Central District • Kissimmee River Basin

Draft Report

Nutrient TMDLs for Lake Fran (WBID 3169G3), Lake Kozart (WBID 3169G4), Lake Richmond (WBID 3169G6), Lake Walker (WBID 3169G5), and Lake Bumby (WBID 3168W7)

Kevin Petrus
Division of Environmental Assessment and Restoration
Florida Department of Environmental Protection

August 2022

2600 Blair Stone Road
Mail Station 3000
Tallahassee, FL 32399-2400
https://floridadep.gov

Executive Summary

This report presents the total maximum daily loads (TMDLs) developed to address the nutrient impairments for the following lakes with waterbody identification (WBID) numbers: Lake Fran (WBID 3169G3), Lake Kozart (WBID 3169G4), Lake Richmond (WBID 3169G6), Lake Walker (WBID 3169G5), and Lake Bumby (WBID 3168W7). These waterbodies are all located in the Kissimmee River Basin in Orange County, Florida. Lakes Fran, Kozart, Richmond, and Walker are situated in the City of Orlando in the headwaters of the Shingle Creek Watershed. Lake Bumby is located near the City of Orlando, approximately four miles south of downtown Orlando in the Boggy Creek Watershed.

These five waterbodies were identified as impaired for nutrients based on elevated chlorophyll *a*, total nitrogen (TN) and total phosphorus (TP) concentrations exceeding the numeric nutrient criteria (NNC) in Subsection 62-302.531(2), Florida Administrative Code (F.A.C.). The lakes were verified as impaired for nutrients and were included on the Verified List of Impaired Waters for the Kissimmee River Basin (Group 4) in Assessment Cycle 3, adopted by Secretarial Order in June 2017.

TMDLs for TN and TP have been developed, and **Table EX-1** lists supporting information for the TMDLs. The TMDLs were developed in accordance with Section 303(d) of the federal Clean Water Act (CWA) and guidance developed by the U.S. Environmental Protection Agency (EPA).

Table EX-1. Summary of TMDL supporting information for Lakes Fran, Kozart, Richmond, Walker, and Bumby

Type of Information	Description
Waterbody name/ Waterbody identification (WBID) number	Lake Fran (WBID 3169G3), Lake Kozart (WBID 3169G4), Lake Richmond (WBID 3169G6), Lake Walker (WBID 3169G5), Lake Bumby (WBID 3168W7)
Hydrologic Unit Code (HUC) 8	Kissimmee River Basin – 03090101
Use classification/ Waterbody designation	Class III/Fresh
Targeted beneficial uses	Fish consumption; recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife
303(d) listing status	Lakes Fran, Kozart, Richmond, Walker, and Bumby: Verified List of Impaired Waters for the Kissimmee River Group 4 Basin adopted via Secretarial Order in June 2017.
TMDL pollutants	TN and TP
Generally applicable chlorophyll a criterion	**Low-color (color ≤ 40 platinum cobalt units [PCU]), high-alkalinity (> 20 milligrams per liter [mg/L]) lakes:** Chlorophyll a: 20 micrograms per liter (µg/L), expressed as an annual geometric mean (AGM) concentration not to be exceeded more than once in any consecutive 3-year period.
Concentration reductions required to meet the TMDLs	**Lake Fran (WBID 3169G3):** TN: 24 % reduction of in-lake concentration to meet the generally applicable numeric nutrient criteria (NNC) for low-color, high-alkalinity lakes. TP: 70 % reduction of in-lake concentration to meet the generally applicable NNC for low-color, high-alkalinity lakes. **Lake Kozart (WBID 3169G4):** TN: 58 % reduction of in-lake concentration to meet the generally applicable NNC for low-color, high-alkalinity lakes. TP: 78 % reduction of in-lake concentration to meet the generally applicable NNC for low-color, high-alkalinity lakes. **Lake Richmond (WBID 3169G6):** TN: 59 % reduction of in-lake concentration to meet the generally applicable NNC for low-color, high-alkalinity lakes. TP: 69 % reduction of in-lake concentration to meet the generally applicable NNC for low-color, high-alkalinity lakes. **Lake Walker (WBID 3169G5):** TN: 34 % reduction of in-lake concentration to meet the generally applicable NNC for low-color, high-alkalinity lakes. TP: 73 % reduction of in-lake concentration to meet the generally applicable NNC for low-color, high-alkalinity lakes. **Lake Bumby (3168W7):** TN: 16 % reduction of in-lake concentration to meet the generally applicable NNC for low-color, high-alkalinity lakes. TP: 51 % reduction of in-lake concentration to meet the generally applicable NNC for low-color, high-alkalinity lakes.

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, and the Watershed Evaluation and TMDL Section. DEP also recognizes the City of Orlando and the Orange County Environmental Protection Division for their contributions towards understanding the issues, history, and processes at work in the lake watersheds.

For additional information regarding the development of this report, please contact the Division of Environmental Assessment and Restoration office at:

2600 Blair Stone Road
Mail Station 3000
Tallahassee, FL 32399-2400
Phone: (850) 245–8668

Contents

List of Figures

List of Tables

List of Acronyms and Abbreviations

µg/L	Micrograms Per Liter
Ac	Acre
AGM	Annual Geometric Mean
BMAP	Basin Management Action Plan
BMP	Best Management Practice
°C.	Celsius
$CaCO_3$	Calcium Carbonate
CWA	Clean Water Act
DEP	Florida Department of Environmental Protection
EPA	U.S. Environmental Protection Agency
F.A.C.	Florida Administrative Code
FDOH	Florida Department of Health
FDOT	Florida Department of Transportation
F.S.	Florida Statutes
Ft	Foot
FWRA	Florida Watershed Restoration Act
HUC	Hydrologic Unit Code
ID	Insufficient Data
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
NAD	North American Datum
NNC	Numeric Nutrient Criteria
NOAA	National Oceanic and Atmospheric Agency
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
OIA	Orlando International Airport
OSTDS	Onsite Sewage Treatment and Disposal System
PCU	Platinum Cobalt Unit
PLRG	Pollutant Load Reduction Goal
POR	Period of Record
SFWMD	South Florida Water Management District
SJRWMD	St. Johns River Water Management District
SWIM	Surface Water Improvement and Management (Program)

TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
USDA	U.S. Department of Agriculture
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 loads (TMDLs) developed to address the nutrient impairment of Lakes Fran, Kozart, Richmond, Walker and Bumby, located in the Kissimmee River Basin in Orange County. The TMDLs are established to achieve the generally applicable numeric nutrient criteria (NNC) in Subsection 62-302.531(2), Florida Administrative Code (F.A.C.), and are intended to attain the chlorophyll *a* criterion applicable to each lake. The TMDL targets are not being adopted as Hierarchy 1 site-specific interpretations of the NNC because the generally applicable NNC fully protect designated uses.

These five waterbodies are impaired for nutrients using the methodology in the Identification of Impaired Surface Waters Rule (IWR) (Chapter 62-303, F.A.C.). They were included on the Verified List of Impaired Waters for the Kissimmee River Basin that was adopted by Secretarial Order in June 2017.

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and provides water quality targets needed to achieve compliance with applicable water quality criteria based on the relationship between pollutant sources and water quality in the receiving waterbody. The TMDLs establish the allowable nutrient concentrations for Lakes Fran, Kozart, Richmond, Walker, and Bumby and associated nutrient reductions that would restore the waterbodies so that they meet their applicable water quality criteria for nutrients.

1.2 Identification of Waterbodies

For assessment purposes, the Florida Department of Environmental Protection (DEP) divided the Kissimmee River Basin (Hydrologic Unit Code [HUC] 8 – 03090101) into watershed assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or surface water segment. Lake Fran is WBID 3169G3, Lake Kozart is WBID 3169G4, Lake Richmond is WBID 3169G6, Lake Walker is WBID 3169G5, and Lake Bumby is WBID 3168W7. The lakes are located in the Upper Kissimmee River Subwatershed.

Lakes Fran, Kozart, Richmond, and Walker are part of a system of connected lakes in the western part of Orlando in Orange County, within an area bounded by Interstate 4 to the east and South Kirkman Road to the west. Lake Fran is the downstream lake of a system of lakes that includes Lakes Kozart, Richmond, Walker, Clear, Mann, Beardall, and Lorna Doone. For the purposes of this report, the eight lakes and their drainage basins are collectively referred to as the Lake Fran Watershed. Lake Bumby is located near the city limits of Orlando, four miles south of downtown Orlando. The lake is situated immediately east of U.S. Highway 441 and west of Lake Jessamine. **Figure 1.1** shows the location of the Lakes Fran and Bumby Watersheds in Orange County. **Figure 1.2** is a detailed map of the Lake Fran Watershed showing the four nutrient-impaired lake WBIDs and their contributing basins, and the major geopolitical and hydrologic features surrounding them. **Figure 1.3** shows the location of Lake Bumby and its watershed, along with major hydrologic features in the area.

Lakes Fran, Kozart, Richmond, and Walker are located in the western portion of the City of Orlando and are part of the headwaters of Shingle Creek. Lakes Fran, Kozart, and Richmond are man-made and are located in an area that in the past was predominantly wetlands. Lake Walker, a natural lake, located just west of Clear Lake, flows into the southwest part of Clear Lake, which has an outlet channel that flows west into Lake Fran. Lakes Kozart, Richmond, and Mann have outlet channels that enter a canal system flowing into Lake Fran. The outlet of Lake Fran exits to a canal system that flows into Shingle Creek. Additionally, surface water can exit portions of the Lake Fran Watershed through drainage wells installed in Lakes Richmond and Lorna Doone (City of Orlando 2019). Lake drainage wells, used to control lake water levels in the Orlando area, allow lake water to flow directly into the aquifer, usually the Floridan aquifer system (Schiffer 1998).

The 4 impaired lakes in the Lake Fran Watershed are small in size, with surface areas ranging from 4 acres (ac) (Lake Walker) to 70 ac (Lake Fran). Lakes Kozart and Richmond are intermediate in size and have surface areas of 7 and 35 ac, respectively. The mean lake depths are 9.0 feet (ft) in Lake Fran, 7.7 ft in Lake Walker, 5.3 ft in Lake Richmond, and 4.3 ft in Lake Kozart. Residential and commercial development dominate land use in the area.

Lake Bumby is situated in the Boggy Creek Watershed and has an outlet at the southeast area of the lake that flows through a ditch to Lake Jessamine. The lake surface area is 11 ac and has a mean depth of 8.0 ft. Residential and commercial development dominate land use in the vicinity of the lake.

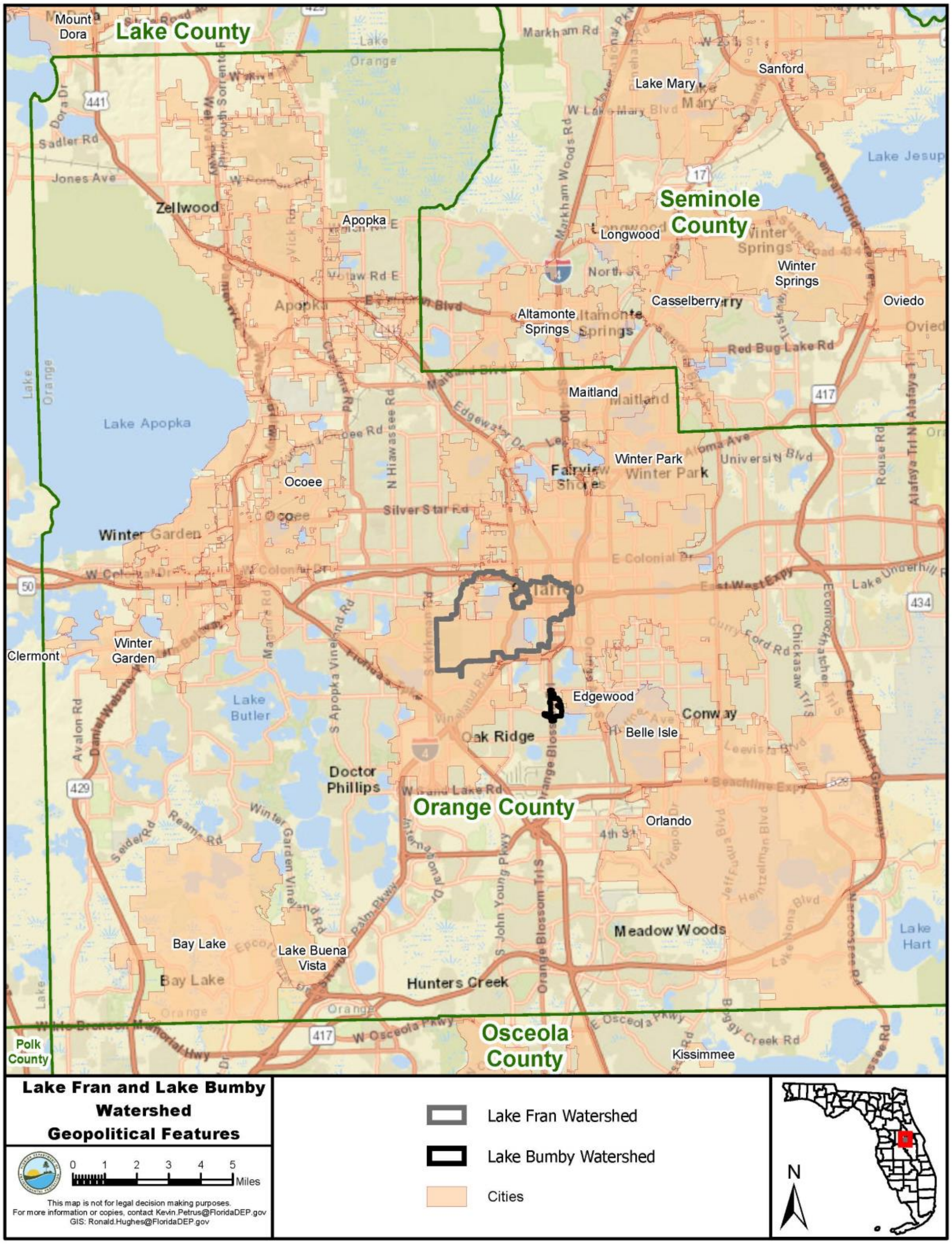

Figure 1.1. Lake Fran and Lake Bumby Watersheds with major geopolitical and hydrologic features in the Upper Kissimmee River Subwatershed

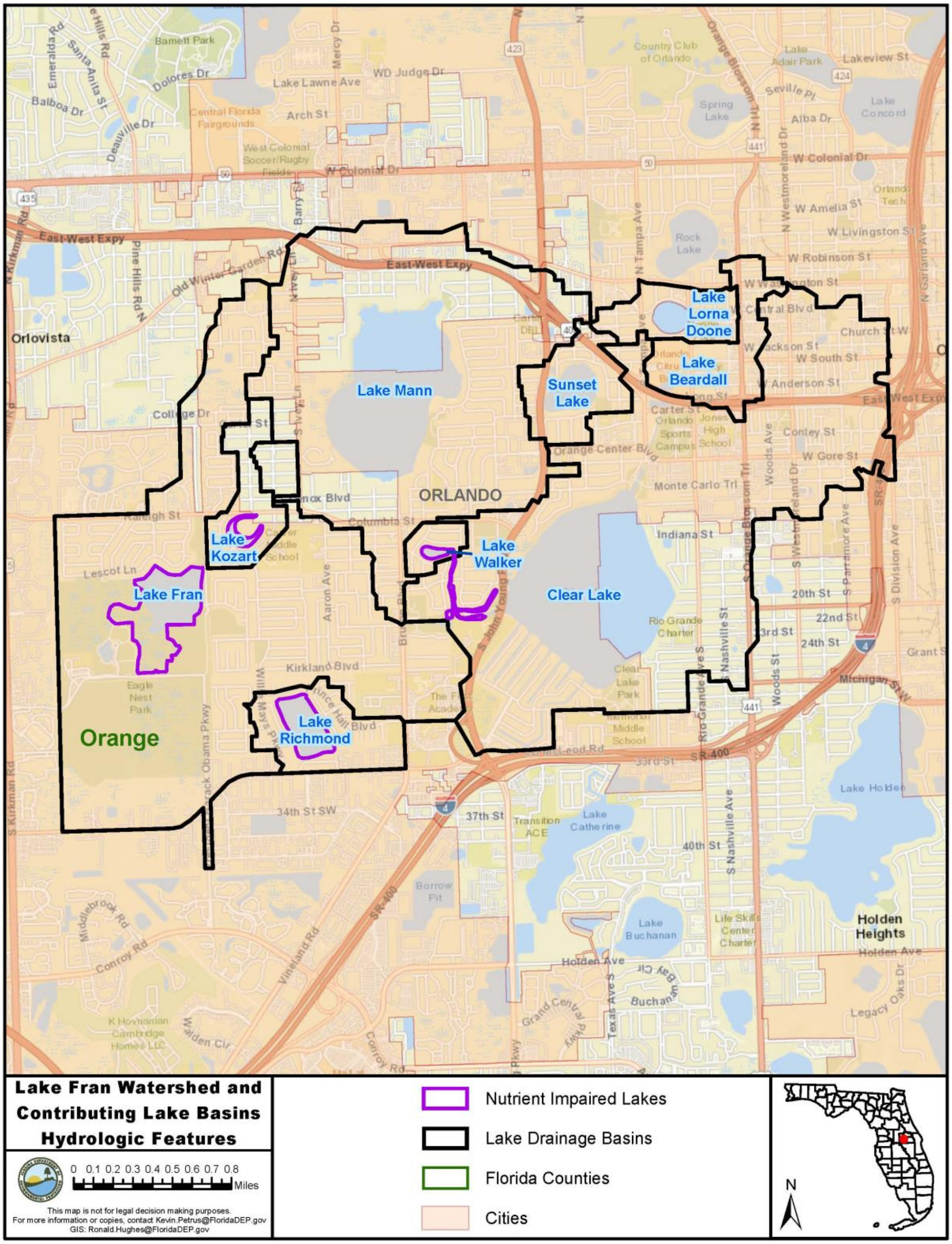

Figure 1.2. Location of Lakes Fran, Kozart, Richmond, and Walker and major hydrologic and geopolitical features in the area

