Central District • Middle St. Johns River Basin

Draft Report

Nutrient TMDLs Lake Giles (WBID 3168Z4) and Documentation in Support of the Development of Site-Specific Numeric Interpretations of the Narrative Nutrient Criterion

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Executive Summary

This report presents the total maximum daily load (TMDL) developed to address the nutrient impairments for Lake Giles with **w**ater**b**ody **id**entification (WBID) number 3168Z4. This lake is located within the City of Orlando in Orange County. The waterbody was identified as impaired for nutrients based on chlorophyll *a*, TN and TP exceeding the numeric nutrient criteria (NNC) in subsection 62-302.531(2), Florida Administrative Code (F.A.C.). Lake Giles was included on the Verified List of Impaired Waters for the Kissimmee River Basin adopted by Secretarial Order in July 2022 for the statewide Biennial Assessment 2020-2022. The U.S. Environmental Protection Agency added Lake Giles to Florida's 2020 303(d) list for total phosphorus and then the 2022 303(d) list for total nitrogen and chlorophyll *a*.

TMDLs for TN and TP have been developed. **Table EX-1** lists supporting information for the TMDLs. Pursuant to paragraph 62-302.531(2)(a), Florida Administrative Code (F.A.C.), these TMDLs 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. 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 Giles

Type of Information	Description
Waterbody name (WBID)	Lake Giles (WBID 3168Z4)
Hydrologic Unit Code (HUC) 8	03090101
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 Kissimmee River basin adopted via Secretarial Order in Jul. 2022.
TMDL pollutants	Total nitrogen (TN) and total phosphorus (TP)
TMDLs and site-specific interpretations of the narrative nutrient criterion	**Lake Giles (WBID 3168Z4)** **Chlorophyll *a*:** 6 micrograms per liter (µg/L), expressed as an annual geometric mean (AGM) concentration not to be exceeded more than once in any 3-year period. **TN:** 1,566 kilograms per year (kg/yr), expressed as a 7-year rolling average load not to be exceeded. **TP:** 48 kg/yr, expressed as a 7-year rolling average load not to be exceeded.
Load reductions required to meet the TMDLs	**WBID 3168Z4:** A 21.1% TN reduction and a 76.3% TP reduction to achieve the applicable AGM chlorophyll *a* criterion for low-color, low-alkalinity lakes.
Concentration-based lake restoration targets (for informational purposes only)	**WBID 3168Z4:** The nutrient concentrations corresponding to the applicable chlorophyll *a* numeric nutrient criterion and the loading-based criteria are a TN AGM of 0.53 milligrams per liter (mg/L) and a TP AGM of 0.014 mg/L, not to be exceeded more than once in any consecutive 3-year 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, Central Regional Operations Center, and Watershed Evaluation and TMDL Section.

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List of Acronyms and Abbreviations

µg/L	Micrograms Per Liter
AGM	Annual Geometric Mean
BMAP	Basin Management Action Plan
BMP	Best Management Practice
$CaCO_3$	Calcium Carbonate
CFR	Code of Federal Regulations
CWA	Clean Water Act
DEP	Florida Department of Environmental Protection
EPA	U.S. Environmental Protection Agency
F.	Fahrenheit
F.A.C.	Florida Administrative Code
FLUCCS	Florida Land Use, Cover and Forms Classification System
F.S.	Florida Statutes
ft	Feet
HUC	Hydrologic Unit Code
ID	Insufficient Data
in/yr	Inches Per Year
IWR	Impaired Surface Waters Rule
LA	Load Allocation
MDL	Method Detection Limit
mg/L	Milligrams Per Liter
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer System
NA	Not Applicable
NPDES	National Pollutant Discharge Elimination System
OSTDS	Onsite Sewage Treatment and Disposal System
PLRG	Pollutant Load Reduction Goal
POR	Period of Record
SWIM	Surface Water Improvement and Management (Program)
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
WBID	Waterbody Identification (Number)
WLA	Wasteload Allocation
WWTF	Wastewater Treatment Facility

Chapter 1: Introduction

1.1 Purpose of Report

This report presents the total maximum daily load developed to address the nutrient impairment of Lake Giles, located in the Middle St Johns River Basin. Pursuant to paragraph 62-302.531(2)(a), Florida Administrative Code (F.A.C.), the TMDLs will also 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 numeric nutrient criteria (NNC) in subsection 62-302.531(2), F.A.C. The waterbody was verified as impaired for nutrients using the methodology in the Identification of Impaired Surface Waters Rule (IWR) (Chapter 62-303, F.A.C.) and was included on the Verified List of Impaired Waters for the Kissimmee River Basin Group adopted by Secretarial Order in July 2022.

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 comply 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 Giles that would restore the waterbody so that it meets the applicable water quality criteria for nutrients.

1.2 Identification of Waterbody

For assessment purposes, the Florida Department of Environmental Protection divided the State of Florida into watershed assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or surface water segment. Lake Giles is WBID 3168Z4. The lake was originally assessed within the Kissimmee River Basin but was revised to be assessed within the Middle St. Johns basin due to more accurate delineation of the hydrologic boundaries. Lake Giles, is located in the Econlockhatchee River Planning Unit. **Figure 1.1** shows the location of the watershed in the basin and major geopolitical and hydrologic features in the region, and **Figure 1.2** contains more detailed maps of the WBID and its watershed, and the major geopolitical and hydrologic features surrounding them.

Lake Giles is located in east-central Orange County in a primarily residential area south of Orlando Executive Airport. It is also within Orlando city limits east of the I4-Spessard L Holland East-West Expressway Interchange. Lake Giles is 26.4 acres in area. It is located within the Little Econlockhatchee River watershed. Lake Giles does not have any surficial hydrologic connections to other waterbodies.

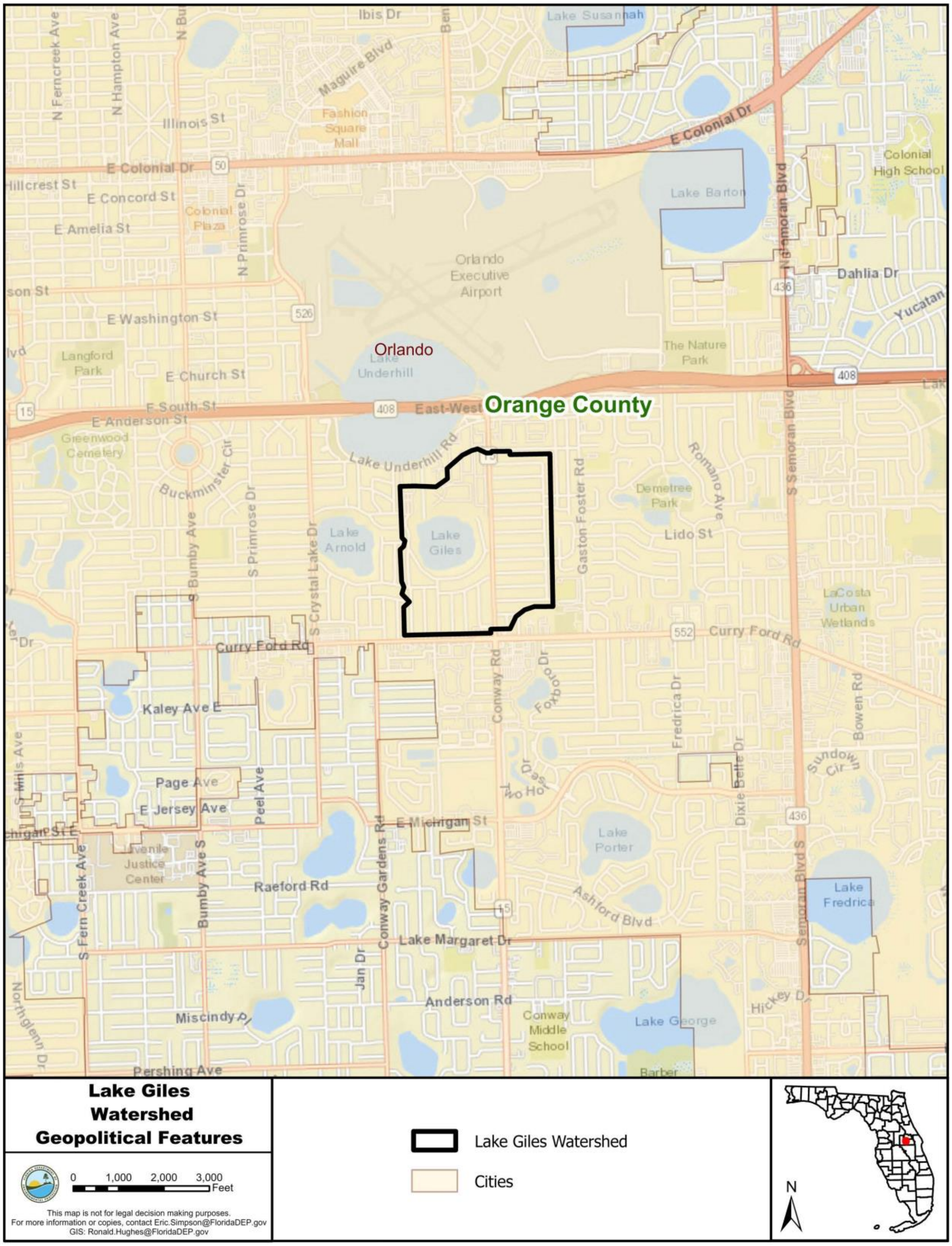

Figure 1.1 Lake Giles Watershed and local geopolitical features

1.3 Watershed Information

1.3.1 Population and Geopolitical Setting

Lake Giles and its watershed is located wholly within Orlando city limits. The population of Orlando was 309,154 as of 2021, and the population density was about 3,004 people per square mile as of 2020.

1.3.2 Topography

The watershed of Lake Giles has soils primarily within hydrologic soil group A, denoting well-drained soils with low runoff potential. Soils in this group are typically sand, loamy sand, or sandy loam. The Lake Giles watershed also contains a small amount of B/D type soil, which acts as a type D in natural conditions and a type B under other conditions, being slightly less well-drained than type A soil when dry and having high runoff potential when wet. A summary of soil hydrologic group areas for Lake Giles is shown in **Table 1.1**, and a map showing the geographic distribution of soil hydrologic group with the Lake Giles watershed is shown in **Figures 1.3**.

Lake Giles is within the Florida Lake Region 75-21, also known as the Orlando Ridge (Griffith et al. 1997). This is a highly karstic area with an elevation of 75 to 120 feet.

The karst features, coupled with the fact that the lake does not drain to any surface waters and is surrounded primarily by well-drained type A soils, indicates that these are important areas for groundwater drainage. Orlando is also a region of relatively high aquifer transmissivity, meaning water moves rapidly through the rock into the aquifer system (Kuniansky et. al, 2012).

Lake Giles is 11 meters deep at its deepest point, while its average depth is 5.4 meters. The depth was most recently recorded in 2014.

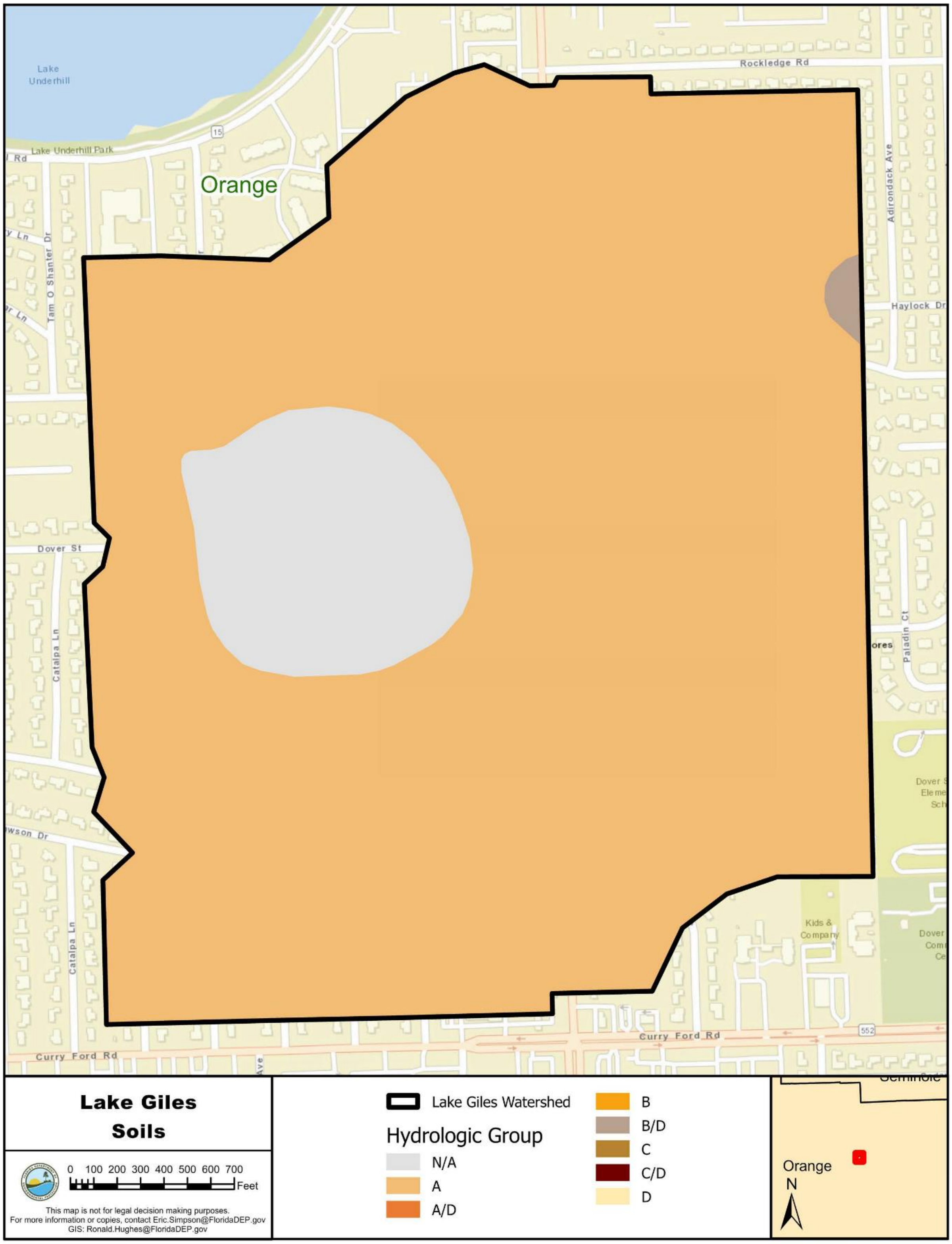

Figure 1.2 Hydrologic Soil Groups of the Lake Giles Watershed

Table 1.1 Summary of soil hydrologic group areas for Lake Giles watershed.

