ST. JOHNS DISTRICT • MIDDLE ST. JOHNS BASIN

Final TMDL Report

Nutrient TMDL for DeLeon Spring (WBID 2921A) and Gemini Springs (WBID 2893) and Documentation in Support of Development of Site-Specific Numeric Interpretations of the Narrative Nutrient Criterion

David Huggins, Gary Maddox, and Brian Katz
Groundwater Management Section
Division of Environmental Assessment and Restoration
Florida Department of Environmental Protection

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2600 Blair Stone Road
Mail Station 3555
Tallahassee, FL 32399-2400
www.dep.state.fl.us

Executive Summary

DeLeon and Gemini Springs are second magnitude springs located in the Middle St. Johns Basin near DeLand, FL. These waterbodies were identified as impaired for nitrate-nitrite (NO_3-NO_2) based on elevated annual geometric mean (AGM) concentrations and were added to the 303(d) list by Secretarial Order on April 27, 2016, as the segments with waterbody identification (WBID) numbers 2921A for DeLeon Spring and 2893 for Gemini Springs. Individual total daily maximum loads (TMDLs) for nitrate-nitrite have been developed, and supporting information for the TMDLs is listed below in **Table EX-1**. These TMDLs were developed in accordance with Section 303(d) of the federal Clean Water Act and guidance from the U.S. Environmental Protection Agency (EPA).

Table EX-1: Summary of TMDL supporting information for DeLeon and Gemini Springs

Type of Information	Description
Waterbody name/ WBID number	DeLeon Spring/WBID 2921A Gemini Springs/WBID 2893
Hydrologic Unit Code (HUC) 8	03080101
Use classification/ Waterbody designation	Class III/Freshwater
Targeted beneficial uses	Fish consumption, recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife
303(d) listing status	Verified List of Impaired Waters for the Middle St. Johns River Basin, Group 2, adopted via Secretarial Order on April 27, 2016.
TMDL pollutants	Nitrate-nitrite (NO_3-NO_2)
TMDL and site-specific interpretations of narrative nutrient criteria	**WBID 2921A**: **NO_3-NO_2**: 0.35 milligrams per liter (mg/L), expressed as an AGM concentration not to be exceeded in any year. **WBID 2893**: **NO_3-NO_2**: 0.35 mg/L, expressed as an AGM concentration not to be exceeded in any year.
Load reductions required to meet TMDL	**WBID 2921A**: 56 % NO_3-NO_2 reduction to achieve a target of 0.35 mg/L. **WBID 2893**: 74 % NO_3-NO_2 reduction to achieve a target of 0.35 mg/L.

Acknowledgments

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Erin Rasnake, Richard Hicks, David Huggins, Gary Maddox, and Brian Katz.

Map production was provided by Janis Morrow in the Office of Watershed Services.

Editorial assistance was provided by Linda Lord in the Watershed Planning and Coordination Section.

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

Richard Hicks, P.G.
Florida Department of Environmental Protection
Water Quality Evaluation and TMDL Program
Groundwater Management Section
2600 Blair Stone Road, Mail Station 3575
Tallahassee, FL 32399-2400
Phone: (850) 245–8229

Moira Homann
BMAP Coordinator
Florida Department of Environmental Protection
Watershed Restoration Program
Watershed Planning and Coordination Section
2600 Blair Stone Road, Mail Station 3575
Tallahassee, FL 32399-2400
Phone: 850-245-8460

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List of Acronyms and Abbreviations

AGM	Annual Geometric Mean
AMSL	Above Mean Sea Level
BMAP	Basin Management Action Plan
BMP	Best Management Practice
CASTNET	Clean Air Status and Trend Network
CFR	Code of Federal Regulations
cfs	Cubic Feet Per Second
CV	Coefficient of Variance
DEP	Florida Department of Environmental Protection
EPA	U.S. Environmental Protection Agency
F.A.C.	Florida Administrative Code
FAVA	Florida Aquifer Vulnerability Assessment
FDACS	Florida Department of Agriculture and Consumer Services
FDOH	Florida Department of Health
FDOT	Florida Department of Transportation
FGS	Florida Geological Survey
FWRA	Florida Watershed Restoration Act
F.S.	Florida Statutes
GIS	Geographic Information System
HUC	Hydrologic Unit Code
IWR	Identification of Impaired Surface Waters Rule
LA	Load Allocation
lb/ac/yr	Pounds Per Acre Per Year
LFA	Lower Floridan Aquifer
mgd	Million Gallons Per Day
mg/L	Milligrams Per Liter
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer System
n	Number
N	Nitrogen
NADP	National Atmospheric Deposition Program
NCEI	National Centers for Environmental Information
NNC	Numeric Nutrient Criterion
NO_3-NO_2	Nitrate-Nitrite
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NSILT	Nitrogen Source Inventory Loading Tool
OFW	Outstanding Florida Water
OSTDS	Onsite Sewage Treatment and Disposal System

P	Phosphorus
PLRG	Pollutant Load Reduction Goal
RIB	Rapid Infiltration Basin
SAS	Surficial Aquifer System
SAV	Submerged Aquatic Vegetation
SJRWMD	St. Johns River Water Management District
SSO	Sanitary Sewer Overflow
Std Dev	Standard Deviation
SWIM	Surface Water Improvement and Management
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TP	Total Phosphorus
UFA	Upper Floridan Aquifer
USGS	U.S. Geological Survey
WBID	Waterbody Identification (Number)
WLA	Wasteload Allocations
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 nitrate-nitrite (NO_3-NO_2) impairment of DeLeon Spring and Gemini Springs, located in the Lake Woodruff and Lake Monroe Planning Units, respectively, of the Middle St. Johns River Basin. The springs were verified as impaired for nutrients using the methodology in the Identification of Impaired Surface Waters Rule (IWR) (Rule 62-303, Florida Administrative Code [F.A.C.]), and were included on the Verified List of impaired waters for the Middle St. Johns River Basin Group 2 that was adopted by Secretarial Order on April 27, 2016.

The TMDLs establish the allowable levels of nutrient loadings that would restore these waterbodies so that they meet the applicable water quality criterion for nutrients. The TMDLs will be consistent with the numeric nutrient criterion (NNC) set forth in Paragraph 62-302.531(2)(b)2, F.A.C., for nitrate-nitrite in spring vents. This report will also be used as the basis for discussions during the development of the basin management action plan (BMAP).

1.2 Identification of Waterbodies

DeLeon Spring is a second magnitude spring located in DeLeon Springs State Park 5 miles northwest of the town of DeLand (**Figure 1.1**). The headspring has a 170-foot diameter concrete-lined spring pool. Water exits from a vent in the north-central part of the pool, flowing downstream through a 0.5-mile run that feeds Spring Garden Lake. A series of lakes and creeks connects the headspring to the St. Johns River 12 miles downstream (St. Johns River Water Management District [SJRWMD] 2017a; Scott et al. 2004).

The DeLeon headspring is located at the base of the DeLand Ridge on the St. Johns River Offset lowlands. The surrounding area includes portions of the DeLand Ridge, the Crescent City Ridge, and the St. John's River Offset river valley. The DeLand and Crescent City Ridges are local topographic highs, and the St. John's River Offset is a lowland dominated by the very poorly drained, mucky soils (Rutledge 1982). The elevation of the contributing area ranges from 2 to 119 feet above sea level. **Figure 1.2** show an aerial photograph of the DeLeon headspring and its outflow, and **Figure 1.4** contains a photograph of the spring pool at DeLeon State Park.

Gemini Springs is in DeBary, south of DeLand, and consists of two flowing spring vents, with a combined historical second magnitude flow (**Figure 1.5**) (SJRWMD 2017b). In Rosenau et al. (1977), three spring vents are described and named (from west to east) as Spring No. 1, Spring No. 2, and Spring No. 3. The authors state that "Spring No.1 reportedly was at one time only a seep, the flow of which has been augmented by an uncased flowing well drilled at the site." The current SJRWMD website for Gemini Springs states, "The springs are numbered Spring 1 (Spring 2 of Rosenau et al.1977) and Spring 2 (Spring 3 of Rosenau) from west to east. Spring 1, as identified by Rosenau, is actually an 8-inch well. The well was initially back-plugged from 340 feet to 141 feet below land surface in September 1991, and the well has been completely abandoned since July 2002" (SJRWMD 2017b). This report follows the revised naming convention adopted by the SJRWMD.

Gemini Spring No. 1 "has a circular pool about 15 feet in diameter, and flow is from a horizontal cavern opening in the limestone. The cavern opening is about 6 feet high and 8 feet wide, with the cavern appearing to extend laterally underground to the north or northeast." (SJRWMD 2017b). Gemini Spring No. 2 "has a circular pool at times inundated by the reservoir. Flow is from a small cavern under a rock ledge about 3 feet below water surface. Spring 1 flows about 150 feet to the east-southeast and converges with the flow from Spring 2 at the west end of the reservoir. The reservoir is impounded on its east end by an earthen dam with a concrete weir outlet. Flow is through the weir, then 1.5 miles east and northeast down a creek and through a marsh area to Lake Monroe on the St. Johns River" (**Figure 1.6**) (SJRWMD 2017b).

Figure 1.8 shows the Gemini Springs headspring and spring run. The topography immediately to the north of Gemini Springs is primarily deep, well-drained sands at higher elevations (~80 feet above mean sea level [AMSL]) along the southwestward end of the DeLand Ridge. The land surface slopes gradually southward from the edge of the ridge to less than five feet AMSL in elevation towards the Lake Monroe marsh.

For assessment purposes, the Florida Department of Environmental Protection (DEP) has divided the Middle St. John's River Basin into watershed assessment polygons with a unique waterbody identification (WBID) number for each watershed or surface water segment. DeLeon Spring is WBID 2921A (**Figure 1.3)**, and Gemini Springs is WBID 2893 (**Figure 1.7**).

The area where precipitation falls and percolates to groundwater, from which a spring receives its water, is known as a groundwater contributing area, or springshed. This area can be estimated using groundwater elevation contour maps, also known as potentiometric surface maps. Geographic information system (GIS) tools are used to create flow lines from areas of higher to lower groundwater elevation and to draw spring capture zones for multiple dates that account for a range of hydrologic conditions, since groundwater elevations change seasonally and over time because of fluctuations in rainfall and withdrawals.

Several versions of groundwater contributing areas (or springsheds) have been created over the years for DeLeon and Gemini Springs. The SJRWMD created revised contributing areas for DeLeon and Gemini Springs in 2017 to provide estimates of the maximum areal extent that groundwater may contribute to the springs based on a consistent methodology that uses potentiometric surface data for the Floridan aquifer (Mouyard and Gordu, 2017). These areas provide DEP with information to assist in evaluating the areas in which potential sources of nutrients could influence water quality in the springs. Due to uncertainty in development of the Gemini Springs contributing area caused by the presence of a large groundwater discharge area along the St. Johns River and major lakes south of the springs, a primary contributing area was also drawn to represent the area of more certain groundwater contribution north of this discharge area. **Figures 1.1** and **1.5** show the estimated contributing areas for DeLeon and Gemini Springs, respectively, and the major geopolitical and hydrologic features in the surrounding area.

The estimated contributing area for DeLeon Spring encompasses 101 square miles in Volusia County. The Gemini Springs maximum contributing area covers 43 square miles and includes portions of both Volusia and Seminole Counties, but the primary contributing area, which occurs in Volusia County covers only 5.5 square miles.

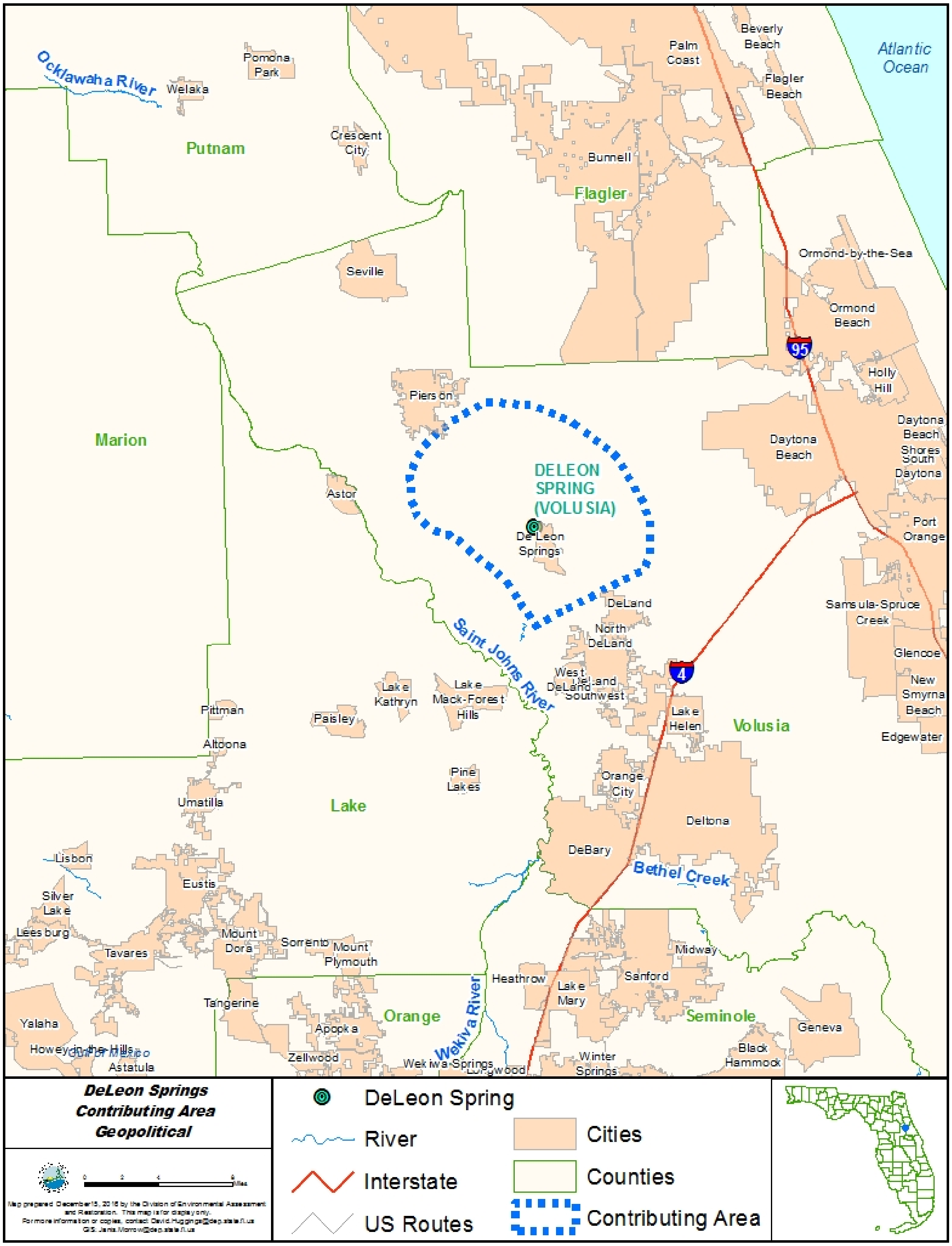

Figure 1.1. Major geopolitical and hydrologic features in the estimated contributing area of DeLeon Spring

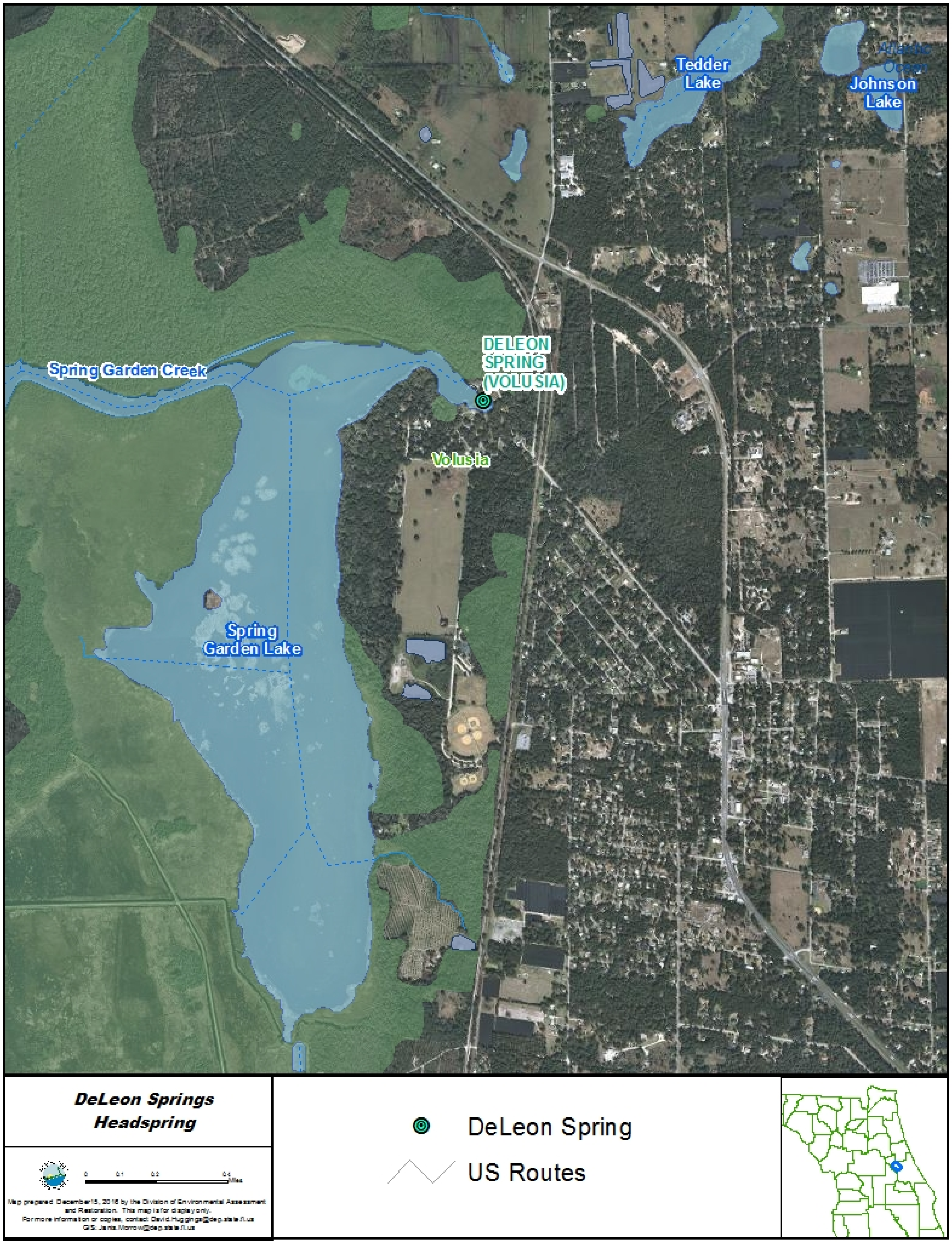

Figure 1.2. Headspring and outflow of DeLeon Spring

Figure 1.3. DeLeon Spring, WBID 2921A

Figure 1.4. Photograph of the DeLeon Spring headspring area (DEP)