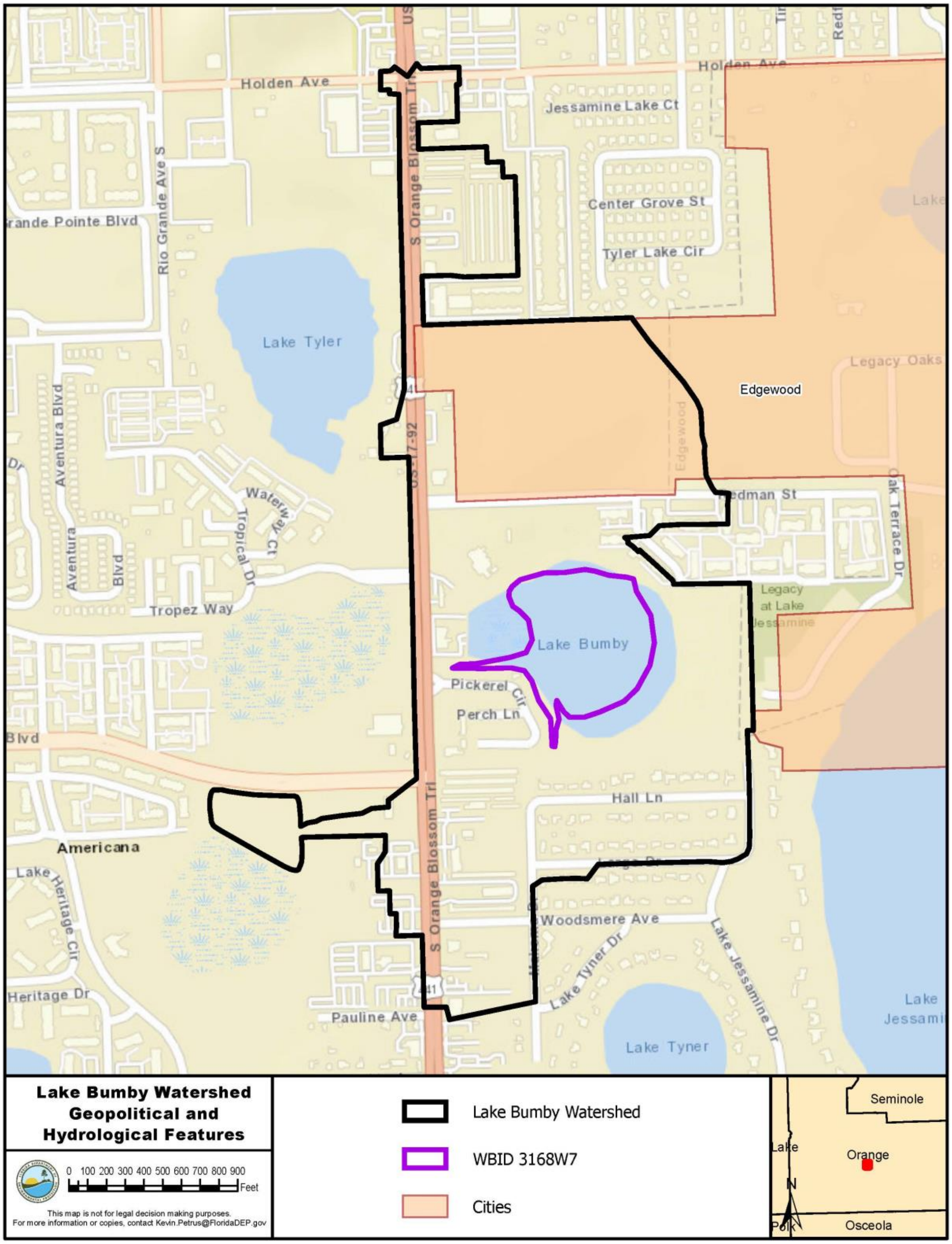

Figure 1.3. Location of Lake Bumby and major hydrologic and geopolitical features in the area

1.3 Watershed Information

1.3.1 Population and Geopolitical Setting

According to data available from the U.S. Census Bureau (2019), the population of Orange County is 1,393,452, with a density of 1,268.5 people per square mile. The county occupies an area of 903.43 square miles and contains 556,896 housing units, with a housing density of 616 houses per square mile. Lakes Fran, Kozart, Richmond, and Walker are situated in the City of Orlando, which has a population of 287,442. Lake Bumby is located in unincorporated Orange County.

1.3.2 Topography

Most of the impaired lakes, with the exception of Lake Fran, are located in the Orlando Ridge lake region, an urbanized karst area of low relief where the lakes are characterized as clear, alkaline, hardwater lakes of moderate mineral content (Griffith et al. 1997). Lake Fran lies in the Apopka Upland lake region, near the western border with the Orlando Ridge region. The Apopka Upland consists of residual sand hills modified by karst processes, with many small lakes and scattered sinkholes (Griffith et al. 1997).

The elevations in both the Lake Fran and Lake Bumby Watersheds range from 95 to 110 ft North American Datum (NAD) 1983.

1.3.3 Hydrogeological Setting

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

The climate of the region is humid subtropical in the Köppen classification system. It is characterized by warm, relatively wet summers and mild, relatively dry winters. Annual average temperatures in the region are 23° Celsius (°C~~.~~). Annual rainfall averages 129 centimeters, and the majority of the rainfall occurs from June through September (Schiffer 1998).

The surficial geology in the Orlando area is composed of a complex mixture of Middle Eocene to Quaternary carbonate and siliciclastic sediments. A combination of factors, including fluvio-deltaic deposition, marine deposition, the dissolution of underlying carbonates (karstification), the erosion of sediments as a result of eustatic changes in sea level, and structural features have influenced the geology of this area.

The hydrologic characteristics of soil can significantly affect the capability of a watershed to hold rainfall or produce surface runoff. Soils are generally classified as one of four major types, as follows, based on their hydrologic characteristics (Viessman et al. 1989). Type A soils have high infiltration rates even if thoroughly wetted. They consist chiefly of deep, well-drained to excessively drained sands or gravels. These soils have a high rate of water transmission. Type B soils have moderate infiltration rates if thoroughly wetted. They consist chiefly of moderately deep to deep, moderately well-drained to well-drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission. Type C soils have slow infiltration rates if thoroughly wetted. They consist chiefly of soils with a layer that impedes the downward movement of water, or soils with moderately fine to fine texture. These soils have a slow rate of water transmission. Type D soils have very slow infiltration rates if thoroughly wetted. They consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a clay pan or clay layer at or near the surface, and shallow soils over nearly impervious materials. These soils have a very slow rate of water transmission.

Hydrologic soil types were tabulated in the Lakes Fran and Bumby Watersheds. **Table 1.1** shows that Type A and A/D soils are predominant in both the Lakes Fran and Bumby Watersheds. Type A/D soil has Type A soil characteristics when unsaturated but behaves like Type D soil when saturated. **Figures 1.4** and **1.5** show detailed maps of the soil hydrologic groups in the Lakes Fran and Bumby Watersheds, respectively. The maps are based on the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) 2010 dataset developed by the National Cooperative Soil Survey.

Table 1.1. Hydrologic soil groups and acreages in the Lakes Fran and Bumby Watersheds

Lake Fran Watershed

Hydrologic Soil Group	Ac	%
A	848	16
A/D	1,329	25
B/D	313	6
C/D	1,914	35
Unspecified	999	18
Total	**5,402**	**100**

Lake Bumby Watershed

Hydrologic Soil Group	Ac	%
A	25	18
A/D	78	55
B/D	25	18
Unspecified	13	9
Total	**141**	**100**

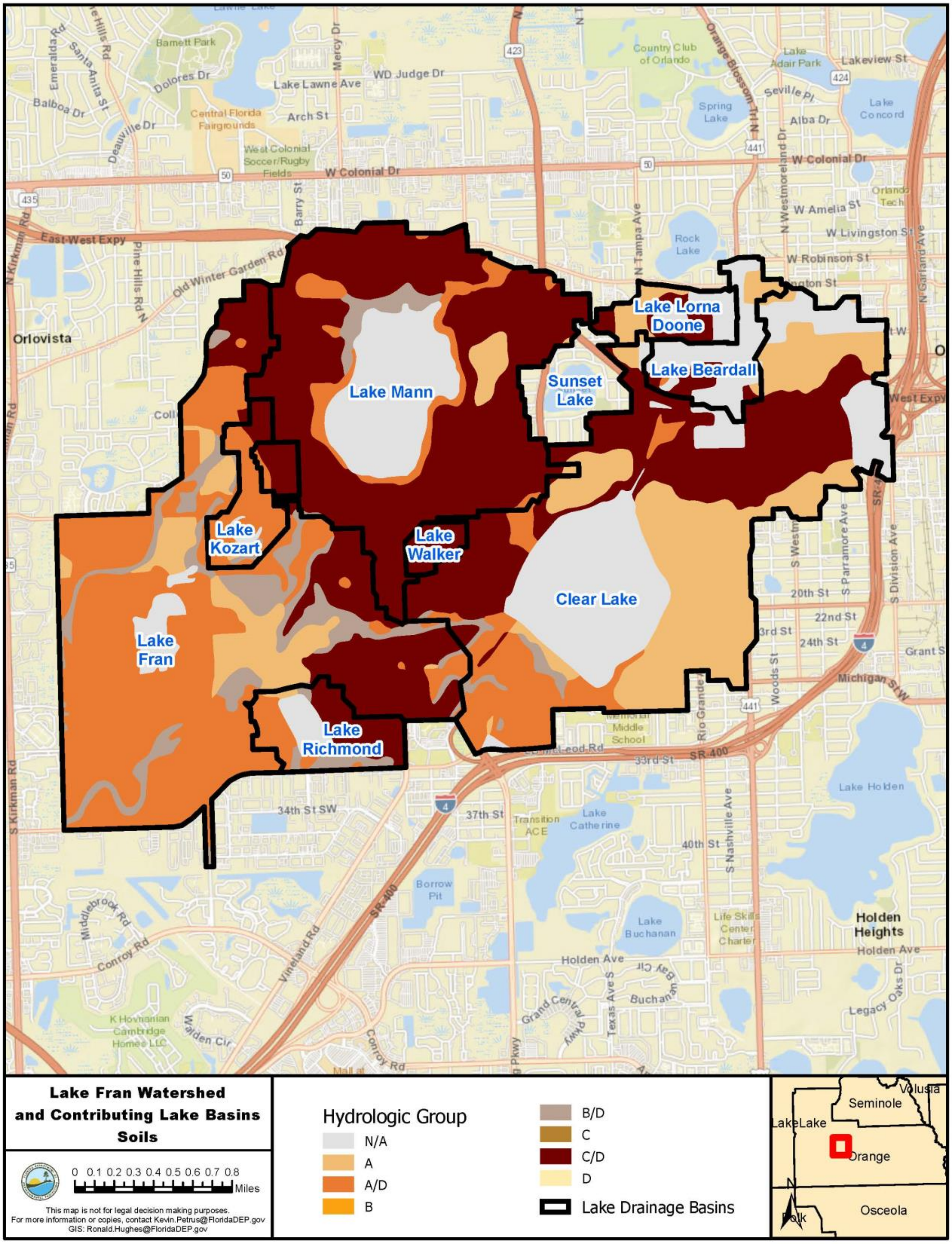

Figure 1.4. Hydrologic soil groups in the Lake Fran Watershed

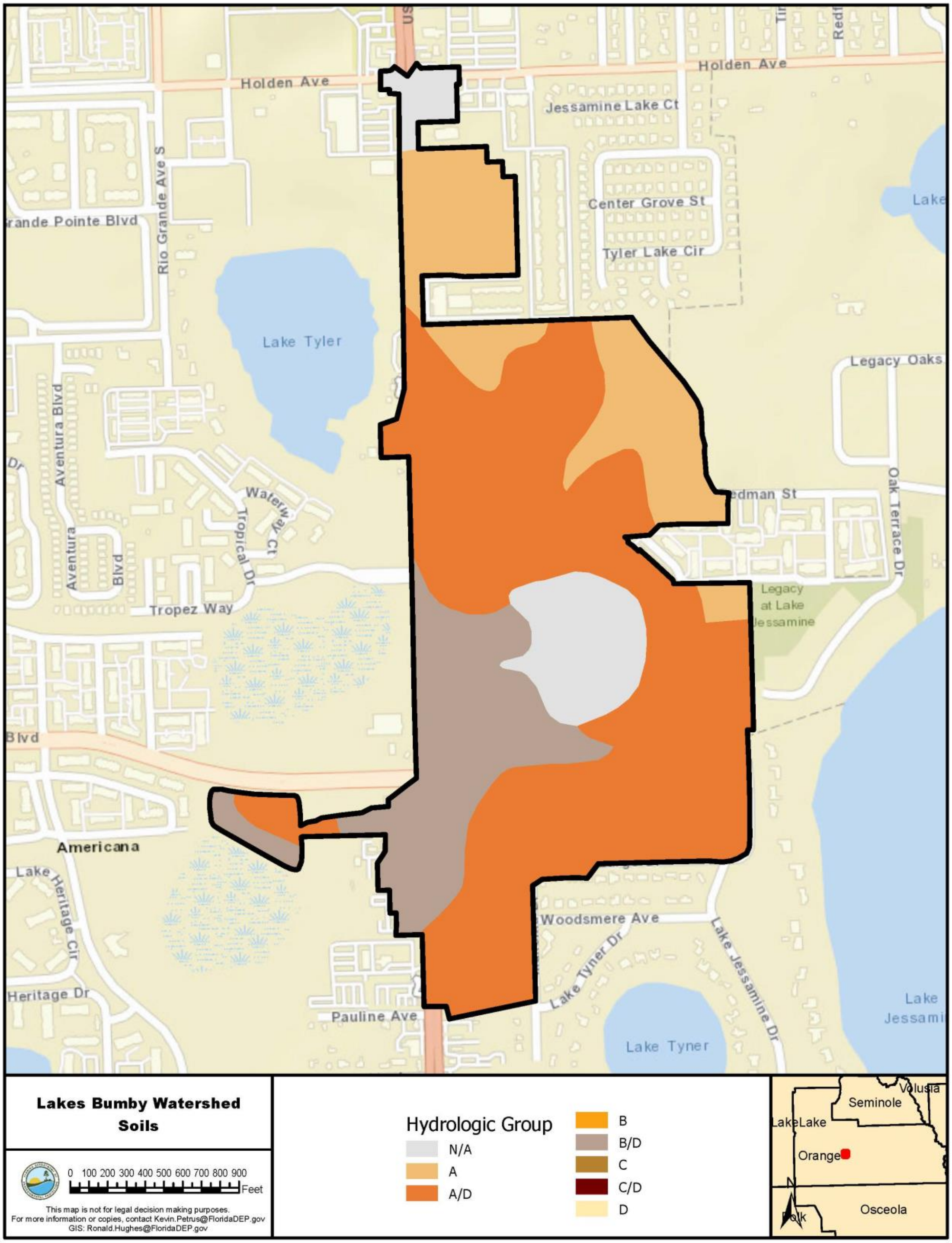

Figure 1.5. Hydrologic soil groups in the Lake Bumby Watershed

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 last amended in 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.). In the past, the state's 303(d) list has been amended annually to include basin updates for 20 % of the state every year, conducted as part of a rotating basin approach to cover the whole state every 5 years. However, the state's 303(d) list will soon be amended biennially and will consist of a statewide assessment every 2 years, beginning with the 2022 biennial assessment.

2.2 Classification of the Waterbody and Applicable Water Quality Standards

Lakes Fran, Kozart, Richmond, Walker, and Bumby are Class III (fresh) waterbodies, with a designated use of fish consumption, recreation, and propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The Class III water quality criterion applicable to the verified impairments for these waterbodies 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 (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 Subparagraph 62-302.531(2)(b)1., F.A.C., color is assessed as true color and should be free from turbidity. Lake color and alkalinity are based on a minimum of 10 data points over at least 3 years with at least 1 data point in each year. Based on available color and alkalinity results (**Table 2.1**), all five lakes are characterized as low-color (≤ 40 PCU), high-alkalinity (> 20 mg/L $CaCO_3$). The POR data for the lakes are from IWR Database Run 61.

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 Fran	2012–19	35	2005–19	67
Lake Kozart	2012–19	39	1993–2019	92
Lake Richmond	2012–19	19	1993–2019	60
Lake Walker	2012–19	20	1993–2019	58
Lake Bumby	2001–20	29	2011–20	58

The chlorophyll *a* NNC for 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. **Table 2.2** lists the NNC for Florida lakes specified in Subparagraph 62-302.531(2)(b)1., F.A.C. The associated total nitrogen (TN) and total phosphorus (TP) criteria for a lake can vary annually, depending on the availability of data for chlorophyll *a* and the concentrations of chlorophyll *a* in the lake. If there are sufficient data to calculate an AGM for chlorophyll *a* and the mean does not exceed the chlorophyll *a* criterion for the lake type listed in **Table 2.2**, then the TN and TP numeric interpretations for that calendar year are the AGMs of lake TN and TP samples, subject to the minimum and maximum TN and TP limits in the table. If there are insufficient data to calculate the AGM for chlorophyll *a* for a given year, or the AGM for chlorophyll *a* exceeds the values in the table for the lake type, then the applicable numeric interpretations for TN and TP are the minimum values.

Table 2.2. Chlorophyll *a*, TN, and TP criteria for Florida lakes (Subparagraph 62-302.531[2][b]1., F.A.C.)

* 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.

Note: Values shown in boldface type and shaded represent the relevant NNC for Lakes Fran, Kozart, Richmond, Walker, and Bumby.

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 nutrient data for Lakes Fran, Kozart, Richmond, and Walker used in the most recent verified assessment period, beginning in 2009, are stations sampled by the City of Orlando. The city began monitoring Lake Walker in 1988, Lakes Kozart and Richmond in 1990, and Lake Fran in 1999. The majority of the nutrient data for all four lakes are from the city's monitoring program. **Figure 2.1** show the sampling locations for these nutrient-impaired lakes in the Lake Fran Watershed.

Figure 2.2 displays the sampling locations in Lake Bumby. The majority of the data from Lake Bumby have been collected by Orange County, which has been sampling the lake since 1994. In 2004, the county began sampling routinely for corrected chlorophyll *a*, the more common form of chlorophyll *a* used in assessing surface water quality.

The water quality measurements discussed in this report are available in the IWR Run 61 Database and are available on request.

