and hydraulics of the waterbody.
- The **eutrophication response model** describes the relationships among eutrophication indicators in the waterbody, including nutrient levels, chlorophyll *a*, transparency, and hypolimnetic oxygen depletion.

The nutrient models in BATHTUB assume that the net accumulation of nutrients in a lake is the difference between nutrient loadings into the lake from various sources and nutrients carried out through outflow, and nutrient losses through whatever decay processes occur in the lake. BATHTUB includes a suite of phosphorus and nitrogen sedimentation, chlorophyll, and Secchi depth models.

Figure 5.2 shows the scheme used to relate these various models in BATHTUB. According to this scheme, external nutrient loading, physical characteristics, and meteorological parameters are all applied to the in-lake nutrient concentrations. The physical, chemical, and biological response of the lake to the level of nutrients then produces waterbody nutrient concentrations, and finally chlorophyll *a* growth. In BATHTUB, other limiting factors can be applied, such as nitrogen, phosphorus, light, or flushing, depending on which chlorophyll model is selected. It relates the external loading of nutrients to the waterbody nutrient concentrations and the physical, chemical, and biological response of the waterbody to the level of nutrients. The BATHTUB model includes a suite of phosphorus and nitrogen sedimentation models along with a set of chlorophyll *a* and Secchi depth models. The nutrient balance models assume that the net accumulation of nutrients in a waterbody is the difference between nutrient loadings into the waterbody from various sources and the nutrients carried out through outflow and the losses of nutrients through decay processes inside the waterbody. Different limiting factors such as nitrogen, phosphorus, light, or flushing are considered in the selection of an appropriate chlorophyll *a* model. The variety of models available in BATHTUB allows the user to choose specific models based on a waterbody's particular condition.



Chla = Chlorophyll *a*

Figure 5.2. BATHTUB Model conceptual diagram

5.4.2 Model Selection and Configuration

Because Pine Lake is a small lake, the BATHTUB model was set up as a single, unsegmented, , well-mixed waterbody. The lake was modeled yearly with annual inputs allowed to vary. The BATHTUB model applies simulated in-lake processes to the initial nutrient input loads to generate in-lake concentrations and constituent loadings. As discussed in **Section 4.4,** the PLSM was used to derive watershed runoff volumes through the application of ROCs associated with different land use types. To reduce uncertainties in the input concentrations and to better capture interannual variation, measured concentration data were used in the calibration process rather than concentrations derived from simulated PLSM results. These measured model input concentrations were obtained from a calibration station located at an upstream station in the Stub Canal. These concentrations were generally comparable to those produced by the PLSM. Measured flows into the lakes were not available, and thus the PLSM-derived flows were retained in the calibration process. Inputs were obtained by combining the measured average concentrations with the simulated flows derived from the PLSM. The PLSM analyses used separate precipitation totals from the dry (November–April) and wet (May–October) seasons for each year.

Figure 2.1 in **Chapter 2** shows the location of the upstream calibration station, 21FLPBCH57, located in the Stub Canal above Pine Lake. Data from this station were available for every year in the model period allowing for separate annual concentration inputs for every year in the model period. It was possible to parse the data further but dividing the annual inputs into yearly seasonal averages did not produce an improvement over simply using annual average concentrations. The model inputs including seasonal PLSM flows and annual upstream concentrations are shown in **Table 5.1**. In this table, TN and TP concentrations are shown as "parts per billion" (PPB, equivalent to µg/L) because this is the format used by BATHTUB.

Table 5.1. Pine Lake BATHTUB model inputs; flows estimated with PLSM and concentrations based on upstream station data

Year	Dry Season Flow (hm^3/yr)	Wet Season Flow (hm^3/yr)	Annual Average TP (PPB)	Annual Average TN (PPB)
2006	3.55	5.34	79	898
2007	4.14	10.94	75	1,238
2008	4.10	7.53	70	1,470
2009	1.33	8.72	124	1,646
2010	6.80	5.30	90	1,099
2011	1.41	7.77	71	1,003
2012	3.10	12.59	91	952
2013	1.96	9.64	73	699
2014	4.33	8.39	75	784

There were no groundwater quality data available to incorporate into the modeling so instead, the number of septic tanks located within a 200-meter buffer of the lakes was used to estimate the potential impacts of septic tank loading into the systems. This buffer was restricted to the immediate area around the lake because of the danger of double-counting the groundwater component from upstream conveyed in the canals. **Section 4.3.2** discusses the known septic tank location information for the whole Pine Lake Watershed in further detail. There are few septic tanks in the watershed as a whole and there are no septic tanks located within the immediate 200-meter buffer zone of Pine Lake. Therefore, no groundwater load was added for Pine Lake.