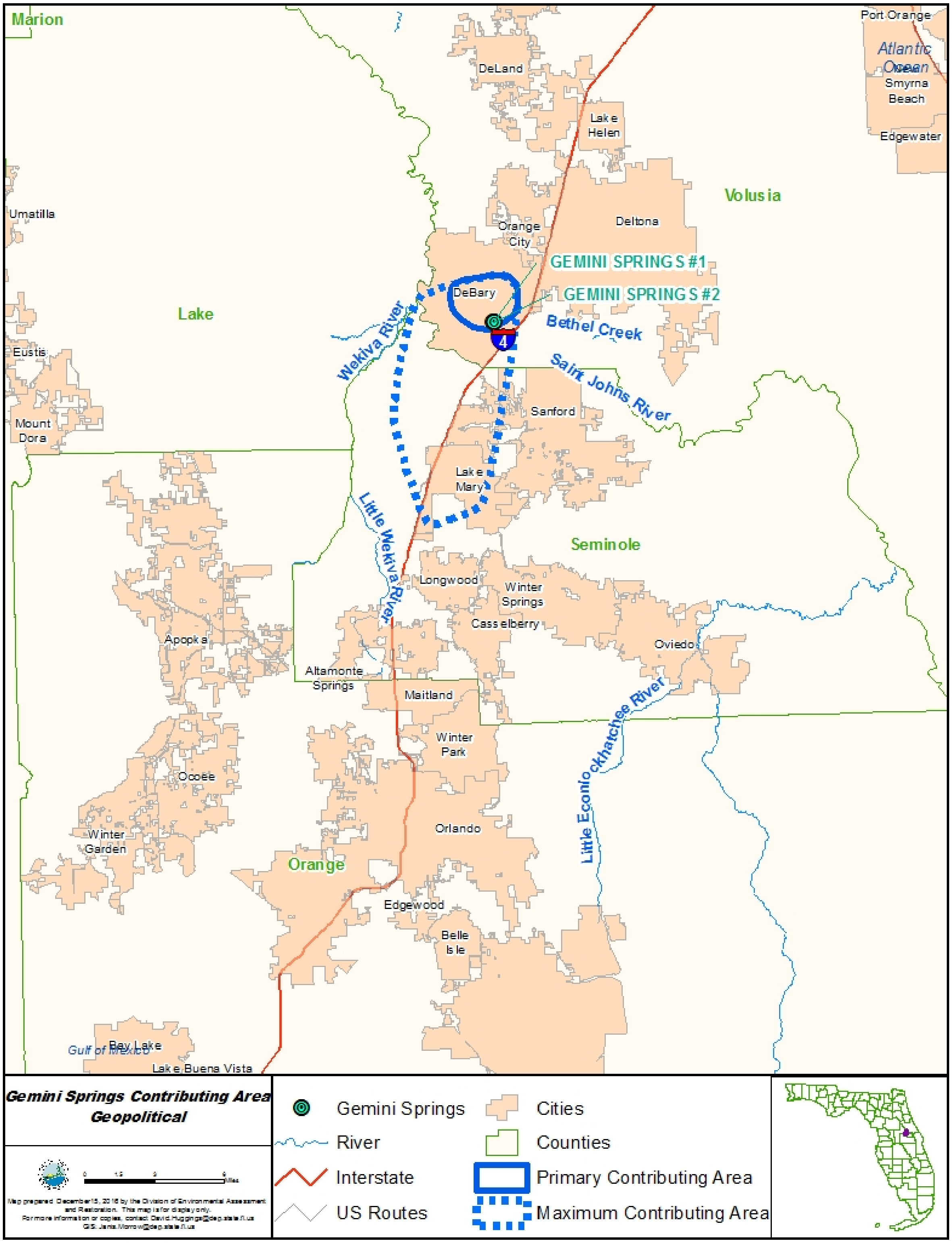

Figure 1.5. Major geopolitical and hydrologic features in the estimated contributing area of Gemini Springs

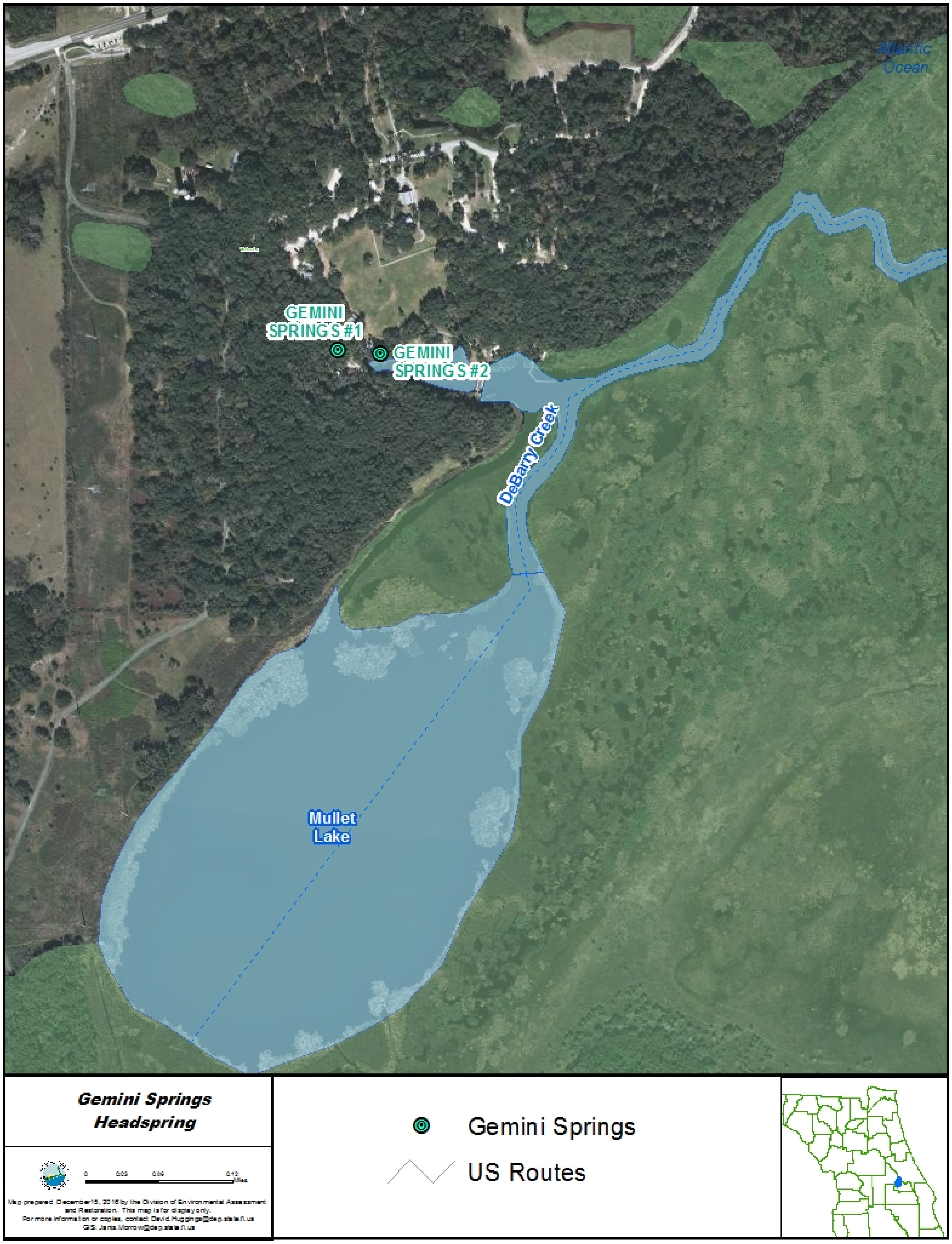

Figure 1.6. Headspring and outflow of Gemini Springs

Figure 1.7. Gemini Springs, WBID 2893

Figure 1.8. Gemini Springs headspring area (DEP)

1.3 Groundwater Hydrology

1.3.1 Aquifers

There are two aquifers within the contributing areas of these springs. The first, the Upper Floridan aquifer (UFA), occurs in Eocene-era limestone and dolostone and is the primary source of water discharging from DeLeon and Gemini Springs. The UFA lies 100 feet below the land surface immediately to the east of DeLeon Spring in the DeLand Ridge. The UFA is only 15 feet below the land surface at DeLeon Spring on the east side of a north-south trending geological fault, which penetrates the Eocene and older carbonate rocks underlying the spring. The Eocene carbonate rock surface is 85 feet below the land surface on the western (downthrown) side of this fault (Wyrick 1960).

At Gemini Springs, the UFA is 10 to 40 feet below the surface based on field observations and nearby FGS well data. A deep east-west trending geologic fault penetrates the Eocene and older carbonate rocks underlying the St. Johns River in the immediate vicinity of Gemini Springs (Wyrick 1960) and provides an avenue for the upwelling of relict seawater from the Lower Floridan aquifer (LFA), mixing with shallower UFA groundwater. Discharge of water from the LFA along this structural feature may complicate the estimation of the groundwater contributing area for Gemini Springs as discussed previously.

The second aquifer, the shallower surficial aquifer system (SAS), occurs between the land surface and up to 100 feet below the land surface beneath the DeLand Ridge, and is thin or absent in the immediate area of both springs (Vecchioli et al. 1990). It is composed of undifferentiated Holocene and Pleistocene sands, clays, and shell material lying atop the Pliocene Cypresshead Formation (Scott 2001). Water movement between the SAS and the UFA is slowed by a low-permeability layer of clay, silt, and fine sand, which form an intermediate confining unit perforated by sinkholes.

Karst processes play a dominant role in the rates and directions of groundwater movement through the UFA in the basin. In karst areas, the dissolution of limestone creates and enlarges cavities along fractures in the limestone that eventually collapse and form sinkholes. Sinkholes capture surface water drainage and funnel it underground, promoting the further dissolution of the limestone. This leads to the progressive integration of voids beneath the surface and allows larger and larger amounts of water to be funneled into the underground drainage system. Dissolution is most active at the water table or in the zone of water table fluctuation, where carbonic acid contained in atmospheric precipitation and generated by reaction with carbon dioxide in the soil reacts with limestone and dolostone (Rutledge 1982).

Over geologic time the elevation of the water table has shifted in response to changes in sea level, and many vertical and lateral paths or conduits have developed in the underlying carbonate strata in the basin. Many of these lie below the present water table and greatly facilitate groundwater flow. Openings along these paths or conduits provide easy avenues for water to travel toward springs (Rutledge 1982). Groundwater rich in nutrients has the potential to flow rapidly through these passages in the limestone, or slowly through much smaller pore spaces in the rock matrix.

1.3.2 Water Chemistry and Age

1.3.2.1 DeLeon Spring

DeLeon Spring has a mixed water type and is slightly undersaturated with respect to calcite and dolomite (the principal minerals in limestone that comprises the UFA). The median dissolved solids concentration was 416 milligrams per liter (mg/L) based on water samples collected from 1932 to 2005 (Walsh et al. 2009). Based on the spring water isotopic composition (values of delta ^{18}O and delta ^{2}H), DeLeon Spring is recharged by meteoric water (rainfall) with little or no evaporation (Toth 1999).

Excess dissolved nitrogen gas (N_2) concentrations were found in spring water during several sampling events in 2004 and 2005 (Phelps et al. 2006). This likely indicated that denitrification was occurring in the UFA near DeLeon Spring. The likelihood of denitrification was corroborated by data on nitrogen and oxygen isotopes of nitrate, which had elevated values compared with other springs in the SJRWMD (Phelps et al. 2006).

In 2001, 3 different atmospheric tracer techniques (tritium-helium-3, sulfur hexafluoride [SF6], and chlorofluorocarbons) were used to determine the age of water discharging from DeLeon

Spring. Based on the concentrations of these tracers, the age of DeLeon Spring water likely represents an exponential mixture containing 30 % old water (greater than 60 years) and 70 % younger water with a mean residence time of 14 years (Toth and Katz 2006). This mixture of old and young waters also is consistent with atmospheric tracer data for water samples collected in 1995 from DeLeon Spring.

1.3.2.2 Gemini Springs

Water discharging from Gemini Springs contains elevated levels of sodium, chloride, and other salinity indicators commonly seen in other St. Johns River springs discharging from the UFA (SJRWMD 2017b). Gemini Springs No. 1 and No. 2 and the Gemini Springs run are somewhat brackish. Gemini Springs No. 1 and No. 2 had median dissolved solids concentrations of 1,520 and 1,570 mg/L, respectively (Walsh et al. 2009). The presence of an east–west trending geologic fault penetrating Eocene and older carbonate rocks underlying the St. Johns River in the immediate vicinity of Gemini Springs (Wyrick 1960) may provide an avenue for the upwelling of relict seawater from the LFA, mixing with shallower UFA groundwater.

Based on the spring water isotopic composition (values of delta ^{18}O and delta ^{2}H), Gemini Springs are recharged by meteoric water (rainfall) with little or no evaporation (Toth 1999). Also, concentrations of dissolved nitrogen and argon gases in water samples from the north and south boils of Gemini Springs were consistent with atmospheric equilibration during groundwater recharge with the addition of minor amounts of excess air (Walsh et al. 2009). Based on the dissolved gas data, the calculated recharge temperature was 22 to 23°C. (assuming a recharge elevation of 50 feet and 100 % humidity at the water table).

Atmospheric tracer data (sulfur hexafluoride (SF_6) and tritium (^{3}H) concentrations) indicate that the age of water from the north and south boils at Gemini Springs likely is young (less than 5 years) (Toth and Katz 2006). However, high concentrations of SF_6 in some of the 2005 samples exceeded atmospheric levels, likely indicating a contribution from nonatmospheric sources and rendering SF_6 concentrations unusable for age dating. However, based on ^{3}H concentrations in spring water samples in 1996, Gemini Springs contains a young fraction of water that is less than 43 years old. In 1999, water samples were analyzed for ^{3}H and its decay product helium-3, and these data indicate that the younger fraction of water from Gemini Springs was 19 years old. Also, a 1996 carbon-14 concentration (41 % modern carbon) indicated likely the mixing of UFA and LFA water.

1.4 Aquifer Recharge and Vulnerability

The rate of groundwater recharge that occurs in an area is a function of the thickness of the overburden material, the presence or absence of sinkholes, and the differences in aquifer water level elevations. **Figures 1.9** and **1.10** show the relative rates of recharge that the Floridan aquifer receives in the estimated contributing areas based on a 2015 recharge coverage developed by the SJRWMD (Boniol and Mouyard 2016). In the DeLand Ridge, east of DeLeon Spring and north and east of Gemini Springs, there are high recharge rates because of the well-developed karst topography and excessively drained fine sandy soils (Knochenmus and Beard

1971). The lowlands of the St. Johns River Offset are dominated by very poorly drained mucky soils in the river valley, where there is either discharge of groundwater through springs or seepage or low recharge rates. Aquifer discharge occurs west of DeLeon Spring and in a wide belt along the St. Johns River corridor south of Gemini Springs. The Crescent City Ridge, located to the north of DeLeon Spring, is characterized by moderately developed karst topography and poorly drained, fine sandy soils. These conditions promote significant recharge as well (Rutledge 1982). Much like the Crescent City and DeLand Ridges, the Geneva-Chuluota-Oviedo Hills area south of Gemini Springs is a predominately sandy upland composed of deeply weathered Plio-Pleistocene coastal sand deposits where there is high recharge to the UFA (Griffith et al. 1997).

The statewide Florida Aquifer Vulnerability Assessment (FAVA) model for the Floridan aquifer system developed by FGS generally represents the vulnerability to aquifer contamination based on conditions such as soil characteristics, depth to groundwater, recharge rate, and the prevalence of sinkhole features (Arthur et al. 2007). **Figures 1.11** and **1.12** show the vulnerability of the Floridan aquifer system in the areas contributing to the springs. In the areas classified as "more vulnerable," contaminants from the surface can more readily move vertically to the aquifer through the geological material or through sinkholes. In the area classified as "vulnerable," confining material is present and sinkholes are less prevalent. The FAVA model shows that the upland areas within the contributing areas show the highest vulnerability to groundwater contamination. The lowlands of the St. John’s River Offset are less vulnerable to contamination because these are areas that predominately discharge groundwater.