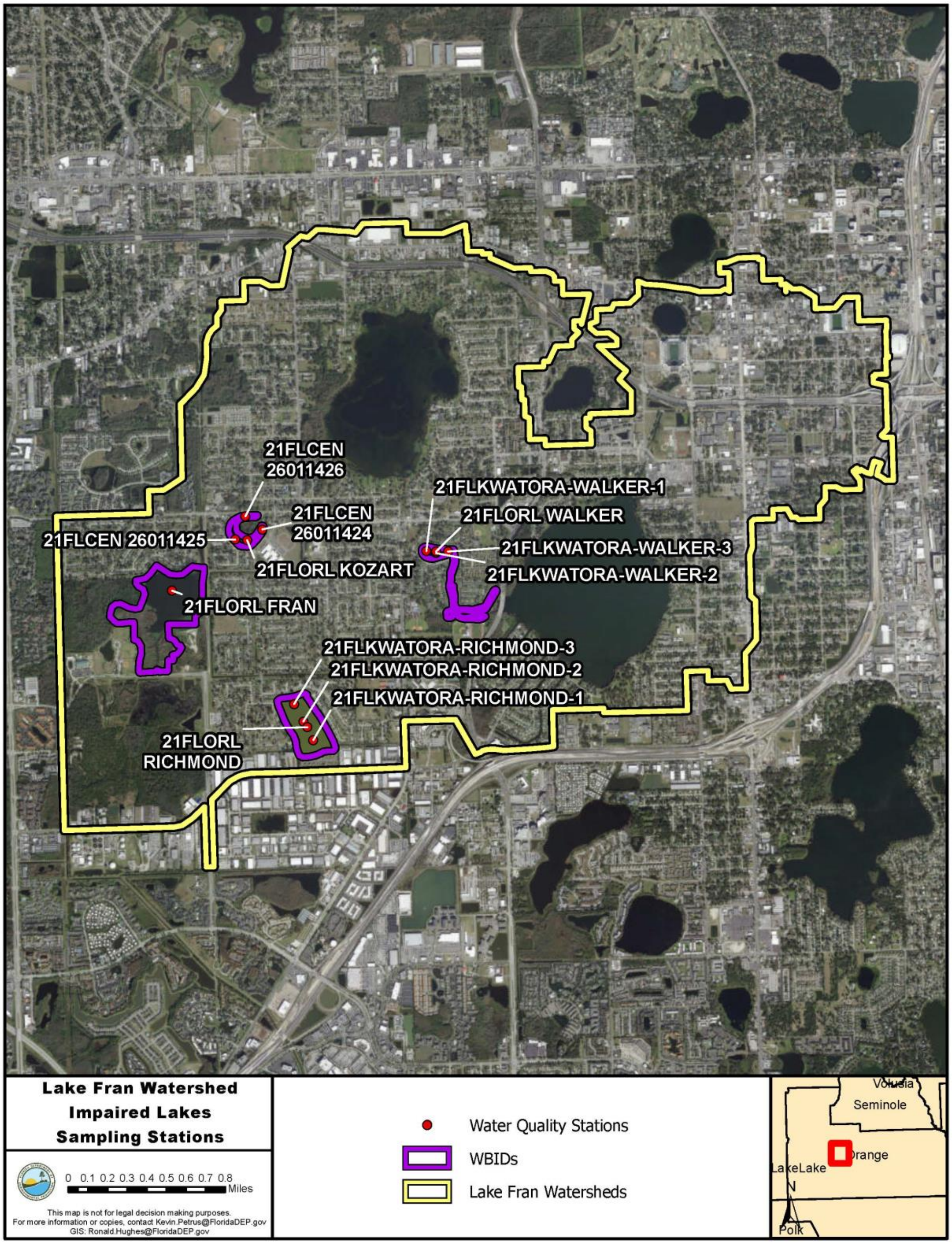

Figure 2.1. Water quality monitoring stations in Lakes Fran, Kozart, Richmond, and Walker

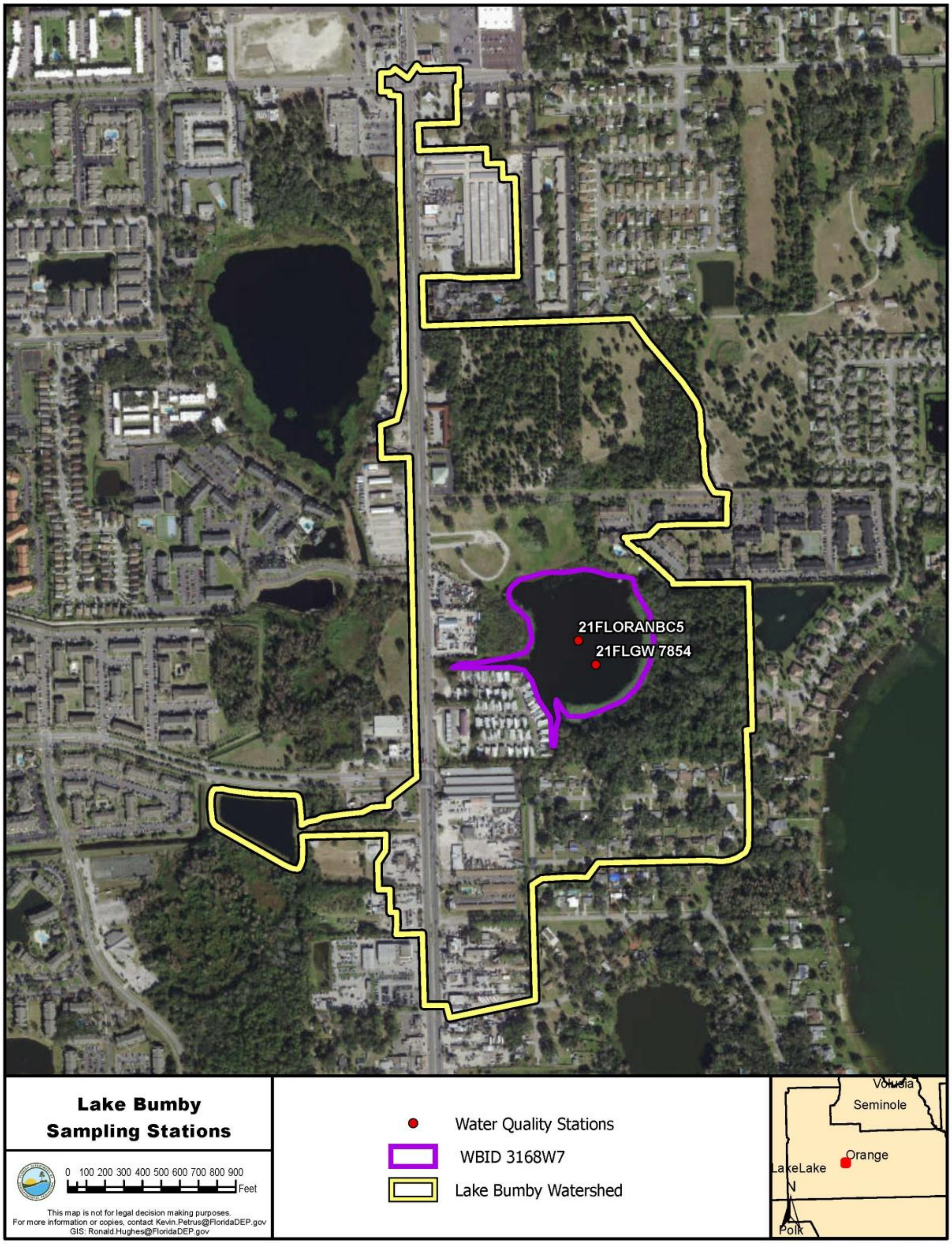

Figure 2.2. Water quality monitoring stations in Lake Bumby

2.3.2 Information on Verified Impairment

Lakes Fran, Kozart, Richmond, Walker, and Bumby were assessed for nutrients as part of the Group 4, Cycle 3 IWR assessment. The verified period was January 1, 2009, to June 30, 2016. Data for the Group 4, Cycle 3 IWR assessment are stored in the IWR Run 53 Access Database. All five lakes were identified as nutrient impaired (Category 5), as AGM values for chlorophyll *a*, TN, and TP exceeded the NNC more than once in a three-year period during the verified period. **Tables 2.3** through **2.5** list the lakes' AGM values for chlorophyll *a*, TN, and TP, respectively, calculated using the most recent results found in the IWR Run 61 Database, for the 2009–16 verified period and AGM results for subsequent years.

Table 2.3. Chlorophyll *a* AGM values (µg/L), 2009–19

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

Year	Lake Fran	Lake Kozart	Lake Richmond	Lake Walker	Lake Bumby
2009	**23**	**45**	ID	**48**	**38**
2010	20	**62**	**32**	20	**43**
2011	**22**	**44**	**24**	**33**	**34**
2012	20	ID	**34**	**35**	ID
2013	**22**	ID	ID	20	**32**
2014	**29**	**47**	**44**	ID	**31**
2015	**37**	**32**	**42**	**51**	**21**
2016	17	**27**	**43**	**33**	**24**
2017	**46**	**54**	ID	ID	17
2018	**32**	**23**	**64**	**39**	13
2019	**39**	**58**	**67**	**39**	**43**

Table 2.4. TN AGM values (mg/L), 2009–19

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	Lake Fran	Lake Kozart	Lake Richmond	Lake Walker	Lake Bumby
2009	**1.12**	**2.93**	**1.91**	**1.41**	**1.54**
2010	1.09	**2.48**	**1.90**	1.35	**1.25**
2011	**1.15**	**2.47**	**1.68**	**1.56**	ID
2012	**1.38**	**2.22**	**2.41**	**1.47**	ID
2013	**1.28**	**2.45**	**2.57**	1.58	ID
2014	**1.17**	**1.99**	**2.02**	ID	1.04
2015	**1.12**	**1.55**	**1.66**	**1.10**	**1.08**
2016	1.07	**1.89**	**2.16**	0.94	0.95
2017	**1.10**	**1.85**	ID	ID	1.06
2018	0.92	**1.20**	**1.73**	0.89	0.90
2019	**1.16**	**1.58**	**2.12**	0.80	ID

Table 2.5. TP AGM values (mg/L), 2009–19

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	Lake Fran	Lake Kozart	Lake Richmond	Lake Walker	Lake Bumby
2009	**0.06**	**0.11**	**0.06**	**0.08**	**0.06**
2010	0.07	**0.10**	**0.07**	0.07	**0.05**
2011	**0.07**	**0.10**	**0.05**	**0.10**	ID
2012	0.09	**0.11**	**0.10**	**0.11**	ID
2013	**0.09**	**0.10**	**0.09**	**0.10**	ID
2014	**0.10**	**0.10**	**0.07**	ID	**0.06**
2015	**0.08**	**0.11**	**0.06**	**0.09**	ID
2016	**0.10**	**0.13**	**0.09**	**0.11**	**0.05**
2017	**0.10**	**0.09**	0.08	ID	0.05
2018	**0.09**	**0.11**	**0.10**	**0.06**	0.05
2019	**0.10**	**0.14**	**0.09**	**0.08**	**0.06**

Chapter 3: Assessment of Sources

3.1 Types of Sources

An important part of the TMDL analysis is the identification of pollutant source categories, source subcategories, or individual sources of the pollutant of concern in the target watershed and the amount of pollutant loading contributed by each of these sources. Sources are broadly classified as either point sources or nonpoint sources. Historically, the term "point sources" has meant discharges to surface waters that typically have a continuous flow via a discernable, confined, and discrete conveyance, such as a pipe. Domestic and industrial wastewater treatment facilities (WWTFs) are examples of traditional point sources. In contrast, the term "nonpoint sources" was used to describe intermittent, rainfall-driven, diffuse sources of pollution associated with everyday human activities, including runoff from urban land uses, agriculture, silviculture, and mining; discharges from septic systems; and atmospheric deposition.

However, the 1987 amendments to the CWA redefined certain nonpoint sources of pollution as point sources subject to regulation under the EPA's National Pollutant Discharge Elimination System (NPDES) Program. These nonpoint sources included certain urban stormwater discharges, such as those from local government master drainage systems, construction sites over five acres, and a wide variety of industries (see **Appendix A** for background information on the federal and state stormwater programs).

To be consistent with CWA definitions, the term "point source" is used to describe traditional point sources (such as domestic and industrial wastewater discharges) and stormwater systems requiring an NPDES stormwater permit when allocating pollutant load reductions required by a TMDL. 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.

3.2 Point Sources

3.2.1 Wastewater Point Sources

There are no NPDES-permitted wastewater facilities discharging into the watersheds of Lake Fran and Lake Bumby.

3.2.2 Municipal Separate Storm Sewer System (MS4) Permittees

The Lake Fran Watershed include areas within the jurisdictions of the City of Orlando and Orange County (**Figure 1.2)**. The stormwater collection systems in the Lake Fran Watershed owned and operated by the City of Orlando are covered by an NPDES MS4 Phase I permit (FLS000014). The systems owned and operated by Orange County and Florida Department of Transportation (FDOT) District 5 in the county are covered by an NPDES MS4 Phase I permit

(FLS000011). For more information on MS4s in the watersheds, send an email to NPDES-stormwater@dep.state.fl.us. .

The Lake Bumby Watershed is covered by the Orange County MS4 Phase I permit (FLS000011) and includes FDOT District 5 and the City of Edgewater as co-permittees with areas of jurisdiction in the watershed.

3.3 Nonpoint Sources

Pollutant sources that are not NPDES wastewater or stormwater dischargers are generally considered nonpoint sources. Nutrient loadings in the Lakes Fran and Bumby Watersheds are primarily generated from nonpoint sources. Nonpoint sources include loadings from land surface runoff, baseflow, and precipitation directly onto the lake surface (atmospheric deposition).

3.3.1 Land Uses

Land use is one of the most important factors in determining nutrient loadings from watersheds. 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 3.1 summarizes land use for each of the eight lake drainage basins located in the Lake Fran Watershed (City of Orlando 2019). Individual lake drainage basin boundaries were provided by the city. **Figure 3.1** shows similar information graphically that was obtained from the Statewide Land Use/Land Cover Dataset (DEP 2021a).

The drainage basin areas for the individual lakes in the Lake Fran Watershed vary considerably. Of the four nutrient-impaired lakes, the immediate Lake Fran drainage basin is the largest, at 1,674 ac (**Table 3.1**). In addition, Lake Fran receives drainage contributions from the 7 upstream lakes in the watershed, resulting in a total drainage area of 5,400 ac. The drainage basin areas for Lakes Kozart, Richmond, and Walker are less than 200 ac, with Lake Walker's being the smallest at 41 ac. The dominant land use throughout the area is medium-density residential, covering 39 % of the entire watershed (**Table 3.1**). The highest percentage of residential land use (medium- and high-density residential) occurs in the Lake Walker drainage area (83 %). The lowest percentage of residential land use (40 %) occurs in the immediate basin area for Lake Fran where natural areas, upland forest and wetlands, codominate. Most of the natural land area throughout the watershed is located in the vicinity of Lake Fran.

Table 3.2 summarizes land use in the Lake Bumby Watershed, and **Figure 3.2** displays the land use during the 2017–19 period obtained from the South Florida Water Management District (SFWMD). The 141-ac watershed land use is dominated by urban development, where high- and medium-density residential covers 20 % of the area, and commercial development makes up

30 % of the watershed. The commercial land use is primarily situated along U.S. Highway 441. The parcel of land designated as agriculture includes a former citrus grove and tree plantation. Natural land cover makes up about 13 % of the watershed area, including a fringe of wetlands around the majority of the lake shoreline and an area of upland forest southeast of the lake.

Table 3.1. Land use summary for the Lake Fran Watershed, by lake drainage basin (ac) (SFWMD 2017–19; SJRWMD 2013–16)

SJRWMD = St. Johns River Water Management District
* 0 value indicates the negligible presence of a land use.

Land Use Classification	Fran Basin	Kozart Basin	Richmond Basin	Walker Basin	Beardall Basin	Clear Basin	Lorna Doone Basin	Mann Basin	Total Acres	% of Watershed
Residential Medium Density	667	89	83	32	4	691	28	492	2,086	38.6
Urban and Built-Up	378	15	43	2	133	492	67	258	1,387	25.7
Water	71	7	34	4	3	378	15	275	788	14.6
Wetlands	247	7				46		27	328	6.1
Residential High Density	48	0	11	2	11	106		80	258	4.8
Upland Forest	182	0						7	190	3.5
Transportation, Communication, and Utilities	0				10	81		53	144	2.7
Residential Low Density	0					22		116	139	2.6
Rangeland	71								71	1.3
Barren Land	9								9	0.2
Total	**1,674**	**118**	**172**	**41**	**160**	**1,816**	**111**	**1,308**	**5,400**	**100**

Table 3.2. Lake Bumby Watershed land use summary (SFWMD 2017–19)

Land Use Classification	Area (ac)	%
Medium-Density Residential	15.7	11.1
High-Density Residential	12.3	8.8
Commercial	41.7	29.7
Open Land	5.3	3.7
Agriculture	25.4	18.1
Forest/Rural Open	13.0	9.2
Water	12.7	9.1
Wetlands	4.8	3.4
Communication and Transportation	9.7	6.9
Total	**140.6**	**100.0**

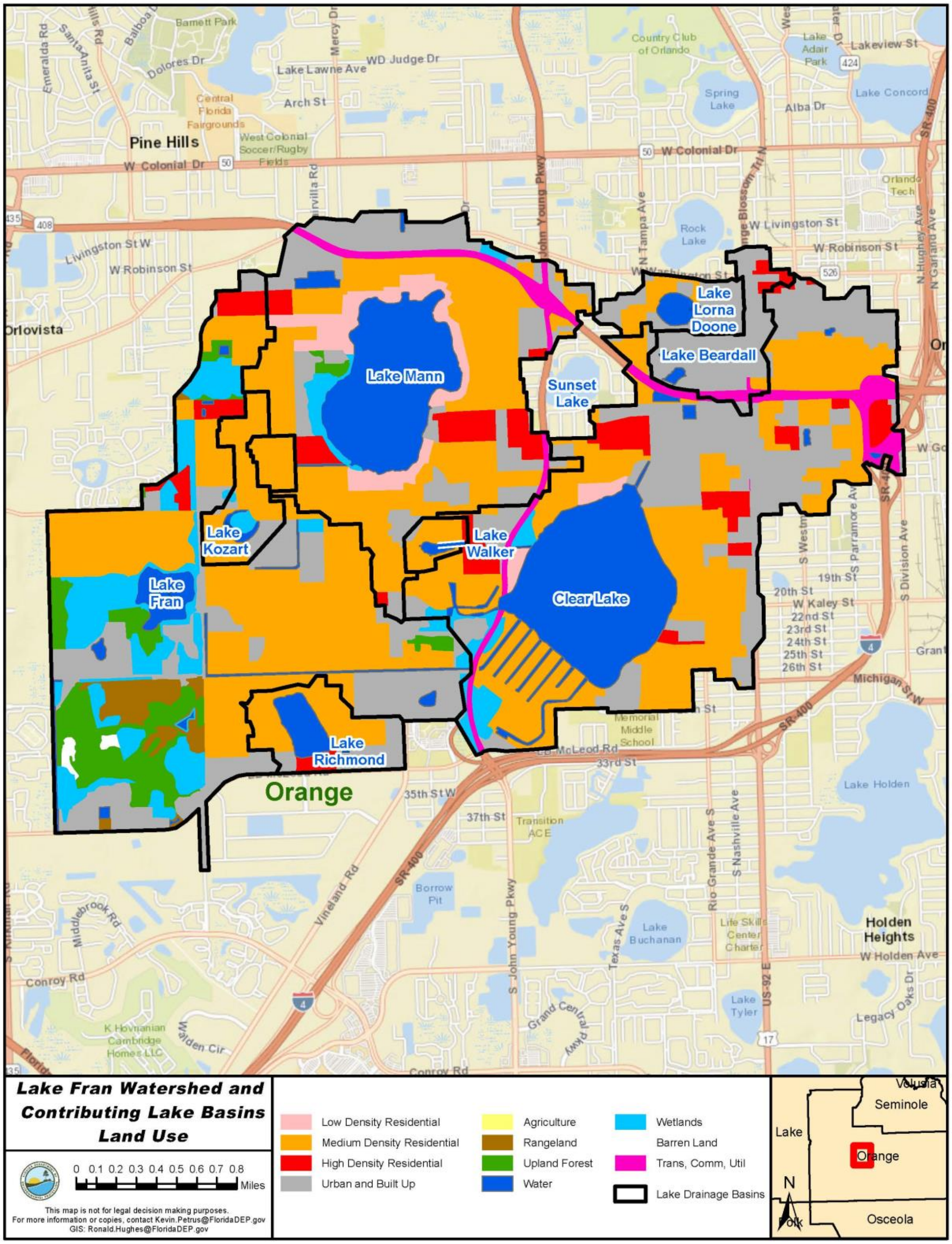

Figure 3.1. Land use in the Lake Fran Watershed (SFWMD 2017–19; SJRWMD 2013–16)