Soil Hydrologic Group	Lake Giles (acres)
Group A	244.7
Group B	0
Group C	0
Group D	0
Group A/D	0
Group B/D	0.99
Water	25.9
Total	271.59

1.3.3 Hydrology

Orlando has a humid sub-tropical climate with a long, hot rainy season and shorter warm, dry season. Extreme weather events such as hurricanes are possible for a large part of the year. The average temperature is 73 degrees Fahrenheit, with an average high of 83.2 degrees and average low of 62.7 degrees. Orlando receives an average of 51.5 inches of rain per year, with the peak rainy season being June-September, covering a portion of hurricane season (NCEI, 2023). Daily rainfall data has been collected near the lake and is shown in **Figure 1.5**. Extreme precipitation carries with it the possibility of inundated soil and increased runoff risk, which would in turn mean a higher nutrient load. These lakes do not have any surface connections to other bodies of water, which makes it likely that water loss is primarily from groundwater recharge and evaporation. Additionally, Lake Giles contains a drain well maintained by the City of Orlando, which allows for drainage from the lake to the aquifer as a means to control lake level and may affect hydrology in the lake.

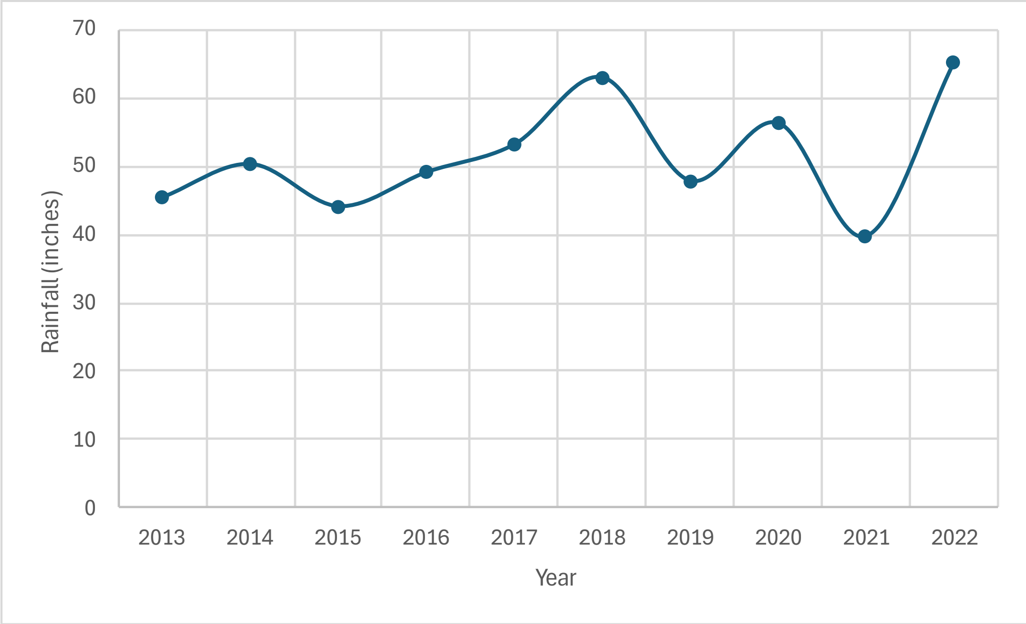

Figure 1.3 Annual Total Rainfall, Orlando FL, 2013-22

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 on a schedule. DEP has developed such lists, commonly referred to as 303(d) lists, since 1992.

The Florida Watershed Restoration Act (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 subsection 403.067(4), F.S. In the past, the state's Verified List had been amended annually to include basin updates for 20% of the state, conducted as part of a rotating basin approach to cover the whole state every five years. However, beginning with the biennial assessment 2020-22, the state's Verified List is now amended biennially and will consist of a statewide assessment every two years.

2.2 Classification of the Waterbody and Applicable Water Quality Standards

Lake Giles is a Class III (fresh) waterbody, with designated uses of fish consumption; recreation, and propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The Class III water quality criteria applicable to the verified impairment (nutrients) for this waterbody are Florida's nutrient criteria 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 (mg/L) as calcium carbonate ($CaCO_3$), and true color (color), measured in platinum cobalt units (PCU), based on long-term period of record (POR) geometric means. For the purpose of determining lake NNC type subparagraph 62-302.531(2)(b)1., F.A.C., specifies that color is assessed as true color and should be free from turbidity. Lake color and alkalinity are based on a minimum of ten data points over at least three years with at least one data point in each year.

Using this threshold for data sufficiency from the POR for data for the verified impaired listing, Lake Giles is a clear low alkalinity lake, as shown in **Table 2.1.** The POR data for Lake Giles was acquired from IWR Database Run 65.

Table 2.1 Long-term geometric means for color and alkalinity for the POR

Waterbody	POR for Color	Long-Term Geometric Mean Color (PCU)	POR for Alkalinity	Long-Term Geometric Mean Alkalinity (mg/L $CaCO_3$)
Lake Giles	2012-22	12	2000-22	18

Table 2.2 lists the NNC for Florida lakes specified in subparagraph 62-302.531(2)(b)1., F.A.C. The relevant row for Lake Giles is the bottom row, corresponding to clear low alkalinity lakes. The chlorophyll *a* NNC for clear acidic lakes is an annual geometric mean (AGM) value of 6 micrograms per liter (µg/L), not to be exceeded more than once in any consecutive three-year period.

The total nitrogen (TN) and total phosphorus (TP) criteria for a lake can vary annually. If there are sufficient data to calculate an AGM for chlorophyll *a* and the AGM does not exceed the chlorophyll *a* criterion for the lake type listed in **Table 2.2**, then the corresponding numeric interpretations for TN and TP are the maximum values. 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 corresponding numeric interpretations for TN and TP are the minimum values.

Table 2.2 Chlorophyll *a*, TN, and TP criteria for Florida lakes

* 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* (µg/L)	Minimum Calculated AGM TP NNC (mg/L)	Minimum Calculated AGM TN NNC (mg/L)	Maximum Calculated AGM TP NNC (mg/L)	Maximum Calculated AGM TN NNC (mg/L)
>40 PCU	20	0.05	1.27	0.16*	2.23
≤ 40 PCU and > 20 mg/L $CaCO_3$	20	0.03	1.05	0.09	1.91
≤ 40 PCU and ≤ 20 mg/L $CaCO_3$	6	0.01	0.51	0.03	0.93

2.3 Determination of the Pollutant of Concern

2.3.1 Data Providers

The sources of lake nutrient data used in the 2020-22 biennial assessment, with the verified period beginning in 2013 for Lake Giles, are stations sampled by the City of Orlando and the DEP Central District. **Figure 2.1** shows these sampling locations in the WBID.

Most of the data used in this report was collected by the City of Orlando, with some sampling completed by the DEP. Lake Giles has been sampled for TN, TP, and corrected chlorophyll *a* since 1988.

The individual water quality measurements for Lake Giles discussed in this report are available in IWR Database Run 65. These water quality results are available on request.

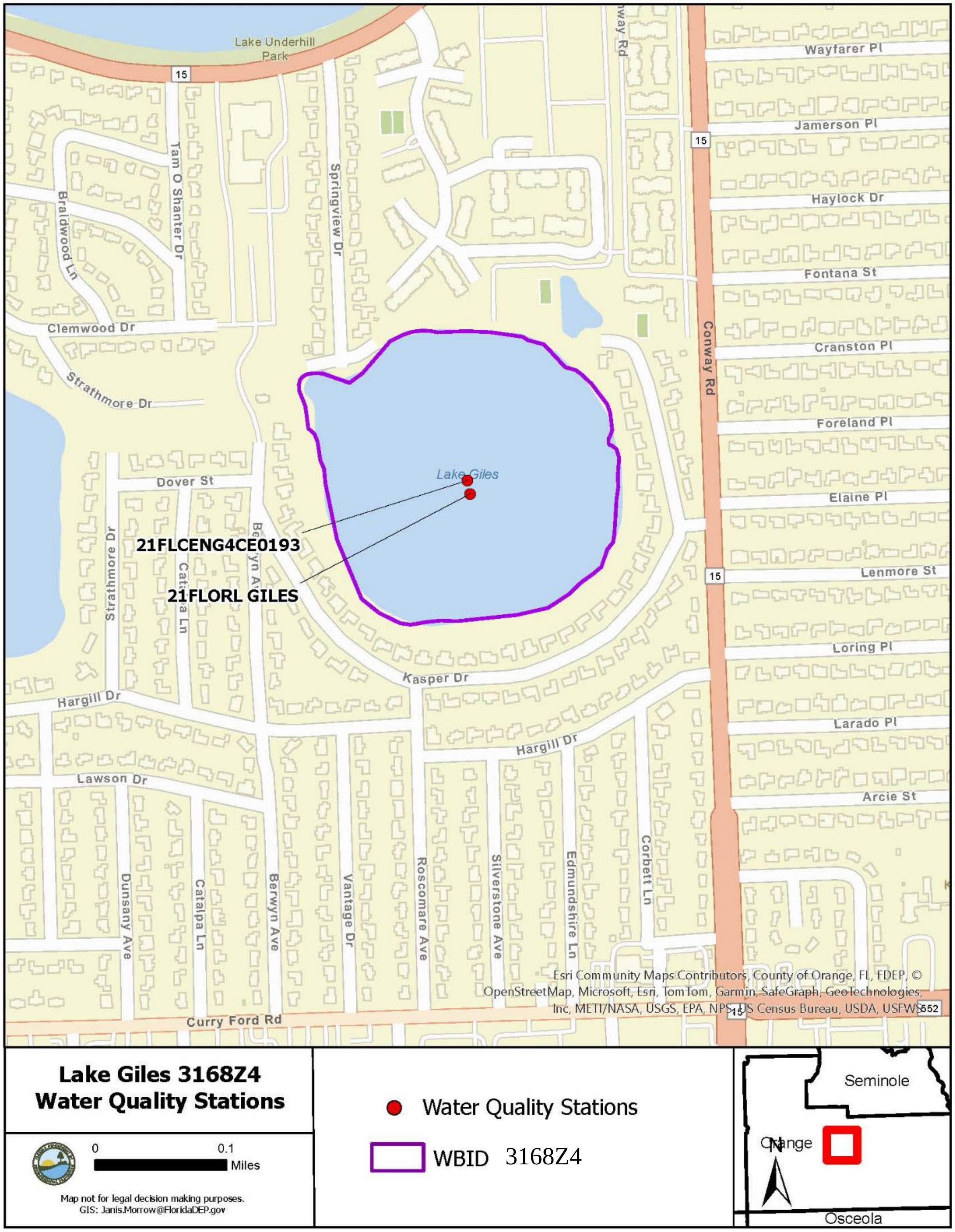

Figure 2.1 Water quality monitoring stations in Lake Giles

2.3.2 Information on Verified Impairment

Lake Giles (WBID 3168Z4) was assessed for lake NNC as part of the statewide Biennial Assessment 2020-22. The verified period was January 1st, 2013, through June 30th, 2020. Data for this assessment are stored in the IWR Run 60 Access Database.

Table 2.3 lists the AGM values for chlorophyll *a*, TN, and TP during the verified periods for Lake Giles in which it was first assessed as impaired and AGM results for subsequent years, calculated using the most recent results found in the IWR Run 65 Database. To be assessed as impaired (Category 5) for nutrients, AGMs for a particular nutrient had to have exceeded the NNC more than once in a three-year period.