The modeler has a choice of eutrophication models available to model the individual nutrient components (via sedimentation of TN and TP) and the resulting chlorophyll *a* concentrations. Since the lakes in the Palm Beach County Chain of Lakes are located very close to each other and are morphologically and geologically similar, the assumption is that similar in-lake processes will be present in each lake. Therefore, the model selections were kept constant. The TN and TP sedimentation models selected were both Model 1, which applies a 2nd-order decay rate to the available TN and TP. Chlorophyll *a* was also simulated using Model 1, which incorporates TP, TN, light, and flushing rates.

BATHTUB includes global variables for each model, including the averaging period for the analysis, precipitation, evaporation, and atmospheric loading. The averaging period for the analysis was set to half a year, as the input was based on the yearly seasonal periods. Precipitation data were obtained from the Palm Beach International Airport. Each year of precipitation data was split into dry (November–April) and wet (May–October) seasons based on the monthly rainfall sums. Evaporation data were collected at the South Florida Water Management District station WPB.EEDD_E in West Palm Beach. A pan coefficient of 0.75 was used to derive lake evaporation rates from the pan evaporation data. Monthly data were aggregated into wet and dry season totals. As discussed in **Section 4.3.3** estimates of atmospheric deposition used St. Johns River Water Management Data from Lake Apopka and local rainfall to obtain dry and wet season estimates of atmospheric loading. **Table 5.3** shows the precipitation, evaporation, and atmospheric deposition data used as global parameters.

Table 5.3. Global water quality inputs for the Pine Lake modeling

Year	Seasonal Precipitation (m/yr)		Lake Evaporation (m/yr)		Atmospheric Load (mg/m^2/yr)			
	Dry	Wet	Dry	Wet	Dry TP	Dry TN	Wet TP	Wet TN
2004	0.51	1.41	0.60	0.76	14.4	383.0	24.3	896.6
2005	0.28	1.11	0.56	0.78	10.5	210.9	19.2	629.0
2006	0.46	0.69	0.61	0.72	11.5	352.6	13.4	483.8
2007	0.53	1.41	0.63	0.78	22.1	471.5	36.3	1,065.4
2008	0.53	0.97	0.60	0.77	20.4	383.3	27.9	634.2
2009	0.17	1.12	0.52	0.76	14.7	169.8	31.6	653.5
2010	0.87	0.68	0.55	0.86	28.2	501.4	25.3	409.3
2011	0.18	1.00	0.58	0.84	12.3	145.6	24.5	498.0
2012	0.40	1.62	0.59	0.77	33.6	428.6	63.2	1,287.2
2013	0.25	1.24	0.54	0.78	12.1	187.9	23.3	638.0
2014	0.56	1.08	0.53	0.82	16.6	306.3	21.8	524.8
2015	0.41	0.71	0.56	0.83	22.6	271.1	28.5	404.5
2016	0.69	0.81	0.60	0.76	20.7	364.4	22.2	412.5

5.4.3 Model Calibration

Separate dry and wet season calibration runs were performed and the outputs combined into an annual average for each model year for both lakes. These simulated nutrient and chlorophyll *a* outputs were then compared with the measured data. BATHTUB allows the user to apply calibration factors to the estimated nutrients by adjusting the sedimentation rates of TN and TP and by applying a calibration factor to chlorophyll *a*. Calibration factors were applied as necessary to better match the measured data. The TP sedimentation rate for Pine Lake was adjusted to 0.75 milligrams per cubic meter per year (mg/m^3/year) and the TN sedimentation rate was adjusted to 0.5 mg/m^3/year. And a small calibration factor of 1.1 was applied to chlorophyll *a*. All calibration factors were within the suggested range in the BATHTUB user manual. **Figures 5.3**, **5.4**, and **5.5** show the model-predicted results and observed concentrations for TN, TP, and chlorophyll *a* for Pine Lake. Nutrient concentrations are displayed as PPB to be consistent with the format used by the BATHTUB program.