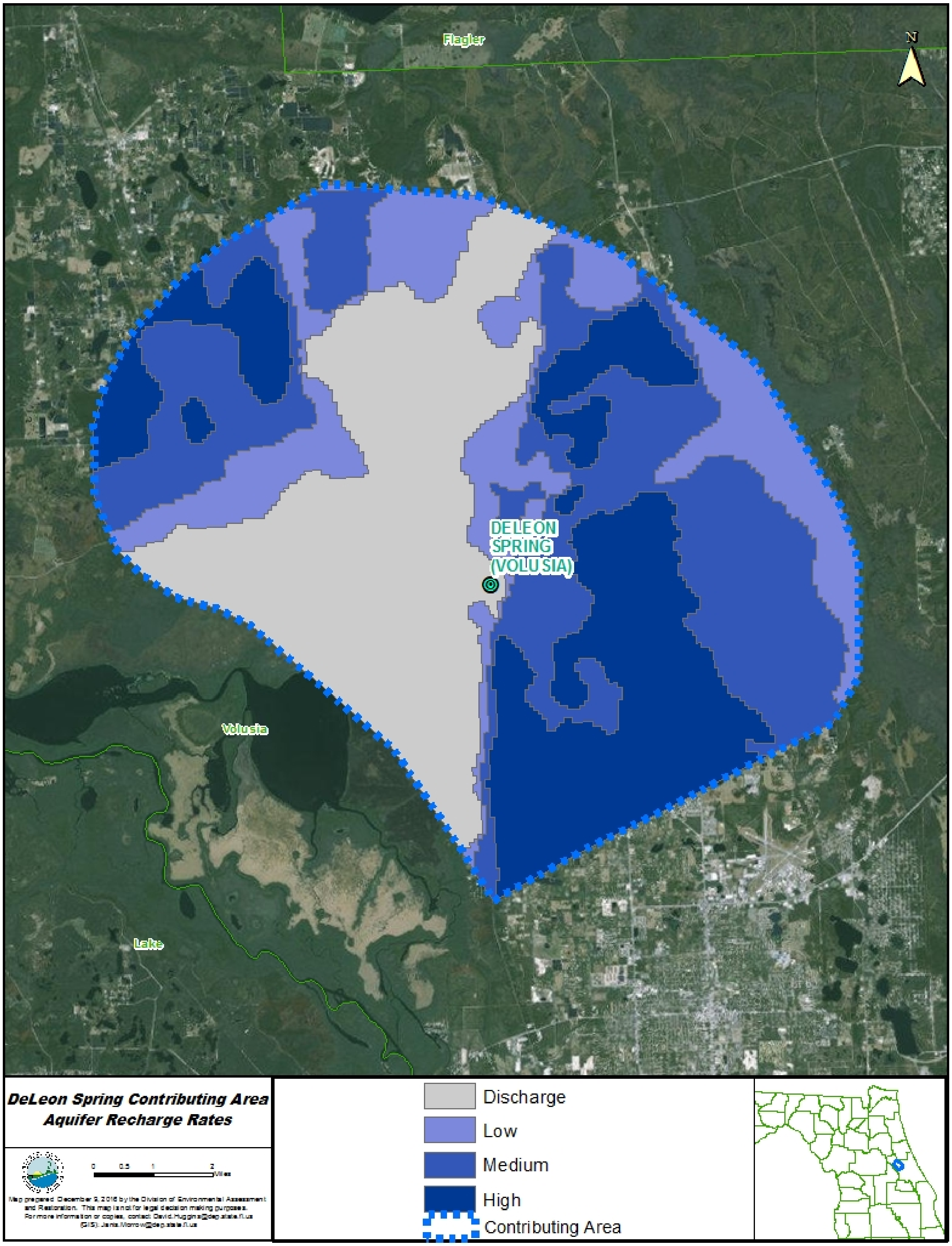

Figure 1.9. Aquifer recharge in the DeLeon Spring contributing area

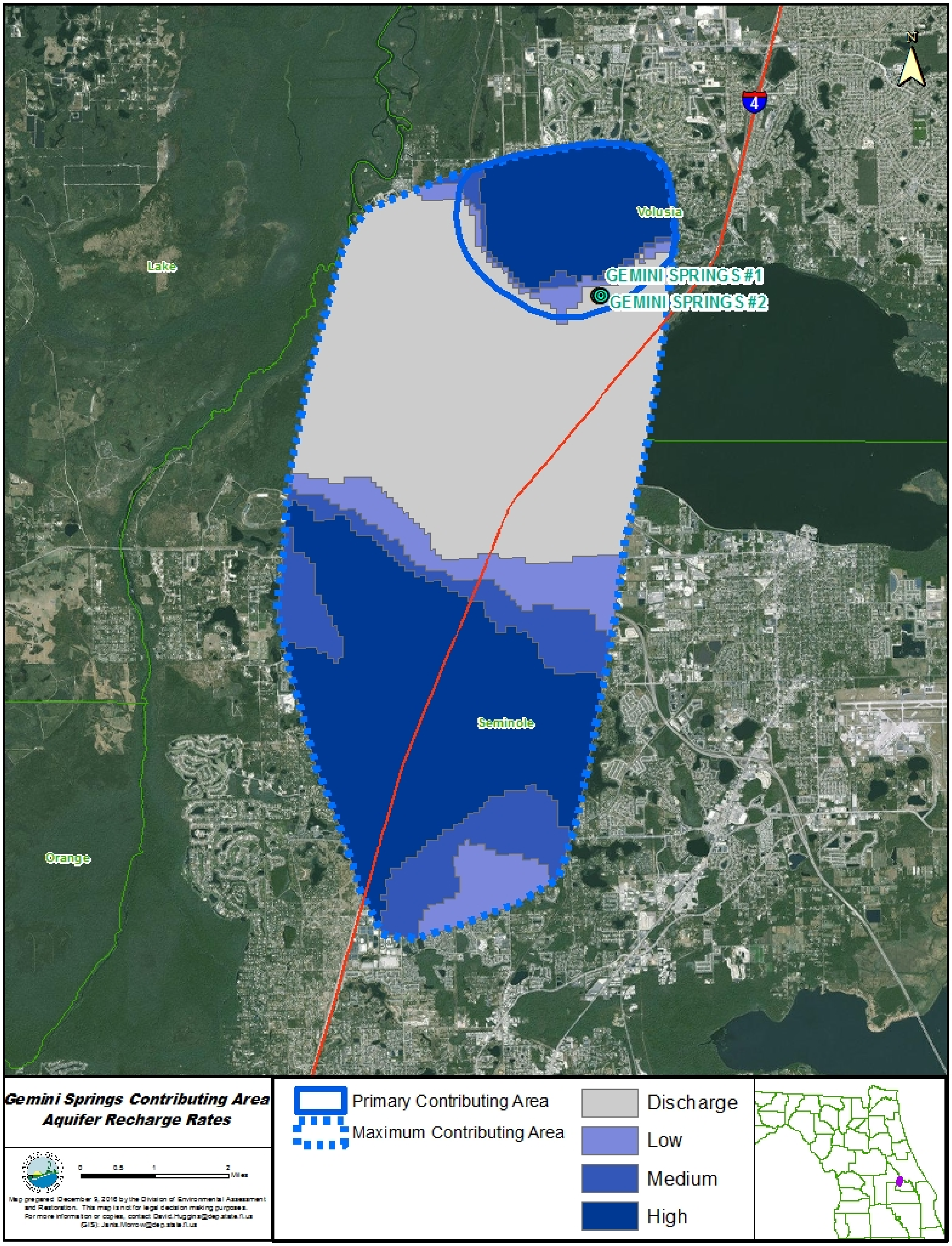

Figure 1.10. Aquifer recharge in the Gemini Springs contributing area

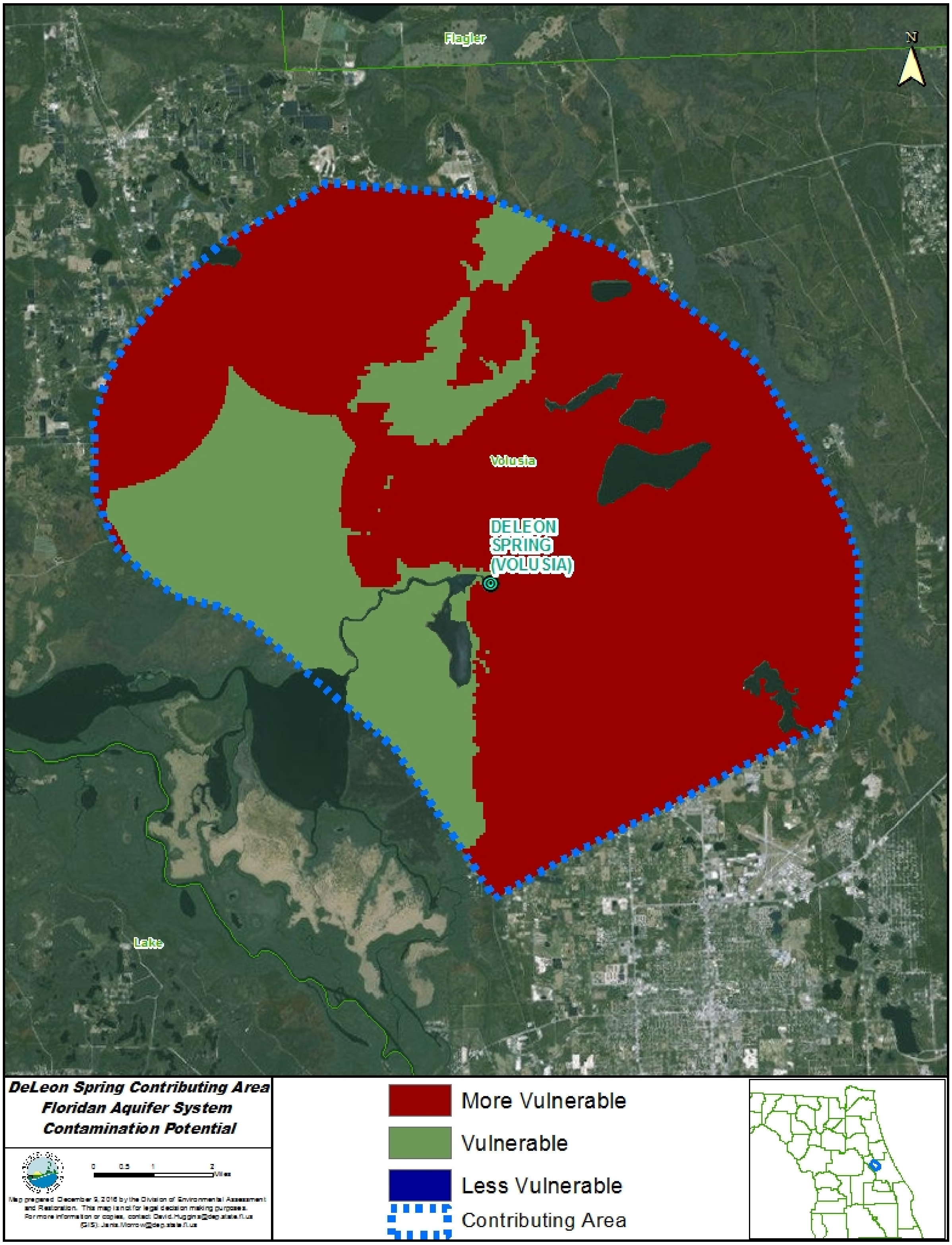

Figure 1.11. Aquifer vulnerability in the DeLeon Spring contributing area

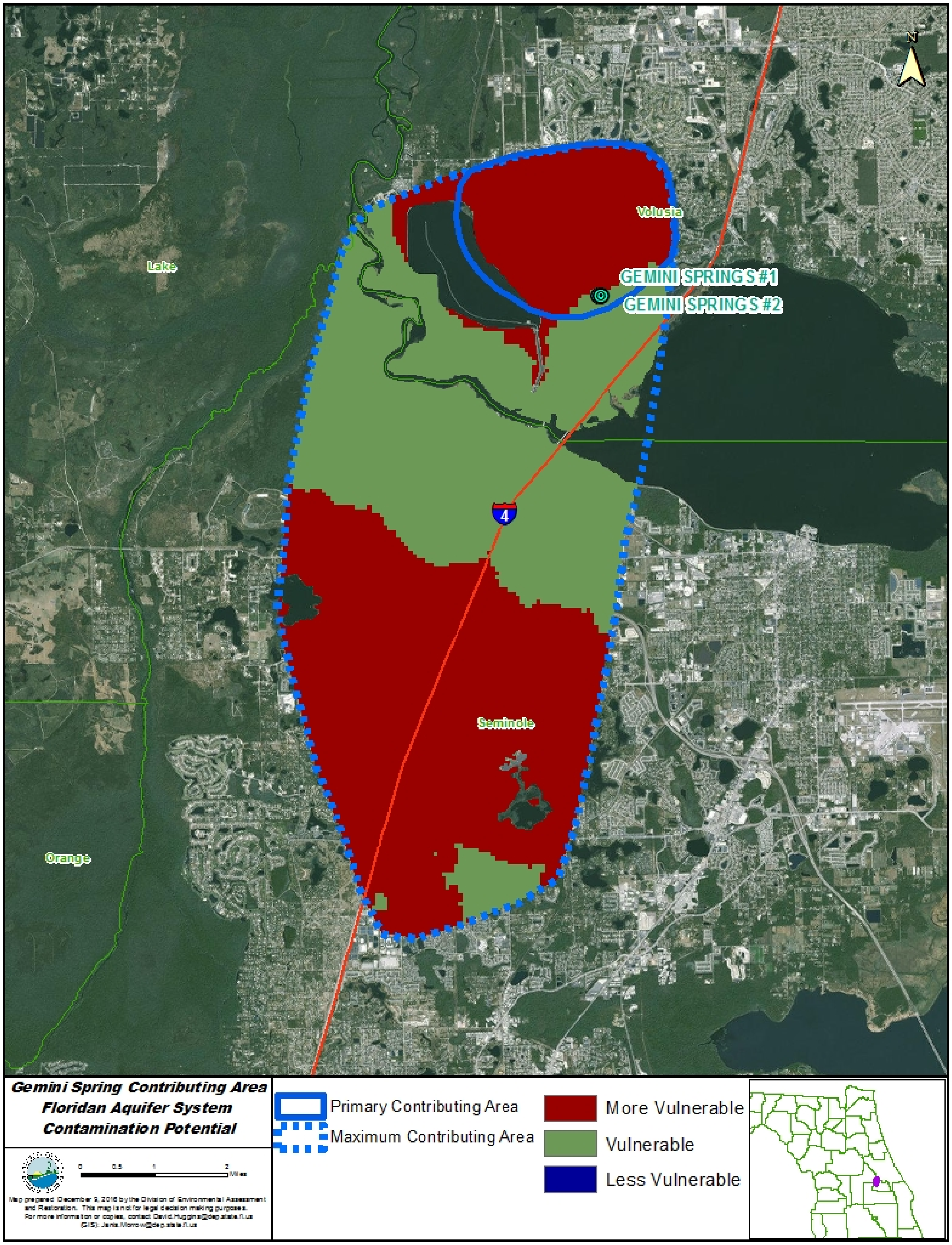

Figure 1.12. Aquifer vulnerability in the Gemini Springs contributing area

1.5 Background

This report was developed as part of DEP's watershed management approach for restoring and protecting state waters and addressing state and U.S. Environmental Protection Agency (EPA) documentation requirements for a TMDL. The watershed approach, which is implemented using a cyclical management process that rotates through the state's 52 river basins over a 5-year cycle, provides a framework for implementing the requirements of the 1972 federal Clean Water Act and the 1999 Florida Watershed Restoration Act (FWRA) (Chapter 403.067, Laws of Florida) for TMDLs.

A TMDL is a scientific determination of the maximum amount of a pollutant that a waterbody can receive each day and still be considered healthy. TMDLs are developed for waterbodies that are verified as not meeting their water quality standards. They provide important water quality restoration goals that will guide restoration activities.

The adoption of a nutrient TMDL for DeLeon Spring and Gemini Springs will be followed by the development and implementation of a BMAP for reducing the levels of nutrients. The restoration of these waterbodies will depend on the active participation of stakeholders in the contributing area, including local governments (Volusia and Seminole Counties), local landowners, permitted facilities, and agricultural interests. The SJRWMD will also be a key partner in working with local stakeholders to develop and implement water quality restoration projects. The Florida Department of Agriculture and Consumer Services (FDACS) will play an important role in helping agricultural producers implement best management practices (BMPs) and other measures (as appropriate) to address nutrient losses.

Chapter 2: Description of Water Quality Problem

2.1. Statutory Requirements and Rulemaking History

Section 303(d) of the federal Clean Water Act requires states to submit to the EPA a list of surface waters or segments 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 list of impaired waters in each basin, referred to as the Verified List, is also required by the FWRA (Subsection 403.067[4], Florida Statutes [F.S.]), and the state's Verified List of impaired waters is amended annually to include basin updates. These updates are then submitted to the EPA with the intent of amending Florida's 303(d) list.

The FWRA (Section 403.067, F.S.) directed DEP to develop, and adopt by rule, a science-based methodology to identify impaired waters. After a long rulemaking process, the Environmental Regulation Commission adopted the new methodology as Chapter 62-303, F.A.C. (Identification of Impaired Surface Waters Rule, or IWR), in April 2001. The IWR was modified in 2006, 2007, 2012, 2013, and 2016.

2.2. Information on Verified Impairment

Chapter 62-303, F.A.C., includes the methodology for listing impaired surface waters based on documentation that supports the determination of a waterbody's imbalance in flora or fauna attributable to nutrients. DEP used the IWR Run 52 data to assess water quality impairments in DeLeon Spring and Gemini Springs, which were verified as impaired for nutrients based on elevated annual geometric mean (AGM) nitrate-nitrite ($NO_3 + NO_2$) values during the Cycle 3 verified period (the verified period for the Group 2 basins was January 2007 to June 2014). DeLeon and Gemini Springs both exceeded the nitrate-nitrite threshold for springs every year since during the verified period.

2.3 Nutrient Enrichment

Nutrient enrichment contributes to the impairment of many surface waters, including springs. The two major nutrient parameters monitored are nitrogen (N) and phosphorus (P). These are essential nutrients to plant life, including algae. For aquatic vegetation and algae to grow, both nutrients must be present. In fact, one can be present in excess, but if the other is absent, the overgrowth of vegetation or algae is unlikely to occur. Historically, many spring systems have had sufficient naturally occurring phosphorus to trigger an imbalance. It is widely accepted that primary production in spring-fed waterbodies is controlled by nutrients, sunlight, flow, spring discharge, temperature, and mineral content in groundwater.

The results of ongoing research on many Florida springs have led to significant progress in understanding the threshold concentrations of nitrogen and phosphorus that cause the overgrowth of nuisance macroalgae (Stevenson et al. 2007). Macroalgae may also sequester nutrients from groundwater seepage, although this may not be apparent from surface water or spring monitoring data. The elevated nitrogen concentrations are connected to the significant overgrowth of macroalgae in both DeLeon and Gemini Springs. The nutrient inputs contributing to the algal growth in these springs may not be exclusively related to spring discharge, as legacy nutrients found in the sediments within the contributing area can diffuse back into the water column.

2.4 Ecological Issues Related to Nutrients

The amount and type of aquatic vegetation are linked to water quality and clarity. Submerged aquatic vegetation (SAV) communities support wildlife species, stabilize sediments, prevent erosion, and remove contaminants from the water column and sediments. Evidence of excessive algal coverage has been documented in DeLeon and Gemini Springs. The photos in **Figures 2.1**, **2.2,** and **2.3** show algal impacts both underwater and on the surface at DeLeon and Gemini Springs.

The response of algae to nutrient enrichment in these springs is not unique to these systems. Unfortunately, algal growth is prolific in many spring systems where nutrient concentrations are elevated. The conditions here are similar to those documented in the nutrient TMDLs for the Suwannee and Santa Fe Rivers (Hallas and Magley 2008), Wekiva River and Rock Springs Run (Gao 2007), Wakulla River (Gilbert 2012), Silver Springs and River (Holland and Hicks 2012), Rainbow Springs and River (Holland and Hicks 2013), Jackson Blue Spring (Dodson 2013), Weeki Wachee Spring (Dodson and Bridger 2014), Volusia Blue Spring (Holland and Bridger 2014), and Wacissa River and Springs (Bridger et al. 2016).

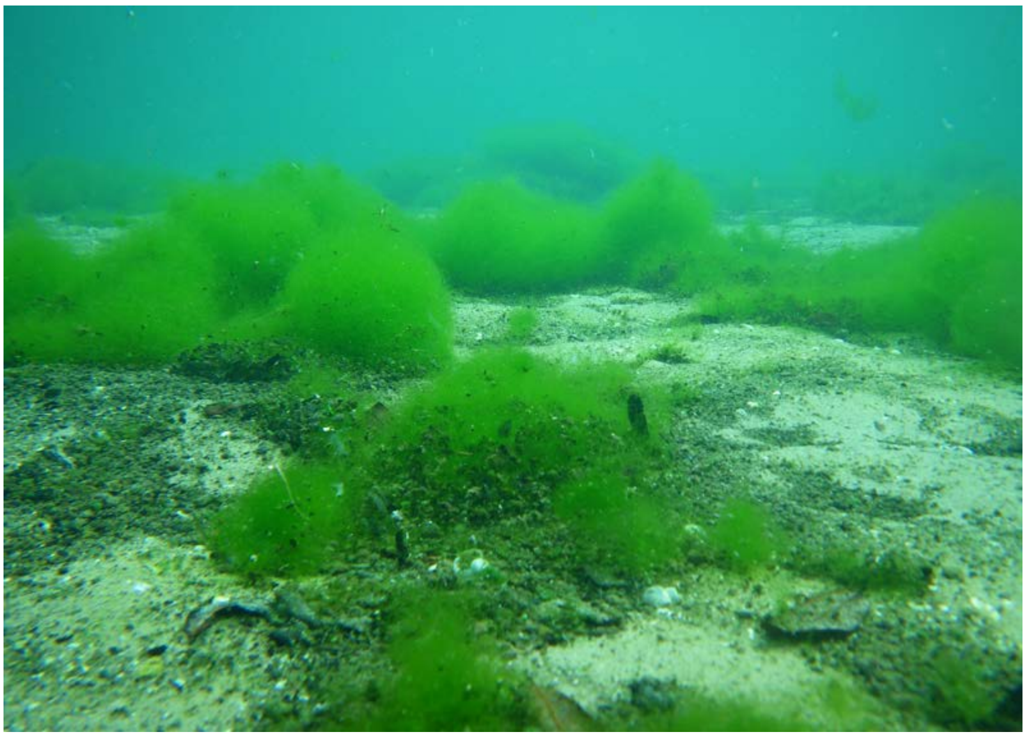

Figure 2.1. Underwater algal impacts southeast of the DeLeon Spring vent, May 12, 2011 (photo by DEP Groundwater Management Section)

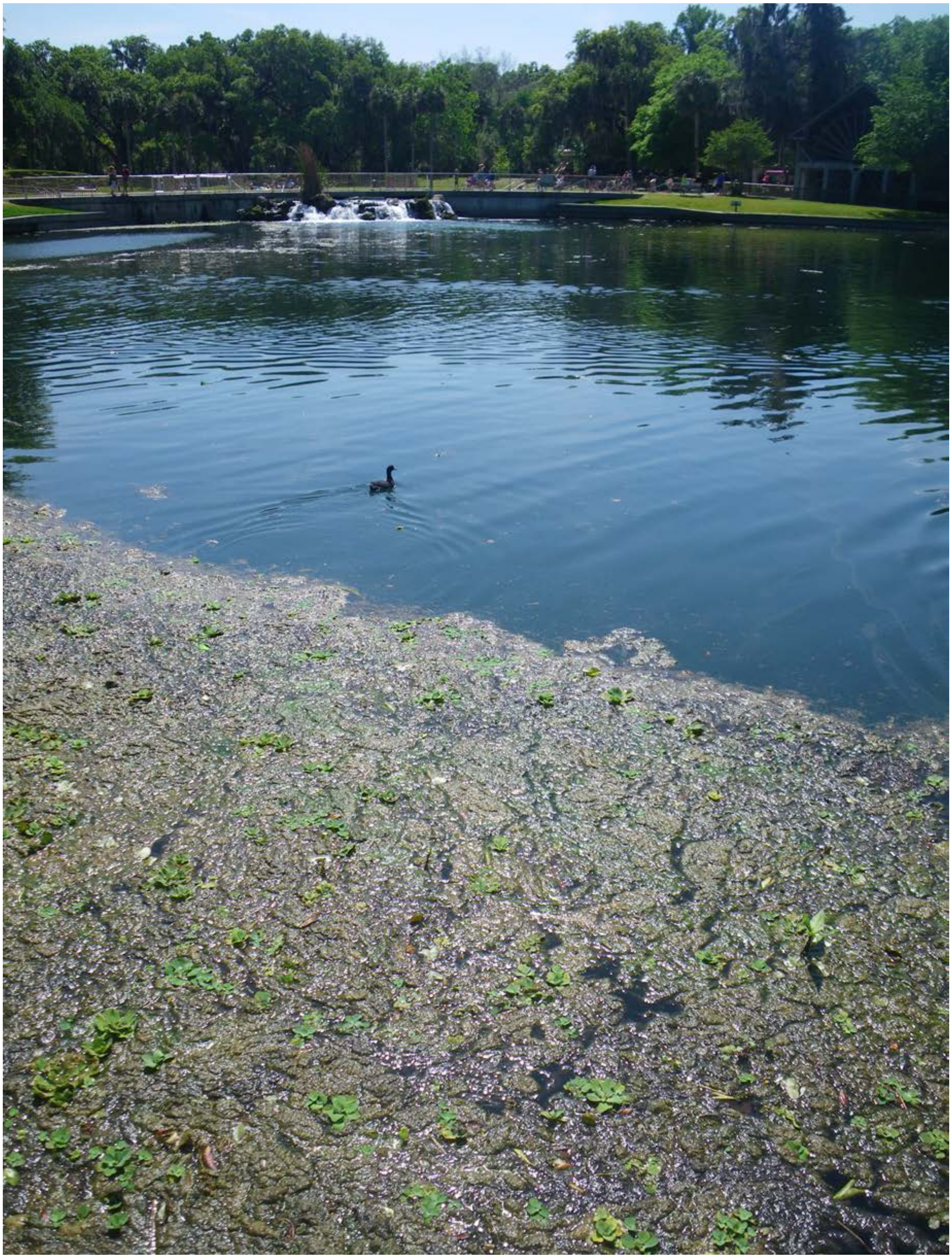

Figure 2.2. Algal impacts at DeLeon Spring looking upstream toward headspring, March 23, 2011 (photo by DEP Groundwater Management Section)

Figure 2.3. Algal impacts in Gemini Springs headspring area, August 8, 2012 (photo by DEP Groundwater Management Section)

2.5 Rainfall and Temperature Data

The climate in the DeLeon and Gemini Springs area is humid subtropical, with hot, rainy summers and cool, drier winters. Recharge to groundwater and flow in springs depends on climatic patterns and available precipitation in the contributing areas. Because the contributing areas are close to the DeLand, FL weather station, rainfall amounts and temperature from this station were used to represent climatic conditions in the contributing areas of these springs. Rainfall and temperature data were reviewed for the 30-year period of record from January 1986 through December 2016. DEP used data from the DeLand, FL National Oceanic and Atmospheric Administration (NOAA) Station: DeLand 1 SSE FL US, GHCND: USC00082229 (NOAA National Centers for Environmental Information [NCEI] 2016).