Table 2.3 Lake Giles AGM values for the 2013-21 period

Year	Chlorophyll *a* (µg/L)	TN (mg/L)	TP (mg/L)
2013	15	0.7	0.03
2014	12	0.71	0.04
2015	11	0.63	0.02
2016	7	0.59	0.03
2017	10	0.54	0.03
2018	9	0.61	0.03
2019	11	0.57	0.02
2020	18	0.67	0.03
2021	16	0.57	0.02

2.3.3 Historical Variation in Water Quality Variables

AGMs for chlorophyll *a*, TN, and TP going back to 1992 are shown along with their applicable NNC in **Figures 2.2a-c**.

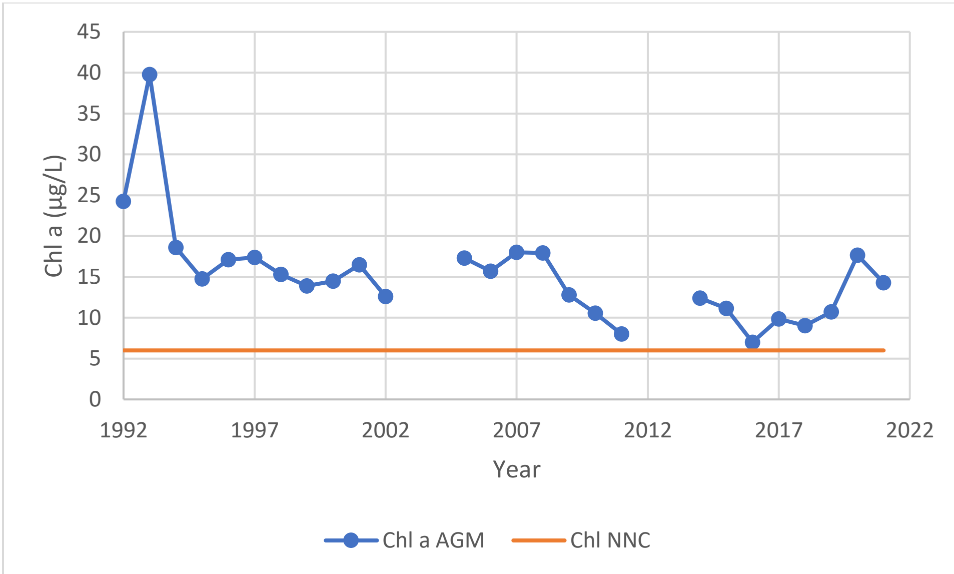

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Figure 2.2a Chl *a* AGMs for the period of record, along with the NNC.

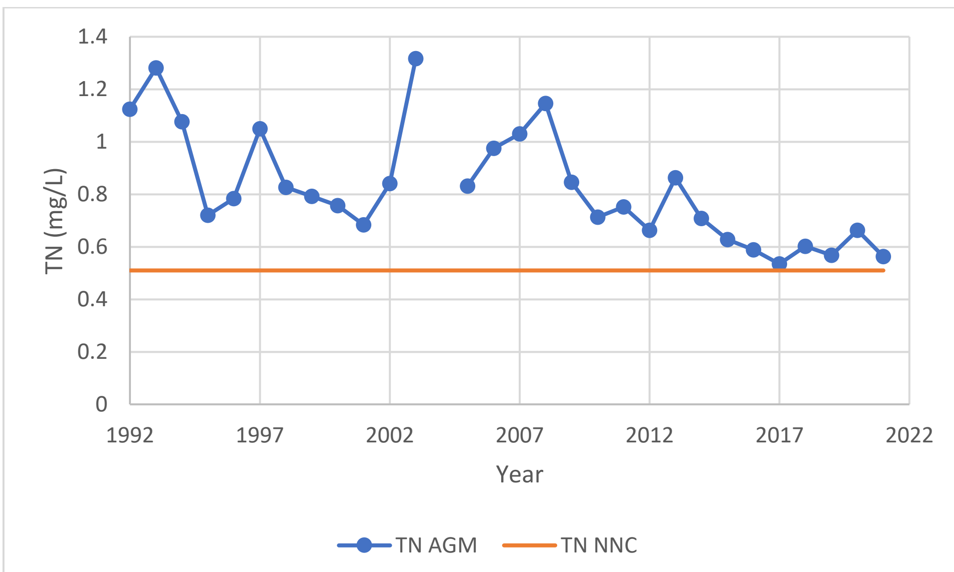


Figure 2.2b TN AGMs for the period of record along with the NNC.

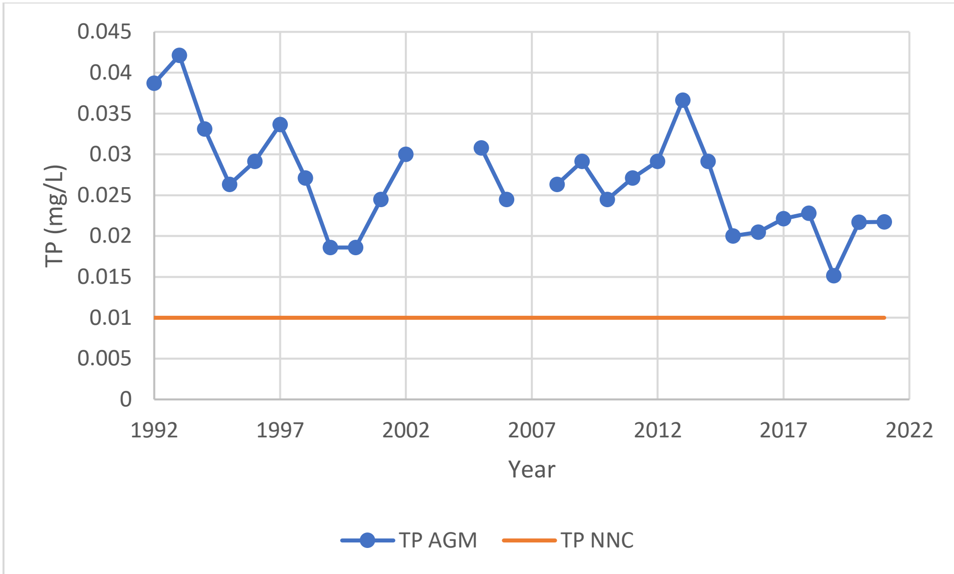


Figure 2.2c TP AGMs for the period of record along with the NNC.

Figures 2.2a-c show that Lake Giles frequently exceeds the generally applicable NNC for clear low alkalinity lakes. A regression analysis was also performed on the period of record AGMs to determine whether a linear relationship existed between chlorophyll *a*, TN, and TP. The resulting graphs are shown in **Figures 2.3a-b**. The *p* values for the individual linear regressions are <0.0001

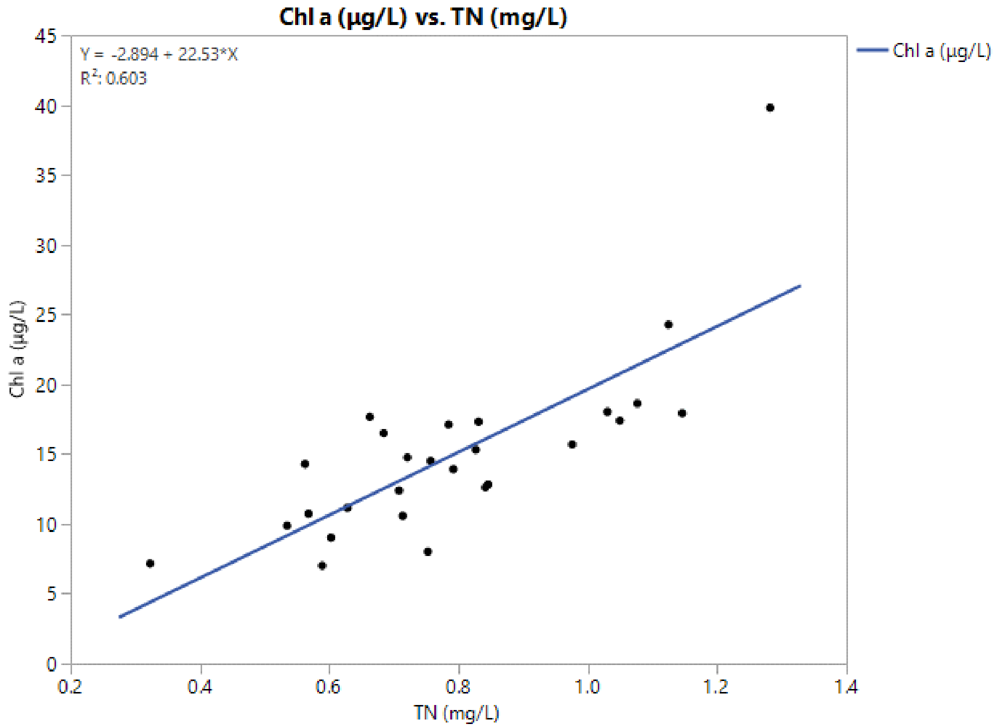


Figure 2.3a Regression analysis between Chlorophyll *a* and TN AGMs for Lake Giles ($p < 0.0001$).

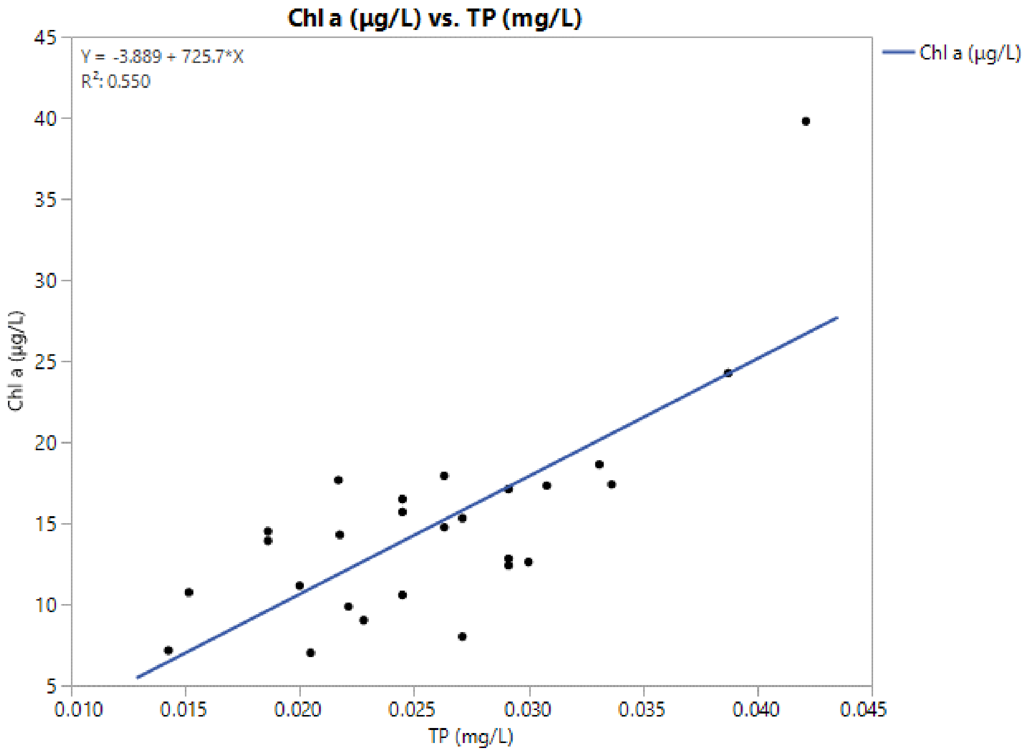


Figure 2.3b Regression analysis betweeen Chlorophyll *a* and TP AGMs ($p < 0.0001$).

While the regression plots and R-squared values show positive correlation between water quality variables and chlorophyll *a* concentration, a multiple regression analysis on the same data yields p values of 0.1336 for the intercept, 0.0271 for TN, and 0.1621 for TP. While TN is significant ($p < 0.05$), TP is not significant. The R-squared value is 0.64. Utilizing AGMs only from 2010-22 yields no significant relationships and an R squared value of 0.11.

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

3.1 Establishing the Site-Specific Interpretation

Pursuant to paragraph 62-302.531(2)(a), F.A.C., the nutrient TMDLs presented in this report, upon adoption into Rule 62-304.505, 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., and will replace the otherwise applicable NNC from subparagraph 62-302.531(2)(b)1., F.A.C. **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 Lake Giles 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 as a better approach to controlling 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 supports 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 an analysis of lake chlorophyll *a* concentrations statewide, comparisons with a smaller population of select reference lakes, paleolimnological studies, expert opinions, user perceptions, and biological responses. Based on these resources, DEP concluded that an annual geometric mean chlorophyll *a* of 6 µg/L in clear low 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.

There are no available data suggesting that Lake Giles differs from those lakes used to develop the NNC. Therefore, DEP has determined that the generally applicable chlorophyll *a* NNC for a clear low alkalinity lake is the most appropriate TMDL restoration target for the lake (and will remain the applicable water quality criterion).