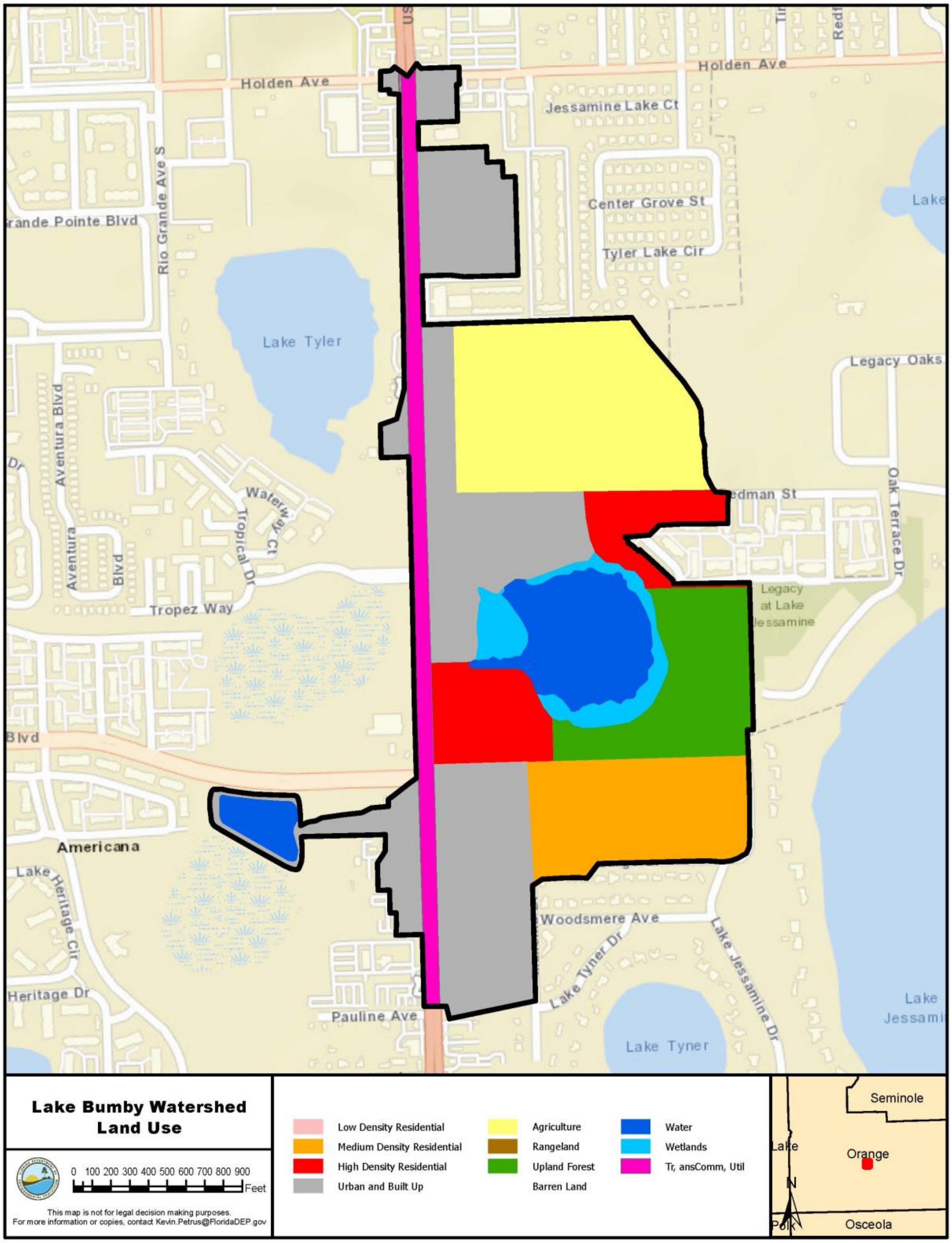

Figure 3.2. Land use in the Lake Bumby Watershed (SFWMD 2017–19)

3.3.2 Onsite Sewage Treatment and Disposal Systems (OSTDS)

OSTDS, including septic systems, are commonly used where providing central sewer service is not cost-effective or practical. When properly sited, designed, constructed, maintained, and operated, OSTDS are a safe means of disposing of domestic waste. The effluent from a well-functioning OSTDS is comparable to secondarily treated wastewater from a sewage treatment plant. OSTDS can be a source of nutrients (nitrogen and phosphorus), pathogens, and other pollutants to both groundwater and surface water.

The Florida Department of Health (FDOH) maintains a list of OSTDS by county, and the FDOH Florida Water Management Inventory dataset was used to determine the number of known septic systems in the area. **Figure 3.3** shows the locations of OSTDS in the Lake Fran Watershed in 2017 based on centroids of parcels with known septic systems, and **Table 3.3** lists the number of OSTDS by individual lake drainage basins. There are 432 OSTDS in the Lake Fran Watershed, with the largest numbers, greater than 80 %, located in the Clear Lake and Lake Mann drainage basins. The number of septic systems in the individual drainage basins for the four impaired lakes is small. However, since Lake Fran receives drainage contributions from the 7 upstream lakes in the watershed, all of the OSTDS are in the contributing area to Lake Fran. The largest number of systems is clustered to the northeast of Lake Kozart, to the north of Lake Mann, and east of Clear Lake. The OSTDS clusters are generally located outside the Orlando city limits.

There are no OSTDS in the Lake Bumby Watershed.

Table 3.3. Number of OSTDS in the Lake Fran Watershed, 2017

Lake Drainage Basins	Number of OSTDS
Beardall	7
Clear	177
Fran	35
Kozart	15
Lorna Doone	4
Mann	193
Richmond	1
Total	**432**

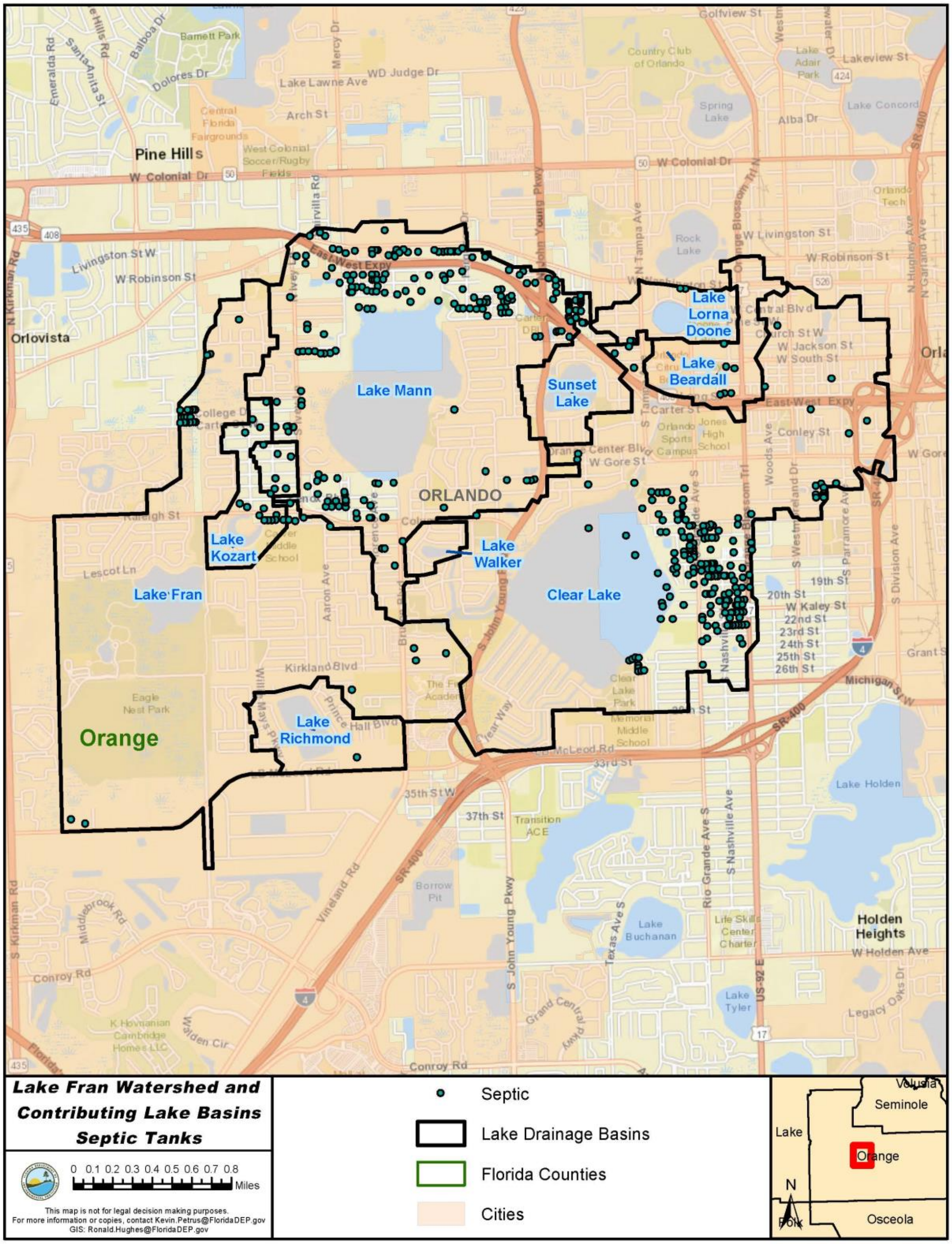

Figure 3.3. OSTDS (septic tanks) in the Lake Fran Watershed (FDOH 2017)

Chapter 4: Determination of Assimilative Capacity

4.1 Overview

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 identify necessary reductions in the in-lake nutrient concentrations, so that the lakes will meet the TMDL restoration target for chlorophyll *a* and thus maintain their function and designated use as Class III freshwaters.

4.2 Evaluation of Water Quality Conditions

4.2.1 Water Quality Data-Handling Procedures for TMDL Development

For the water quality analyses conducted for TMDL development, AGMs were used in order to be consistent with the expression of the adopted NNC for lakes. The results found in the IWR Run 61 Database were used to calculate AGMs. The AGMs were calculated using a minimum of three samples per year for showing time series results for the POR and in the scatter plots of chlorophyll *a* and nutrient AGMs presented in this section. A minimum of four sample results per year were used to calculate AGMs for characterizing current conditions used to calculate percent reductions needed to meet the TMDL nutrient targets, presented in **Section 4.4**. For calculating AGMs using a minimum of three or four samples per year, at least one of the samples must have been collected in the May to September period and at least one sample collected from other months. Values with an "I" qualifier code, defined as values greater than or equal to the method detection limit (MDL) but less than the practical quantitation limit (PQL), were used as reported. Values reported as either compound analyzed for but not detected or is less than the MDL, "U" or "T" qualifier codes, respectively, were changed to the MDL divided by the square root of 2. Values with "G" or "V" qualifier codes, associated with results that do not meet data quality objectives, were removed from the analysis. 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 IWR methodology in Chapter 62-303, F.A.C. The IWR methods are designed to determine compliance with surface water quality criteria that focuses more on measurement uncertainty associated with qualified results. For results reported to be less than the MDL or PQL, the IWR rule follows the same method used for determining compliance with permit effluent limits. Results applied in TMDL development are used in part to describe the variability in ambient water quality, and not compliance with criteria, and for this reason results reported as less than the MDL or PQL are expressed differently when calculating AGMs. Therefore, the AGMs listed in **Tables 2.3** through **2.5** in **Chapter 2** may not exactly match the AGMs used in these analyses and for TMDL development.

4.2.2 Relationships Between Water Quality Variables

Water quality monitoring for nutrients in all four impaired lakes in the Lake Fran Watershed has been conducted primarily by the City of Orlando, and the sampling of Lake Bumby has been performed mainly by Orange County. **Figures 4.1** through **4.3** show the POR chlorophyll *a*, TN, and TP AGM values, respectively, for impaired lakes in the Lake Fran Watershed.

Figure 4.1 shows the chlorophyll *a* AGM values for the POR in these impaired lakes. Sufficient data were available, in most years, from 1992 to 2019 for Lakes Kozart, Richmond, and Walker to calculate AGM values. Lake Fran had a shorter data record (2001 to 2019) available to calculate AGM values. Lakes Kozart, Richmond, and Walker, situated upstream of Lake Fran, had chlorophyll *a* AGMs consistently above the chlorophyll *a* NNC of 20 µg/L. Lake Kozart values were in most years higher than those of the other lakes, ranging from 23 to 62 µg/L. Lake Richmond AGMs ranged from 12 to 67 µg/L, and AGMs in Lake Walker ranged from 20 to 51 µg/L. The AGMs in Lake Fran were distinctly different than the values in the other 3 impaired lakes, where they increased over time. Prior to 2009, the values were less than the chlorophyll *a* NNC, ranging from 10 to 18 µg/L. Between 2009 and 2019, most of the Lake Fran chlorophyll *a* values were above the NNC and ranged from 17 µg/L in 2016 to 46 µg/L in 2017.

Figure 4.2 displays the TN AGM values from 1992 to 2019. Lake Kozart had higher values compared with the other three lakes, ranging from 1.20 to 2.93 mg/L. AGM results in Lake Richmond ranged from 1.27 to 2.57 mg/L and in Lake Walker from 0.80 to 1.84 mg/L. The lowest TN AGM values, ranging from 0.91 to 1.38 mg/L, occurred in Lake Fran in most years.

Figure 4.3 shows the TP AGM values from 1992 to 2019. Over the monitoring period, Lakes Kozart and Walker exhibited the highest values. The AGM values ranged from 0.07 to 0.15 mg/L in Lake Kozart and 0.05 to 0.14 mg/L in Lake Walker. Lake Richmond AGM results ranged from 0.04 to 0.10 mg/L during the 28-year period. Lake Fran values in the 2000–19 period ranged from 0.04 to 0.10 mg/L, with the highest values occurring in the last 6 years.

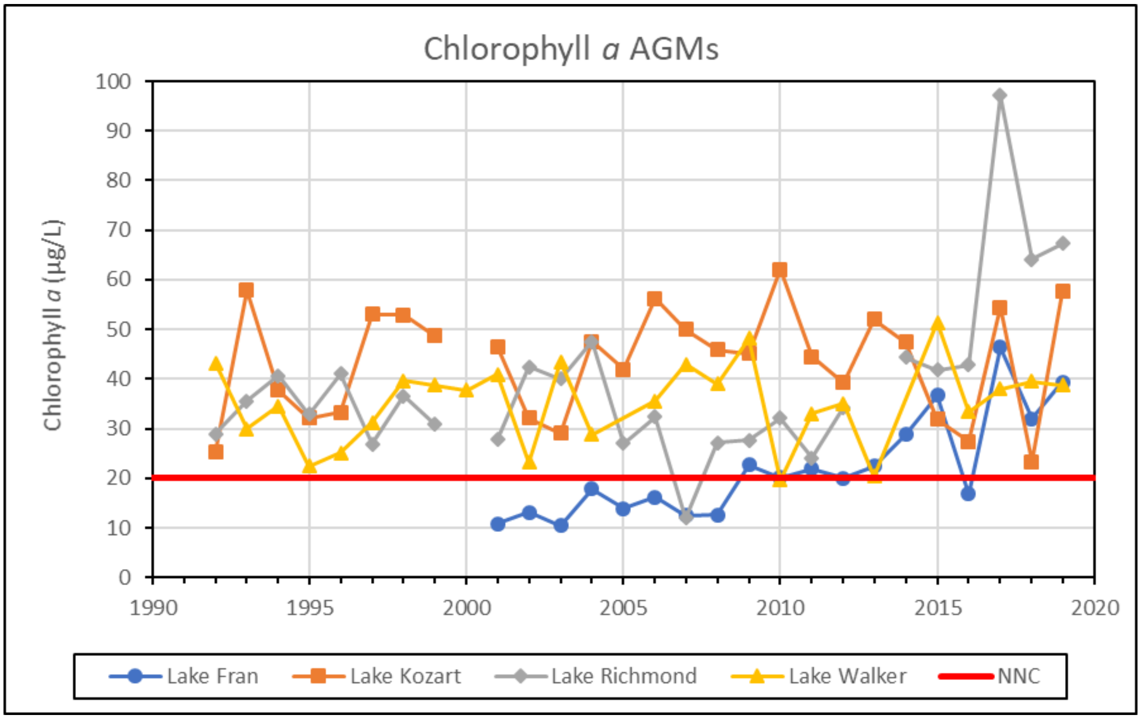

Figure 4.1. Chlorophyll *a* AGM values for lakes in the Lake Fran Watershed in the POR