Table 2.1 summarizes monthly temperature data from 1986 to 2016. Annual rainfall averages 56.1 inches per year (in/yr), with an average air temperature of 63.6° F. (NOAA 2016). **Figure 2.4** shows the 30-year historical rainfall trends measured for DeLand. Over this period, the lowest annual rainfall of 38.48 inches occurred in 2006, and the highest annual rainfall of 76.69 inches occurred in 2001.

Table 2.1. Temperature and precipitation at DeLand, FL (Station: DeLand 1 SSE FL US, GHCND: USC00082229 (NOAA NCEI), January 1986–December 2016

Analysis	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Max Temp (°F)	69.6	71.9	76.7	81.4	86.2	89.5	91.2	90.8	87.9	82.5	76.5	71.5	81.3
Mean Min Temp (°F)	45.6	47.8	51.8	57.0	63.6	70.5	72.3	72.8	71.1	63.2	54.6	48.7	59.9
Mean Observed Temp (°F)	50.6	52.9	56.5	61.5	67.3	73.0	74.7	74.8	73.2	66.2	58.5	53.7	63.6
Mean Monthly Precipitation (in)	3.3	2.8	3.9	2.4	3.7	7.9	8.1	7.9	6.9	4.0	2.6	2.5	56.1

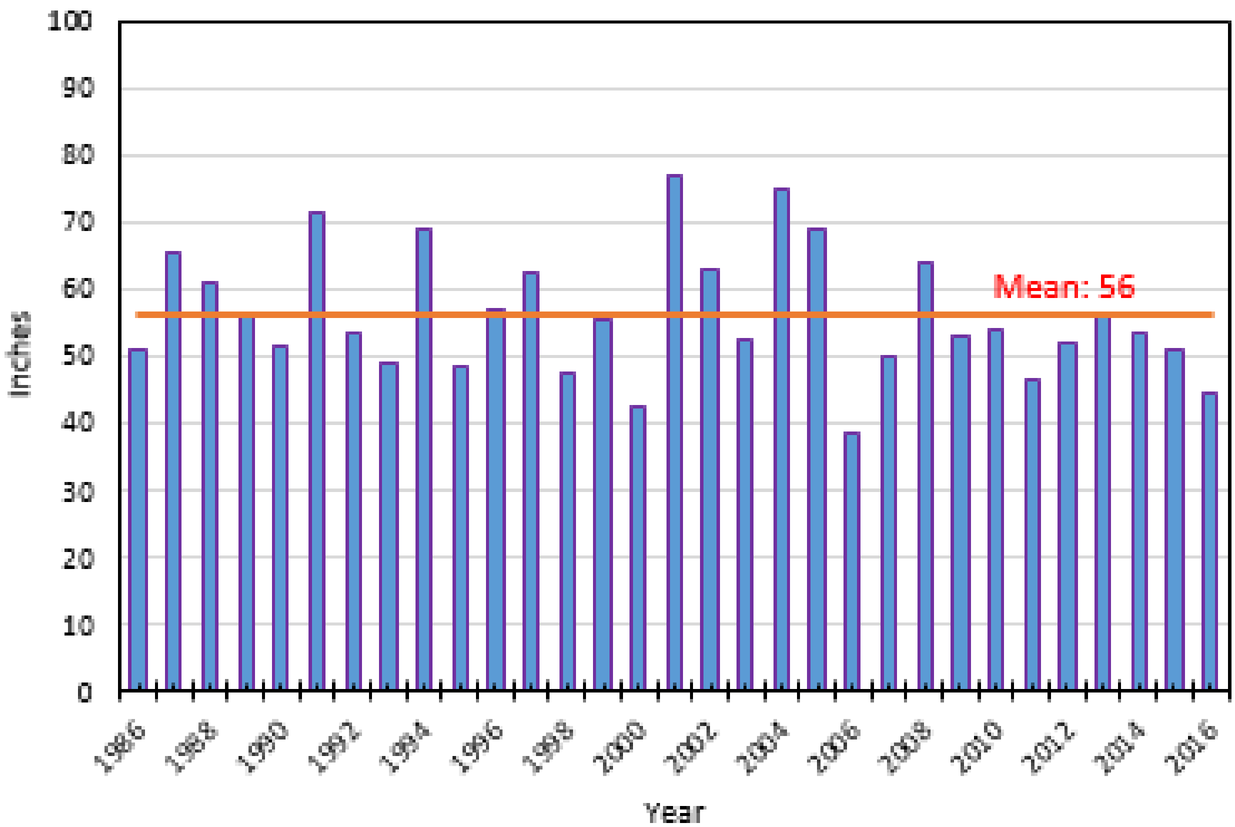

Figure 2.4. Thirty-year average precipitation for DeLand, Florida, January 1986–December 2016 (NOAA NCEI; Station: DELAND 1 SSE FL US)

2.6 Discharge Data

The SJRWMD collects discharge measurements at gauging stations throughout the district. Measurements have been collected at DeLeon Spring since February 1983, and continuous daily mean discharge data are available from October 2006 to the present (SJRWMD 2016). This station (U.S. Geological Survey [USGS] Station #0030189) is located at the headspring outflow of DeLeon Spring. Average discharge from the spring from October 2006 to December 2016 was 22.92 cubic feet per second (cfs) with a maximum discharge of 31.04 cfs, and a minimum discharge of 15.08 cfs (**Figure 2.5**; **Table 2.2**).

The measurements of Gemini Springs discharge began in 1972, and a continuous daily discharge dataset is available from October 2007 to the present. The Gemini Springs station at Debary, FL (Station No. 00410494) is located at the weir outlet at the east end of the reservoir, which receives discharge from the three spring vents. The average discharge from Gemini Springs from October 2007 to February 2016 was 9.66 cfs, with a maximum discharge of 12.16 and a minimum of 7.62 cfs (**Figure 2.6; Table 2.2**).

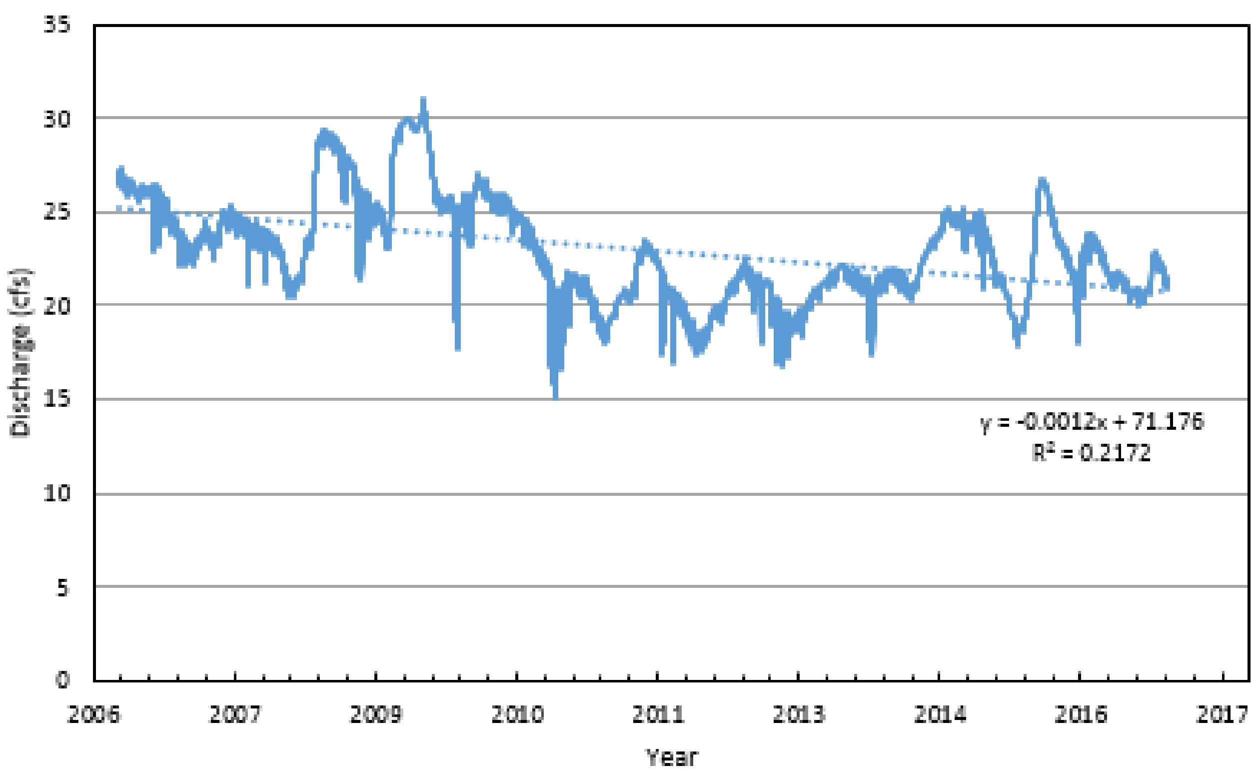

Figure 2.5. Daily discharge data, DeLeon Spring, FL, October 2006–December 2016 (SJRWMD; USGS)

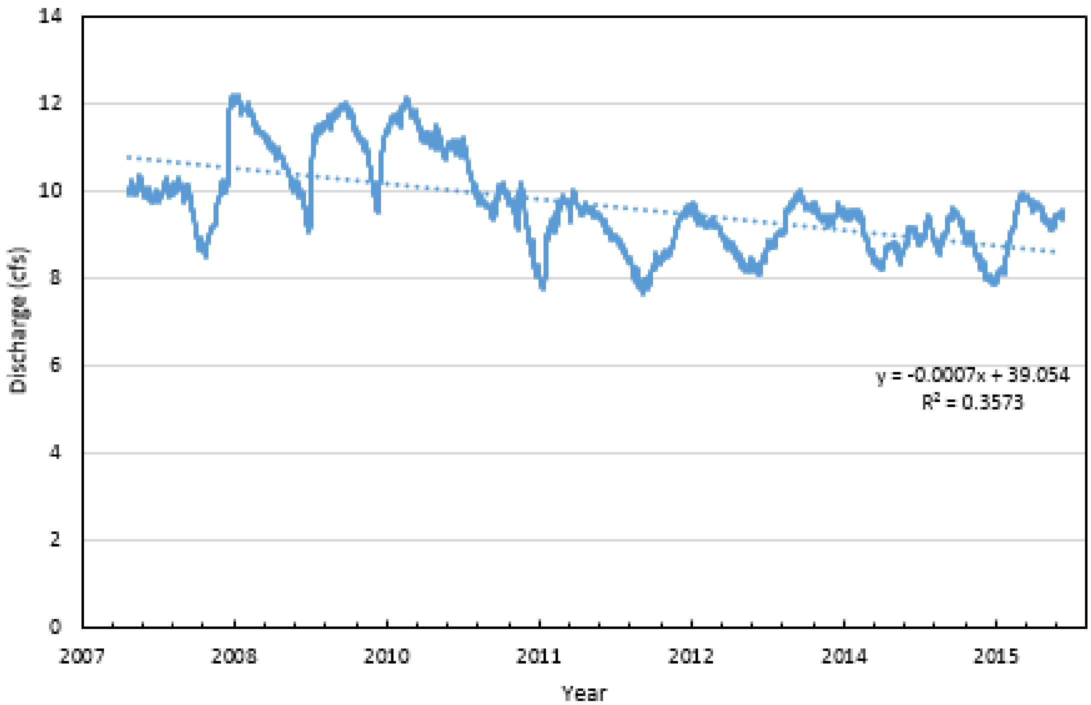

Figure 2.6. Daily discharge data, Gemini Springs, October 2007–February 2016 (SJRWMD; USGS)

Table 2.2. Summary statistics of discharge data, DeLeon Spring (October 2006–December 2016) and Gemini Springs (October 2007–February 2016) (SJRWMD; USGS)

Measurements are in cfs
Std Dev = Standard deviation; CV = Coefficient of variance; n = Number

Waterbody Name	WBID	Mean	Median	Maximum	Minimum	Std Dev	CV	n
DeLeon Spring	2921A	22.92	22.58	31.04	15.08	2.72	0.12	3,696
Gemini Springs	2893	9.66	9.49	12.16	7.62	1.06	0.11	3,041

2.7 Monitoring Sites and Sampling

Figures 2.7 and **2.8** show the locations of the water quality sampling stations used for assessing impairment at both DeLeon and Gemini Springs, respectively. Volusia County, DEP, and the SJRWMD collected all the samples used to verify the impairment of the springs at the spring pools, which are represented by DeLeon Spring (WBID 2921A) and Gemini Springs (WBID 2823). To ensure that the nutrient TMDLs were developed based on current conditions and that recent trends in spring water quality were included, monitoring data were used from samples collected during the Cycle 3 verified period (2007–13 for DeLeon Spring; 2008–13 for Gemini Springs) plus more recently collected data (2013–16).

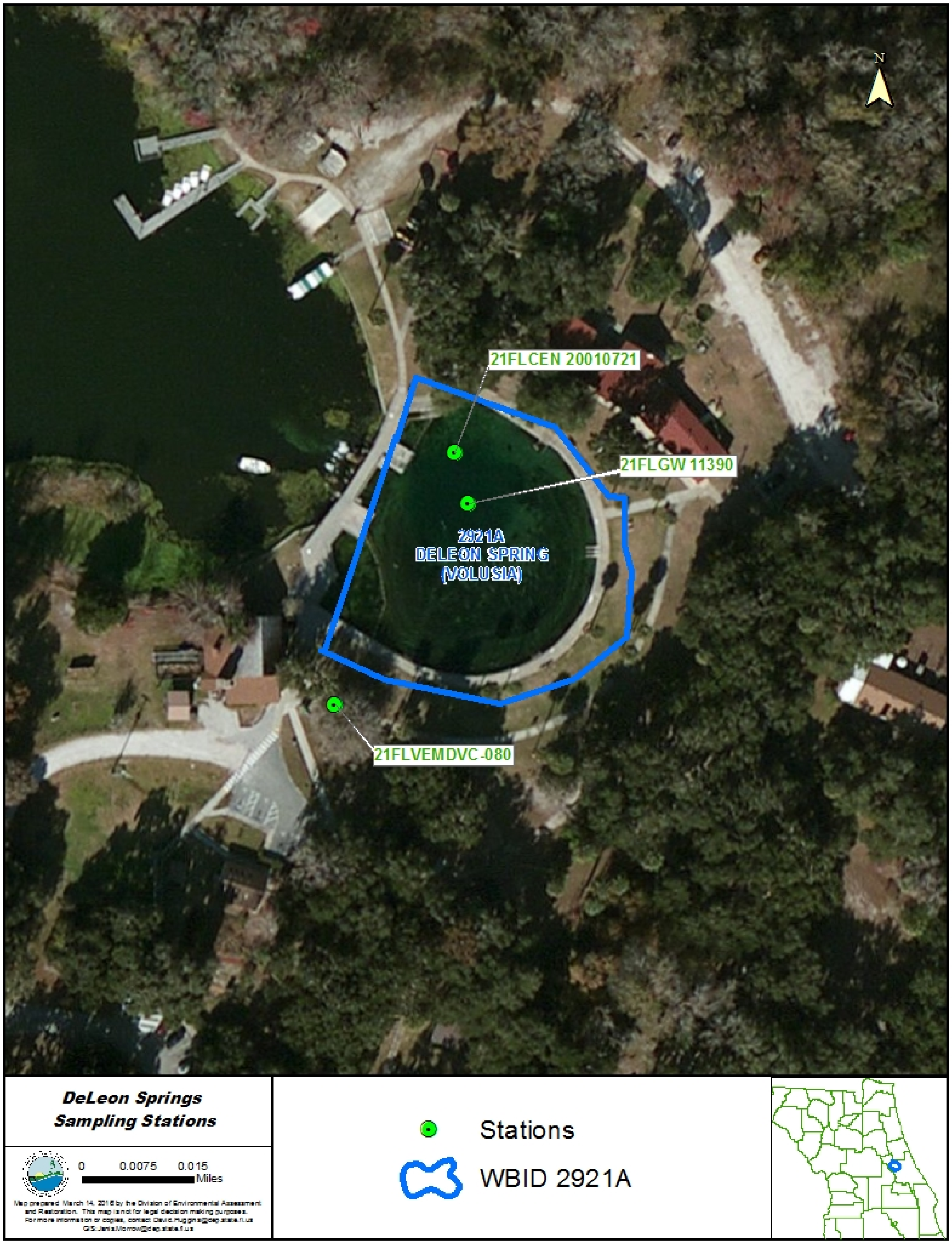

Figure 2.7. Spring monitoring sites associated with the listing of impaired DeLeon Spring (WBID 2921A) and the development of a TMDL (Note: Station location information from data providers may not be accurate)

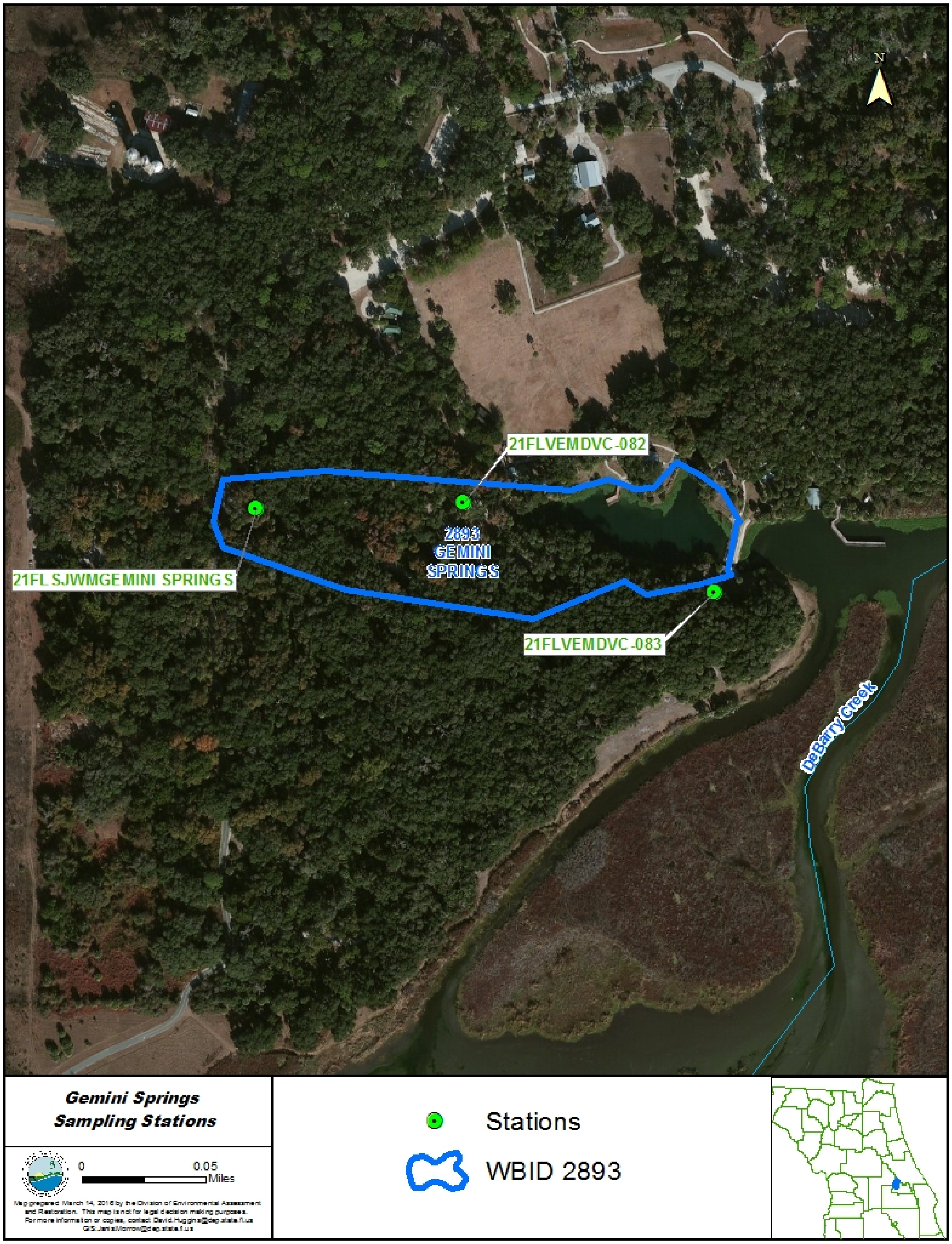

Figure 2.8. Spring monitoring sites associated with the listing of impaired Gemini Springs (WBID 2893) and the development of a TMDL (Note: Station location information from data providers may not be accurate)

2.8 Monitoring Results

2.8.1 Nitrogen

Nitrogen is found in several forms and is ubiquitous in the environment. Nitrate-nitrogen is the nutrient most commonly associated with ecological imbalances in spring systems because it is the most mobile and available form of nitrogen for use by plants and algae. Increases in nitrate concentrations in springs have been found to correlate with the degradation of biological systems because of the overgrowth of filamentous algal mats, phytoplankton blooms, and sometimes aquatic plants (Harrington et al. 2010).