3.3 Expression of the Site-Specific Numeric Interpretations

Site-specific numeric interpretations of the narrative nutrient standard for Lake Giles were determined for TN and TP using the modeling approach discussed in **Chapter 5** to determine the nutrient loads that resulted in the lake attaining the chlorophyll *a* criterion. The modeling related annual watershed TN and TP loading to in-lake chlorophyll *a*, TN, and TP concentrations. For Lake Giles, nutrient and chlorophyll concentrations were simulated from 2013 to 2022.

The model was used to determine annual TN and TP loads necessary to attain the chlorophyll *a* target. The chlorophyll *a* target was based on the applicable criterion of 6 µg/L as an AGM not to be exceeded more than once in any consecutive 3-year period. DEP calculated a rolling 7-year average loading for each parameter. The site-specific interpretations of the narrative nutrient criterion were then set for each parameter at the maximum 7-year rolling average load for Lake Giles. **Section 5.5** discusses in more detail the method used to determine these loading values.

Site-specific interpretations for Lake Giles are expressed as a 7-year rolling annual average load not to be exceeded. **Table 3.1** summarizes the site-specific interpretations for TN and TP for Lake Giles.

Table 3.1 Lake Giles site-specific numeric interpretations of the narrative nutrient criterion.

kg/yr = Kilograms per year

Waterbody	WBID	7-Year Annual Average TN (kg/yr)	7-Year Annual Average TP (kg/yr)
Lake Giles	3168Z4	1,566	**48**

DEP also calculated the in-lake TN and TP concentrations corresponding to the load-based TN and TP site-specific interpretations of the narrative criterion that attain the target chlorophyll *a* concentration of 6 µg/L. For Lake Giles, the TN and TP AGM concentrations of 0.53 and 0.014 mg/L, respectively, are not to be exceeded more than once in any consecutive 3-year period. These concentration-based restoration targets are provided for informational purposes only and will be used to help evaluate the effectiveness of restoration activities. The loads listed in **Table 3.1** are the site-specific interpretations of the narrative criterion for the lake.

3.4 Downstream Protection

Lake Giles has no surficial hydrological connections to any other bodies of water; therefore, downstream protection is not calculated for this TMDL. Protection considerations due to the drain well connecting Lake Giles to the underlying aquifer take place during environmental permitting processes for specific projects.

3.5 Endangered Species Consideration

Section 7(a)(2) of the Endangered Species Act requires each federal agency, in consultation with the services (i.e., U.S. Fish and Wildlife Service [FWS] and National Oceanic and Atmospheric Agency [NOAA] National Marine Fisheries Service [NMFS]), to ensure that any federal 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 (see **Appendix B**) identifies terrestrial species potentially affected by activities in the watershed. DEP is not aware of any aquatic, amphibious, or anadromous endangered species present in the Lake Giles watershed. Furthermore, it is expected that restoration efforts and subsequent water quality improvements will positively affect aquatic species living in the lake and its watershed.

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. Point sources also include 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). 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.

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 a National Pollutant Discharge Elimination System (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

Currently, there are no NPDES-permitted wastewater facilities that discharge Lake Giles or that discharge to surface waters in its watershed.

4.2.2 Municipal Separate Storm Sewer System (MS4) Permittees

The Lake Giles Watershed is covered by one NPDES MS4 Phase I permit. Only co-permittees whose jurisdictions are included, wholly or in part, within the boundaries of the Lake Giles watershed are listed here. Also note that while these permittees are located wholly or partially within the 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. For more information on MS4s in the watershed, send an email to

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 Giles Watershed.

Lake	Permit Number	Permittee/Co-Permittees	Phase
Giles	FLS000014	City of Orlando	I

4.3 Nonpoint Sources

Pollutant sources that are not NPDES wastewater or stormwater dischargers are generally considered nonpoint sources. Nutrient loadings to Lake Giles are mainly generated from nonpoint sources. Nonpoint sources addressed in this analysis primarily include loadings from surface runoff, baseflow, and precipitation directly onto the lake surface (atmospheric deposition).

4.3.1 Land Use

Land use is one of the most important factors in determining nutrient loadings from the Lake Giles 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 4.2** lists land use in the watershed in 2016 based on data from the St. Johns River Water Management District, and **Figures 4.1** shows the information graphically.

Figure 3.1 shows that Lake Giles has a contributing watershed of 245 acres, excluding the lake itself. 73.8% is medium density residential, 12.1% is high density residential, 0.74% is commercial and services, 3% is institutional, 0.37% is vegetated non-forested wetlands, and 0.37% is utilities.

Table 4.2 St. Johns River Water Management District land use in the Lake Giles Watershed in 2016.

Land Use Description	Lake Giles Acres	Lake Giles Percent
Residential Medium Density	200	73.8
Residential High Density	33	12.17
Commercial and Services	2	0.73
Institutional	8	2.9
Recreational	0	0
Lakes	26	9.6
Vegetated Non-Forested Wetlands	1	0.37
Transportation	0	0
Utilities	1	0.37
Reservoirs	0	0

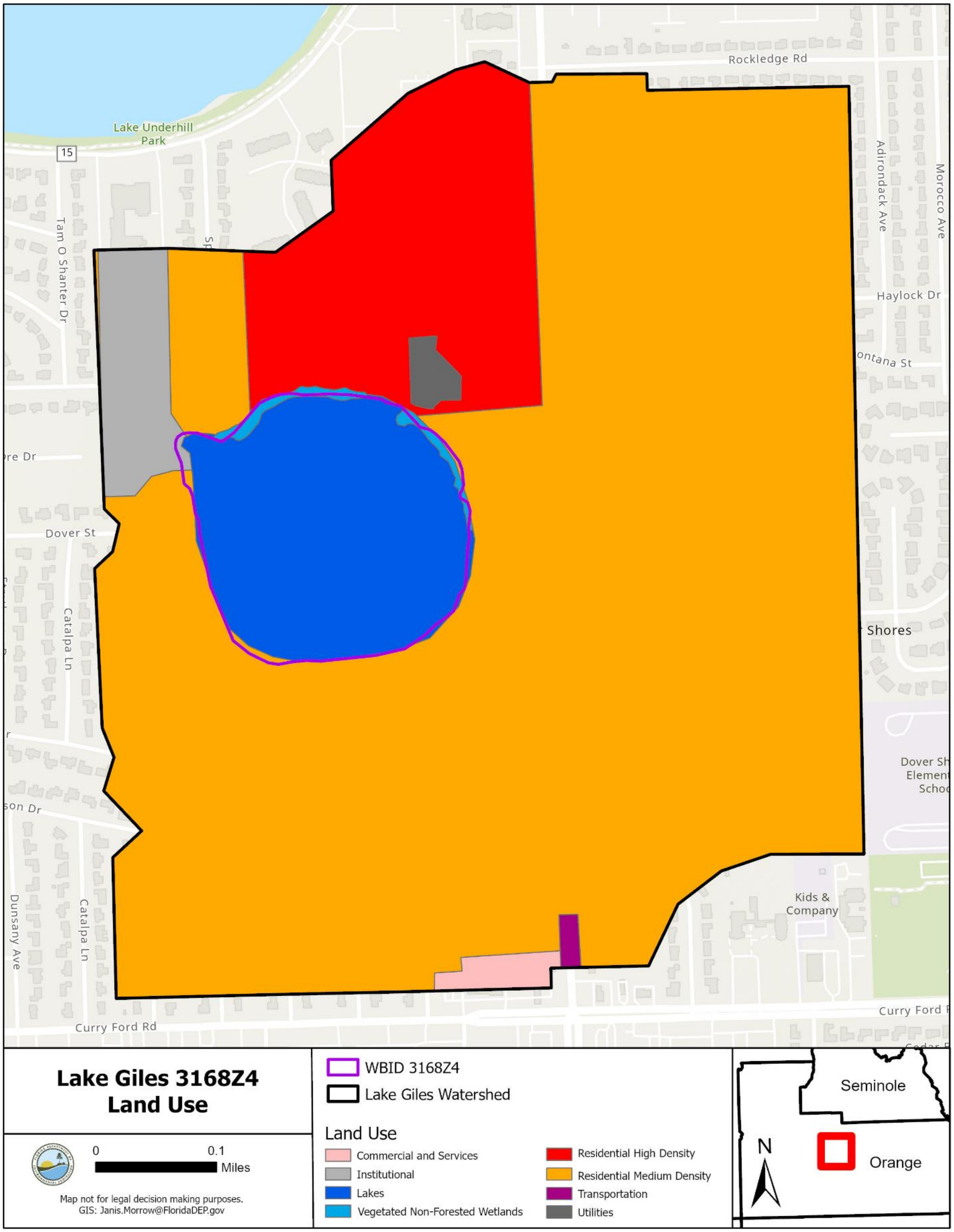


Figure 4.1 Land use in the Lake Giles Watershed in 2016

4.3.2 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 system 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. **Figure 4.2** shows the approximate locations of OSTDS in the watershed. There are currently 13 total OSTDS reported within the watershed.

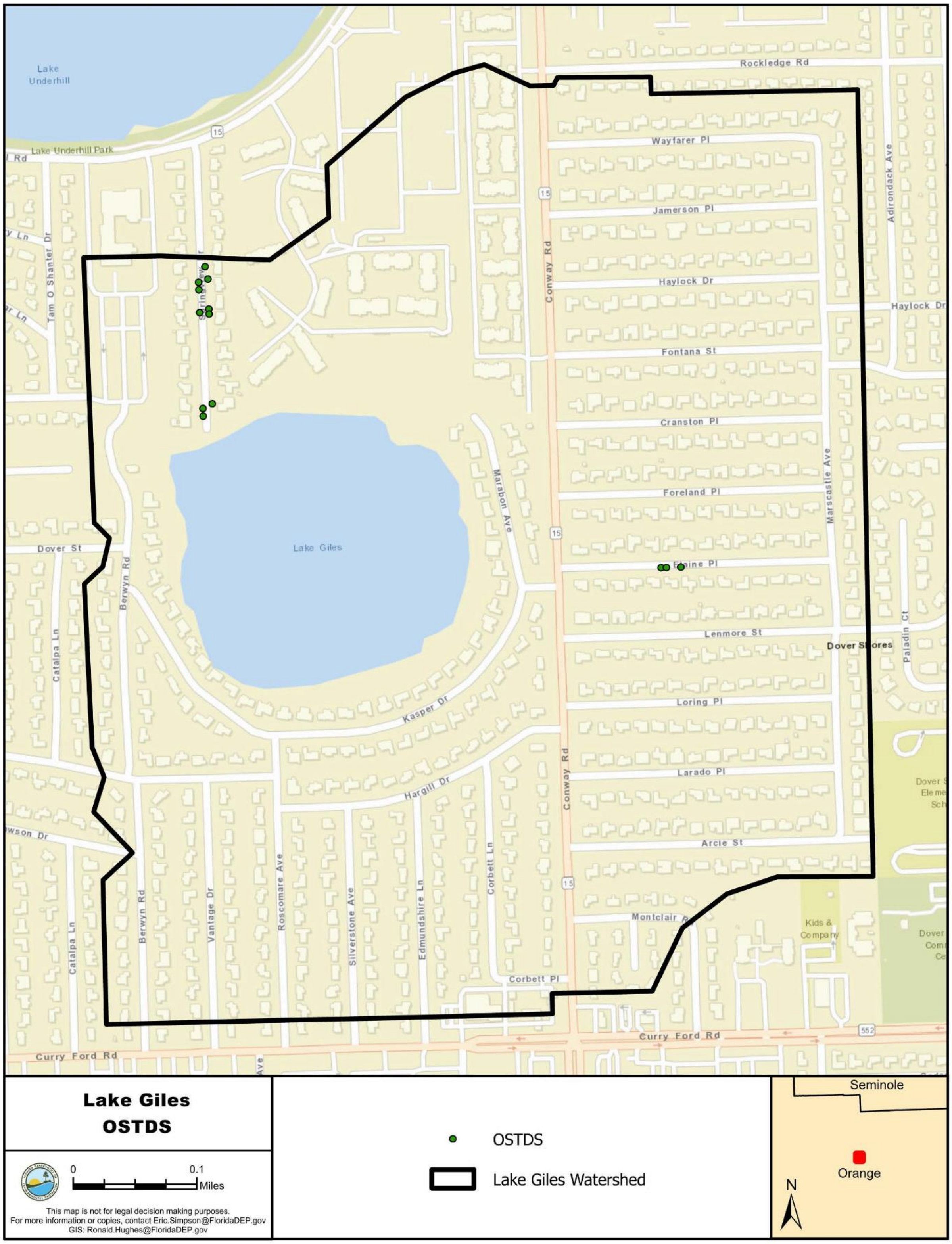


Figure 4.2. OSTDS in the Lake Giles Watershed

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 Lake Giles watershed is assumed to be accounted for in the loading rates used to estimate the watershed loading from land. There are no known complete atmospheric deposition datasets for Lake Giles.