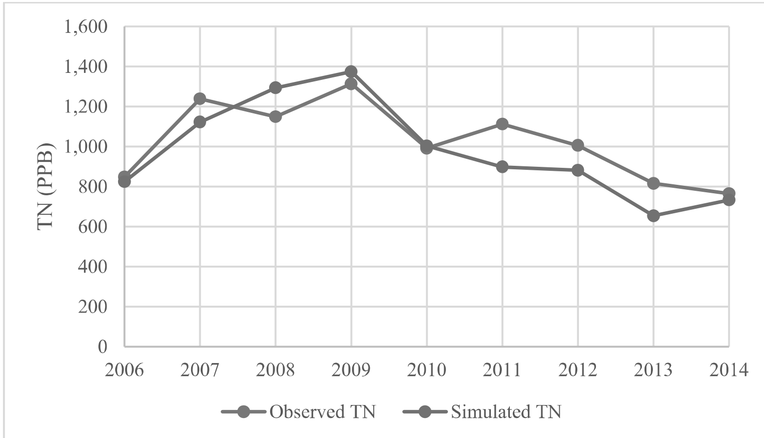


Figure 5.3. Predicted and observed TN concentrations in Pine Lake

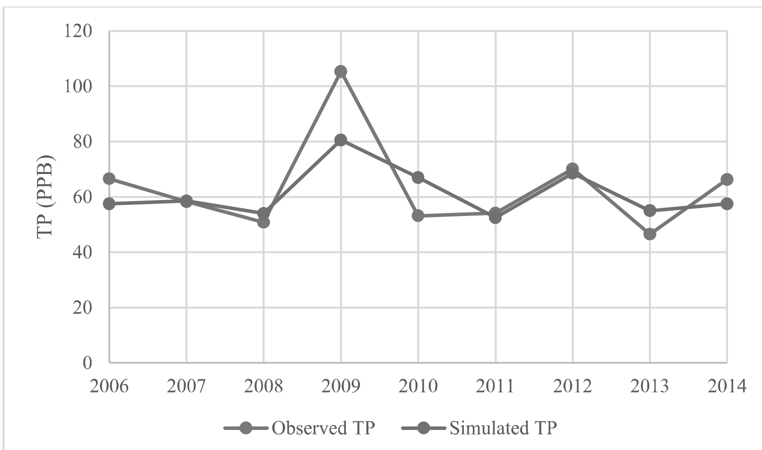


Figure 5.4. Predicted and observed TP concentrations in Pine Lake

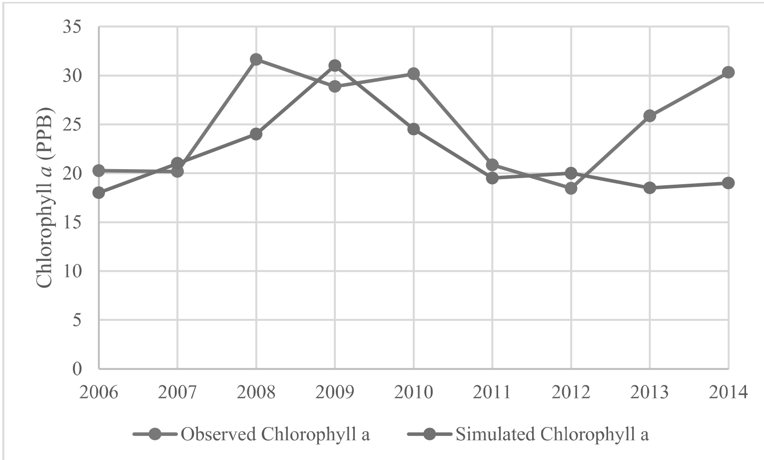


Figure 5.5. Predicted and observed chlorophyll *a* concentrations in Pine Lake

To evaluate the model performance, the percent difference between the average simulated and average observed values was calculated annually for each year in the model period for both lakes. Donigian (2000) published a widely accepted set of model calibration tolerance thresholds for water quality modeling. The calibration/validation tolerances for water quality modeling are expressed qualitatively as "Very Good" for percent differences < 15 %, "Good" for percent differences from 15 % to 25 %, and "Fair" for percent differences from 25% to 35 %. **Table 5.4** shows the annual percent differences between measured and simulated TN, TP, and chlorophyll *a* in Pine Lake. For Pine Lake, TN calibrations were rated as “Good” to “Very Good” in every year and TP calibrations were rated as “Good” to “Very Good” in every year other than 2009, which was rated as “Fair”. Chlorophyll *a* calibrations ranged a bit more widely with 6 out of 9 years rated “Good” or “Very Good”, with two years rated as “Fair” (2008 and 2013) and with 2014 rated as “Poor”.

Table 5.4. Water quality calibration statistics for Pine Lake (2006–2014)

Calibration ratings are based on suggested water quality calibration metrics from Donigian (2000)

Year	TN Average Percent Difference	Calibration Rating	TP Average Percent Difference	Calibration Rating	Chlorophyll *a* Average Percent Difference	Calibration Rating
2006	3%	Very Good	15%	Very Good	12%	Very Good
2007	10%	Very Good	0%	Very Good	-4%	Very Good
2008	-12%	Very Good	-6%	Very Good	27%	Fair
2009	-5%	Very Good	27%	Fair	-7%	Very Good
2010	-1%	Very Good	-23%	Good	21%	Good
2011	21%	Good	3%	Very Good	7%	Very Good
2012	13%	Very Good	2%	Very Good	-8%	Very Good
2013	22%	Good	-17%	Good	33%	Fair
2014	4%	Very Good	14%	Very Good	46%	Poor

5.5 Calculation of the TMDLs