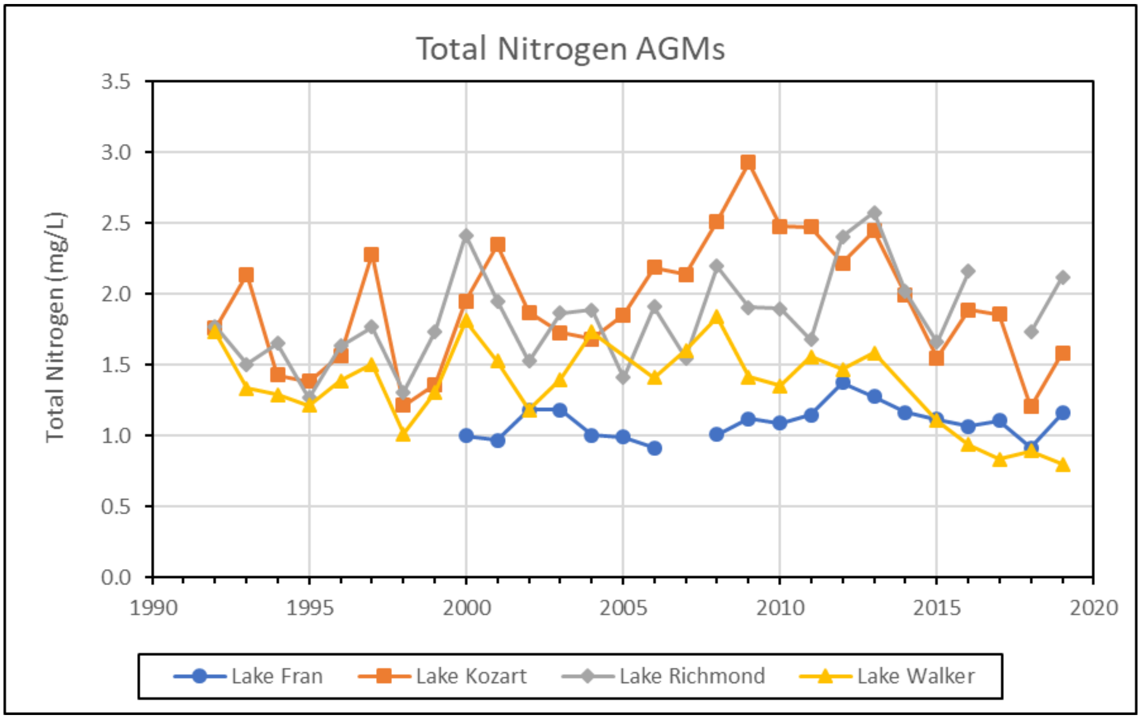

Figure 4.2. TN AGM values for lakes in the Lake Fran Watershed in the POR

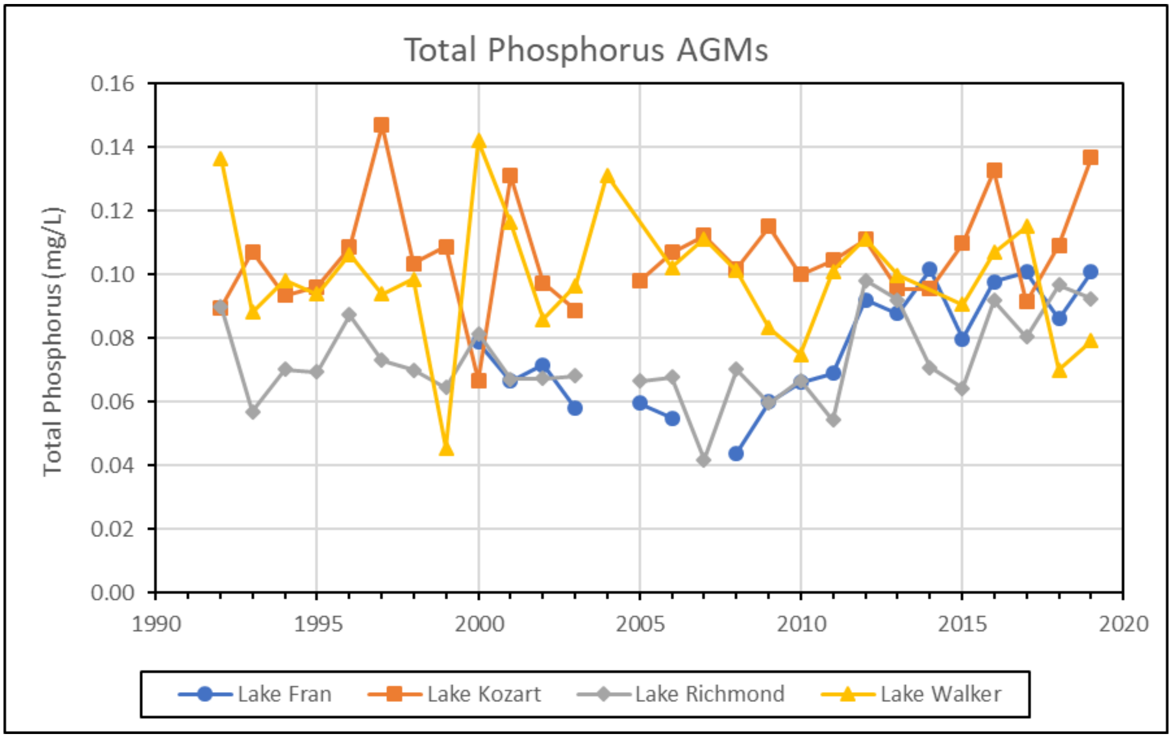

Figure 4.3. TP AGM values for lakes in the Lake Fran Watershed in the POR

Figures 4.4 through **4.6** show the POR chlorophyll a, TN, and TP AGMs, respectively, for Lake Bumby. From 2004 to 2020, chlorophyll *a* AGM values varied from a low of 11 µg/L in 2008 to a high of 44 µg/L in 2007. These AGM results were above the chlorophyll *a* NNC of 20 µg/L for the majority of the time, with the exceptions of 2004, 2008, and 2018. The chlorophyll *a* AGM values exhibited a steady decline between 2010 and 2018, followed by AGM values above the chlorophyll *a* NNC in 2019 and 2020 (**Figure 4.4**).

Lake Bumby TN AGM values ranged between 0.52 and 1.70 mg/L from 1994 to 2020 (**Figure 4.5**). Since 2013, there has been less variability in the AGM results, which have ranged between 0.90 and 1.08 mg/L.

Figure 4.6 shows the TP AGM values from 1994 to 2020 for Lake Bumby. Prior to 2005, the AGM results were mostly at or below the minimum TP NNC AGM of 0.03 mg/L. Between 2004 and 2005 the TP AGM results rose sharply and have remained above 0.04 mg/L since 2005.

Figure 4.7 shows annual rainfall in the area of the lakes, as recorded at the Orlando International Airport (OIA) National Oceanic and Atmospheric Agency (NOAA) weather station. The long-term, 30-year average rainfall at this location is 50.7 inches per year. During the lakes' monitoring period, the largest rainfall deviations from the long-term average occurred prior to 2008.

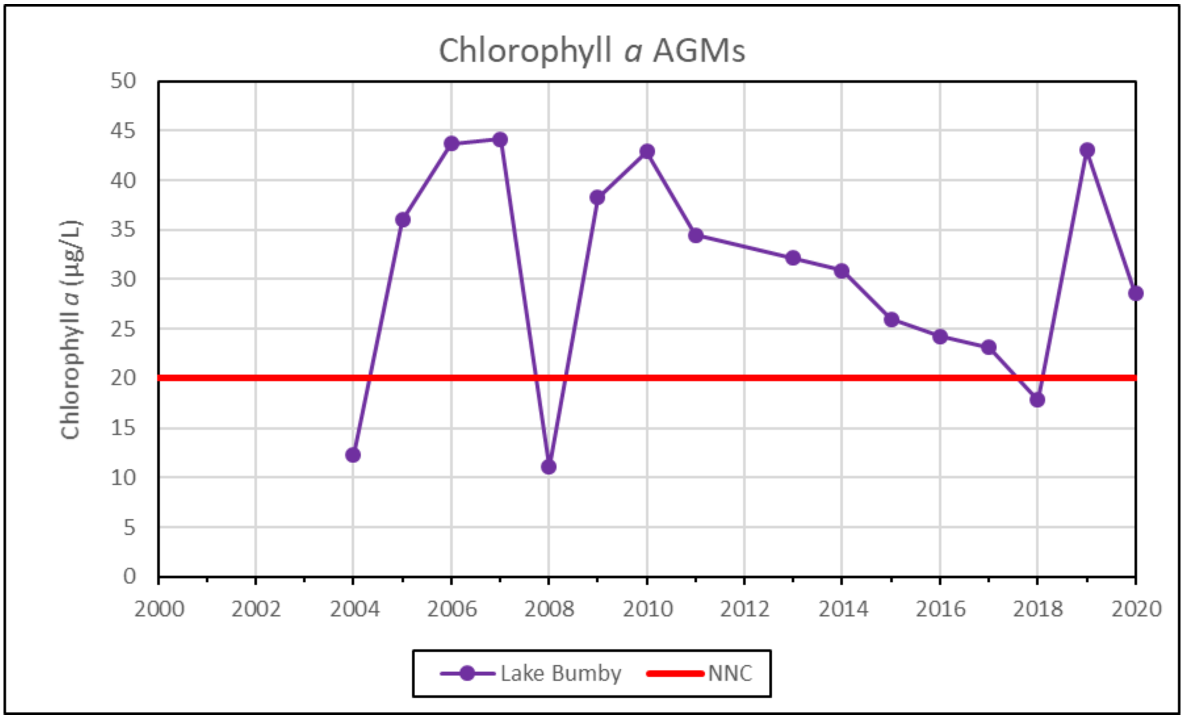

Figure 4.4. Chlorophyll *a* AGM values for Lake Bumby

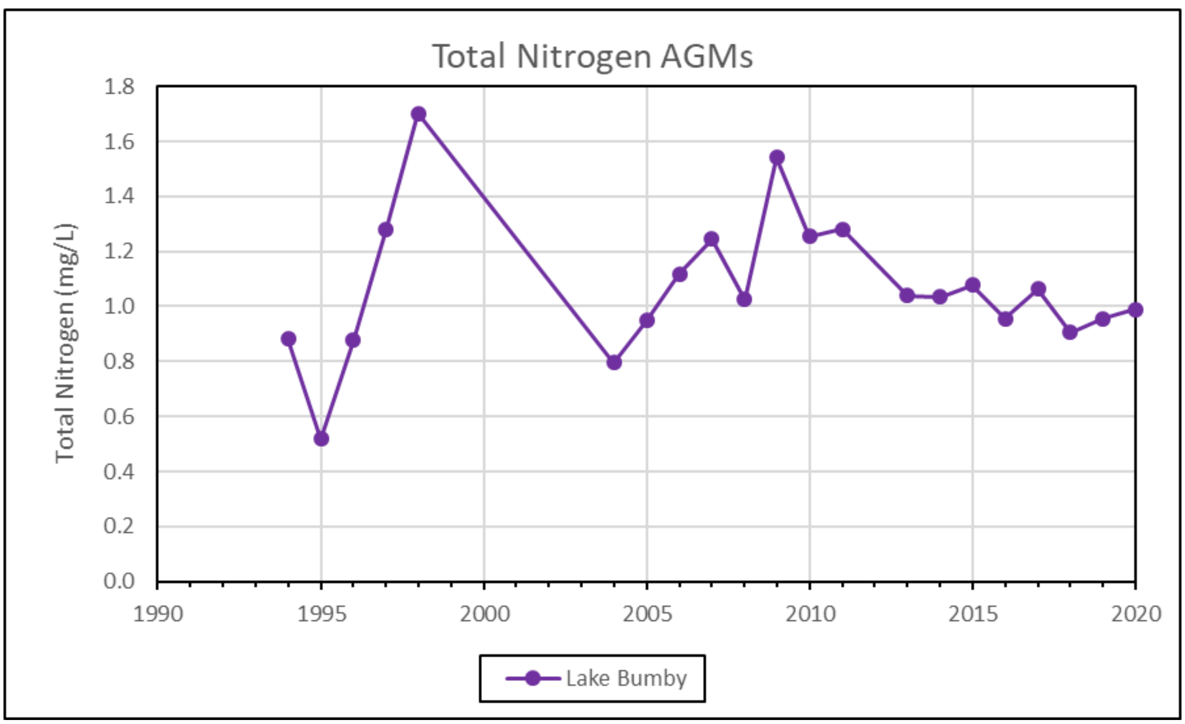

Figure 4.5. TN AGM values for Lake Bumby

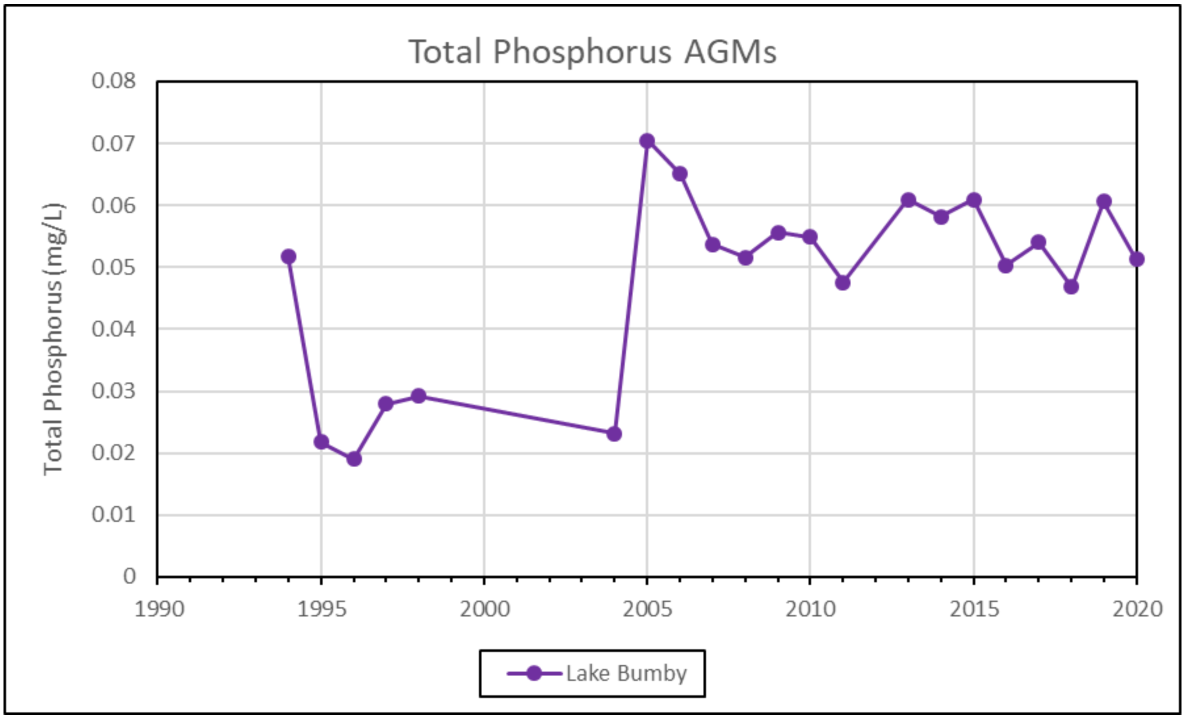

Figure 4.6. TP AGM values for Lake Bumby

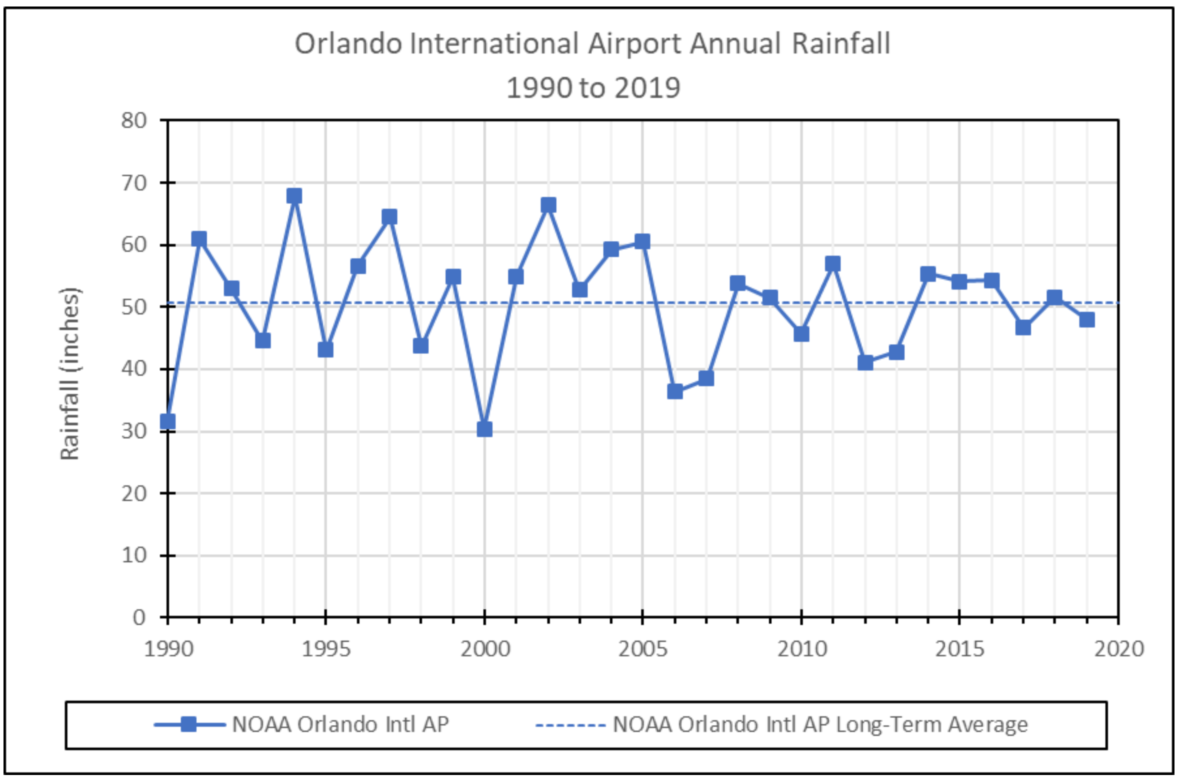

Figure 4.7. OIA annual rainfall, 1990–2019

The relationships between chlorophyll *a* and TN AGMs (**Figure 4.8**) and chlorophyll *a* and TP AGMs (**Figure 4.9**), for the impaired lakes in the Lake Fran Watershed show positive responses between chlorophyll *a* and nutrient concentrations. Although the relationships are not strong in each lake, they do confirm that chlorophyll *a* tends to increase when in-lake nutrient concentrations are higher. The relationships are based on the 13 years in the 2001–19 period when all four lakes had paired lake results, with AGMs calculated using a minimum of three 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.

Figures 4.10 and **4.11** display the relationships between chlorophyll *a* and TN AGMs and chlorophyll *a* and TP AGMs, respectively, in Lake Bumby during the 2004–20 period. The AGMs were calculated using a minimum of three 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. The results indicate that, in general, chlorophyll *a* levels increase when TN and TP concentrations are higher.