Nitrate-nitrite (NO_3-NO_2) is the form of nitrogen that occurs in the highest concentrations in groundwater and springs. Historically, nitrogen was only a minor constituent of spring water, and typical nitrate concentrations in Florida were less than 0.2 mg/L until the early 1970s. Since then, elevated concentrations of nitrate have been found in many springs. Nitrate is the dominant form of nitrogen in DeLeon and Gemini Springs. Other forms of nitrogen (organic and ammonia nitrogen) make up less than 30 % of the total nitrogen in samples from DeLeon and Gemini Springs for the period of record used in TMDL development.

Historical water quality data for DeLeon and Gemini Springs provide a glimpse of current versus background water quality. Water quality data have been collected from various locations around the springs and their receiving waters. The Florida Storage and Retrieval (STORET) and SJRWMD databases contain many of these data.

At DeLeon Spring, the earliest dated nitrate sample in the STORET database (IWR Run 52) was collected by the USGS in 1956. The USGS collected a total of 15 samples from 1956 to 1972, and these had a mean concentration of 0.34 mg/L. Beginning in 2000, Volusia County and DEP began sampling DeLeon Spring with more regularity, with data from one agency or the other on a near-monthly basis. Then, in 2002, the SJRWMD also began collecting nitrate-nitrite samples quarterly. The dataset used in the assessment of this waterbody includes data collected by all 3 entities.

At Gemini Springs, the earliest dated nitrate-nitrite sample in the STORET database (IWR Run 52) was collected by Volusia County in 2000, and had a nitrate-nitrite concentration of 0.75 mg/L. The near-monthly sampling by Volusia County, and sampling conducted by the SJRWMD provided the dataset used in the assessment of this waterbody.

AGM nitrate-nitrite concentrations from spring samples in the DeLeon headspring ranged from 0.47 to 0.79 mg/L, based on historical data. For Gemini Springs, AGM nitrate-nitrite concentrations ranged from 0.97 to 1.33 mg/L at the headsprings. The nitrate-nitrite concentrations for both DeLeon and Gemini Springs exceeded the 0.35 mg/L AGM threshold set under the Florida NNC (Paragraph 62-302.530(90)(b), F.A.C.) every year during the verified period, and for the following years through 2016 (**Figures 2.9** and **2.10**). AGM concentrations were not calculated for the small portion of 2017 used in the evaluation because of insufficient sample size.

Table 2.3 summarizes nitrate-nitrite results for DeLeon and Gemini Springs. Average ammonia concentrations for these springs are only around 0.06 mg/L, and average organic carbon concentrations (measured as total Kjeldahl nitrogen [TKN]) are around 0.20 mg/L. Because it is the main form of nitrogen in the springs, nitrate-nitrite is considered the target nutrient for the TMDL for these springs. **Chapter 5** discusses the nutrient impairment and the setting of the target concentration for nitrate.

Table 2.3. Summary statistics for all nitrate-nitrite data in DeLeon and Gemini Springs, 2007–17

Location	Analyte	Sample Dates	Units	Number of Samples	Mean	Median	Minimum	Maximum
DeLeon Spring	Nitrate+Nitrite	1/2007–1/2017	mg/L	154	0.59	0.55	0.25	1.10
Gemini Spring	Nitrate+Nitrite	1/2008–1/2017	mg/L	112	1.18	1.18	0.97	1.49

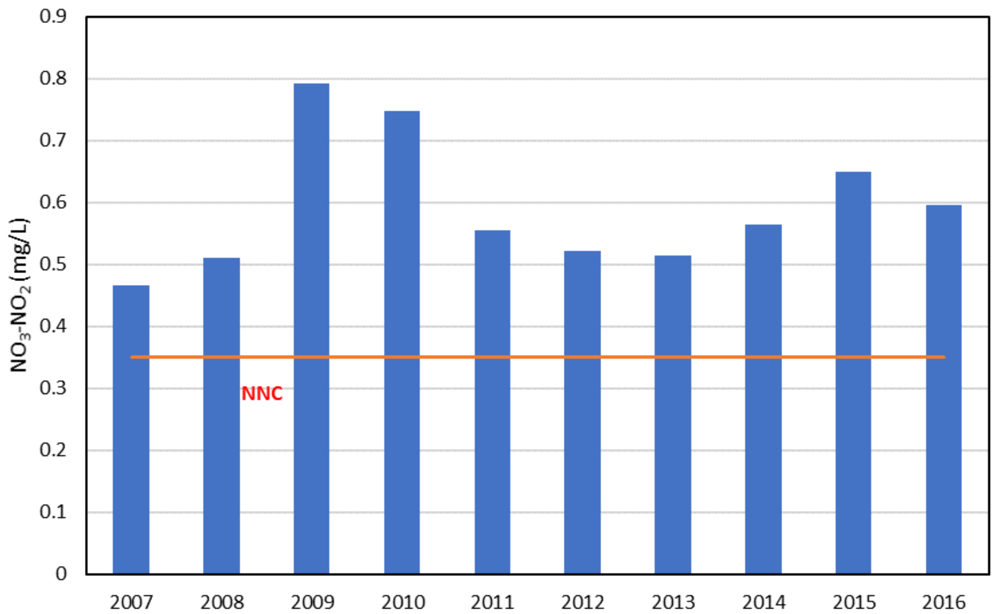

Figure 2.9. AGM nitrate-nitrite at DeLeon Spring, 2007–16

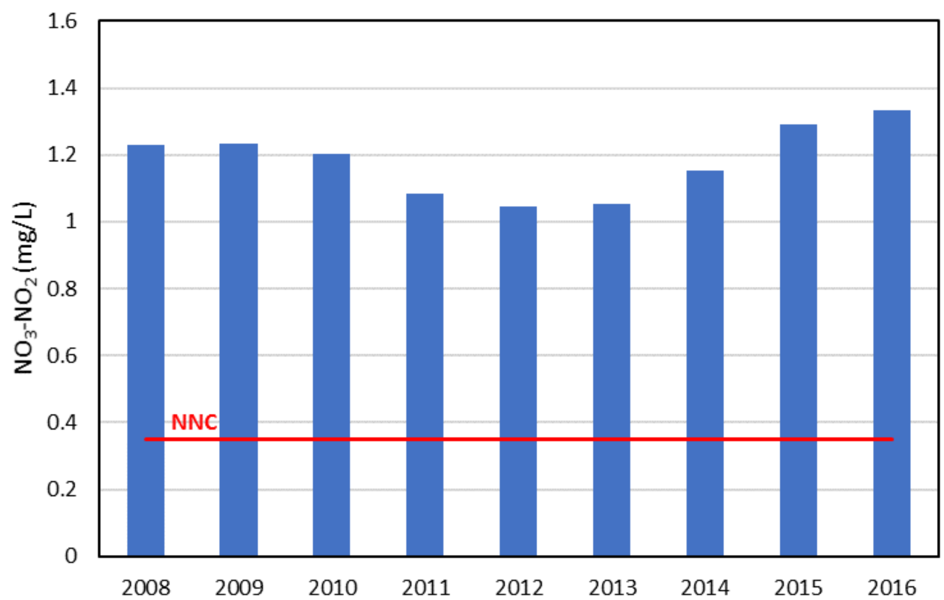

Figure 2.10. AGM nitrate-nitrite at Gemini Springs, 2007–16

2.8.2 Phosphorus

Total phosphorus (TP) includes both phosphorus from organic sources and orthophosphate. Organic phosphorus comes from peat and muck in riverbeds and lake bottoms and decaying aquatic vegetation. The organic phosphorus content in spring water is normally low. Orthophosphate is naturally abundant in the geologic material in much of Florida, coming from clays overlying the Floridan aquifer and in the limestone as dissolved phosphorus bound to calcium in the rock matrix (Fitts 2013). Only the inorganic form of phosphorus, orthophosphate, is generally found at significant concentrations in groundwater and springs.

In DeLeon and Gemini Springs, orthophosphate has historically been the largest contributor to TP based on historical water quality data from DeLeon and Gemini Springs (historical TP medians of 0.059 and 0.076 mg/L, respectively, compared with historical orthophosphate medians of 0.053 and 0.064 mg/L, respectively). Historical monitoring data for orthophosphate for all spring samples from DeLeon and Gemini Springs, as well as groundwater samples collected across the Middle St John's Basin show no significant trends, indicating that the orthophosphate is a persistent natural condition. **Table 2.4** summarizes TP and orthophosphate statistics for DeLeon and Gemini Springs for the TMDL verified period, as well as basinwide TP and orthophosphate statistics for groundwater within the Middle St. Johns Basin from the Florida Generalized Well Information System (GWIS) database.

Table 2.4. Summary statistics for phosphorus data in DeLeon and Gemini Springs (2007–16) and the Middle St. Johns Basin (1980–2017)

* Outliers were removed.

DeLeon Spring

Sample Dates	Units	Analyte	Number of Samples	Mean	Median	Minimum	Maximum
Jan. 2007–Dec. 2016	mg/L	Total Phosphate	164	0.059	0.059	0.005	0.350
Jan. 2007–Dec. 2016	mg/L	Ortho-phosphate	137	0.053	0.054	0.037	0.073

Gemini Springs

Sample Dates	Units	Analyte	Number of Samples	Mean	Median	Minimum	Maximum
Jan. 2008–Dec. 2016	mg/L	Total Phosphate	131	0.076	0.073	0.012	0.856
Jan. 2008–Dec. 2016	mg/L	Ortho-phosphate	111	0.064	0.064	0.048	0.082

Middle St. Johns Basin Groundwater

Sample Dates	Units	Analyte	Number of Samples	Mean	Median	Minimum	Maximum
Jan. 1980–Mar. 2017	mg/L	Total Phosphate	Maximum of 60 wells	0.094	0.055	0.002	0.54
Jan. 1980–Mar. 2017	mg/L	Ortho-phosphate	Maximum of 60 wells	0.108	0.067	0.002	0.64

Chapter 3. Description of Applicable Water Quality Standards and Targets

3.1 Classification of the Waterbody and Criterion Applicable to the TMDLs

Florida's surface waters are protected for six designated use classifications, as follows:

Class I	**Potable Water Supplies**
Class II	**Shellfish propagation or harvesting**
Class III	**Fish consumption; recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife**
Class III–Limited	**Fish consumption; recreation or limited recreation; and/or propagation and maintenance of a limited population of fish and wildlife**
Class IV	**Agricultural water supplies**
Class V	**Navigation, utility, and industrial use (there are no state waters currently in this class)**

DeLeon Spring (WBID 2921A) and Gemini Springs (WBID 2893) are Class III waterbodies (with designated uses of fish consumption; recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife). The Class III water quality criterion applicable to the impairment addressed by these TMDLs is the nitrate-nitrite criterion for spring vents.

3.2 Applicable Water Quality Standards and Numeric Water Quality Targets

The Class III water quality criterion applicable to the verified impairment of nitrate-nitrite (NO_3-NO_2) for this water is Florida's nutrient criteria in Paragraph 62-302.530(90)(b), F.A.C. Florida adopted new numeric nutrient standards for lakes, spring vents, and streams on December 8, 2011, which were approved by the EPA on November 30, 2012 and became effective on October 27, 2014. It is envisioned that these standards, in combination with the related bioassessment tools, will facilitate the assessment of designated use attainment for its waters and provide a better means to protect state waters from the adverse effects of nutrient overenrichment.

Paragraph 62-302.530(90)(b), F.A.C., states that "in no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna." The spring vent nitrate-nitrite criterion is based on a strong stressor-response relationship between nitrate-nitrite and the presence of nuisance algal mats, with the criterion established at a concentration that would prevent nuisance mats from occurring (compared with natural background levels). A "spring vent" is defined as a location where groundwater flows out of a natural, discernible opening in the ground onto the land surface or into a predominantly fresh surface water.

Florida's nitrate-nitrite (NO_3-NO_2) NNC for spring vents, set forth in Paragraph 62-302.530(90)(b), F.A.C., is expressed as an AGM value of 0.35 mg/L, which is not to be exceeded more than once in any consecutive 3-year period. DEP's hierarchical approach gives preference to the numeric nutrient value of 0.35 mg/L of nitrate-nitrite for spring vents based on the quantifiable stressor-response relationships between nutrients and biological response (DEP 2013).

While TMDLs can establish a site-specific interpretation of the narrative nutrient criterion, both DeLeon and Gemini Springs have the characteristics of typical freshwater, nontidal spring systems to which the NNC for spring vents apply. Consequently, an AGM of 0.35 mg/L nitrate-nitrite (NO3-NO2) not to be exceeded in any year is the most appropriate target for both TMDLs.

Chapter 4: Assessment of Sources

4.1 Population and Land Use in the Contributing Area for Impaired Waters

4.1.1 Population

Per the U.S. Census Bureau, the population density in Volusia and Seminole Counties in the most recent Census year (2010) was 449.2 and 1,367.0 persons per square mile, respectively. The Census Bureau reports that the total population in 2010 for Volusia and Seminole Counties (which includes but is not exclusive to the DeLeon and Gemini Springs contributing areas) was 494,593 persons with 254,226 housing units, and 422,718 with 181,619 housing units, respectively. The land area of Volusia County is 1,432 square miles, and Seminole County covers an area of 309.22 square miles (U.S. Census Bureau 2017).

4.1.2 Land Uses

Land use information for the DeLeon and Gemini Springs contributing areas was obtained from the 2009 SJRWMD land use/land cover GIS coverage, which were the most recent land use data available. **Table 4.1** and **Figure 4.1** show the breakdown of the various land use categories in the DeLeon Spring contributing area. Wetland, forest, and agriculture were the predominant land cover, covering 32 %, 31 %, and 18 % of the area, respectively. Low-density residential was fourth most prevalent, comprising 9 % of the contributing area. Based on its proximity to the spring, however, low-density residential development in the Town of DeLeon Springs could be an important contributing source of nitrogen. Additionally, a portion of the Lake Woodruff Wildlife Management Area covers 14,001 acres of the DeLeon Spring contributing area.

Table 4.2 and **Figure 4.2** show the breakdown of the various land use categories in the Gemini Springs maximum and primary contributing areas. In the SJRWMD maximum contributing area, wetland, medium-density residential, and water were the predominant land uses, covering 22 %, 14 %, and 13 % of the area, respectively. Low-density residential ranked fourth, comprising 9 % of the area. In the primary contributing area, medium-density residential, low-density residential, and water were the predominant land uses covering 33%, 17%, and 8% of the area, respectively. Wetlands ranked fourth comprising 6% of the area.

Table 4.1. Percentages of major land uses in the DeLeon Spring contributing area in 2009

Code	Land Use	Square Miles	Acres	% of Contributing Area
1100	Low-Density Residential	9.5	6,094.21	9.39
1200	Medium-Density Residential	1.41	900.71	1.39
1300	High-Density Residential	0.44	281.18	0.43
1400	Commercial	0.37	237.82	0.37
1500	Light Industrial	0.05	30.79	0.05
1600	Extractive/Quarries/Mines	0.02	12.93	0.02
1700	Institutional	0.44	280.66	0.43
1800	Recreational (golf courses, parks, marinas, etc.)	0.38	245.33	0.38
1900	Open Land	0.06	36.76	0.06
2000	Agriculture	18.06	11,560.70	17.81
3000 & 7000	Rangeland	1.87	1,199.33	1.85
4000	Forest/Rural Open	31.23	19,985.70	30.79
5000	Water	5.17	3,308.83	5.10
6000	Wetlands	31.98	20,465.74	31.52
8000	Communication and Transportation	0.44	280.26	0.43
	Total	**101.44**	**64,920.92**	**100**

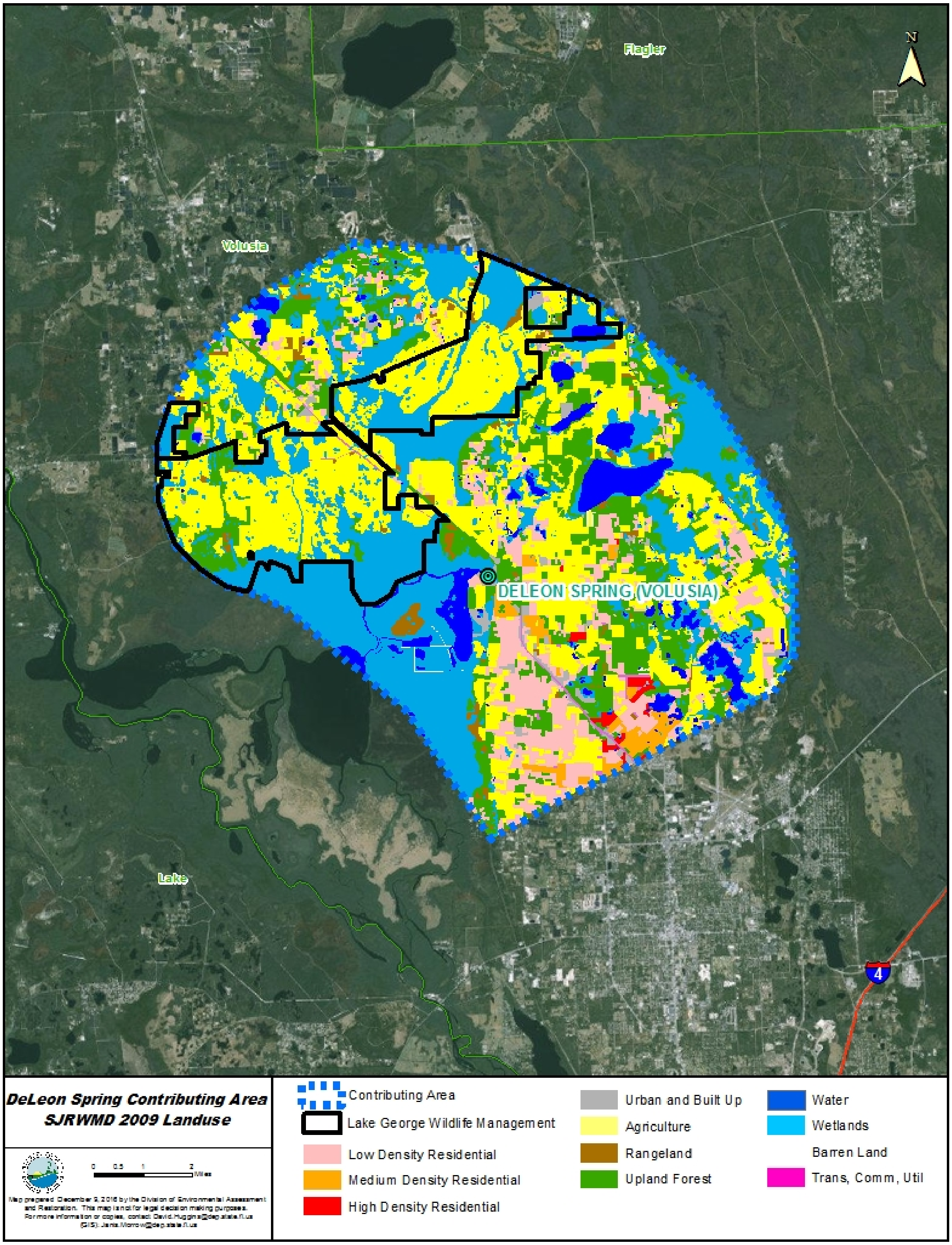

Figure 4.1. Land uses in the DeLeon Spring contributing area in 2009

Table 4.2. Percentages of major land uses in the Gemini Springs contributing area in 2009