To achieve the target chlorophyll *a* concentration of 20 µg/L, the existing TN and TP loads were iteratively reduced using the calibrated BATHTUB model until the chlorophyll *a* target was achieved in every year of the modeling period of 2006–14 for Pine Lake. Meeting the chlorophyll *a* target in every year is considered a conservative assumption for establishing TMDLs, as this ensures that all exceedances of the nutrient targets are addressed. **Tables 5.5** lists the BATHTUB-modeled loads for Pine Lake, including the existing TN and TP loads, the loads that achieve the criterion of 20 µg/L chlorophyll *a* (under the TMDL condition), and the maximum 3-year rolling averages. Annual loads were calculated by taking the sum of the dry season and wet season modeled loads for each year.

The final reductions to establish the TMDLs for Pine Lake were calculated by using the maximum three-year rolling average of both the existing and TMDL condition TN and TP loads. The general equation used to calculate the percent reductions based on the maximum 3-year rolling averages is as follows:

$$\frac{\text{(Maximum Existing Load – TMDL Condition Load)} * 100}{\text{Maximum Existing Load}}$$

The maximum 3-year rolling averages of TN existing loads and TN loads under the TMDL conditions for Pine Lake are 17,592 and 9,749 kg/yr, respectively. The maximum 3-year rolling averages of TP existing loads and TP loads under the TMDL conditions for Pine Lake are 1,084 and 611 kg/yr, respectively. To meet the TMDL loads for Pine Lake, the required percent reductions for the TN and TP existing loads are 45 % and 44 %, respectively.

Table 5.5. Pine Lake TMDL condition nutrient loads, 2008–14

Year	Existing TN Loads (kg/yr)	Existing TP Loads (kg/yr)	3-Year Rolling Average TN Load (kg)	3-Year Rolling Average TP Load (kg)	TMDL Condition TN Loads (kg/yr)	TMDL Condition TP Loads (kg/yr)	3-Year Rolling Average TN Load (kg)	3-Year Rolling Average TP Load (kg)
2006	8,103	703			4,511	396		
2007	18,877	1,139			10,482	642		
2008	17,243	819	14,741	887	9,551	462	8,181	500
2009	16,657	1,250	17,592	1,069	9,216	703	9,749	602
2010	13,429	1,094	15,776	1,054	7,446	616	8,738	594
2011	9,302	657	13,129	1,000	5,159	371	7,274	563
2012	15,180	1,444	12,637	1,065	8,456	815	7,020	601
2013	8,219	850	10,901	984	4,573	478	6,063	555
2014	10,094	958	11,165	1,084	5,603	538	6,211	611
Maximum 3-year rolling averages			**17,592**	**1,084**			**9,749**	**611**