The dry deposition portion is expressed as a per area loading rate (areal loading rate) on an annual scale. Wet deposition is delivered by precipitation, and annual wet deposition is therefore expressed as a concentration of solutes in precipitation multiplied by the total volume of precipitation. The precipitation data used in this analysis were obtained from the Florida Automated Weather Network (FAWN) Apopka Weather Station. Wet and dry deposition onto the lake surface was estimated using data collected by the SJRWMD at Lake Apopka, about 20 miles away, as part of the model setup discussed in **Chapter 5**. These deposition rates are shown in **Table 4.3**.

4.4 Estimating Watershed Loadings

To simulate nutrient loading from the Lake Giles watershed, the PLSM (Pollutant Load Simulation Model) approach was used (**Appendix C).** PLSM works by relating land uses to concentrations of total nitrogen and total phosphorus, known as event mean concentrations (EMCs). These numbers are empirically derived in Harper (1994, 2012) and are presented along with runoff coefficients relating land use to impervious surfaces associated with different land uses. These runoff coefficients and land use areas, along with annual rainfall totals from the FAWN Apopka station, were used to calculate nutrient loadings to Lake Giles by multiplying the runoff coefficient by annual rainfall and the respective EMC for each nutrient. These give annual total loadings for TN and TP. Runoff volume and annual TN/TP loadings from the model period are shown in **Table 4.4** and **Table 4.5**, respectively. The unit of runoff volume used by the BATHTUB model is hectometers cubed (hm^3); one cubic hectometer is equal to 1,000,000 cubic meters.

Table 4.3 Wet and dry deposition for TN and TP at Lake Giles using measurements from Lake Apopka.

Year	TN wet loading (mg/m^2/yr)	TN dry loading (mg/m^2/yr)	TP wet loading (mg/m^2/yr)	TP dry loading (mg/m^2/yr)	Total TN (mg/m^2/yr)	Total TP (mg/m^2/yr)	Total TN (kg)	Total TP (kg)
2013	525	149	13	19	674	32	73.7	3.5
2014	534	134	13	22	668	35	72.9	3.8
2014	534	134	13	22	668	35	72.94	3.80
2015	494	181	22	29	676	51	73.84	5.58
2016	507	170	16	24	677	40	74.01	4.35
2017	458	244	15	32	702	47	76.70	5.09
2018	567	129	16	16	696	33	76.01	3.57
2019	436	159	16	28	595	44	65.04	4.81
2020	645	143	31	38	788	69	86.12	7.52
2021	579	184	24	52	763	77	83.4	8.4
2022	688	142	29	23	830	51	90.7	5.6

Table 4.4 Annual runoff volume from the Lake Giles watershed.

Year	Runoff volume (hm^3)
2013	0.50
2014	0.55
2015	0.48
2016	0.54
2017	0.58
2018	0.69
2019	0.52
2020	0.62
2021	0.44
2022	0.72

Table 4.5 Annual TN and TP loadings from the Lake Giles watershed.

Year	TN Loading (kg/yr)	TP Loading (kg/yr)
2013	923	165
2014	1021	182
2015	895	160
2016	997	178
2017	1080	193
2018	1279	228
2019	972	173
2020	1143	204
2021	808	144
2022	1326	237

Due to Lake Giles's presence in a high aquifer transmissivity region, depth, and lack of surface hydrological connections, it is likely that groundwater input is an important component in nutrient loading as well as water levels in general. As groundwater input (and export) are neither measured nor modelled for Lake Giles, groundwater input to the lake was estimated using Darcy's Law according to the following equation, where Q is groundwater flow in square meters per second, K_{sat} is the hydrologic conductivity of the matrix, dh is one half of the change in altitude from the edge of the watershed to the lake edge (used to estimate the slope of the aquifer), and dL is the length between the same two points.

$$Q = -K_{sat} * \frac{dh}{dL}$$

Q is calculated for the north, south, east, and west sides of the watershed. These values were summed together and multiplied by 5 meters (representing average depth of the lake) and 353.43 meters (representing the width of the lake) in order to convert groundwater velocity to discharge in $m^3 \cdot s^{-1}$. For K_{sat}, a value of 200 inches per hour was used considering the porous nature of the soil surrounding Lake Giles, which consists of fine sand (USDA, 2018). To this end, groundwater discharge to the lake was estimated to be 1.58 hm^3 per year. Groundwater nutrient concentration data is limited in the area around Lake Giles, resulting in estimated concentrations of 400 ppb TN and 1 ppb TP being used based off the available information from GWIS (generalized well information system). **Table 4.6** lists the calculated groundwater loadings.

Table 4.6 Calculated groundwater loadings to Lake Giles

Water Body	Hydrologic Load (hm^3/yr)	TN Load (kg/yr)	TP Load (kg/yr)
Lake Giles	1.58	790	1.6

4.4.1 Estimating Septic Tank Flow Rate and Nutrient Loadings

Septic tank nitrogen loadings to Lake Giles were derived using estimates of flow rate and nitrogen concentrations from systems located within a 200-meter buffer around the lake perimeter. To estimate flow, the following equation was used:

$$S * P * W * flr * 365 = Flow\ rate\ (gallons/year)$$

Where:

S = Number of known septic tanks within 200 meters.
P = Average number of people per household.
W = Individual water consumption (70 gallons/day).
flr = Flow loss rate (15 %).

There are 12 known septic tanks within a 200-meter buffer of Lake Giles. According to the U.S. Census Bureau, the City of Orlando averages 2.49 people per household. Each individual uses approximately 70 gallons of water per day, with a flow loss rate of 15 % (EPA 2002; Tetra Tech 2017). The number of septic tanks, the number of people per household, the individual water consumption, and a value of 0.85 were multiplied to calculate the total flow rate for septic tanks. Flow rates were converted to cubic hectometers for input to the BATHTUB model. The average flow rate from septic tanks within the buffer area was estimated to be 0.0025 hm^3/yr.

Seepage from septic tanks may contribute nutrients to the waterbody. Inorganic nutrients, such as nitrate nitrogen and ammonia, are the main nutrients associated with septic tanks, since the majority of phosphorus loads to groundwater from septic tanks are adsorbed onto soil particles immediately or very soon after discharge. For modeling purposes, these various forms of nutrients are referred to as TN. The following flow equation was used to estimate TN loading from septic tanks in the watershed:

$$S * P * I * L = \textit{Total TN (lbs) from septic tanks}$$

Where:

S = Number of known septic tanks in groundwater zones.
P = Average number of people per household.
I = Number of pounds of TN per person per septic tank.
L = Percentage of TN lost during seepage.

The number of septic tanks was multiplied by the number of people per household. These values were then multiplied by 4.088, which is the number of kilograms of TN per person seeping from a septic tank per year (EPA 2002; Toor et al. 2019), and by 0.50, which accounts for the 50 % nitrogen loss that occurs as septic tank effluent moves through the unsaturated zone to groundwater. **Figure 4.2** shows the locations of the known septic tanks, and **Table 4.7** lists the estimated TN load from septic tank contributions.

Table 4.7 Septic tank loads from the Lake Giles watershed

Waterbody	Flow Rate (hm^3/yr)	TN Concentration (mg/L)	TN Load (kg/yr)
Lake Giles	0.0025	11.27	28.2

Tables 4.8 and **4.9** show average annual TN and TP loadings by source, along with percent contributions.

Table 4.8 Annual Average TN Loading by source in kilograms per year and percent of total

Metric	TN Loading from Surface Runoff (kg/yr)	TN Loading from Groundwater (kg/yr)	TN Loading from OSTDS (kg/yr)	TN Loading from Atmospheric Deposition (kg/yr)
Annual Average	1045.43	790	28.2	77.2
Percent of Total	53.9	40.7	1.5	4.0

Table 4.9 Annual Average TP Loading by source in kilograms per year and percent of total

Metric	TP Loading from Surface Runoff (kg/yr)	TP Loading from Groundwater (kg/yr)	TP Loading from OSTDS (kg/yr)	TP Loading from Atmospheric Deposition (kg/yr)
Annual Average	187.52	1.6	0	5.22
Percent of Total	96.5	0.8	0.0	2.7

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 Lake Giles and to identify the maximum allowable TN and TP loadings from the watershed, so that the waterbody will meet the TMDL targets and thus maintain its function and designated uses as a Class III water.

5.2 Evaluation of Water Quality Conditions

For the water quality analysis conducted for TMDL development, AGMs were used to be consistent with the expression of the adopted NNC for lakes. For the purpose of this analysis, AGMs were calculated using a minimum of four sample results per year, with at least one of the samples collected in the May to September period and at least one 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 method 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 purposes. Negative values and zero values were also removed. Multiple sample results collected in the same day at the same station 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. Therefore, the AGMs listed in **Chapter 2** may not exactly match the AGMs used for TMDL development.

From 2013 to 2022, Lake Giles chlorophyll *a* AGMs varied from 7.01 µg/L in 2016 to 17.7 µg/L in 2020 (**Figure 5.2**). TN AGMs ranged from 0.33 mg/L in 2022 to 0.86 mg/L in 2013 (**Figure 5.3**). TP AGMs ranged from 0.018 mg/L in 2019 to 0.038 mg/L in 2013 (**Figure 5.4**). These AGMs are presented along with data points representing the simulated values.

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

5.4 Water Quality Modeling to Determine Assimilative Capacity

To represent water quality processes occurring in Lake Giles, the U.S. Army Corps of Engineers (USACE) BATHTUB model was used (Walker 1987; 1999). The model simulates steady-state lake conditions and is set up to simulate water quality for long-term receiving water conditions. It is designed to represent reservoirs and other large waterbodies with relatively stable water levels.

5.4.1 Water Quality Model Description

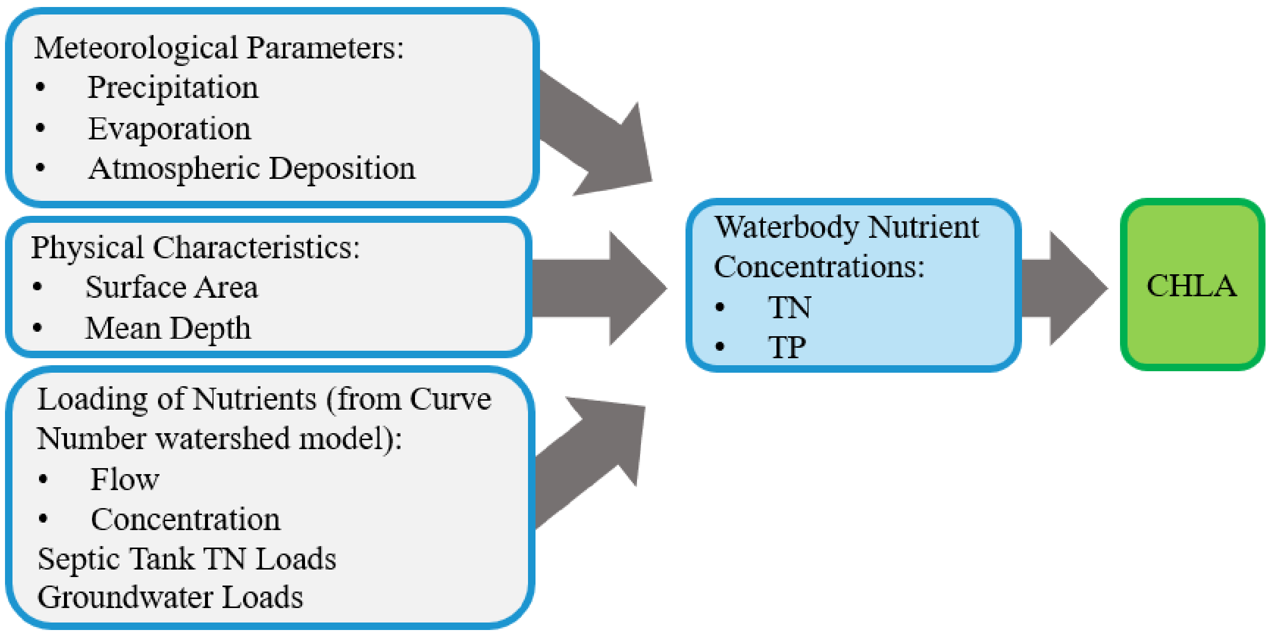
The BATHTUB model runs on a modeling framework that uses empirical relationships between nutrient loading, meteorological conditions, and physical parameters to estimate algal growth. The model's framework includes lake and lake segments morphometry, which may be directly or indirectly connected, as well as inputs of rainfall, atmospheric nutrient deposition, nutrient loads from the surrounding watershed, and internal loading of nutrients.

The primary goal of the BATHTUB model is to estimate in-lake nutrient concentrations and algal biomass (represented by chlorophyll *a* concentrations) as they relate to nutrient loadings. Walker (1999) describes methods for choosing the appropriate models for producing these nutrient estimates for different waterbodies. Two categories of models are used to empirically predict lake eutrophication, and this process usually occurs in two stages. The nutrient balance model describes the relationships between nutrient concentrations in the lake to external nutrient loadings, morphometry, and lake hydraulics. The eutrophication response model relates eutrophication indicators in the lake, including nutrient levels, chlorophyll *a*, hypolimnetic oxygen depletion, and transparency (Walker 1999).