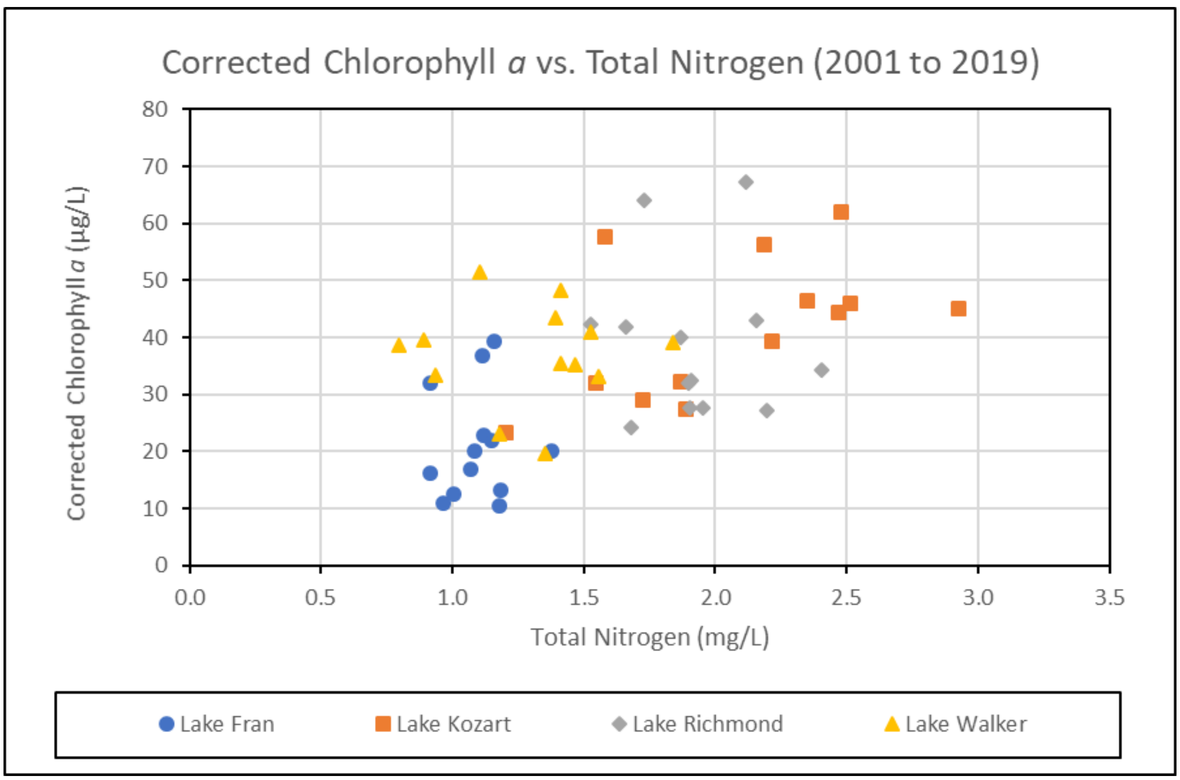

Figure 4.8. Relationship between chlorophyll *a* and TN AGM results for impaired lakes in the Lake Fran Watershed

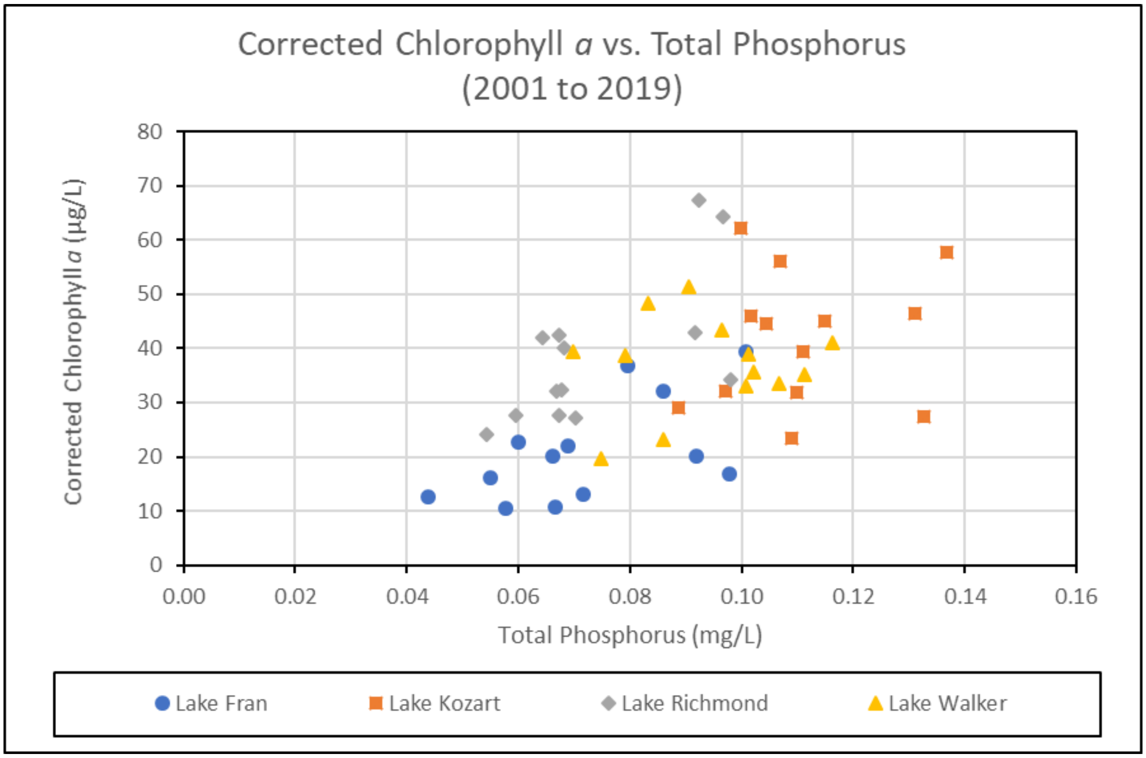

Figure 4.9. Relationship between chlorophyll *a* and TP AGM results for impaired lakes in the Lake Fran Watershed

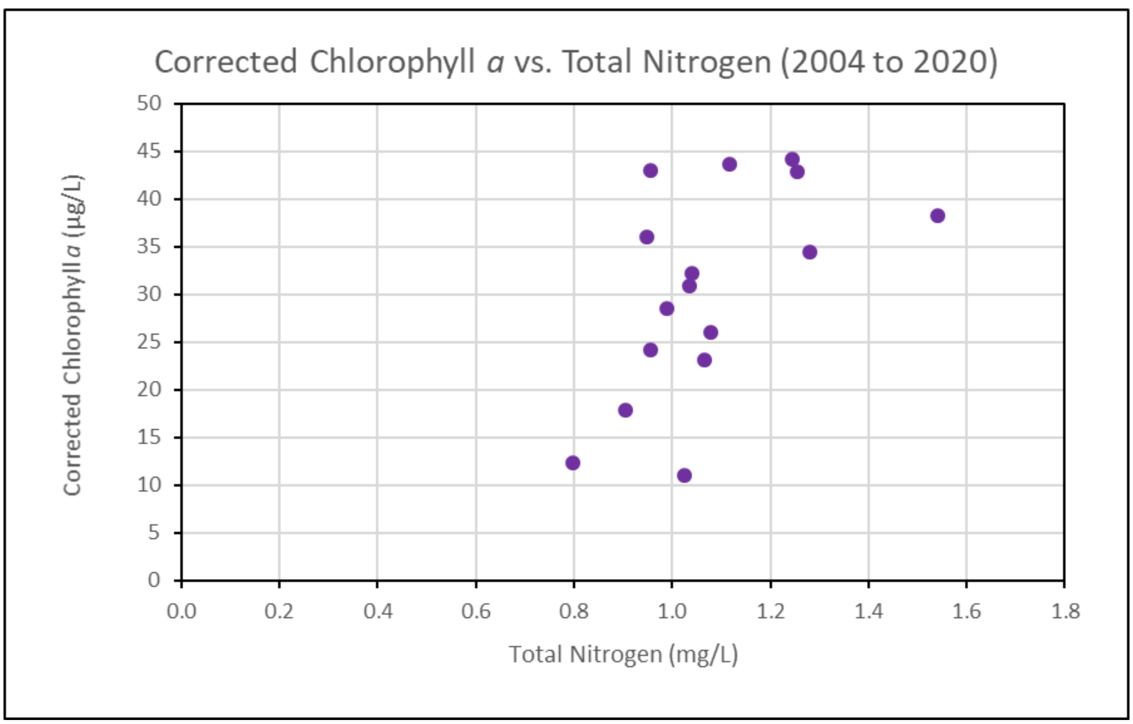

Figure 4.10. Relationship between chlorophyll a and TN AGM results in Lake Bumby

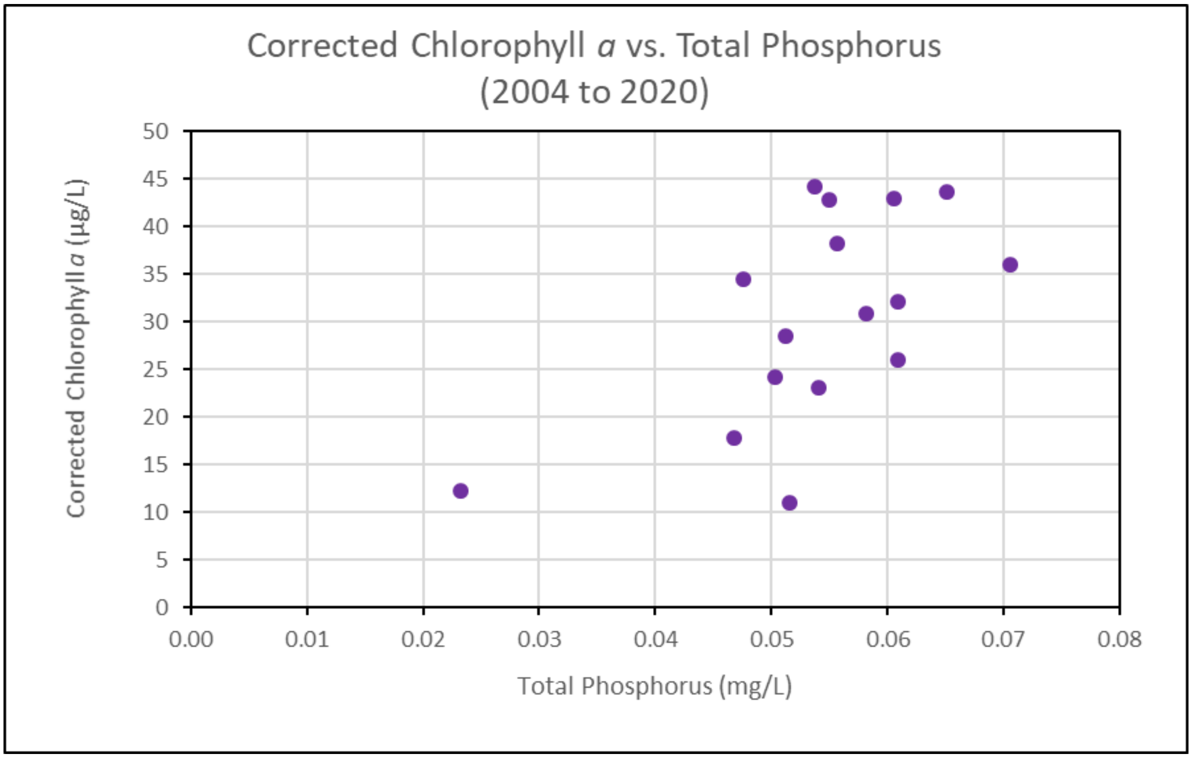

Figure 4.11. Relationship between chlorophyll a and TP AGM results in Lake Bumby

4.3 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 in Florida lakes 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, and (4) the chlorophyll *a* criterion used as the TMDL restoration target is expressed as an AGM.

4.4 Basis of the TMDLs

DEP developed the generally applicable statewide NNC based on robust empirical relationships between nutrients and chlorophyll *a* derived from a large dataset of lakes statewide, and an evaluation of the relationships between chlorophyll *a* and TN and TP in those lakes. The dataset consists of paired nutrient and chlorophyll *a* data for 195 low-color lakes and 129 high-color lakes. The NNC takes into account the hydrologic variability (waterbody type) and spatial variability (location in Florida) of the nutrient levels that naturally occur in the state's waters, and the variability in ecosystem response to those nutrient concentrations. This was done in order to determine TN and TP concentrations that would be protective of designated uses (DEP 2012). DEP developed a chlorophyll *a* criterion of 20 µg/L for both high-color (> 40 PCU) lakes and low-color (< 40 PCU), high-alkalinity (> 20 mg/L $CaCO_3$) lakes, and a chlorophyll *a* criterion of 6 µg/L for low-color (< 40 PCU), low-alkalinity (< 20 mg/L $CaCO_3$) lakes, based on evidence that demonstrated the chlorophyll *a* criterion is protective of designated uses and maintains the health of a balanced community of aquatic flora and fauna.

Lakes Fran, Kozart, Richmond, Walker and Bumby are low-color (< 40 PCU) high-alkalinity (> 20 mg/L $CaCO_3$) lakes. The chlorophyll *a* NNC for low-color, high-alkalinity lakes is an AGM value of 20 µg/L, not to be exceeded more than once in any consecutive 3-year period. Additionally, the criteria range for TN is 1.05 to 1.91 mg/L, and 0.03 to 0.09 mg/L for TP, with an exceedance frequency of no more than once in any 3-year period. The TN and TP criteria are based on whether there are sufficient data to calculate an AGM for chlorophyll *a*, and whether the mean chlorophyll *a* exceeds the criteria for the particular lake type.

For all five lakes, the majority of chlorophyll *a* AGMs exceeded the applicable NNC values for the lake type, and so the corresponding numeric interpretations for TN and TP are the minimum values in the criteria range. Since in-lake nutrient concentrations have been found to influence chlorophyll *a* response (excess algal growth) (DEP 2012), TN and TP limits are set to achieve the chlorophyll *a* restoration target. For these lakes, the nutrient TMDLs and percent reductions are based on TN and TP concentration limits.

The individual nutrient data for these five lakes were compared with the larger statewide nutrient dataset to see if they fell within the range of the data used to establish the generally applicable NNC. This was done to verify that these lakes behave similarly to the lakes used to derive the NNC and are exhibiting the same nutrient responses to determine if site-specific criteria would be needed.

Figures 4.12 through **4.16** show scatter plots of the POR chlorophyll *a* and TN AGM values for Lakes Fran, Kozart, Richmond, Walker, and Bumby, respectively, plotted with the statewide population of low-color lakes AGM results, used in deriving the NNC. **Figures 4.17** through **4.21** show scatter plots of the POR chlorophyll *a* and TP AGM values for Lakes Fran, Kozart, Richmond, Walker, and Bumby, respectively, plotted with the statewide population of low-color lakes AGM results, used in deriving the NNC.

The graphs demonstrate that the relationship of TN and TP to chlorophyll *a* in these lakes does not fall outside the range used to develop the generally applicable NNC. The TN and TP values for all lakes are indicated with red circles. The statewide lake population results are represented by the gray "x's". The dashed line shown on these graphs bounds the distributions at the 90 % prediction intervals. Lake values that plot within these intervals are characteristic of the majority of lakes in the statewide dataset, while any lakes that plot outside those bounds are not operating in a manner consistent with the majority of lakes in the dataset.

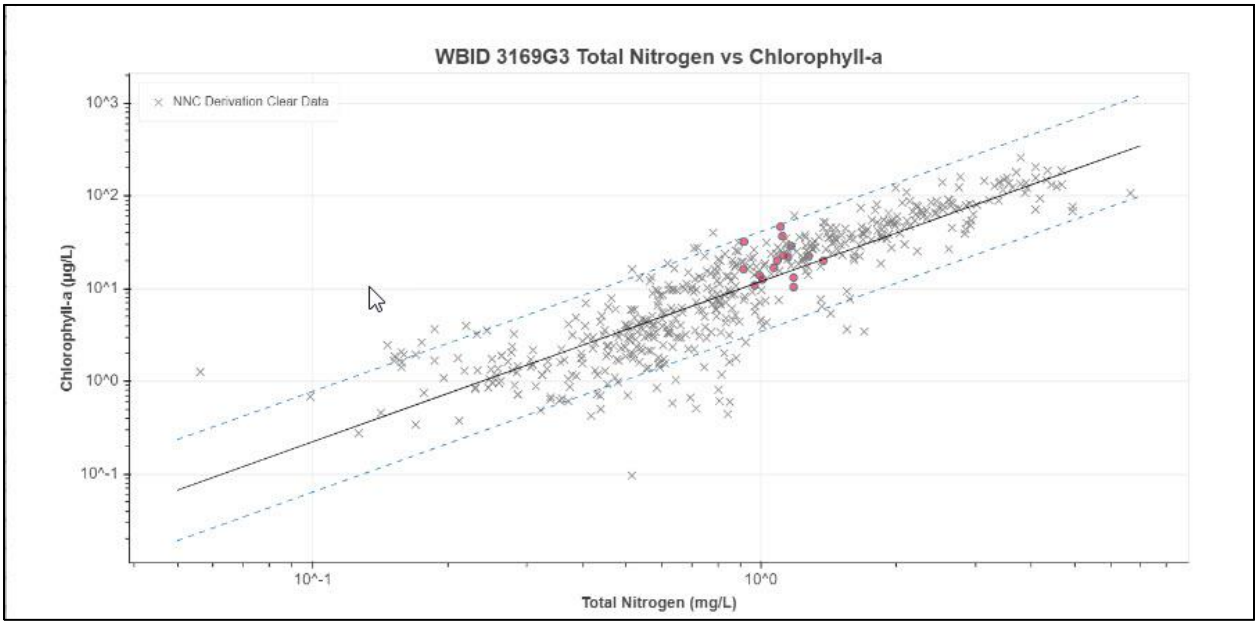

Figure 4.12. Relationship between chlorophyll *a* and TN AGMs in Lake Fran (red circles) plotted against the statewide dataset used to derive the NNC for low-color lakes

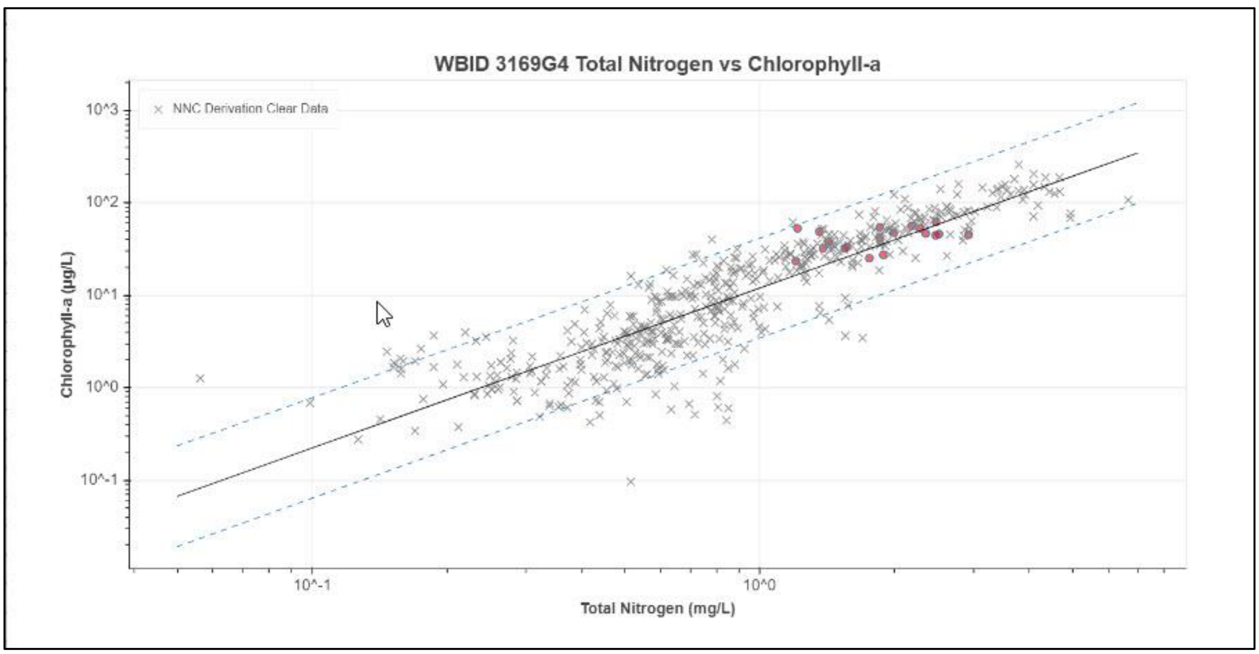

Figure 4.13. Relationship between chlorophyll *a* and TN AGMs in Lake Kozart (red circles) plotted against the statewide dataset used to derive the NNC for low-color lakes