Code	Land Use	Square Miles *	Acres *	% of Contributing Area *
1100	Low-Density Residential	3.97; **0.92**	2,541.69; **591.68**	9.32; **16.67**
1200	Medium-Density Residential	6.12; **1.86**	3,917.37; **1,187.45**	14.37; **33.45**
1300	High-Density Residential	2.95; **0.25**	1,885.06; **162.11**	6.92; **4.57**
1400	Commercial	3.22; **0.25**	2,063.45; **160.04**	7.57; **4.51**
1500	Light Industrial	0.77; **0.13**	491.49; **80.43**	1.8; **2.27**
1600	Extractive/Quarries/Mines	0.02; **0.00**	12.93; **0.00**	0.02; **0.00**
1700	Institutional	0.62; **0.04**	397.33; **27.21**	1.46; **0.77**
1800	Recreational (golf courses, parks, marinas, etc.)	1.25; **0.26**	802.91; **163.90**	2.95; **4.62**
1900	Open Land	0.54; **0.03**	346.73; **18.30**	1.27; **0.52**
2000	Agriculture	1.68; **0.12**	1,073.68; **79.74**	3.94; **2.25**
3000 & 7000	Rangeland	1.07; **0.28**	682.85; **181.54**	2.5; **5.11**
4000	Forest/Rural Open	2.53; **0.32**	1,619.65; **207.85**	5.94; **5.85**
5000	Water	5.42; **0.47**	3,468.56; **298.89**	12.72; **8.42**
6000	Wetlands	9.26; **0.34**	5,924.92; **214.61**	21.73; **6.04**
8000	Communication and Transportation	3.19; **0.28**	2,044.64; **176.69**	7.5; **4.98**
	Total	42.59; **5.55**	27,260.33; **3,550.46**	**100**

* The first value listed is for the SJRWMD maximum contributing area, and the **second value** is for the primary contributing area

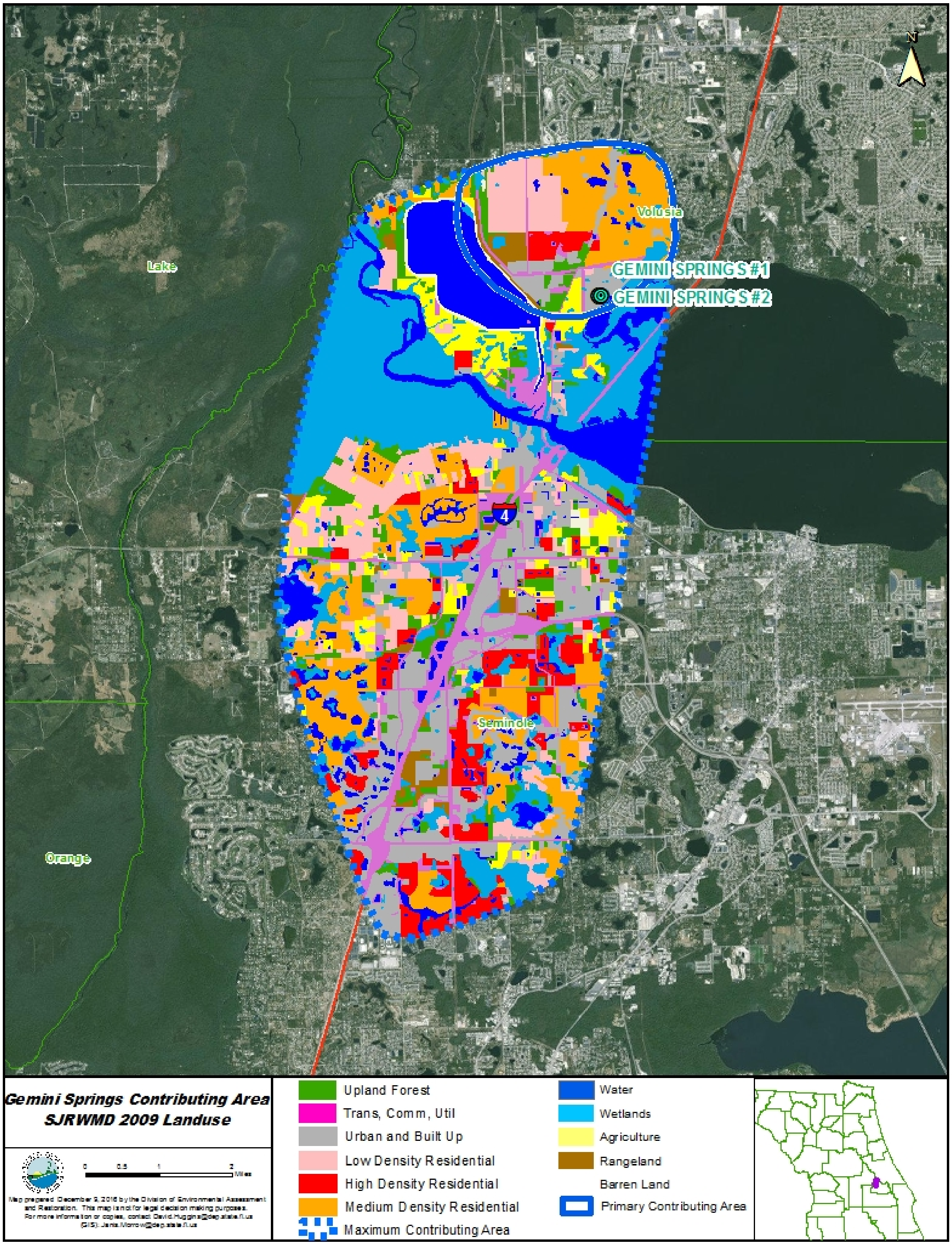

Figure 4.2. Land uses in the Gemini Springs contributing area in 2009

4.2 Pollutant Source Categories

An important part of the TMDL analysis is the identification of pollutant source categories, source subcategories, or individual sources of nutrients in the contributing area and an estimation of the magnitude 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 discernible, confined, and discrete conveyance, such as a pipe. Domestic and industrial wastewater treatment facilities (WWTFs) that discharge directly to surface waters and are covered by a National Pollutant Discharge Elimination System (NPDES) permit are examples of traditional point sources.

In contrast, the term "nonpoint sources" refers to intermittent, rainfall-driven, diffuse sources of pollution associated with everyday human activities and those sources that do not directly discharge to an impaired surface water, including runoff from urban land uses, wastewater treatment sites, stormwater drainage wells, agriculture, silviculture, mining, discharges from onsite sewage treatment and disposal systems (OSTDS, or septic systems), and atmospheric deposition. All pollutant sources that discharge to groundwater, including wastewater application sites, are also classified as nonpoint sources.

However, the 1987 amendments to the Clean Water Act redefined certain nonpoint sources of surface water pollution as point sources subject to regulation under the EPA's NPDES Program. These nonpoint sources include certain urban stormwater discharges to surface water, such as those from local government master drainage systems, construction sites with land disturbance over one acre, and a wide variety of industries (see **Appendix A** for background information on the federal and state stormwater programs).

To be consistent with Clean Water Act definitions, the term "point source" will be used to describe traditional point sources (such as domestic and industrial wastewater discharges to surface water) and stormwater system discharges to surface water that require an NPDES stormwater permit when allocating pollutant load reductions required by a TMDL (see **Section 6.1**). However, the methodologies used to estimate nonpoint source loads do not distinguish between NPDES stormwater discharges and non-NPDES stormwater discharges, and as such, this source assessment section does not make any distinction between the two types of stormwater.

4.3 Potential Nutrient Sources in the Contributing Area of DeLeon and Gemini Springs

While nitrate-nitrite occurs naturally in the environment through nitrogen fixation, bacterial processes, and lightning, the elevated and increasing levels of nitrate in the springs may come from a variety of anthropogenic sources. These may include permitted domestic wastewater treatment sites, OSTDS, fertilizer applied to residential landscaping and lawns, golf courses, agricultural operations, pet and livestock waste, and atmospheric deposition. While not a nitrate source per se, stormwater runoff is an important pathway for nitrate to reach an impaired waterbody.

4.3.1 DEP-Permitted Facilities

4.3.1.1 Wastewater Facilities

Domestic wastewater land application sites can produce a significant load of nitrogen in spring areas. Five permitted domestic wastewater facilities discharge in the DeLeon contributing area, and two in the Gemini maximum contributing area. There are no facilities within the primary contributing area. **Table 4.3** provides details on these facilities. All the facilities use land application for treated wastewater effluent such as rapid infiltration basins (RIBs) or drainfields. When the effluent is applied to the land surface, it infiltrates into groundwater and can deliver nutrient loads to the aquifer. **Figures 4.3** and **4.4** show the locations of these facilities.

Table 4.3. Permitted wastewater facilities in the contributing areas of DeLeon and Gemini Springs

mgd = Million gallons per day

DeLeon Contributing Area

Facility ID #	Facility Name	Design Capacity (mgd)	Permitted Capacity (mgd)	County
FLA011190	Hidden Valley	0.03	0.03	Volusia
FLA011124	McInnis Elementary School	0.01	0.01	Volusia
FLA011182	Sparton Electronics	0.012	0.012	Volusia
FLA011200	Phoenix Estates Mobile Home Park	0.015	0.015	Volusia
FLA011211	Duvall Home	0.06	0.06	Volusia

Gemini Maximum Contributing Area

Facility ID #	Facility Name	Design Capacity (mgd)	Permitted Capacity (mgd)	County
FLA011095	Twelve Oaks RV Resort	0.025	0.025	Seminole
FLA011079	Siemens ICN	0.035	0.035	Seminole

4.3.1.2 Municipal Separate Storm Sewer Systems (MS4s)

MS4s may also discharge pollutants to waterbodies in response to storm events. To address stormwater discharges, the EPA developed the NPDES stormwater permitting program in two phases. Phase 1, promulgated in 1990, addresses large and medium-size MS4s located in incorporated areas and counties with populations of 100,000 or more. Phase 2 permitting began in 2003. Regulated Phase 2 MS4s are defined in Rule 62-624.800, F.A.C., and typically cover urbanized areas serving jurisdictions with a population of at least 10,000 or discharging into Class I or Class II waters, or into Outstanding Florida Waters (OFWs).

The stormwater collection system in the DeLeon Spring contributing area, which is owned and operated by Volusia County, is covered by an NPDES Phase II MS4 permit (Permit No. FLR04E033). In the Gemini Springs maximum contributing area, the stormwater collection system is permitted under the same Volusia County permit (Permit No. FLR04E033) as well as to Seminole County and co-permittees, including the City of Lake Mary and the City of Sanford. One Phase I MS4 permit covers the county and these municipalities (Permit No. FLS000038). The primary contributing area is only within the area covered by the Volusia County permit (Permit No. FLR04E033).

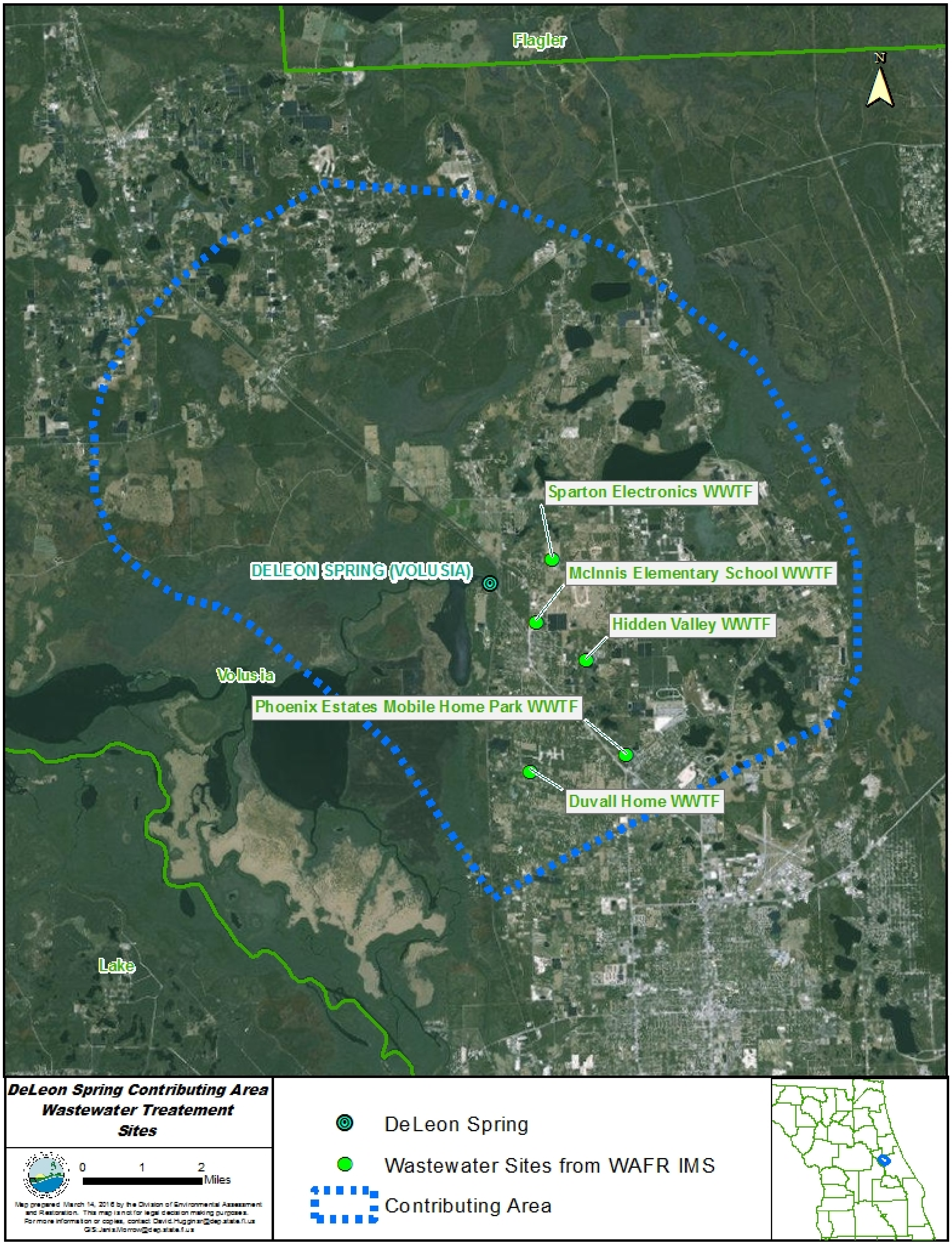

Figure 4.3. Domestic wastewater facilities in the contributing area of DeLeon Spring

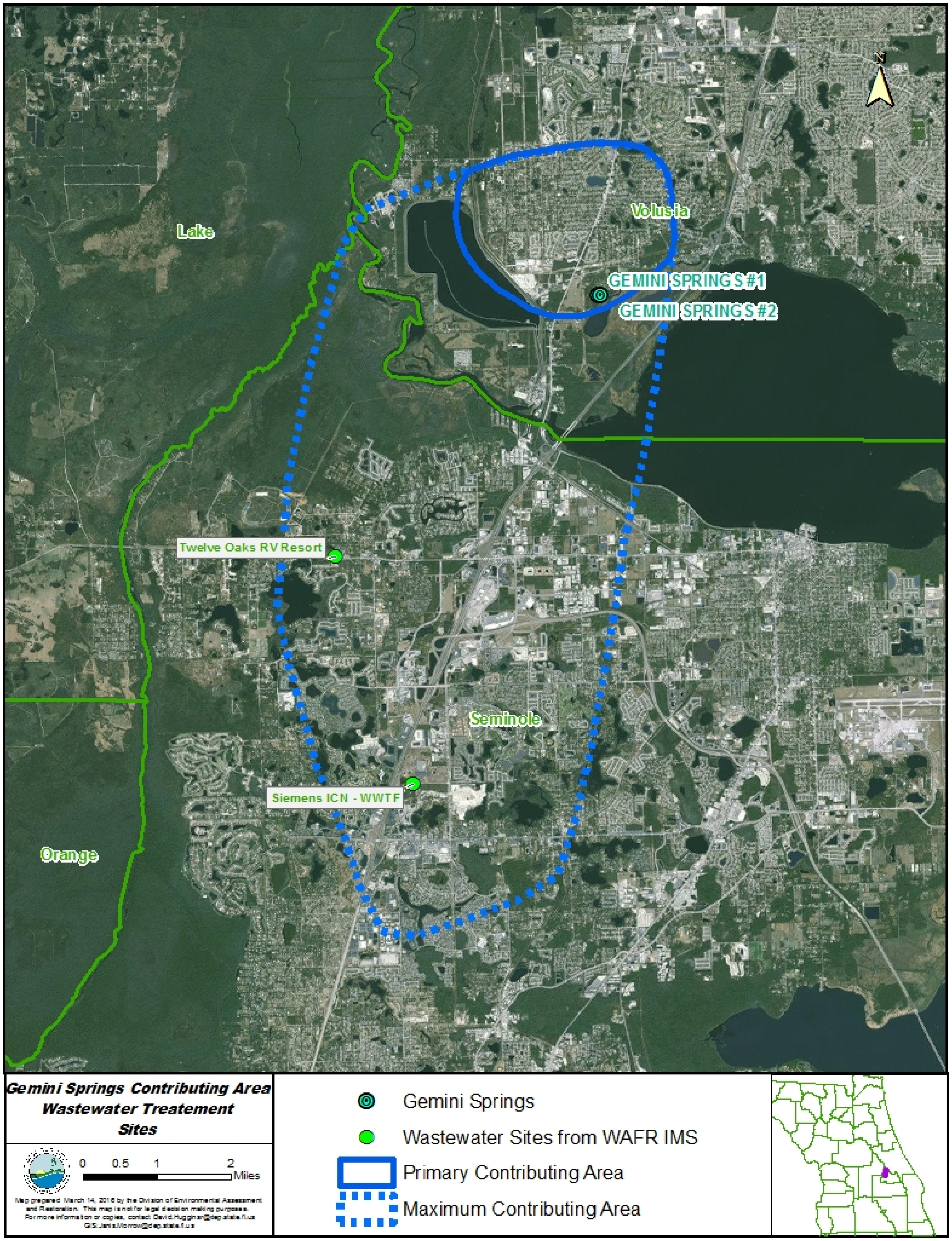

Figure 4.4. Domestic wastewater facilities in the contributing area of Gemini Springs

4.3.2 Nonpoint Sources

4.3.2.1 OSTDS

OSTDS are used to dispose of domestic waste at homes that are not on central sewer, often because providing central sewer is not cost-effective or practical. When properly sited, designed, constructed, maintained, and operated, OSTDS are a sanitary means of disposing of domestic waste. The nitrogen concentrations in effluent from OSTDS are considerably higher than those in effluent from typical domestic WWTFs, although the wastewater profile can vary from home to home. The physical setting of an OSTDS (soil and aquifer characteristics and proximity) is also a factor in the amount of nitrogen it can contribute to groundwater and springs (USGS 2010).

On average, the TN concentration in the effluent from a typical OSTDS is 57.7 mg/L (Hazen and Sawyer 2009), although this concentration is reduced further as the effluent is discharged to the drainfield and percolates to groundwater. In a low-density residential setting, nitrogen loadings from OSTDS may not be significant, but in a higher density setting, one could expect the nitrogen input to be 129 pounds per acre per year (lb/ac/yr) (Harrington et al. 2010). However, some nitrogen reduction would occur in the drainfield and soil above the water table, and, as discussed previously, the actual load to groundwater would vary based on actual use and setting.