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). Stormwater reductions are included in both the MS4 WLA and LA, as applicable. However, in determining the overall stormwater reductions needed, the Department does not differentiate between the MS4 WLA and the LA, and instead applies the same overall reductions to both as if the two categories were a single category source, unless otherwise specified.

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 Pine Lake are expressed in terms of kilograms per year and percent reduction of TN and TP, and represent the loads of TN and TP that the waterbodies can assimilate while maintaining a balanced aquatic flora and fauna. The Pine Lake TMDLs are based on maximum 3-year averages of simulated data from 2006 to 2014. The restoration goal is to achieve the generally applicable chlorophyll *a* criterion of high-color lakes, and thus protecting the designated uses in these lakes.

Tables 6.1 lists the TMDLs for the Pine Lake Watershed. The load-based TMDLs (column 3) will constitute the site-specific numeric interpretations of the narrative nutrient criterion set forth in Paragraph 62-302.530(48)(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 Pine Lake (WBID 3245C4)

Note: The LA and TMDL daily load for TN is 27 kg/day, and for TP 2 kg/day.
NA = Not applicable
* The required percent reductions listed in this table represent the reduction from all sources.

Waterbody (WBID)	Parameter	TMDL (kg/yr)	WLA Wastewater (% reduction)	WLA NPDES Stormwater (% reduction)*	LA (% reduction)*	MOS
3245C4	TN	9,749	NA	45	45	Implicit
3245C4	TP	611	NA	44	44	Implicit

6.2 Load Allocation

To achieve the load allocation (LA) for Pine Lake, a 45 % and 44 % reduction in current TN and TP loads, respectively, will be required. The TMDLs are based on the percent reduction in total watershed loading; however, it is not DEP's intent to abate natural conditions. It should be noted that the LA includes loading from stormwater discharges regulated by DEP and the water management districts 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 wastewater facilities in the Pine Lake Watershed discharge either into the waterbody or its watershed. Therefore, a WLA for wastewater discharges is not applicable to Pine Lake.

6.3.2 NPDES Stormwater Discharges

Co-permittees (Palm Beach County, Northern Palm Beach County Improvement District, City of West Palm Beach, Florida Department of Transportation District IV) are covered by a Phase I NPDES MS4 permit (FLS000018). Those co-permittees which discharge to the Pine Lake Watershed are responsible for a 45 % reduction in TN and a 44 % reduction in TP from the current anthropogenic loading to Pine Lake from the land areas discharging into their respective MS4s.

The above list of co-permittees is inclusive for all entities that share jurisdiction within the area encompassed by the Pine Lake Watershed; however, this list is not meant to imply that all such entities are included in associated reductions. Any MS4 permittee or co-permittee is only responsible for reducing the anthropogenic loads associated with stormwater outfalls that it owns or otherwise has responsible control over. No MS4 permittee of co-permittee is responsible for reducing other nonpoint source loads within its jurisdiction. Any future modifications to outfalls associated with the MS4 entities will need to be taken into account via revised permit allocations if those outfalls discharge into the Pine Lake Watershed.

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.

An implicit MOS was used because the TMDLs were based on conservative decisions in the modeling assumptions used in determining the assimilative capacity (i.e., loading and water quality response for the lakes). The TMDLs were developed using water quality results from both high- and low-rainfall years. The lake morphology and global parameters used in the existing condition model runs remained the same for every year in the model period. Additionally, the TMDL nutrient loads were derived based on the chlorophyll *a* criterion being met in every year of the model simulation, while the criterion is expressed as not to be exceeded more than once in any consecutive three-year period.

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, industrial permits, environmental resource permits, and, as appropriate, through local or regional water quality initiatives or basin management action plans (BMAPs). These activities will heavily depend on the active participation of the South Florida Water Management District (SFWMD), local governments, businesses, industrial permit holders, and other stakeholders. DEP will work with these organizations and individuals to undertake or continue reductions in discharges of pollutants in order to achieve the established TMDL and thereby ensure the impaired waterbody's restoration.