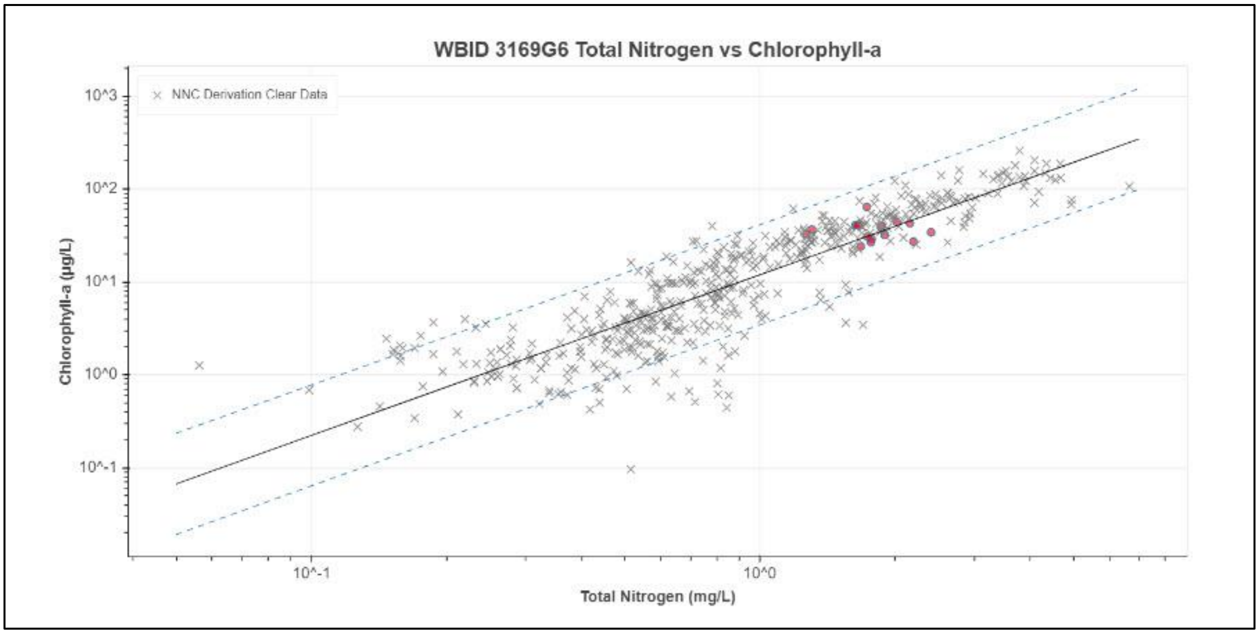

Figure 4.14. Relationship between chlorophyll *a* and TN AGMs in Lake Richmond (red circles) plotted against the statewide dataset used to derive the NNC for low-color lakes

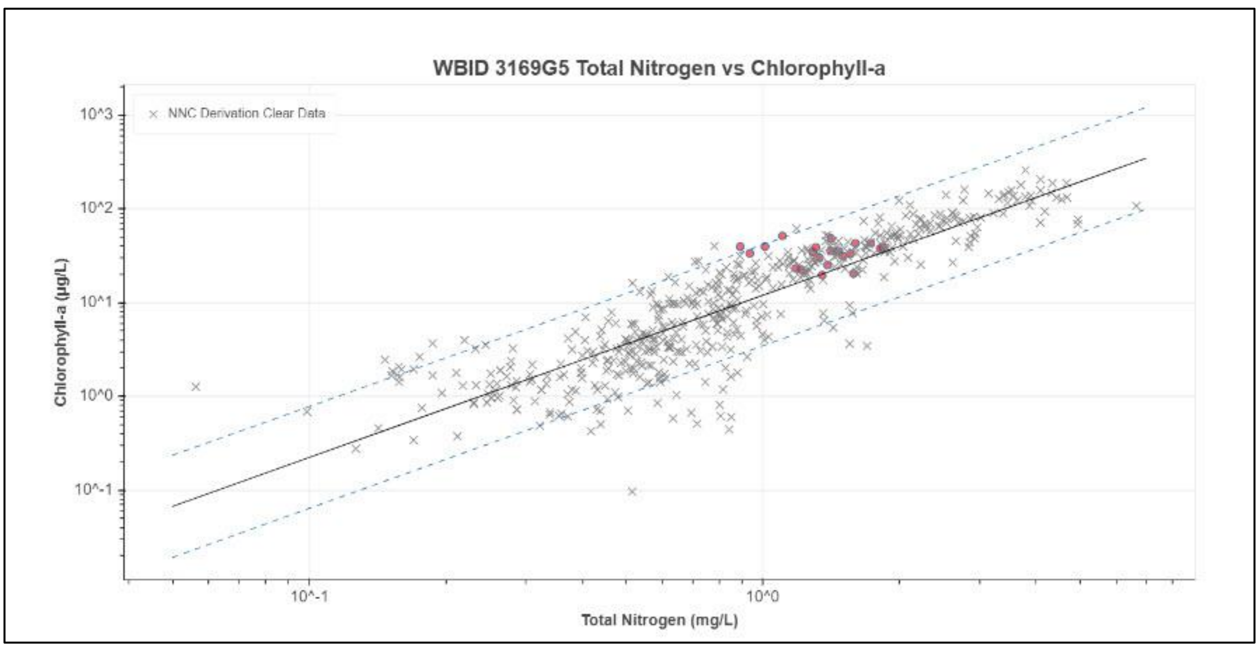

Figure 4.15. Relationship between chlorophyll *a* and TN AGMs in Lake Walker (red circles) plotted against the statewide dataset used to derive the NNC for low-color lakes

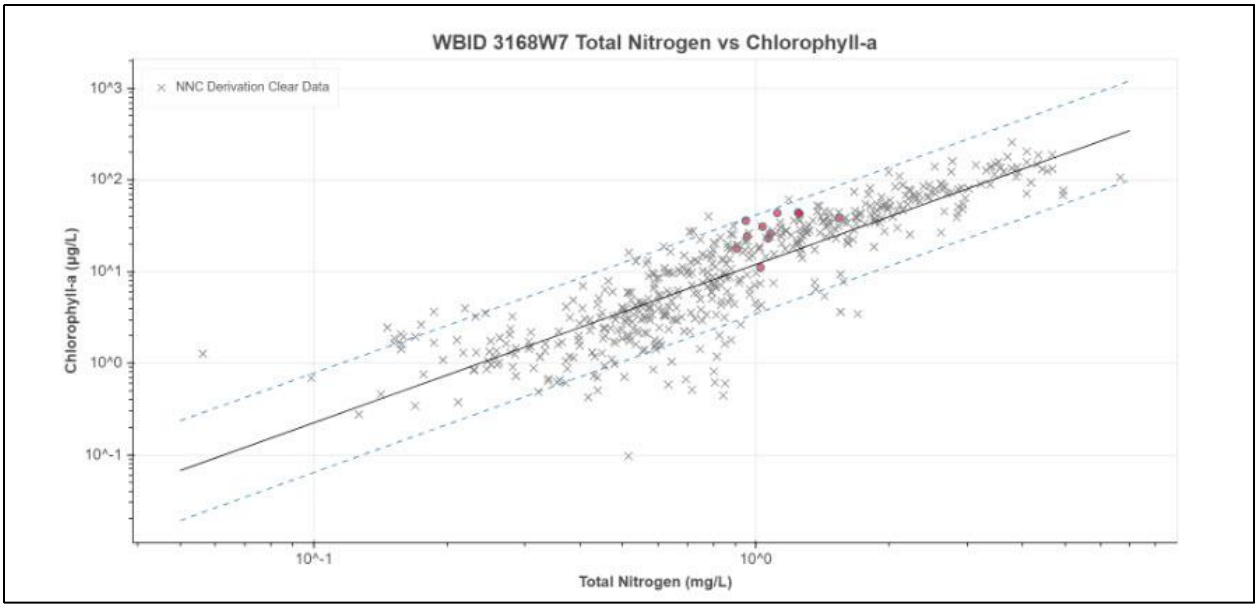

Figure 4.16. Relationship between chlorophyll *a* and TN AGMs in Lake Bumby (red circles) plotted against the statewide dataset used to derive the NNC for low-color lakes

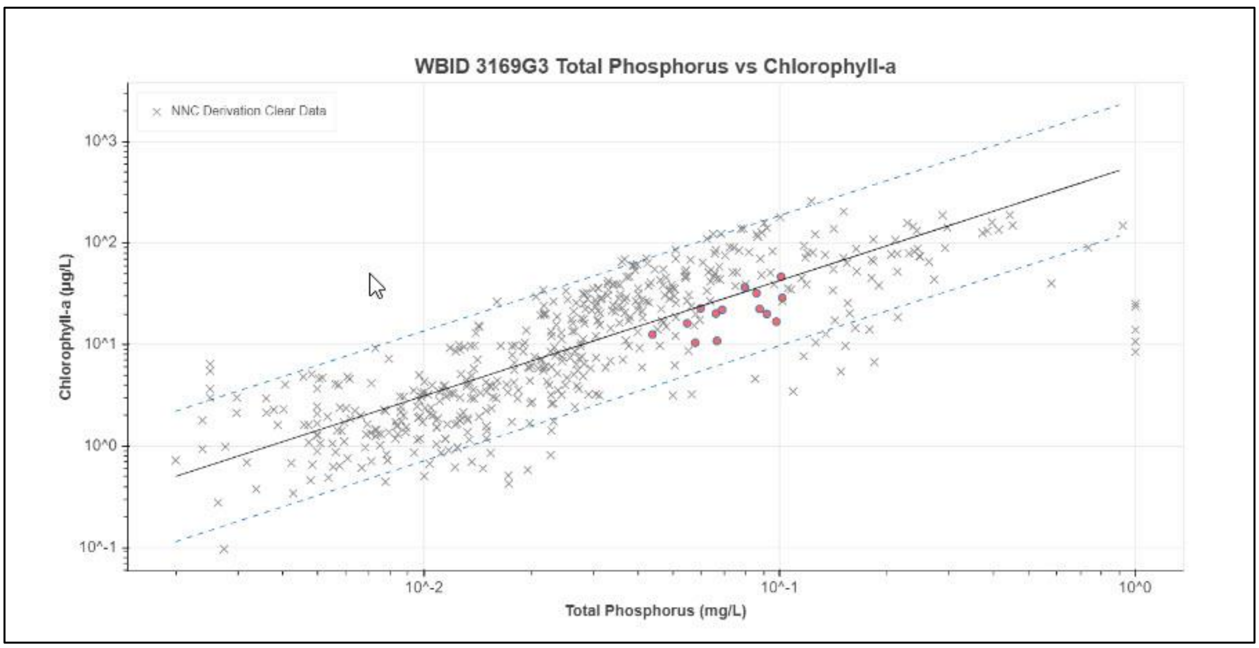

Figure 4.17. Relationship between chlorophyll *a* and TP AGMs in Lake Fran (red circles) plotted against the statewide dataset used to derive the NNC for low-color lakes

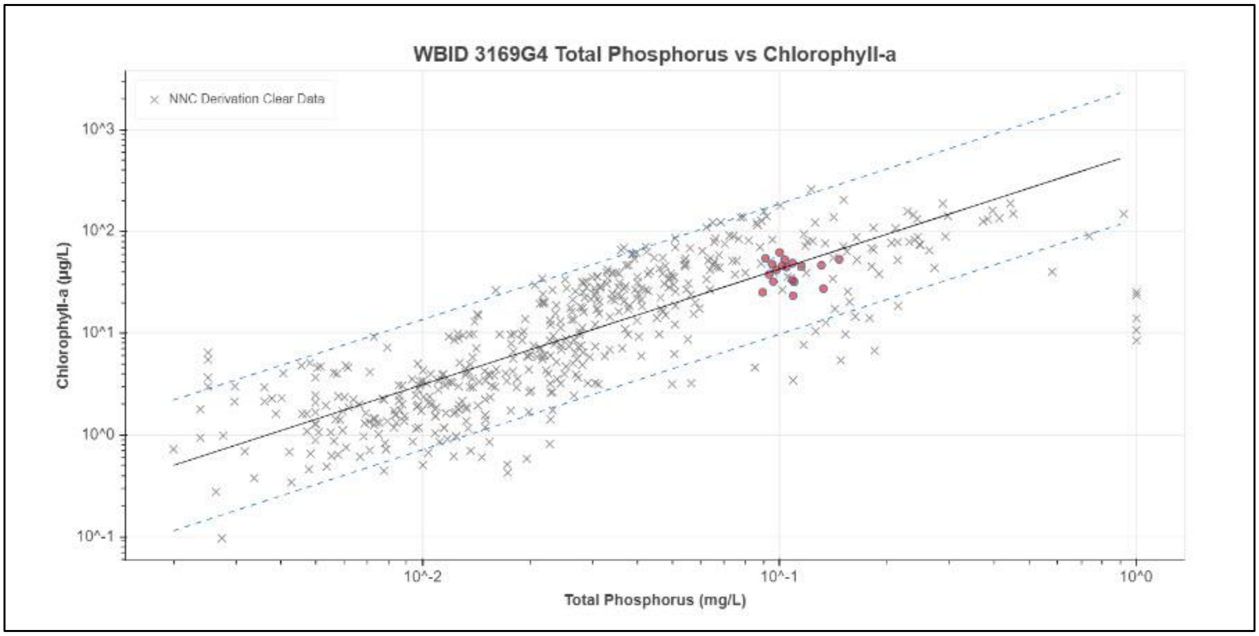

Figure 4.18. Relationship between chlorophyll *a* and TP AGMs in Lake Kozart (red circles) plotted against the statewide dataset used to derive the NNC for low-color lakes

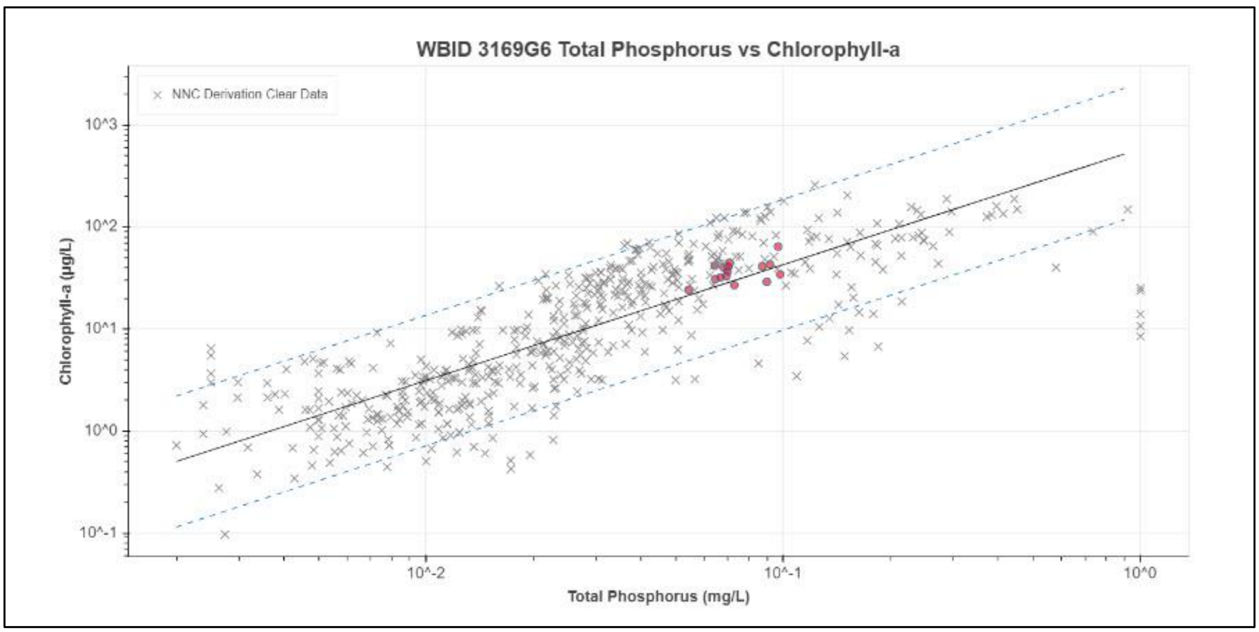

Figure 4.19. Relationship between chlorophyll *a* and TP AGMs in Lake Richmond (red circles) plotted against the statewide dataset used to derive the NNC for low-color lakes

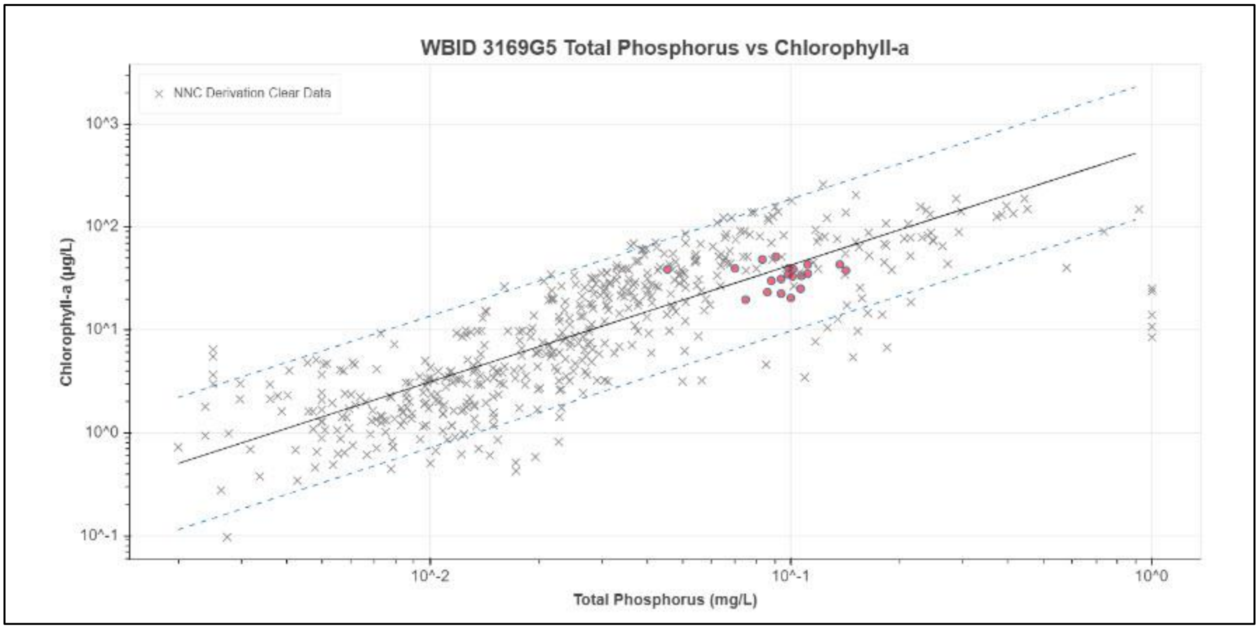

Figure 4.20. Relationship between chlorophyll *a* and TP AGMs in Lake Walker (red circles) plotted against the statewide dataset used to derive the NNC for low-color lakes