Known and estimated locations of OSTDS in the DeLeon and Gemini contributing areas are displayed in **Figures 4.5** and **4.6**, respectively. These were obtained from the 2016 Florida Department of Health (FDOH) Florida Water Management Inventory. Currently, there are 4,535 known and estimated OSTDS in the DeLeon contributing area, with most concentrated in the eastern part of the contributing area in the Town of DeLeon Springs. In the Gemini Springs maximum contributing area, there are 4,677 known and estimated OSTDS, and in the primary contributing area, there are 2,706 known and estimated OSTDS. The highest OSTDS density is near the spring vent in Debary.

4.3.2.2 Runoff from Urbanized Areas

Urban areas include land uses such as residential, industrial, utility easements, recreational, institutional, commercial, and extractive (mining). Nutrient loading from urban areas (whether in an MS4 jurisdiction or not) can come from multiple sources, including groundwater seepage, stormwater runoff, illicit discharges of sanitary waste as a result of sanitary sewer overflows (SSOs), OSTDS, domestic animals, and fertilizers from home gardens, lawns, and golf courses. Of the total land area in the DeLeon Spring contributing area, 12% is mapped as one of these urban land uses. In the Gemini Springs maximum contributing area and primary contributing area, 44% and 67% of the land area is mapped as urban, respectively. Urban areas include sources and activities that can contribute nitrogen to springs.

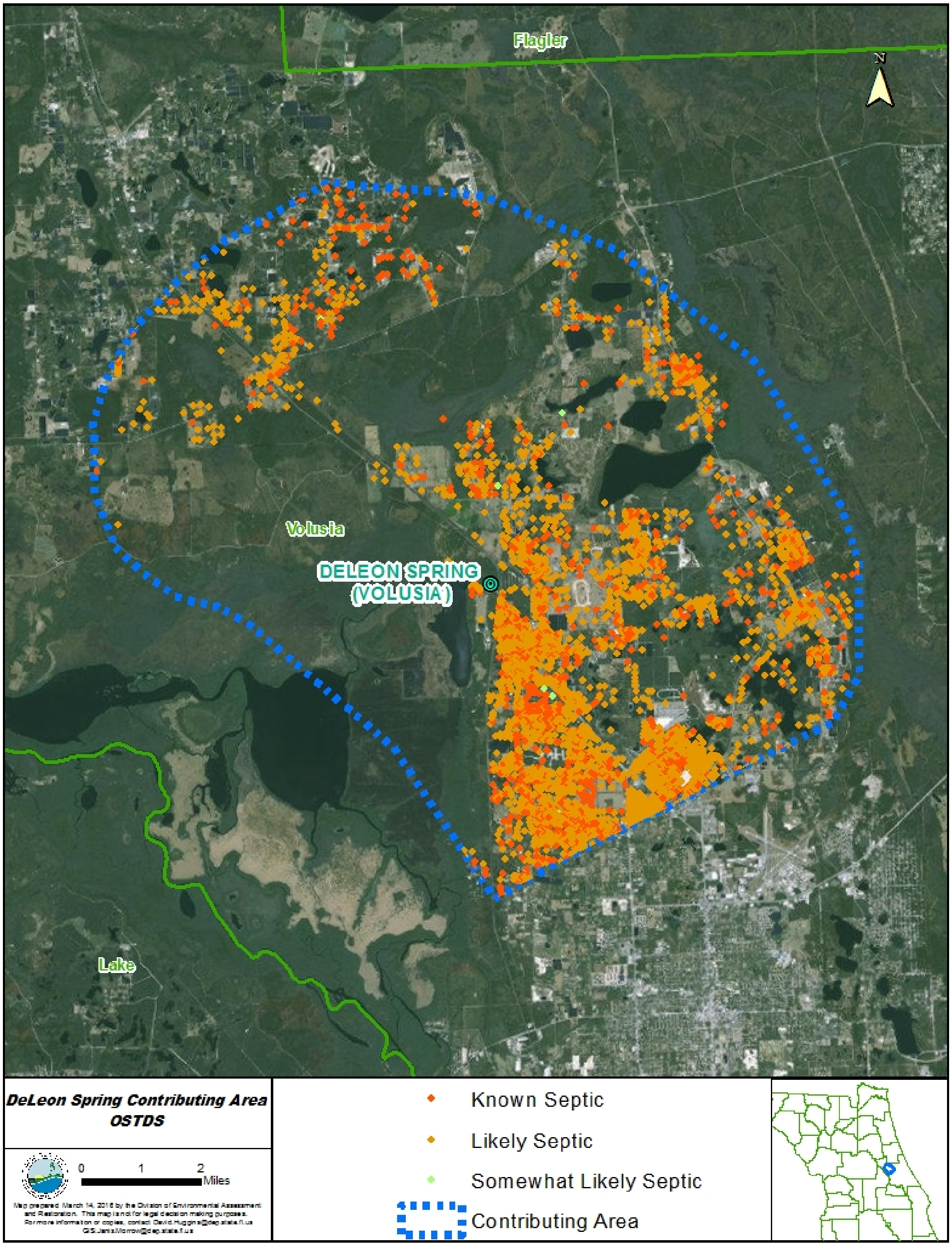

Figure 4.5. OSTDS distribution in the contributing area of DeLeon Spring based on FDOH inventory results

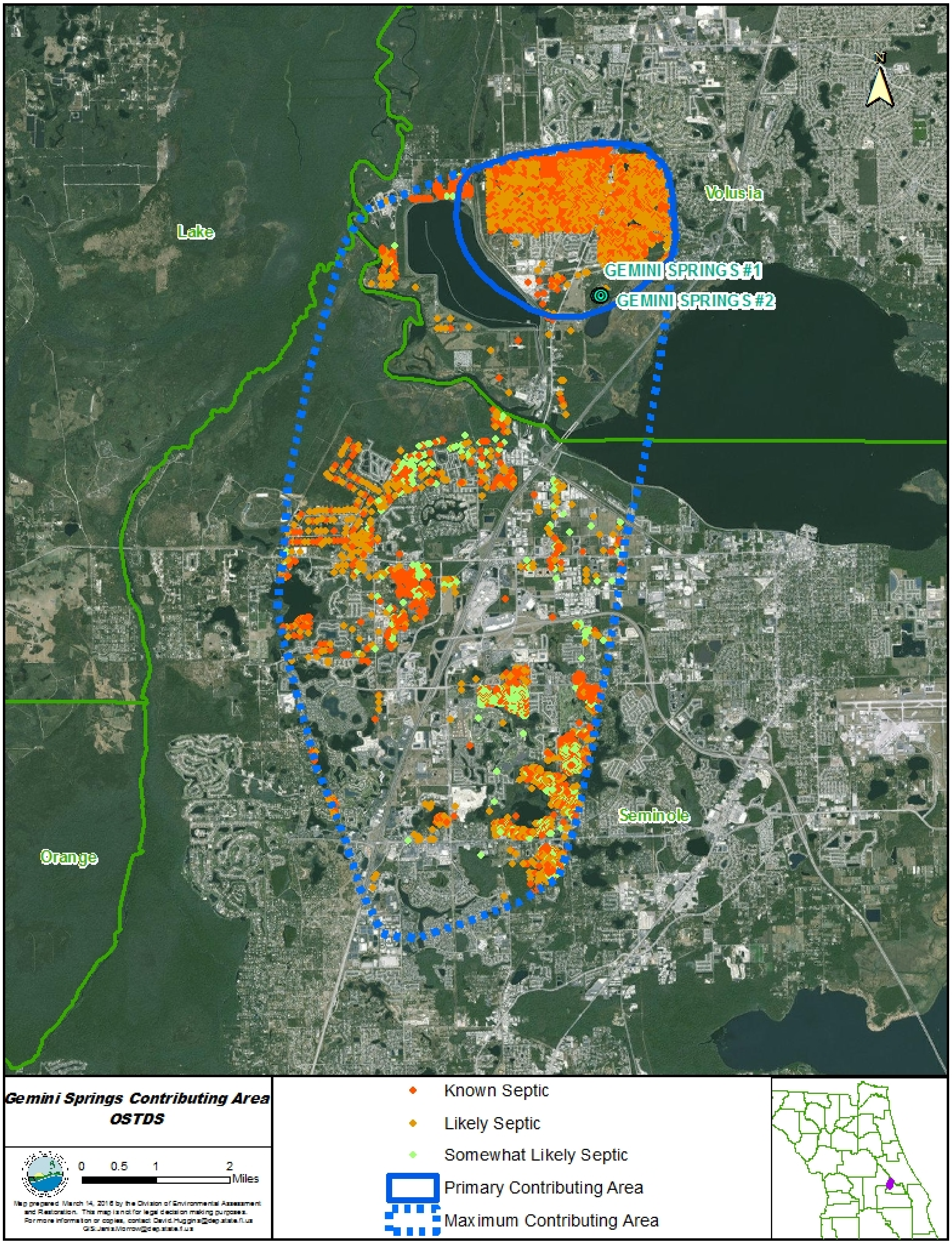

Figure 4.6. OSTDS distribution in the contributing area of Gemini Springs based on FDOH inventory results

4.3.2.3 Livestock Waste and Agricultural Fertilizer

Agricultural land uses in the contributing area are likely to contribute nitrogen to the springs. Nitrogen sources related to these land uses include fertilizer applied to fields, nurseries, and livestock waste in pastures and housing and feeding areas.

In the DeLeon Spring contributing area, land uses associated with livestock include pastures, horse farms, and dairies, and cover an area of 6,473 acres. Land uses associated with agricultural fertilizer use include field and row crops, pastures, citrus groves, ferneries, and ornamental plant and tree nurseries, and cover an area of 4,473 acres.

In the Gemini Springs maximum contributing area, land uses associated with livestock include pastures and horse farms, and cover an area of 619 acres. Land uses associated with agricultural fertilizer use include pastures, field and row crops, ornamental and tree nurseries, and citrus groves, and cover an area of 427 acres. In the primary contributing area, land uses associated with livestock include 54 acres of pastureland, and land uses associated with agricultural fertilizer include 26 acres of field crops (2009 SJRWMD land use). Actual inputs of nitrogen from livestock waste and fertilizer application rates specific to different crop types will be calculated during the BMAP process with assistance from FDACS and the agricultural community.

4.3.2.4 Atmospheric Deposition

Atmospheric deposition can also be a contributing source of nitrogen to springs. Wet and dry deposition will be estimated using a nationwide model developed by Schwede and Lear (2014) based on several monitoring networks—including the Clean Air Status and Trend Network (CASTNET), the National Atmospheric Deposition Program (NADP) Ammonia Monitoring Network, the Southeastern Aerosol Research and Characterization Network, and modeled data from the Community Multi-Scale Air Quality Model and the National Trends Network. Atmospheric loading calculations will be done during the BMAP process.

4.3.3 Nitrogen Source Inventory Loading Tool (NSILT)

During the BMAP development process, DEP will develop nitrogen source inventories to estimate the current loads of nitrogen to groundwater in the DeLeon and Gemini Springs contributing areas. The NSILT for estimating nitrogen loads uses a consistent, well-documented methodology that has been employed at other spring systems in the state. Similar estimates have been made in the past and have largely been based on land use. However, the NSILT takes this process a step further.

The nitrogen input to the land surface for anthropogenic sources is estimated based on detailed methods specific to each nitrogen source category. These main categories include atmospheric deposition, septic tanks, WWTFs, fertilizers (urban and agricultural), livestock waste, and any additional source category relevant to the specific area. After the nitrogen input is estimated, environmental attenuation is considered. This attenuation is specific to each source category and related to land application and other factors. The final step in the process is evaluating the influence of groundwater recharge, which varies depending on hydrogeology and soil characteristics. The final DEP NSILT report contains a series of pie charts that illustrate the estimated percent contribution of each loading category in a BMAP area.

This process is constantly being improved on and tailored to each specific area as new data become available. Stakeholder involvement is a critical aspect of this process and has been very helpful in NSILT development. DEP recognizes that no two BMAP areas are the same and tries to account for these differences in its estimates so that the end product is representative of the hydrogeology, anthropogenic inputs, and nitrogen attenuation in a BMAP-designated area.

Chapter 5: Determination of Loading Capacity

DEP often uses hydraulic and water quality models to simulate loading and the effects of loading in a given waterbody. However, there are other appropriate methods to develop NNC and TMDLs that are just as credible as a modeling approach. Such an alternative approach was used to estimate existing mean concentrations and calculate the NNC and TMDLs for DeLeon and Gemini Springs.

5.1 Determination of Loading Capacity

Typically, the target loading and existing loading for a stream or watershed are based on hydrologic and water quality modeling. Many of these models depend on the relationship between flow and surface water drainage area, as well as the relationship between land use, soils, and pollutant delivery.

The predominant source of nutrient loading to DeLeon and Gemini Springs is groundwater discharged at the springs. In most of the contributing area, recharge to the aquifer can readily occur. Rainwater percolates directly through the soil profile, and surface drainage flows toward sinkholes and closed depressions, where it infiltrates and reaches the surface via groundwater discharged from the spring vents. Thus, a direct relationship between surface water loadings in the watershed is not appropriate. This diffuse loading situation requires the use of an alternative approach for establishing the nutrient NNC and TMDLs.

Existing spring loading can be estimated by multiplying the measured spring flow by the measured pollutant concentrations in the spring. To calculate the pollutant loading in this way, synoptic flow and concentration data measured at the outlet of each spring vent under assessment are required. These data were not available when the NNC and TMDLs were developed. Therefore, the nitrate loads were not explicitly calculated, nor were they needed, since the NNC and TMDL targets for these waters are being established as concentrations.

Percent reductions required to achieve the nitrate concentration targets for DeLeon and Gemini Springs were calculated using the following formula:

[(maximum mean concentration – target concentration)/maximum mean concentration] x 100

5.2 Critical Conditions/Seasonality

Establishing the critical condition for nitrogen inputs that affect algal growth in a waterbody depends on many factors, including the presence of point sources and the land use pattern in the contributing area. The critical condition for point source loading to a waterbody usually occurs during periods of low flow, when dilution is minimized. Typically, the critical condition for nonpoint source loading to a surface water is a period of rainfall-related flushing preceded by an extended dry period. During the wet weather period, rainfall mobilizes nitrogen that has accumulated on the land surface and in the soil under dry conditions, resulting in higher pollutant concentrations. However, significant nonpoint source contributions can also appear under dry conditions without any major surface runoff event. Also, there can be a lag time between nitrogen inputs into groundwater and discharge from the spring vents.

For DeLeon and Gemini Springs, there is minimal seasonal variation in nitrate concentrations. **Figure 5.1** shows the plotted mean monthly nitrate concentrations in both DeLeon and Gemini Springs compared with average monthly rainfall at the weather station in DeLand, FL, from 2007 through 2016. **Figures 5.2** and **5.3** show mean monthly nitrate-nitrite concentrations and discharge for DeLeon Spring and Gemini Springs from 2007 to 2016 and 2008 to 2016, respectively. For both springs, there was no apparent relationship between nitrate-nitrite concentrations and precipitation or discharge.

Additionally, a Kruskal-Wallis test was used to detect monthly variations in nitrate-nitrite concentrations in DeLeon and Gemini Springs. Nitrate-nitrite data used in the development of the TMDLs were used in these tests, and no significant monthly variation in concentration was detected (p-value < 0.05). **Table 5.1** summarizes the results of the Kruskal-Wallis tests.

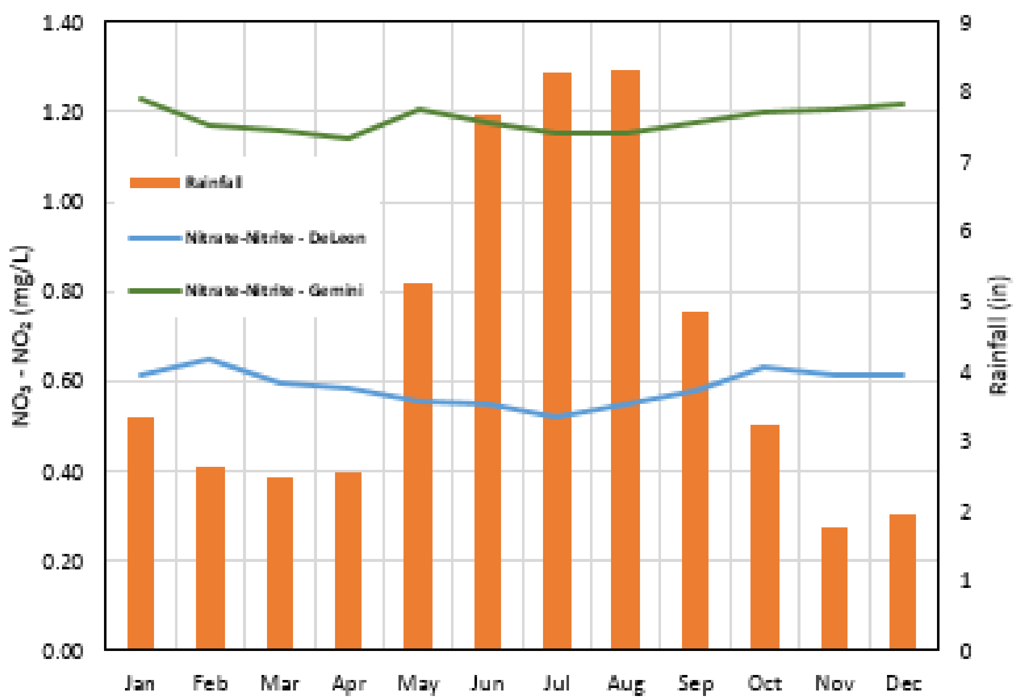

Figure 5.1. Comparison of mean monthly nitrate-nitrite concentrations in DeLeon and Gemini Springs with average monthly rainfall at the weather station in DeLand, FL (Station: GHCND: USC00082229 DeLand 1 SSE FL US), 2007–16

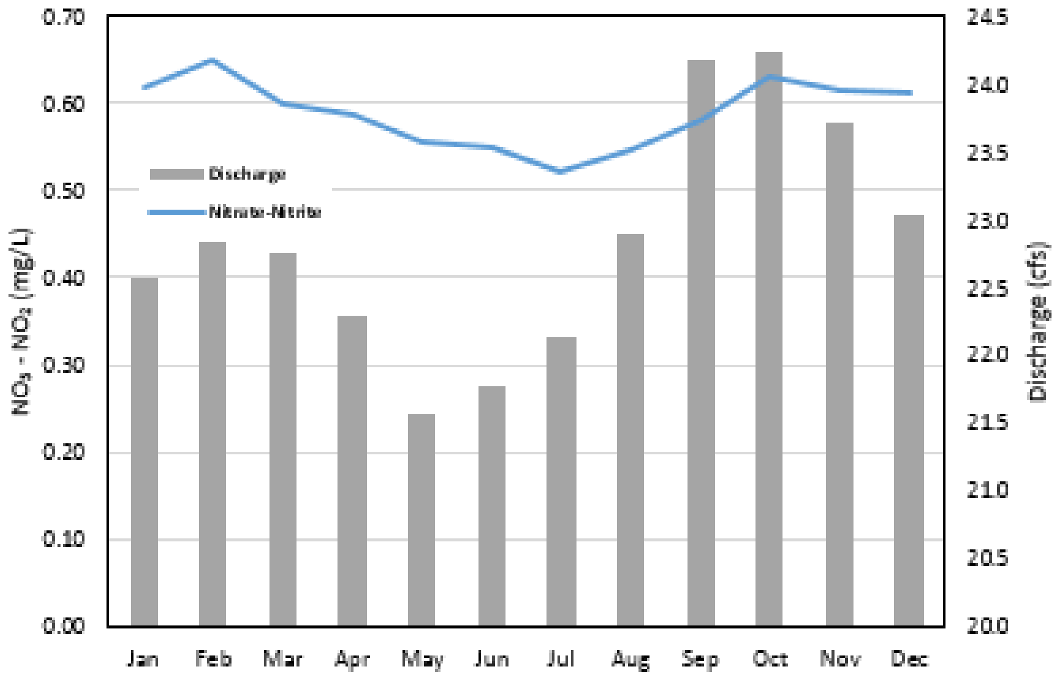

Figure 5.2. Comparison of mean monthly nitrate-nitrite concentrations and discharge at DeLeon Spring, 2007–16