Facilities with NPDES permits (MS4 and industrial) and Environmental Resource Permits that discharge to the TMDL waterbody must respond to the permit conditions that reflect target concentrations, reductions, or WLAs 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).

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. Stormwater reductions are included in both the MS4 WLA and LA. In determining the overall stormwater reductions needed, however, the TMDLs do not differentiate between the MS4 WLA and the LA, and instead, apply the same overall percent reductions to both as if these were a single category source. Aggregated allocations for a category of sources are not intended to be applied uniformly to individual sources in that category. Pollutant reductions to attain a TMDL can come from many sources, and these percent reductions do not directly apply to any individual MS4 outfall.

7.2 BMAPs

Information on the development and implementation of BMAPs is found in Section 403.067, F.S. (the FWRA). 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 watersheds, 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, such as wastewater facilities, industrial sources, agricultural producers, county and city stormwater systems, military bases, water control districts, state agencies, and individual property owners, usually implement these strategies. BMAPs can also identify mechanisms to address potential pollutant loading from future growth and development.

Additional information about BMAPs is available online.

7.3 Implementation Considerations for the Waterbody

In addition to addressing reductions in watershed pollutant contributions to impaired waters during the implementation phase, it may also be 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. Approaches for addressing these other factors should be included in a comprehensive management plan for the waterbodies. Additionally, the current water quality and water level monitoring of Pine 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 the Florida Department of Transportation (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	Pine Lake
Waterbody type(s)	Lake
WBID	WBIDs 3245C4 (see **Figure 1.1** of this report)
Description	Pine Lake is part of the Palm Beach County Chain of Lakes, located immediately west of the Atlantic Coastal Ridge in West Palm Beach and unincorporated Palm Beach County. The Pine Lake Watershed covers 11 km^2, with a lake surface area of 0.14 km^2 and an average lake depth of 2.3 m. The lake watershed is almost entirely urban. The dominant land use for Pine Lake is transportation (including the Palm Beach Airport) at 32 % of the watershed, followed by commercial at 24 % and residential at 21 %. **Chapter 1** of this report describes Pine Lake in more detail.
Specific location (latitude/longitude or river miles)	The center of Pine Lake is located at N: 26° 40' 55"/ W: 80° 04' 20."
Map	**Figure 1.1** shows the general location of the lake and **Figure 1.2** shows the individual lake and its watershed in detail. **Figure 4.1** shows land uses in the Pine Lake Watershed.
Classification(s)	Class III Freshwater
Basin name (HUC 8)	Lake Worth Lagoon (03090206)

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: Generally applicable lake classification (if applicable) and corresponding NNC	Pine Lake is a high-color 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.
Proposed TN, TP, chlorophyll *a*, and/or nitrate + nitrite concentrations (magnitude, duration, and frequency)	Numeric interpretations of the narrative nutrient criterion: For Pine Lake the TN and TP NNC are expressed as 3-year annual average loads not to be exceeded in any year. The loads are 9,749 and 611 kg/yr for TN and TP, respectively.
Period of record used to develop numeric interpretations of the narrative nutrient criterion for TN and TP	The criteria were developed based on the application of the BATHTUB model, which simulated hydrology and water quality conditions over the 2006–14 period for Pine Lake. The primary datasets for this period include water quality data from the IWR Run 57, SFWMD rainfall data, and 2016 SFWMD land use coverage. **Sections 2.3** and **4.4** of this TMDL report provide a complete description of the data used in the derivation of the proposed site-specific criteria
How the criteria developed are spatially and temporally representative of the waterbody or critical condition	The models simulated the 2006–14 period for Pine Lake. These periods included wet and dry years. The long-term average annual rainfall total from Palm Beach International Airport (1939–2018) was 60 inches. A comparison with this long-term average indicates that 2009 and 2014 were near-normal rainfall years, 2010 and 2011 were dry years, and 2012 and 2013 were wet years. This period captures the hydrologic variability of the Palm Beach County Chain of Lakes system. The models simulated each watershed to evaluate how changes in watershed loads impacted lake nutrient and chlorophyll *a* concentrations. **Figures 2.1** shows the locations of the sampling stations in Pine Lake. Monitoring stations were distributed across the spatial extent of the lake and represented the full range of spatial distribution of nutrient dynamics.