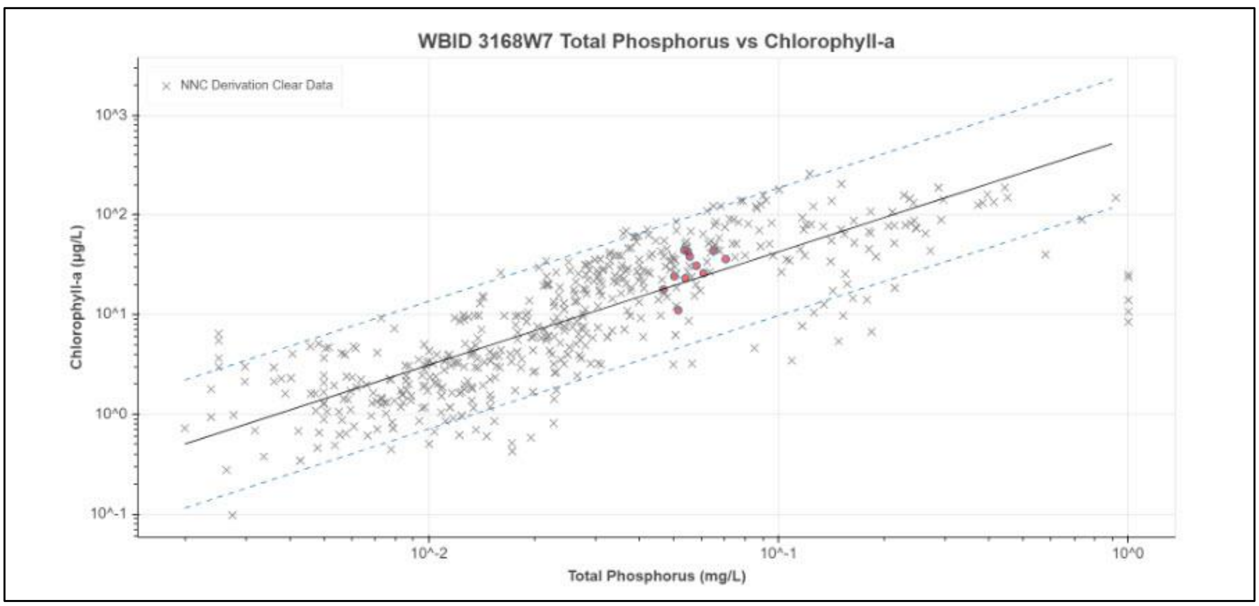

Figure 4.21. Relationship between chlorophyll *a* and TP AGMs in Lake Bumby (red circles) plotted against the statewide dataset used to derive the NNC for low-color lakes

The available information suggests that designated use attainment for the five lakes would be protected at the chlorophyll *a* threshold of 20 µg/L. The data do not indicate that the lakes respond differently from statewide generally applicable relationships depicted in **Figures 4.12** through **4.21**. Therefore, it can be concluded that basing the TMDL targets on the low-end TN (1.05 mg/L) and TP (0.03 mg/L), generally applicable NNC will meet the TMDL restoration target for chlorophyll *a* and fully protect designated uses in these lakes. Additionally, the TMDL targets do not need to be adopted as Hierarchy 1 site-specific interpretations of the NNC because the generally applicable NNC for low-color, high-alkalinity lakes fully protect designated uses.

The lakes are expected to meet the applicable nutrient criteria and maintain their function and designated use as Class III freshwater lakes when surface water nutrient concentrations are reduced to the TMDL target concentrations, addressing the anthropogenic contributions to the water quality impairments.

The method used to determine the reductions needed to attain the nutrient TMDLs is the percent reduction approach. Existing lake nutrient condition calculations are based on the nutrient concentrations measured in the 2010–20 period, which is considered representative of current conditions. The existing nutrient conditions used to calculate the required reductions were the maximum TN and TP AGM values in each lake. The geometric means were calculated from nutrient results available in the IWR Run 61 Database.

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

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

Table 4.1 lists the maximum AGMs during the 2010–19 period and the percent reductions needed to achieve the TN AGM target of 1.05 mg/L and the TP AGM target of 0.03 mg/L for the impaired lakes in the Lake Fran Watershed. The TN percent reductions range from a high of 59 % in Lake Richmond to a low of 24 % in Lake Fran, while the TP percent reductions range from a high of 78 % in Lake Kozart to a low of 69 % in Lake Richmond.

Table 4.2 lists the Lake Bumby maximum TN and TP AGMs during the 2010–20 period and the percent reductions needed to meet the TN and TP TMDL targets. A 16 % reduction in TN concentrations and a 51 % reduction in TP concentrations is necessary to achieve the nutrient TMDL targets.

Table 4.1. Reductions required in existing TN and TP concentrations to meet water quality targets for the Lake Fran Watershed impaired lakes

Year	Lake Fran TN AGM (mg/L)	Lake Kozart TN AGM (mg/L)	Lake Richmond TN AGM (mg/L)	Lake Walker TN AGM (mg/L)	Lake Fran TP AGM (mg/L)	Lake Kozart TP AGM (mg/L)	Lake Richmond TP AGM (mg/L)	Lake Walker TP AGM (mg/L)
2010	1.09	2.48	1.90	1.35	0.07	0.10	0.07	0.07
2011	1.15	2.47	1.68	1.56	0.07	0.10	0.05	0.10
2012	1.38	2.22	2.41	1.47	0.09	0.11	0.10	0.11
2013	1.28	2.45	2.57	1.58	0.09	0.10	0.09	0.10
2014	1.17	1.99	2.02		0.10	0.10	0.07	
2015	1.12	1.55	1.66	1.10	0.08	0.11	0.06	0.09
2016	1.07	1.89	2.16	0.94	0.10	0.13	0.09	0.11
2017	1.10	1.85			0.10	0.09	0.08	
2018	0.92	1.20	1.73	0.89	0.09	0.11	0.10	0.06
2019	1.16	1.58	2.12	0.80	0.10	0.14	0.09	0.08
Maximum	**1.38**	**2.48**	**2.57**	**1.58**	**0.10**	**0.14**	**0.10**	**0.11**
TMDL Target	**1.05**	**1.05**	**1.05**	**1.05**	**0.03**	**0.03**	**0.03**	**0.03**
% Reduction to Meet Target	**24**	**58**	**59**	**34**	**70**	**78**	**69**	**73**

Table 4.2. Reductions required in existing TN and TP concentrations to meet water quality targets for Lake Bumby

Year	Lake Bumby TN AGM (mg/L)	Lake Bumby TP AGM (mg/L)
2010	1.25	0.05
2011		
2012		
2013		
2014	1.04	0.06
2015	1.08	0.06
2016	0.95	0.05
2017	1.06	0.05
2018	0.90	0.05
2019		0.06
2020	0.99	0.05
Maximum	**1.25**	**0.06**
TMDL Target	**1.05**	**0.03**
% Reduction to Meet Target	**16**	**51**

Chapter 5: Determination of Loading Allocations

5.1 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:

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

The various components of the revised TMDL equation may not sum up to the value of the TMDL because (1) the WLA for NPDES stormwater is typically based on the percent reduction needed for nonpoint sources and is also accounted for within the LA, and (2) TMDL components can be expressed in different terms (for example, the WLA for stormwater is typically expressed as a percent reduction, and the WLA for wastewater is typically expressed as mass per day).

WLAs for stormwater discharges are typically expressed as "percent reduction" because it is very difficult to quantify the loads from MS4s (given the numerous discharge points) and to distinguish loads from MS4s from other nonpoint sources (given the nature of stormwater transport). The permitting of stormwater discharges also differs from the permitting of most wastewater point sources. Because stormwater discharges cannot be centrally collected, monitored, and treated, they are not subject to the same types of effluent limitations as wastewater facilities, and instead are required to meet a performance standard of providing treatment to the "maximum extent practical" through the implementation of best management practices (BMPs).

This approach is consistent with federal regulations, 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 Lakes Fran, Kozart, Richmond, Walker, and Bumby are expressed in terms of nutrient concentration targets and the percent reductions necessary to meet the targets, and represent the lake nutrient concentrations the waterbodies can assimilate while maintaining a balanced aquatic flora and fauna (see **Table 5.1**). They are based on the generally applicable NNC in Subsection 62-302.531(2), F.A.C. The minimum TN and TP NNC values were applied to establish the percent reduction targets for the in-lake TN and TP concentrations. The lakes' restoration goal is to achieve the generally applicable chlorophyll a criterion of 20 µg/L, which is expressed as an AGM not to be exceeded more than once in any consecutive 3-year period. This protects each lake's designated use.

Table 5.1. TMDL components for nutrients in Lakes Fran, Kozart, Richmond, Walker, and Bumby

Note: MOS is implicit.
NA = Not applicable
[1] The TMDLs are based on the generally applicable NNC. The minimum TN and TP NNC values shown are used to calculate the percent reductions.
[2] The required percent reductions listed in this table represent the reductions of in-lake concentrations and do not directly reflect reductions in source loadings.

Waterbody Name (WBID)	Parameter	TMDL Target (mg/L)[1]	WLA Wastewater (% reduction)	WLA NPDES Stormwater (% reduction)[2]	LA (% reduction)[2]
Lake Fran (3169G3)	TN	1.05	NA	24	24
Lake Fran (3169G3)	TP	0.03	NA	70	70
Lake Kozart (3169G4)	TN	1.05	NA	58	58
Lake Kozart (3169G4)	TP	0.03	NA	78	78
Lake Richmond (3169G6)	TN	1.05	NA	59	59
Lake Richmond (3169G6)	TP	0.03	NA	69	69
Lake Walker (3169G5)	TN	1.05	NA	34	34
Lake Walker (3169G5)	TP	0.03	NA	73	73
Lake Bumby (3168W7)	TN	1.05	NA	16	16
Lake Bumby (3168W7)	TP	0.03	NA	51	51

5.2 Load Allocation

The TMDLs are based on the percent reduction in in-lake nutrient concentrations. To achieve the LA, decreases in current TN and TP loads to the lakes have been identified to meet the percent reductions, as specified in **Table 5.1.** Although the TMDLs are based on the percent reductions from all sources to the lakes, it is not DEP's intent to abate natural conditions. The needed reduction from anthropogenic inputs will be calculated based on more detailed source information when a restoration plan is developed. The reductions in nonpoint source nutrient loads are expected to result in reduced sediment nutrient flux, which is commonly a factor in lake eutrophication.

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**).

5.3 Wasteload Allocation

5.3.1 NPDES Wastewater Discharges

As noted in **Chapter 3**, no active NPDES-permitted wastewater facilities discharge into the lakes or the watersheds of Lakes Fran, Kozart, Richmond, Walker, and Bumby. Therefore, a WLA for wastewater discharges is not applicable.

5.3.2 NPDES Stormwater Discharges

The Lake Fran Watershed, which includes the drainage basins of Lakes Fran, Kozart, Richmond, and Walker, are covered by the MS4 Phase 1 permits issued to the City of Orlando (Permit No. FLS000014) and Orange County (Permit No. FLS000011), with FDOT District 5 as a copermittee. Areas within these jurisdictions may be responsible for reductions in current anthropogenic TN and TP loadings to the lakes, equivalent to the percent reductions indicated in **Table 5.1**.

The Lake Bumby Watershed is within the jurisdiction of Orange County, and is covered by the county's MS4 Phase I permit (FLS000011); it includes FDOT District 5 and the City of Edgewater as copermittees with areas of jurisdiction in the watershed. Areas in these jurisdictions may be responsible for reductions in current anthropogenic TN and TP loadings to Lake Bumby, equivalent to the percent reductions indicated in **Table 5.1**.

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.

5.4 MOS

The MOS can either be implicitly accounted for by choosing conservative assumptions about loadings or water quality response, or explicitly accounted for during the allocation of loadings. The MOS is a required component of a TMDL and accounts for the uncertainty about the relationship between pollutant loads and the quality of the receiving waterbody (CWA, Section 303(d)(1)(C)). Considerable uncertainty is usually inherent in estimating nutrient loading from nonpoint sources, as well as in predicting water quality response. The effectiveness of management activities (e.g., stormwater management plans) in reducing loading is also subject to uncertainty.

Consistent with the recommendations of the Allocation Technical Advisory Committee (DEP 2001), an implicit MOS was used in the development of the TMDLs because of the conservative assumptions that were applied. The conservative elements are that reductions were calculated from the highest measured AGM TN and TP values to achieve the low end of the TN and TP criteria range within the generally applicable NNC to calculate the percent reductions. However, these conservative measures are only components of the MOS and are not intended to change the frequency or duration of the applicable NNC.

Chapter 6: Implementation Plan Development and Beyond

6.1 Implementation Mechanisms

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

Facilities with NPDES permits that discharge to the TMDL waterbody must respond to the permit conditions that reflect target concentrations, reductions, or 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).

6.2 BMAPs

Information on the development and implementation of BMAPs is contained 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 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 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.

The Lakes Fran, Kozart, Richmond, Walker, and Bumby Watersheds are located in the Lake Okeechobee BMAP area (DEP 2020). The BMAP was adopted in December 2014 to implement the TP TMDL in the Lake Okeechobee Watershed, and activities are ongoing to reduce nutrient loads to Lake Okeechobee. An updated BMAP was adopted in February 2020. BMPs and other projects have been conducted to reduce nutrient loading to lakes in the basin. FDOT District Five, Orange County, and the City of Orlando have conducted projects and educational and outreach efforts in the area to help reduce nutrient loading. Projects include detention ponds, street sweeping, curb and grate inlet baskets, and baffle boxes. Educational and outreach efforts include the illicit discharge program; Florida Yards and Neighborhoods Program; landscaping, irrigation, fertilizer, and pet waste management ordinances; public service announcements; pamphlets; and the Orange County Water Atlas website. These projects and others are further described in the Lake Okeechobee BMAP (DEP 2020) and Florida Statewide Annual Report (DEP 2021b).Additional information about BMAPs is available online.

6.3 Implementation Considerations for the Waterbody

Existing nutrient reduction and management infrastructure and plans should be included in any future pollutant mitigation strategies. In addition to addressing reductions in watershed pollutant contributions to impaired waters during the implementation phase, it is also necessary to consider the impacts of internal sources (e.g., sediment nutrient fluxes or the presence of nitrogen-fixing cyanobacteria) and the results of any associated remediation projects on surface water quality. Approaches for addressing these other factors should be included in comprehensive management plans for the waterbodies. Additionally, the current water quality monitoring of the lakes should continue and be expanded, as necessary, during the implementation phase to ensure that adequate information is available for tracking restoration progress. Consideration should be given to expanding monitoring to include likely sources of nutrients to the waterbodies to better guide restoration activities.

While the low-end TN and TP applicable NNC were used to establish percent reduction targets for the in-lake TN and TP concentrations, the NNC remain the relevant water quality standards. If the chlorophyll *a* NNC threshold (20 µg/L) is achieved, the NNC set the applicable TN and TP criteria as the measured concentration subject to the stated maximum and minimum concentrations. Stakeholders should focus on nutrient control strategies that help decrease in-lake nutrient concentrations sufficient to reduce chlorophyll *a* levels below the applicable NNC. Once each lake is consistently meeting the NNC over the assessment period, it can be assumed that the TMDLs are being met.

References

City of Orlando. 2019. *Lake water quality report.* Public Works Department, Streets and Stormwater Division, Stormwater Compliance Section.

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.

———.2020. *Lake Okeechobee Basin Management Action Plan*. Tallahassee, FL: Division of Environmental Assessment and Restoration, Water Quality Restoration Program.

———. 2021a. *Statewide land use land cover dataset – Compilation of land use/land cover datasets by the South Florida Water Management District, 2017–2019, and the St. Johns River Water Management District, 2013–2016*.

———.2021b. *Statewide annual report*. Tallahassee, FL: Division of Environmental Assessment and Restoration, Water Quality Restoration Program.

Florida Department of Health. 2017. *OSTDS statistics, Orange County.*

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, National Health and Environmental Effects Research Laboratory.

Schiffer, D.M. 1998. *Hydrology of central Florida lakes – A primer.* U.S. Geological Survey Circular 1137.

U.S. Census Bureau. 2019. *QuickFacts Orange County, Florida.*

Viessman, W. Jr., G.L. Lewis, and J.W. Knapp. 1989. *Introduction to hydrology.* Third edition. New York: Harper Collins Publisher.

Appendices

Appendix A: Background Information on Federal and State Stormwater Programs

In 1982, Florida became the first state in the country to implement statewide regulations to address the issue of nonpoint source pollution by requiring new development and redevelopment to treat stormwater before it is discharged. The Stormwater Rule, as authorized in Chapter 403, F.S., was established as a technology-based program that relies on the implementation of BMPs designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Chapter 62-40, F.A.C. In 1994, DEP stormwater treatment requirements were integrated with the stormwater flood control requirements of the water management districts, along with wetland protection requirements, into the Environmental Resource Permit regulations, as authorized under Part IV of Chapter 373, F.S.

Chapter 62-40, F.A.C., also requires the state's water management districts to establish stormwater pollutant load reduction goals (PLRGs) and adopt them as part of a Surface Water Improvement and Management (SWIM) Program plan, other watershed plan, or rule. Stormwater PLRGs are a major component of the load allocation part of a TMDL. To date, they have been established for Tampa Bay, Lake Thonotosassa, the Winter Haven Chain of Lakes, the Everglades, Lake Okeechobee, and Lake Apopka.

In 1987, the U.S. Congress established Section 402(p) as part of the federal CWA Reauthorization. This section of the law amended the scope of the federal NPDES permitting program to designate certain stormwater discharges as "point sources" of pollution. The EPA promulgated regulations and began implementing the Phase I NPDES stormwater program in 1990 to address stormwater discharges associated with industrial activity, including 11 categories of industrial activity, construction activities disturbing 5 or more acres of land, and large and medium MS4s located in incorporated places and counties with populations of 100,000 or more.

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

The Phase II NPDES stormwater program, promulgated in 1999, addresses additional sources, including small MS4s and small construction activities disturbing between 1 and 5 acres, and urbanized areas serving a minimum resident population of at least 1,000 individuals. While these urban stormwater discharges are technically referred to as "point sources" for the purpose of regulation, they are still diffuse sources of pollution that cannot be easily collected and treated by a central treatment facility, as are other point sources of pollution such as domestic and industrial wastewater discharges. It should be noted that Phase I MS4 permits issued in Florida include a reopener clause that allows permit revisions to implement TMDLs when the implementation plan is formally adopted.