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 *a*, and Secchi depth models.

Figure 5.1 shows the scheme used to relate these various models in BATHTUB. According to this scheme, external nutrient loadings, physical characteristics, and meteorological parameters are all applied to simulate in-lake nutrient concentrations. The physical, chemical, and biological response of the lake to the level of nutrients then produces waterbody nutrient concentrations, which are used to predict algal biomass. In BATHTUB, chlorophyll models are available to account for nitrogen, phosphorus, light, or flushing, as limiting factors to algal growth.

Lake Giles was represented as one waterbody in the BATHTUB model because the lake is relatively small and is spatially homogeneous because of its geometry. The waterbody was modeled on a yearly basis, with inputs including the watershed nutrient delivery derived from the PLSM model, atmospheric deposition, groundwater contributions, and septic tank flux (see **Sections 4.3** and **4.4**).



CHLA = Chlorophyll *a*

Figure 5.1 BATHTUB concept scheme

5.4.2 Morphologic Inputs

The physical characteristics of the lake were input for each year into BATHTUB. Two processes—residence time and nutrient fate and transport—vary based on these physical features. Lake Giles has an average depth of 5.4 meters (m), a surface area of 0.109 square kilometers (km^2), and a lake length of 0.35 kilometers (km).

5.4.3 Meteorological Data

Rainfall

Rainfall data (2013–2022) used as input on the lake surface area were obtained from the FAWN weather station at Apopka. **Table 5.1** shows annual rainfall totals for the model simulation period. The annual average rainfall in this area from 1990-2020 was 1.3 m. During the simulation period, wetter than average conditions occurred in 2017, 2018, and 2020, while drier than average conditions were present in 2014, 2015, 2016, and 2019.

Evaporation

Penman open-water evaporation was calculated using the Evapotranspiration R package developed by Guo et al (2022); R is developed by the R Core Team (2021). In order to calculate evaporation, the following data were gathered from FAWN's Apopka station: minimum and maximum temperature, minimum and maximum relative humidity, solar radiation, and wind speed. Latitude, height of the wind instrument, and lake elevation. Default values were used for latent heat of evapotranspiration (2.45 MJ kg^{-1}), solar constant (0.082 MJ m^{-2} min^{-1}), and Stefan-Boltzmann constant (4.903×10^{-9} MJ K^{-4} m^{-2} day^{-1}).

Table 5.1 Precipitation and modeled evaporation data for Lake Giles

Year	Precipitation (m)	Evaporation (m)
2013	1.15	1.68
2014	1.28	1.57
2015	1.12	1.60
2016	1.25	1.70
2017	1.35	1.64
2018	1.60	1.55
2019	1.22	1.64
2020	1.43	1.73
2021	1.01	1.86
2022	1.66	1.88

Atmospheric Deposition

Atmospheric deposition rates (total deposition of TN and TP) to the lake surface area were applied in the BATHTUB model. These rates were calculated based on data collected by the SJRWMD in Lake Apopka (see **Section 4.3.3**) that included both wet and dry atmospheric deposition rates (see **Table 4.3**), and the average over the model period was used for the input rates.

5.4.4 Watershed Nutrient Inputs

The PLSM approach was used to simulate watershed surface runoff (see **Section 4.4**). Annual loading rates from this approach were entered as watershed tributary inputs in the BATHTUB model for simulating yearly conditions. Annual loading rates from septic tank and groundwater contributions (see **Section 4.4**) were also entered as watershed tributary inputs in the model.

5.4.5 BATHTUB Model Calibration

The BATHTUB model was set up to simulate in-lake TN, TP, and chlorophyll *a* concentrations. Lake AGMs for chlorophyll *a*, TN, and TP were input into the model as observed values from 2013 to 2022. AGMs for chlorophyll *a*, TN, and TP were calculated using results from a minimum of 4 sampling events per year. These observed AGM values were used to calibrate the BATHTUB model and guided the selection of the appropriate nitrogen, phosphorus, and chlorophyll *a* models to apply.

For model calibration, model option 2 (2^{nd} order decay) was used to simulate both TP and TN, and model selection 1 ("P, N, light, T") was used for chlorophyll *a*. The main drivers of this model are TP, TN, light, and turbidity, and it assumes that phytoplankton growth is limited by not only both phosphorus and nitrogen but also light. Model option 01 (VS. Chla & Turbidity) was also selected for transparency. A calibration factor of 3 was applied to TP for all years in order to calibrate the model. Calibration factors of 1.3 and 0.7 were used for TP and Secchi Depth, respectively. A calibration factor of 1.2 was applied to chlorophyll *a*. The year 2020 has an observed chlorophyll *a* AGM of 17.7 µg/L, which does not correspond to significantly higher TN and TP concentrations in the AGMs, resulting in a poor fit in 2020. Additionally, overestimation of nutrients by the model in 2022 occurred due in part due to the high level of rainfall in that year, which lead to higher levels of runoff loading in the model. Additionally, Orlando was affected by category 5 Hurricane Ian that year which may have disrupted the lake. Finally, Lake Giles also experienced a fish kill in 2022, which may have affected the biological and chemical makeup in the lake. There is no data regarding internal loading in Lake Giles, and the model was calibrated without consideration for internal loading. **Figures 5.2-5** show the measured and simulated values for chlorophyll *a*, TN, and TP for Lake Giles in units of $mg \cdot m^{-3}$, the concentration units used by BATHTUB, while the values and percent differences between observed and simulated are shown in **Tables 5.2-3**.

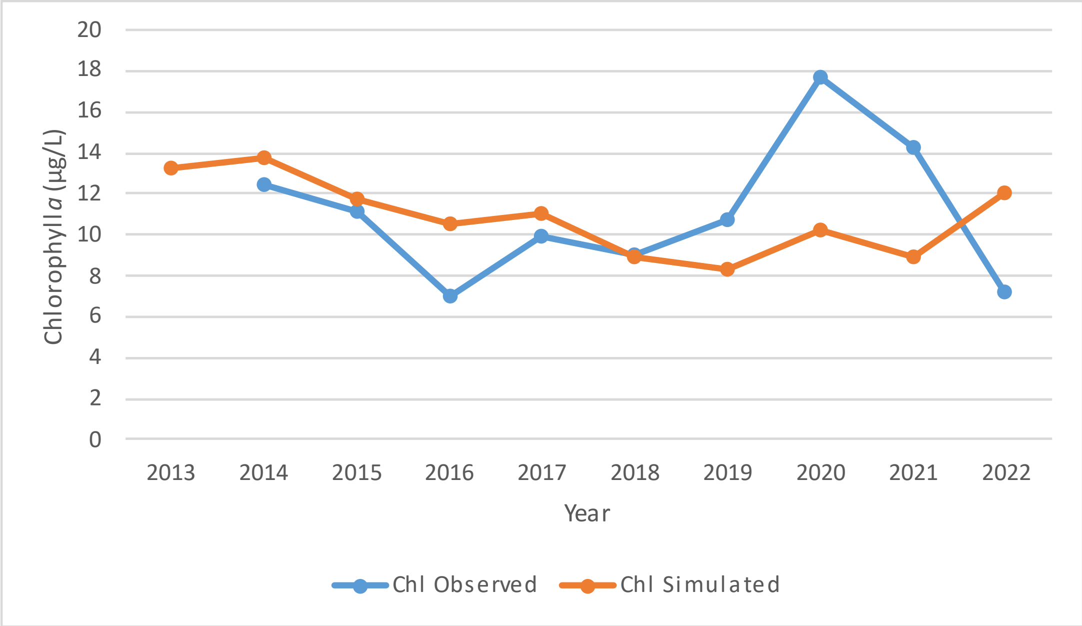


Figure 5.2 Measured and simulated annual chlorophyll a values from the calibrated BATHTUB model

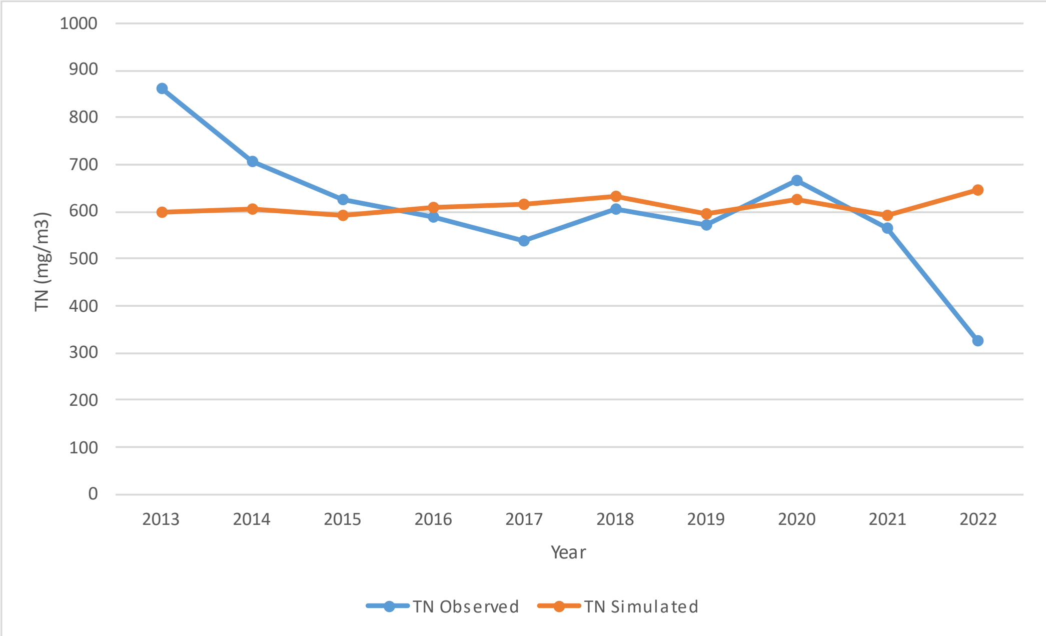


Figure 5.3 Measured and simulated annual TN values from the calibrated BATHTUB model

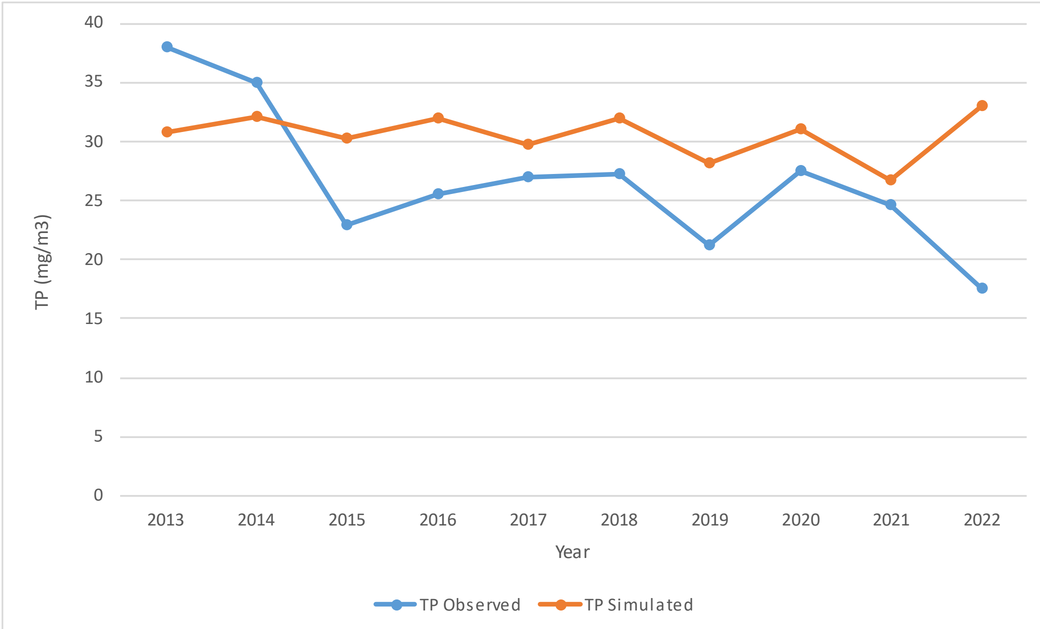


Figure 5.4 Measured and simulated annual TP values from the calibrated BATHTUB model

Table 5.2 Modeled and measured TP and TN values and percent difference

Year	Predicted TP (mg/L)	Observed TP (mg/L)	Percent Difference	Predicted TN (mg/L)	Observed TN (mg/L)	Percent Difference
2013	0.031	0.038	19	0.6	0.863	30
2014	0.032	0.035	8	0.6074	0.708	14
2015	0.030	0.023	32	0.5942	0.628	5
2016	0.032	0.026	25	0.6081	0.589	3
2017	0.030	0.027	10	0.6151	0.539	14
2018	0.032	0.027	18	0.6327	0.607	4
2019	0.028	0.021	33	0.5965	0.572	4
2020	0.031	0.028	13	0.6264	0.666	6
2021	0.027	0.025	9	0.5941	0.5657	5
2022	0.033	0.018	89	0.6471	0.3275	98

Table 5.3 Modeled and measured Chlorophyll *a* values in units of µg/L with percent difference

Year	Observed Chl (µg/L)	Predicted Chl (µg/L)	Percent Difference
2013	N/A	13.3	N/A
2014	12.4	13.8	-11
2015	11.1	11.7	-5
2016	7	10.5	-50
2017	9.9	11	-11
2018	9	8.9	1
2019	10.7	8.3	22
2020	17.7	10.2	42
2021	14.3	8.9	38
2022	7.2	12	-67

5.4.6 Natural Background Conditions and TMDL Scenario Run

To ensure that the site-specific restoration target would not abate natural background conditions, a Lake Giles natural background conditions model scenario was developed. To estimate the natural background nutrient loading conditions, all anthropogenic land uses applied in the existing condition scenario were converted to forest land cover in the PLSM calculations, replacing the EMCs and runoff coefficients with those of forested land. Wetland and water land cover remained unchanged in the spreadsheet for the natural background condition. The watershed background loadings were then input to the BATHTUB model file. Additionally, the septic tank loading estimates were removed as inputs in the BATHTUB model. The atmospheric deposition and groundwater were kept the same as in the current condition simulation.