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	DEP used the IWR Database to assess water quality impairments in Pine Lake (WBID 3245C4). Pine Lake was originally verified as impaired for nutrients based on an elevated annual average TSI during the Cycle 2 verified period for the Group 3 basins. During the Cycle 3 assessment, the NNC were used to assess Pine Lake for the verified period (2008–15) using data from IWR Run 52. Pine Lake was determined to be impaired for chlorophyll *a* (AGMs exceeded 20 µg/L in 2008–11 and 2013–14). The Cycle 3 Verified List of Impaired Waters was adopted by Secretarial Order on October 21, 2016. See **Section 2.3.3** of this report for a detailed discussion.
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 high-color lakes. Based on the available information, there is nothing unique about Pine Lake that would make the use of the chlorophyll *a* threshold of 20 µg/L inappropriate for the lake.
Approach used to develop criteria and how it protects uses	For the Pine Lake nutrient TMDL, DEP created loading-based criteria using the PLSM watershed load model to simulate flows from the lake watershed, and this information was input into BATHTUB for the lake. Watershed nutrient concentrations were ultimately calibrated to in-stream stations adjacent to the lake. DEP established the site-specific TN and TP loadings using the calibrated models to achieve an in-lake chlorophyll *a* AGM concentration of 20 µg/L. The maximum of the 3-year rolling averages for Pine Lake of TN and TP loadings to achieve the chlorophyll *a* target was determined by decreasing TN and TP loads from anthropogenic sources into the lakes until the chlorophyll *a* target was achieved in every year. **Chapter 5** of this report provides a more detailed description of the derivation of the TMDL and criteria.
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	Model simulations indicated that the target chlorophyll *a* concentration (20 µg/L) in the lakes will be attained at the TMDL loads for TN and TP. DEP notes that no other impairments were verified for Pine Lake that may be related to nutrients (such as dissolved oxygen [DO], un-ionized ammonia, or total ammonia nitrogen [TAN]). Reducing the nutrient loads entering the lakes will not negatively impact other water quality parameters of the lakes.

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	Outflow from Pine Lake generally flows southward via the continuation of the Stub Canal to its confluence with the larger C-51 Canal. This portion of the C-51 Canal East is assessed as WBID 3245F and is a Class III freshwater flowing stream, which captures drainage from farther west as well as the smaller contributions from Pine Lake and Lake Clarke. The nutrient impairment threshold for chlorophyll *a* in south Florida streams is 20 µg/L, and WBID 3245F is not currently impaired for chlorophyll *a*. Lake Clarke (WBID 3245B) is a Class III freshwater lake with the applicable NNC for a high color lakes Lake Clarke is not verified impaired for TN, TP, or chlorophyll *a*. Based on the healthy existing conditions in the downstream waters, the existing nutrient loads from Pine Lake to the C-51 Canal have not caused downstream waters to fail to achieve their designated uses or to cause an imbalance in aquatic flora and fauna.
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.	Palm Beach County and DEP conduct routine monitoring of the Pine Lake. 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 loads in subsequent water quality assessment cycles.

Table B-5. Documentation of endangered species consideration

Administrative Requirements	Information for Administrative Requirements
Endangered species consideration	DEP is not aware of any aquatic or amphibious endangered species present in the Pine Lake Watershed. It is expected that restoration efforts and subsequent water quality improvements will positively affect aquatic species living in the lake and its respective watershed.

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 March 29, 2019 to initiate TMDL development for impaired waters in the Lake Worth Lagoon Basin. A rule development public workshop for the TMDLs was held on January 22, 2020. A second rule development workshop for revisions to the proposed TMDLS was held on August 26, 2021. DEP published an updated Notice of Development of Rulemaking on March 29, 2019 covering the Lake Worth Lagoon Basin, to address the need for TMDLs to be adopted within one year after the Notice of Development of Rulemaking is published.
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.
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 the EPA.