The natural background model yielded chlorophyll values below the NNC of 6 µg/L. The DEP has demonstrated that the chlorophyll *a* criterion of 6 µg/L is protective of designated uses and maintains a balanced aquatic flora and fauna for clear low alkalinity lakes (DEP 2012). Therefore, 6 µg/L of chlorophyll *a* is appropriate to use as the restoration target for Lake Giles.

The TMDL nutrient loading scenario was developed by iteratively reducing the anthropogenic loadings in the BATHTUB model until the simulated chlorophyll *a* concentrations did not exceed 6 µg/L more than once in any consecutive 3-year period. The BATHTUB simulated in-lake chlorophyll *a*, TN, and TP results for the TMDL loading scenario in a 95% reduction in anthropogenic input are presented in **Table 5.4**, and displayed in **Figures 5.6-8**, respectively. The in-lake TN and TP concentrations (0.53 and 0.014 mg/L, respectively) for the TMDL scenario serve as concentration-based restoration targets to assist in evaluating the effectiveness of restoration activities. These nutrient concentration targets are for informational purposes only.

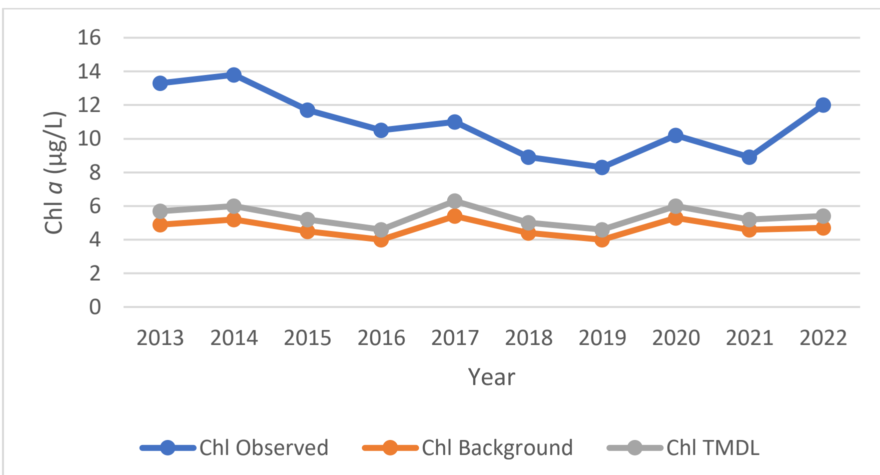


Figure 5.6 Chlorophyll a concentrations in existing, background, and target conditions from the BATHTUB model, 2013-22

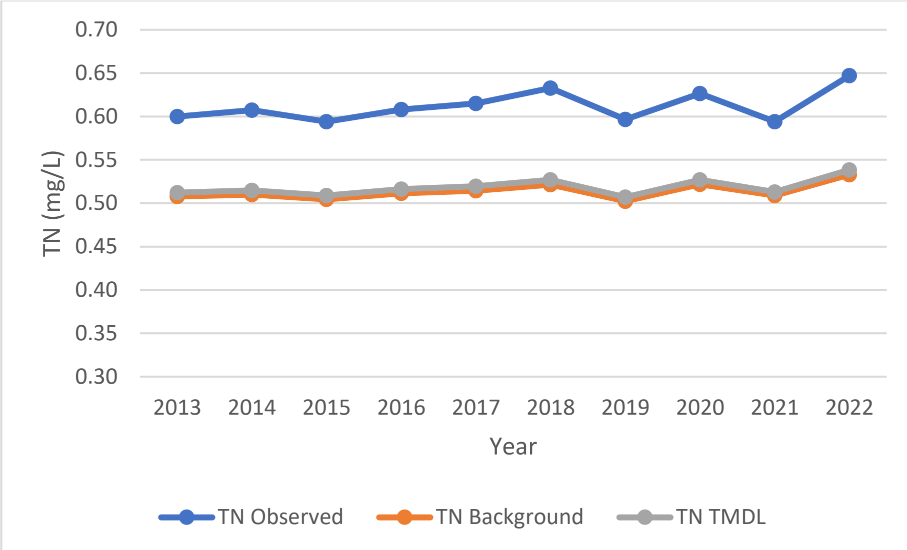


Figure 5.7TN concentrations in existing, background, and target conditions from the BATHTUB model, 2013-22

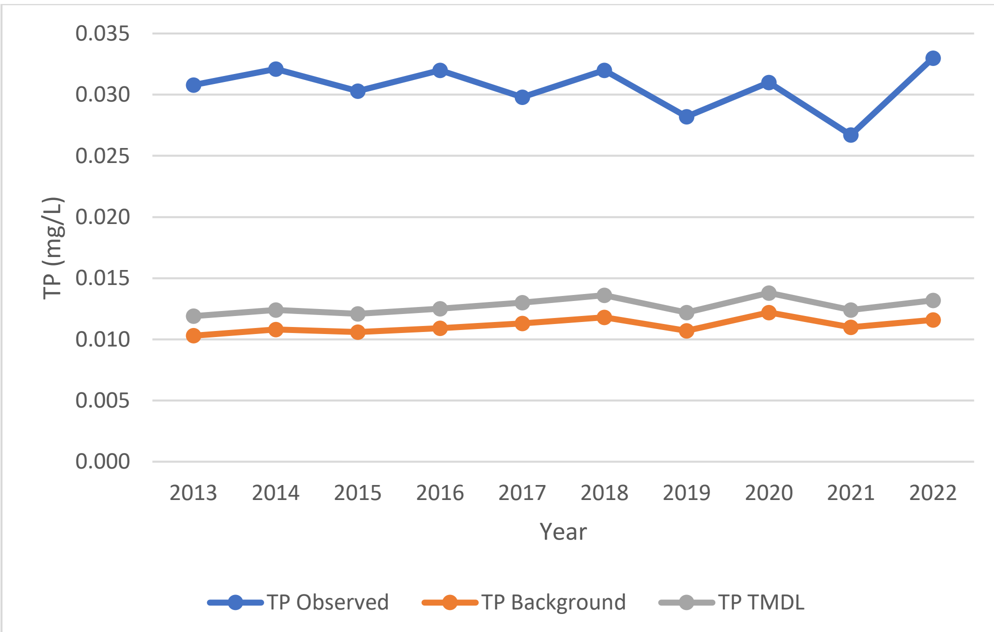


Figure 5.8 TP concentrations in existing, background, and target conditions from the BATHTUB model, 2013-22

Table 5.4 Current, background, and TMDL concentrations for Chl, TN, and TP in Lake Giles.

Year	Simulated Current TP (mg/L)	Background TP (mg/L)	TMDL TP (mg/L)	Simulated Current TN (mg/L)	Background TN (mg/L)	TMDL TN (mg/L)	Simulated Current Chl (µg/L)	Background Chl (µg/L)	TMDL Chl (µg/L)
2013	0.031	0.0103	0.0119	0.60	0.51	0.51	13.3	4.9	5.7
2014	0.032	0.0108	0.0124	0.61	0.51	0.51	13.8	5.2	6
2015	0.030	0.0106	0.0121	0.59	0.50	0.51	11.7	4.5	5.2
2016	0.032	0.0109	0.0125	0.61	0.51	0.52	10.5	4	4.6
2017	0.030	0.0113	0.013	0.62	0.51	0.52	11	5.4	6.3
2018	0.032	0.0118	0.0136	0.63	0.52	0.53	8.9	4.4	5
2019	0.028	0.0107	0.0122	0.60	0.50	0.51	8.3	4	4.6
2020	0.031	0.0122	0.0138	0.63	0.52	0.53	10.2	5.3	6
2021	0.027	0.011	0.0124	0.59	0.51	0.51	8.9	4.6	5.2
2022	0.033	0.0116	0.0132	0.65	0.53	0.54	12	4.7	5.4

5.5 Calculation of the TMDLs

The nutrient loadings for the TMDL scenario are the loadings where the annual in-lake chlorophyll *a* concentrations do not exceed 6 µg/L more than once in any consecutive 3-year time frame during the modeling period (2013–2022). **Tables 5.5** lists the nutrient loads input to the BATHTUB model for Lake Giles, including the TN and TP existing loads, the loads that achieve the criterion of 6 µg/L chlorophyll *a* (TMDL condition), and their maximum 7-year averages.

The final reductions to establish the TMDLs for Lake Giles were calculated by using the maximum 7-year average of both the existing and TMDL condition TN and TP loads. The maximum 7-year averages for TN existing loads and TMDL condition loads for the lake are 1,985 and 1,566 kg/yr, respectively. The maximum 7-year averages for TP existing loads and TMDL condition loads for the lake are 202 and 48 kg/yr, respectively (**Table 5.5**). The general equation used to calculate the percent reductions based on maximum 7-year averages is as follows:

$$\frac{\textbf{Existing Load – TMDL Condition Load}}{\textbf{Existing Load}} \textbf{ * 100}$$

To meet the TMDL loads for Lake Giles, the required percent reductions for the TN and TP existing loads are 21% and 76%, respectively (**Table 5.5**). The TN and TP TMDLs of 1,566 and

48 kg/yr, respectively, which are expressed as a 7-year average load, not to be exceeded, address the anthropogenic nutrient inputs contributing to the exceedances of the chlorophyll *a* restoration target.

Table 5.5. Lake Giles TMDL condition nutrient loads, 2011–22

Note: Values shown in boldface type and shaded cells represent the maximum 7 year averages, the 7-year loads used for the calculations, and percent reductions.

Year	Modeled Existing Condition TN Loads (kg/yr)	7-Year Rolling Average TN Loads (kg/yr)	Modeled TMDL Condition TN Loads (kg/yr)	7-Year Rolling Average TN Loads (kg/yr)	Modeled Existing Condition TP Loads (kg/yr)	7-Year Rolling Average TP Loads (kg/yr)	Modeled TMDL Condition TP Loads (kg/yr)	7-Year Rolling Average TP Loads (kg/yr)
2013	1818		1457		171		40	
2014	1911		1516		187		43	
2015	1782		1434		166		40	
2016	1893		1505		185		43	
2017	1970		1555		199		47	
2018	2173		1685		234		53	
2019	1847	1,913	1473	1,518	178	188	42	44
2020	2054	1,947	1612	1,540	214	195	52	46
2021	1717	1,919	1396	1,523	156	190	40	45
2022	2243	1,985	1735	1,566	245	202	57	48
Maximum 7-Year Average		**1,985**		**1,566**		**202**		**48**
% Reduction			**21.1**				**76.3**	

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:

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

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

$$\textbf{TMDL} \cong \sum \textbf{WLAs}_{\textbf{wastewater}} + \sum \textbf{WLAs}_{\textbf{NPDES Stormwater}} + \sum \textbf{LAs} + \textbf{MOS}$$

It should be noted that the various components of the revised TMDL equation may not sum up to the value of the TMDL because (1) the WLA for NPDES stormwater is typically based on the percent reduction needed for nonpoint sources and is also accounted for in 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, DEP does not differentiate between the MS4 WLA and 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 BMPs.

This approach is consistent with federal regulations, which state that TMDLs can be expressed in terms of mass per time (e.g., pounds per day), toxicity, or other appropriate measure—see 40 Code of Federal Regulations (CFR) § 130.2(i). The TMDLs for Lake Giles are expressed in terms of kg/yr and percent reduction of TN and TP and represent the loads of TN and TP that the waterbody can assimilate while maintaining balanced communities of aquatic flora and fauna (see **Table 6.1**). These TMDLs are based on 7-year rolling averages of simulated loads from 2013 to 2022. For the TMDLs, the restoration goal is to achieve the generally applicable chlorophyll *a* criterion of 6 µg/L, which is expressed as an AGM not to be exceeded more than once in any consecutive 3-year period, thus meeting the water quality criteria and protecting designated uses for Lake Giles.

Table 6.1. TMDL components for nutrients in Lake Giles (WBID 3168Z4)

Note: The LA and TMDL daily load for TN is 2.8 kg/day and for TP 0.21 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
3168Z4	TN	1,566	NA	21	21	Implicit
3168Z4	TP	48	NA	76	76	Implicit

To achieve the LA for Lake Giles, 21% and 76% reductions in existing TN and TP loads, respectively, will be required. Load reductions were calculated from 1,985kg/yr for TN and 202 kg/yr for TP based on the highest 7-year average load from the 2013–2022 period. Reductions may need to be adjusted to meet the TMDLs in the future based on future loadings.

The TMDLs are based on the percent reduction in total watershed loading of TN and TP from all anthropogenic sources. 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 district that are not part of the NPDES stormwater program (see **Appendix A**).

6.2 Wasteload Allocation

6.2.1 NPDES Wastewater Discharges

As noted in **Chapter 4**, no active NPDES-permitted facilities in the Lake Giles Watershed discharge into either the lake or the watershed. Therefore, a WLA for wastewater discharges is not applicable.

6.2.2 NPDES Stormwater Discharges

The Giles Watershed is covered by an NPDES MS4 Phase I permit (FLS000014), issued to the City of Orlando. Any MS4 permittee is only responsible for reducing the anthropogenic loads associated with stormwater outfalls that it owns or otherwise has responsible control over. It is not responsible for reducing other nonpoint source loads in its jurisdiction.

6.3 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)). An implicit MOS was used because the TMDLs were based on the conservative decisions associated with a number of the modeling assumptions in determining assimilative capacity (i.e., loading and water quality response). The TMDLs were developed using the maximum seven-year averages for TN and TP existing loads to calculate the percent reductions and requiring the TMDL loads not to be exceeded in any one year.

Chapter 7: Implementation Plan Development and Beyond

7.1 Implementation Mechanisms

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

Facilities with NPDES permits that discharge to the TMDL waterbody must implement 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 restoration plan (e.g., a reasonable assurance plan).

7.2 BMAPs

Information on the development and implementation of BMAPs is available in Section 403.067, F.S. 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 DEP Secretarial Order and are legally enforceable.

BMAPs can 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—such as wastewater facilities, industrial sources, agricultural landowners, 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.

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 potential factors should be included in a comprehensive management plan for the lake.

Given the nature of the loading to Lake Giles, nonpoint source reductions are required to reach the TMDL target. In the Lake Giles Watershed, runoff from residential areas is the leading nonpoint source for nutrients. Nutrient loading from groundwater may also need to be quantified in order to make proper decisions on management practices applicable to Lake Giles.

References

Conley, D.J., H.W. Paerl, R.W. Howarth, D.F. Boesch, S.P. Seitzinger, K.E. Havens, C. Lancelot, and G.E. Likens. 2009. *Controlling eutrophication: Nitrogen and phosphorus. Science* 323: 1014–1015.

Florida Department of Environmental Protection. 2001. *A report to the Governor and the Legislature on the allocation of total maximum daily loads in Florida.* Tallahassee, FL: Bureau of Watershed Management.

———. 2012. *Development of numeric nutrient criteria for Florida lakes, spring vents, and streams.* Technical support document. Tallahassee, FL: Division of Environmental Assessment and Restoration, Standards and Assessment Section.

Griffith, G.E., D.E. Canfield, Jr., C.A. Horsburgh, and J.M. Omernik. 1997. *Lake regions of Florida.* EPA/R-97/127. Corvallis, OR: U.S. Environmental Protection Agency.

Guo, D., Westra, S., and Peterson, T. 2022. Evapotranspiration: Modelling Actual, Potential and Reference Crop Evapotranspiration V. 1.16. https://CRAN.R-project.org/package=Evapotranspiration

Harper, H. 1994. *Stormwater loading rate parameters for central and south Florida.* Orlando, FL: Environmental Research and Design, Inc.

———. 2012. *BMPTRAINS MODEL: Rainfall characteristics*. PowerPoint slides.

Kuniansky, E., Bellino, J., and Dixon, J. 2012. Transmissivity of the Upper Floridan Aquifer in Florida and Parts of Georgia, South Carolina, and Alabama. United States Geological Survey.

Lewis, W.M., W.A. Wurtsbaugh, and H.W. Paerl. 2011. *Rationale for control of anthropogenic nitrogen and phosphorus in inland waters. Environmental Science and Technology* 45: 10300–10305.

Paerl, H.W. 2009. *Controlling eutrophication along the freshwater-marine continuum: Dual nutrient (N and P) reductions are essential. Estuaries and Coasts* 32: 593–601.

Paerl, H.W., and T.G. Otten. 2013. *Harmful cyanobacterial blooms: Causes, consequences and controls. Microbial Ecology* 65: 995–1010.

R Core Team (2021). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/.

Tetra Tech 2017. *Hydrology and water quality modeling report for the Caloosahatchee River and Estuary*, Florida. Atlanta, GA.

Toor, G.S., M. Lusk, and T. Obreza. 2019. *Onsite sewage treatment and disposal systems: An overview*. SL347. Gainesville, FL: University of Florida Institute of Food and Agricultural Sciences.

USDA. 2018. Tavares Series. United States Department of Agriculture. https://soilseries.sc.egov.usda.gov/OSD_Docs/T/TAVARES.html#:~:text=The%20Tavares%20series%20consists%20of,from%200%20to%208%20percent.

Walker, W.W., Jr. 1987. *Empirical methods for predicting eutrophication in impoundments. Report 4, Phase III: Application manual.* Technical report E-81-9. Vicksburg, MS: U.S. Army Corps of Engineers, Waterways Experiment Station.

———. 1999. *Simplified procedures for eutrophication assessment and prediction: User manual.* Instruction Report W-96-2. Washington, DC: U.S. Army Corps of Engineers.

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 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 five 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, 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 from one to five 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. 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 Giles
Waterbody type(s)	Lake
WBID	Lake Giles (WBID 3168Z4) (see **Figure 1.1** of this report)
Description	Lake Giles is located in the City of Orlando The lake and its surrounding watershed cover an area of 271 acres. Lake Giles has a surface area of 26.4 acres, with an average depth of 5.4 meters. Residential land use predominates in the Lake Giles watershed, with 86 % coverage. **Chapter 1** of this report describes the Lake Giles system in more detail.
Specific location (latitude/longitude or river miles)	The center of Lake Giles is located at 28.53023°N, -81.33421°W The site-specific criteria apply as a spatial average for the lake, as defined by WBID 3168Z4.
Map	**Figure 1.2** shows the general location of Lake Giles and its associated watershed, and **Figure 4.1** shows the land uses in the watershed.
Classification(s)	Class III Freshwater
Basin name (HUC 8)	Middle St Johns River Basin (03090101)

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	Lake Giles is a low-color, low-alkalinity 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 6 µg/L, TN of 0.51 to 0.93 mg/L, and TP of 0.01 to 0.03 mg/L.
Proposed TN, TP, chlorophyll *a*, and/or nitrate + nitrite concentrations (magnitude, duration, and frequency)	**Numeric interpretations of the narrative nutrient criterion:** For Lake Giles Nutrient concentrations are provided for informational purposes only. The in-lake TN and TP AGM concentrations for Lake Giles at the allowable TMDL loading are 0.53 and 0.014 mg/L, respectively, not to be exceeded more than once in any consecutive 3-year period. These restoration concentrations represent the in-lake concentrations that would still meet the target chlorophyll *a* concentration of 6 µg/L with a 1-in-3-year exceedance rate.
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 PLSM model and the BATHTUB model, which simulated hydrology and water quality conditions from 2013 to 2022 for Lake Giles. The primary datasets for this period include water quality data from IWR Run 65, Apopka Station Weather Data, and 2016 SJRWMD land use coverage. **Sections 2.3** and **4.4** of this 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 BATHTUB model was used to simulate lake conditions in the 2013–22 period. The period included wet and dry years. Long-term average rainfall for the Lake Giles Watershed from 1991 to 2020 was 1.3m/yr. During the simulation period, wetter than average conditions occurred in 2017, 2018, and 2020, and 2022 while drier than average conditions were present in 2014, 2015, 2016, and 2019. This period captures the hydrologic variability of the system. The PLSM approach model simulated loads generated in the watershed to evaluate how changes in watershed loads impact lake nutrient and chlorophyll *a* concentrations. **Figure 2.1** shows the locations of the sampling stations in Lake Giles.

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 Lake Giles (WBID 3168Z4). Firstly, the NNC were used to assess Lake Giles during the 2020-22 Biennial Assessment (the verified period: January 1, 2015–June 30, 2020, based on data from IWR Run 60 Lake Giles was determined to be verified impaired for chlorophyll *a*, TN, and TP. **Table 2.3** lists the AGM values for chlorophyll *a*, TN, and TP during the verified period for the waterbody.
Basis for use support	The basis for use support is the NNC chlorophyll *a* concentration of 6 µg/L, which is protective of designated uses for low-color, low-alkalinity lakes. Based on the available information, there is nothing unique about Lake Giles that would make the use of the chlorophyll *a* threshold of 6 µg/L inappropriate for the lake.
Approach used to develop criteria and how it protects uses	For the Lake Giles nutrient TMDLs, DEP created loading-based criteria using the PLSM method to simulate loading from the Lake Giles Watershed, and this information and other loading data from atmospheric deposition, OSTDS, and groundwater to the lake were inputs into BATHTUB. DEP established the site-specific TN and TP loadings using the calibrated models to achieve an in-lake chlorophyll *a* AGM concentration of 6 µg/L. The maximum of the 7-year rolling averages of TN and TP loadings to achieve the chlorophyll *a* target was determined by decreasing TN and TP loads from anthropogenic sources into the lake until the chlorophyll *a* target was achieved. **Chapter 3** of this report describes the derivation of the TMDLs 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 (6 µg/L) in the lake will be attained at the TMDL loads for TN and TP. DEP notes that no other impairments were verified for Lake Giles that may be related to nutrients (such as dissolved oxygen [DO] or un-ionized ammonia). Reducing the nutrient loads entering the lake will not negatively affect other water quality parameters in the lake.

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	Lake Giles does not discharge into any surficial waterbodies.
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.	The City of Orlando conducts routine monitoring of Lake Giles with supplemental data from DEP. 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, amphibious, or anadromous endangered species present in the Lake Giles Watershed. Furthermore, it is expected that restoration efforts and subsequent water quality improvements will positively affect aquatic species living in the lake and its 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 January 16, 2024, to initiate TMDL development for impaired waters in the Middle St. Johns Basin. A rule development public workshop for the TMDLs will be held following public meeting to present the TMDL.
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.

Appendix C. Estimating the Runoff Volume and Nutrient Loads from the Lake Giles Watershed

Stormwater runoff volume was estimated using a combination of rainfall minus measured evapotranspiration, land use, event mean concentrations (EMCs), and runoff coefficients (ROCs). EMCs exist for both TN and TP and were taken from Harper (1994, 2012) along with runoff coefficients. Each land use has an EMC and a runoff coefficient. The EMCs and runoff coefficients for the land uses in the Lake Giles watershed are listed in **Table C.1**.

Table C.1 EMC and ROC values for each land use in the Lake Giles watershed

Land Use Code	Land Use Description	TN EMC	TP EMC	ROC
1400	Commercial and Services	1.635	0.213	0.862
1700	Institutional	1.07	0.179	0.887
5200	Lakes	0	0	1
1300	Residential High Density	2.1	0.497	0.675
1200	Residential Medium Density	1.87	0.301	0.373
8100	Transportation	1.19	0.213	0.783
8300	Utilities	1.19	0.213	0.793
6400	Vegetated Non-Forested Wetlands	1.15	0.055	0.225

To calculate loading from runoff, the area of each land use was multiplied by the ROC and the amount of rainfall in the watershed minus evapotranspiration. The higher the runoff coefficient, the more runoff is produced by a land use. Anthropogenic land uses tend to have higher ROCs. The resulting runoff volume is multiplied by the EMCs; this step is done for both TN and TP. The values for the land uses are added together and represent the total annual TN and TP loading from the watershed. For this reason, the area of the lake is left out of the runoff calculation as nutrient loading directly to the lake is represented by atmospheric deposition. Annual runoff volume, rainfall, evapotranspiration, and estimated TN and TP loadings are shown in **Table C.2**.

Table C.2 Rainfall, runoff volume, and nutrient loadings from the Lake Giles watershed for the model period

Year	Rainfall (m)	Runoff Volume (m^3)	TN Loading (kg/yr)	TP Loading (kg/yr)
2013	1.156464	497,851	922	164
2014	1.279909	550,736	1,021	182
2015	1.122174	483,078	895	160
2016	1.249428	537,814	997	178
2017	1.353569	582,703	1,080	193
2018	1.603505	690,235	1,279	228
2019	1.217678	524,212	972	173
2020	1.433071	616,894	1,143	204
2021	1.010668	435,757	808	144
2022	1.658877	715,237	1,326	237