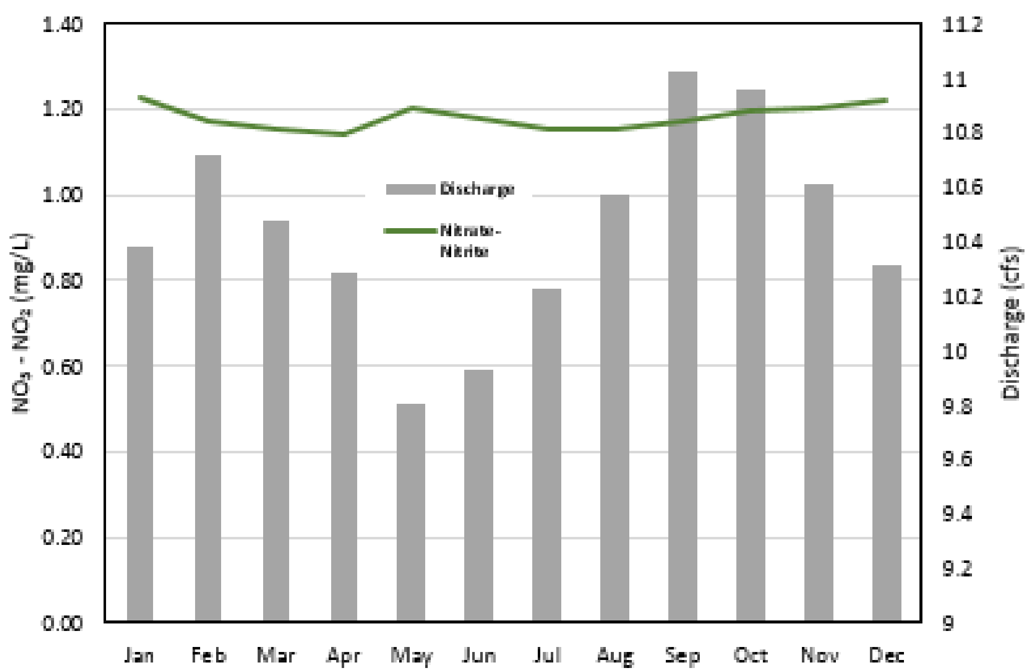

Figure 5.3. Comparison of mean monthly nitrate-nitrite concentrations and discharge at Gemini Springs, 2007–16

Table 5.1. Kruskal-Wallis test for monthly variation in nitrate-nitrite concentrations in DeLeon and Gemini Springs, 2007–16

Waterbody	N	χ^2	df	p-value
DeLeon Spring	154	16.752	11	0.1154
Gemini Springs	113	5.0692	11	0.9278

5.4 TMDL Development

Florida's nitrate-nitrite (NO_3-NO_2) NNC for spring vents, set forth in Paragraph 62-302.530(90)(b), F.A.C., is expressed as an AGM value of 0.35 mg/L, which is not to be exceeded more than once in any consecutive 3-year period. Since DeLeon and Gemini Springs have the characteristics of typical freshwater, nontidal spring systems to which the NNC for spring vents apply, 0.35 mg/L nitrate-nitrite (NO_3-NO_2) is the most appropriate target for both TMDLs. An AGM was determined to be more appropriate than a monthly mean because nitrate-nitrite concentrations in both springs did not have a strong seasonal trend. AGM concentrations were calculated for each spring for each year based on measured concentrations over the verified period (DeLeon Spring, 2007–13; Gemini Springs, 2008–13) plus more recent data (2013–17). **Table 5.2** lists the calculated AGM concentrations for both springs. The highest AGM nitrate-nitrite concentrations were used as existing annual mean concentrations to calculate the percent reduction required to achieve the nitrate-nitrite target. This approach adds to the margin of safety of the TMDLs because it will ensure that the AGM concentrations will meet the concentration target even under the worst-case scenario.

Table 5.2. AGM nitrate-nitrite concentrations for DeLeon and Gemini Springs

Note: Italic font and red highlighting indicate the year with the highest annual mean nitrate-nitrite concentration.
* Insufficient sample size

Year	AGM for DeLeon Spring NO_3-NO_2 (mg/L)	n
2007	0.47	22
2008	0.51	18
2009	***0.79***	14
2010	0.75	15
2011	0.56	17
2012	0.52	16
2013	0.51	15
2014	0.56	12
2015	0.65	12
2016	0.59	12
2017	NA*	1

Note: Italic font and red highlighting indicate the year with the highest annual mean nitrate-nitrite concentration.
* Insufficient sample size

Year	AGM for Gemini Springs NO_3-NO_2 (mg/L)	n
2008	1.23	15
2009	1.24	10
2010	1.20	13
2011	1.08	14
2012	1.05	12
2013	1.06	13
2014	1.15	11
2015	1.29	12
2016	***1.33***	11
2017	NA*	1

5.3 Protection of Downstream Waters

An imbalance of flora occurring in DeLeon and Gemini Springs is attributable to elevated nitrate-nitrite concentrations at the spring vent. When the nitrate-nitrite concentration thresholds established for DeLeon and Gemini Springs are met, algal growth that contributes to the floral imbalance will be reduced so that algal coverage will be at background levels (<20%) (DEP 2013). Since the source of elevated nitrate-nitrite is from the headsprings, decreasing the concentration from the headsprings will also reduce nitrate-nitrite in downstream waters. DeLeon Spring flows to Spring Garden Lake (2921E) and Gemini Springs flows through DeBary Creek (2893A4) into Lake Monroe (WBID 2893D). Downstream waters are Class III with specific numeric interpretations of the NNC for Chlorophyll a, TN and TP. Spring Garden Lake has no history of nutrient impairments, and based on the most recent assessment results, Spring Garden Lake is not currently impaired for nutrients. Lake Monroe has an impairment for nutrients based on TSI and had a TMDL developed and adopted in 2009. A BMAP was established in August 2012. Therefore, the reductions in nitrate-nitrite loads prescribed in this TMDL are not expected to cause nutrient impairments downstream but will result in water quality improvements to downstream waters.

5.4 Calculation of TMDL Percent Reduction

Based on an examination of the data listed in **Table 5.1**, the percent reductions for DeLeon and Gemini Springs were based on the highest annual mean nitrate-nitrite concentration for each, which occurred in 2009 and 2016, respectively. This approach is the most protective and adds to the implicit margin of safety.

The maximum annual mean nitrate-nitrite concentration for DeLeon Spring was 0.79 mg/L in 2009, and for Gemini Springs it was 1.33 mg/L in 2016. The percent reductions required to achieve the water quality target for each spring were calculated using the following formula:

[(maximum mean concentration – target concentration)/maximum mean concentration] x 100

For **DeLeon Spring**:

[(0.79 mg/L – 0.35 mg/L) / 0.79 mg/L] * 100

Equals a 56 % reduction in nitrate-nitrite.

For **Gemini Springs**:

[(1.33 mg/L – 0.35 mg/L) / 1.33 mg/L] * 100

Equals a 74 % reduction in nitrate-nitrite.

Percent reductions of 56 % and 74 % in nitrate-nitrite concentrations for the DeLeon and Gemini Springs WBIDs, respectively, are proposed because they are protective values that, when achieved, will satisfy the nutrient reduction requirement for the springs.

Chapter 6: Determination of the TMDLs

6.1 Allocation of the TMDLs

The objective of a TMDL is to provide a basis for allocating acceptable loads among 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 any uncertainty concerning the relationship between effluent limitations and water quality:

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

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

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

It should be noted that the various components of a 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 a 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 (40 Code of Federal Regulations [CFR] § 130.2[I]), which state that TMDLs can be expressed in terms of mass per time (e.g., pounds per day), toxicity, or **other appropriate measure**. The TMDLs for DeLeon and Gemini Springs are expressed in terms of the nitrate-nitrite concentration that the springs can assimilate and maintain healthy levels of algal growth that do not contribute to an ecological imbalance (**Table 6.1**).

The TMDLs are also represented as the percent reductions in existing nitrate-nitrite concentrations required to achieve the nutrient targets. The existing nitrate-nitrite concentrations used for the springs are conservative and based on worst-case water quality conditions from the

TMDL period of record. The percent reductions assigned to all the nonpoint source areas (LAs) are the same as those defined for the TMDL percent reductions.

Table 6.1. TMDL components for DeLeon Spring (WBID 2921A) and Gemini Springs (WBID 2893)

N/A = Not applicable
[1] Nutrient concentrations represent AGM, not to be exceeded.
[2]-Applies to existing and future NPDES discharges, if they occur.

Waterbody (WBID)	Parameter	TMDL[1] (mg/L)	TMDL % Reduction	Wasteload Allocation for Wastewater	Wasteload Allocation for NPDES Stormwater % Reduction[2]	Load Allocation % Reduction	MOS
DeLeon Spring (WBID 2921A)	Nutrients (Nitrate-Nitrite)	0.35	56	N/A	56	56	Implicit
Gemini Springs (WBID 2893)	Nutrients (Nitrate-Nitrite)	0.35	74	N/A	74	74	Implicit

6.2 Wasteload Allocation (Point Sources)

6.2.1 NPDES Wastewater Discharges

Currently, no NPDES wastewater facilities discharge directly into DeLeon or Gemini Springs. Any new potential discharger is expected to comply with the Class III criterion for nutrients and with nitrate limits consistent with this TMDL. If it is determined that any of the wastewater facilities discharge into these springs, they will be subject to the assigned WLA.

6.2.2 NPDES Stormwater Discharges

Table 6.1 lists the NPDES stormwater percent reductions, which represent the allowable nutrient loads that would result in ecosystem improvement. The MS4 permittees in the contributing area are only responsible for reducing the anthropogenic loads associated with stormwater outfalls that they own or otherwise have responsible control over, and are not responsible for reducing other nonpoint source loads in their jurisdictions.

6.3 Load Allocation (Nonpoint Sources)

Because no target loads were explicitly calculated in this TMDL report, the TMDL is represented as the percent reduction of nitrate-nitrite loadings required to achieve the nutrient target. The percent reduction assigned to all the nonpoint source areas (LA) is the same as that defined for the TMDL percent reduction. To achieve the AGM nitrate-nitrite target of 0.35 mg/L in DeLeon and Gemini Springs, the nitrate-nitrite contribution to the impaired waters that comes from sources in the contributing area needs to be reduced by 56 % and 74 %, respectively.

The target AGM nitrate-nitrite of 0.35 mg/L and the percent reduction represent an estimate of the maximum reduction required to meet the target. It may be possible to meet the target before achieving the percent reductions. The nonpoint sources included in the LA include fertilizer, domestic wastewater from OSTDS and wastewater application sites, animal waste, atmospheric deposition, and stormwater discharges to groundwater. The LA also includes loading in the contributing area from stormwater discharges regulated by DEP and the water management district that are part of the NPDES Stormwater Program but do not discharge to the impaired waters (see **Appendix A**).

6.4 Margin of Safety (MOS)

Consistent with the recommendations of the Allocation Technical Advisory Committee (DEP 2001), an implicit MOS was used in the development of this TMDL, and was provided by the conservative decisions associated with a number of assumptions and the development of assimilative capacity. Also, when estimating the required percent reduction to achieve the water quality target, the highest AGM of measured nitrate-nitrite concentration in the 10-year data period (2007–16) was used. Requiring the 0.35 mg/L target to be met every year should result in a nitrate-nitrite concentration even lower than the target concentration in the long term, and therefore adds to the MOS.

Chapter 7: Next Steps: Implementation Plan Development and Beyond

7.1 Implementation Mechanisms

Following the adoption of a TMDL, implementation may occur through specific requirements for domestic wastewater and MS4 permits, and, as appropriate, through local or regional water quality initiatives or BMAPs.

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 take action to address a TMDL unless management actions are already defined in a BMAP for that particular TMDL. MS4 Phase II permit holders must also implement responsibilities defined in a BMAP.

7.2 BMAPs

BMAPs are discretionary and are not initiated for all TMDLs. A BMAP is a TMDL implementation tool that integrates the appropriate management strategies applicable through existing water quality protection programs. DEP or a local entity may develop a BMAP that addresses some or all of the contributing areas to the TMDL waterbody.

Section 403.067, F.S. (the FWRA), provides for the development and implementation of BMAPs. BMAPs are adopted by the DEP Secretary and are legally enforceable.

BMAPs describe the management strategies that will be implemented as well as funding strategies, project tracking mechanisms, water quality monitoring, and the fair and equitable allocations of pollution reduction responsibilities to the sources in the watershed. BMAPs can also identify mechanisms to address potential pollutant loading from future growth and development.

The most important component of a BMAP is the list of management strategies to reduce pollution sources, as these are the activities needed to implement the TMDLs. The local entities that will conduct these management strategies are identified and their responsibilities are enforceable. Management strategies may include wastewater treatment upgrades, stormwater improvements, and agricultural BMPs.

Additional information about BMAPs is available online.

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Appendices

Appendix A: Background Information on Federal and State Stormwater Programs

In 1982, Florida became the first state in the country to implement statewide regulations to address the issue of nonpoint source pollution by requiring new development and redevelopment to treat stormwater before it is discharged. The Stormwater Rule, as authorized in Chapter 403, F.S., was established as a technology-based program that relies on the implementation of BMPs that are designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Rule 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 (ERP) regulations, as authorized under Part IV of Chapter 373, F.S.

Rule 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) plan, other watershed plan, or rule. Stormwater PLRGs are a major component of the load allocation part of a TMDL. To date, stormwater PLRGs have been established for Tampa Bay, Lake Thonotosassa, the Winter Haven Chain of Lakes, the Everglades, Lake Okeechobee, and Lake Apopka.

In 1987, the U.S. Congress established Section 402(p) as part of the federal Clean Water Act Reauthorization. This section of the law amended the scope of the federal NPDES 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, which includes 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 October 2000. DEP authority to administer the program is set forth in Section 403.0885, F.S.

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

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

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

Waterbody Information	Description of Waterbody and Location
Waterbody name	1. DeLeon Spring 2. Gemini Springs
Waterbody type(s)	Springs
Waterbody ID (WBID)	WBIDs 2921A, 2893 (See **Figures 1.2** and **1.3** of this TMDL report)
Description	DeLeon Spring is a second magnitude spring located in DeLeon Springs State Park 5 miles northwest of the Town of DeLand, FL. A series of lakes and creeks connects the headspring to the St. Johns River 12 miles downstream. Gemini Springs is located in DeBary, FL, south of DeLand, and consists of 2 flowing spring vents, with a combined second magnitude flow. Flow is through the weir, then 1.5 miles east and northeast down a creek and through a marsh area to Lake Monroe on the St. Johns River
Specific location (latitude/longitude or river miles)	DeLeon Spring is located at N29°08'03.408", W81°21'45.894". Gemini Spring #1 is located at N28°51'46.412", W81°18'41.312", and Gemini Spring #2 is located at N28°51'46.227", W81°18'39.306".
Map	**Figure 1.1** of this TMDL report shows the general location of DeLeon Spring, and **Figure 4.1** shows land uses in the contributing area. Wetland, forest, and agriculture were the predominant land uses in the contributing area, covering 32 %, 31 %, and 18 %, respectively. Low-density residential ranked fourth, comprising 9 %. **Figure 1.4** of this TMDL report shows the general location of Gemini Springs, and **Figure 4.2** shows land uses in the contributing area. Wetland, medium-density residential, and water were the predominant land uses in the contributing area, covering 22 %, 14 %, and 13 %, respectively. Low-density residential ranked fourth, comprising 9 % of the contributing area.
Classification(s)	Class III Freshwater
Basin name (Hydrologic Unit Code [HUC] 8)	Upper St. Johns (03080101)

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

Numeric Interpretation of Narrative Nutrient Criterion	Parameter Information Related to Numeric Interpretation of Narrative Nutrient Criterion
NNC summary: Default classification (if applicable) and corresponding NNC	Per Rule 62-302.531, F.A.C., the applicable nutrient criterion for spring vents is 0.35 mg/L of nitrate-nitrite (NO_3-NO_2) as an AGM, not to be exceeded more than once in any 3-calendar-year period.
Proposed nitrate+nitrite (magnitude, duration, and frequency)	DEP selected a nitrate-nitrite threshold of 0.35 mg/L for DeLeon and Gemini Springs, expressed as an AGM not to be exceeded in any year. This target is based directly on Rule 62-302.531, F.A.C., because no additional site-specific data were available, and the data did not indicate the presence of seasonality. Without variation in concentration by season, an annual target of 0.35 mg/L will be protective of Class III designated use. **Chapter 5** of this document describes the approach. The nitrate-nitrite water quality targets will be established as NNC and will be expressed as an AGM not to be exceeded in any year. An AGM was chosen because of the lack of seasonal trends, as described in **Section 5.4**.
Period of record used to develop the numeric interpretations of the narrative nutrient criterion for nitrate+nitrite	To ensure that the proposed nitrate TMDL was developed based on current conditions and that recent trends in spring water quality were adequately captured, monitoring data from the Cycle 3 verified period (DeLeon Spring, 2007–13; Gemini Springs, 2008–13) and more recent data (2013–16) were used to develop the TMDLs and nutrient criteria.
Indicate how criteria developed are spatially and temporally representative of the waterbody or critical condition.	The data used were spatially representative of the waterbodies because the samples were collected at the DeLeon and Gemini spring vents. **Figures 2.6** and **2.7** show the locations of the current and historical routine water quality sampling stations. To ensure that the nutrient TMDLs were developed based on current conditions and that recent trends in spring water quality were adequately captured, monitoring data were compiled for the Cycle 3 verified period (DeLeon Spring, 2007–13; Gemini Springs: 2008–13) and more recent data (2013–16). The data used for the TMDLs are from samples collected by Volusia County, the SJRWMD, and DEP. **Figures 2.6** and **2.7** show the AGM nitrate-nitrite monitoring results for these impaired springs during the Cycle 3 verified period (DeLeon Spring, 2007–13; Gemini Springs, 2008–13) and more recent data (2013–16. **Table 2.4** summarizes the nitrate-nitrite monitoring results for DeLeon and Gemini Springs. Establishing the critical condition for nitrate-nitrite inputs that affect algal growth in each contributing area depends on many factors, including the presence of point sources and the land use pattern in the contributing area. The critical condition for point source loading to a waterbody typically occurs during periods of low flow, when dilution is minimized. Typically, the critical condition for nonpoint source loading is a period of rainfall-related flushing preceded by an extended dry period. During the wet weather period, rainfall mobilizes nitrogen that has accumulated on the land surface and in the soil under dry conditions, resulting in higher pollutant concentrations. However, significant nonpoint source contributions can also appear under dry conditions without any major surface runoff event. Also, there can be a lag between nitrogen inputs into groundwater and discharge from the spring vents. **Figures 5.1, 5.2,** and **5.3** and **Table 5.1** show nitrate-nitrite concentrations in relation to rainfall and discharge for DeLeon and Gemini Springs (for the verified period plus 2013–16). Based on the data available, nitrate-nitrite concentrations in the river and springs do not appear to respond consistently to rainfall. In general, there does not appear to be any significant seasonal trend.

Table B-3. Designated use, verified impairment, and approach to establish protective restoration targets

Designated Use Requirements	Information Related to Designated Use Requirements
History of assessment of designated use support	These springs were listed as impaired by nitrate-nitrite because of their elevated nitrate-nitrite concentrations and the corresponding evidence in the upper river and vicinity of the headsprings of imbalances in flora and fauna caused by algal smothering. This information was used in the determination of impairment for the 2016 Verified List of Impaired Waters.
Basis for use support	DEP selected the nitrate-nitrite criteria based on the nutrient criterion in Rule 62-302.531, F.A.C. The targets for the springs were set at 0.35 mg/L AGM not to be exceeded in any year. These targets are demonstrated to be protective of Class III designated use because DeLeon and Gemini Springs have the characteristics of typical freshwater, nontidal spring systems to which the NNC for spring vents apply, and do not show significant correlation between concentrations and seasonality.
Summarize approach used to develop criteria and how it protects uses	The numeric interpretations for nitrate-nitrite were based on the nutrient criterion in Rule 62-302.531, F.A.C. These targets were selected because they will be protective of Class III designated use and will reduce the growth rate of algae populations through nitrate reduction.
How the TMDL will ensure that nutrient-related parameters are attained to demonstrate that the TMDL will not negatively impact other water quality criteria.	Reductions in nitrate-nitrite concentrations of 56 % in DeLeon Spring and 74 % in Gemini Springs are proposed because they will result in nitrate-nitrite levels that are demonstrated to be protective. The proposed reductions in nutrient inputs will further improve water quality. Once the target concentrations are consistently achieved, each WBID will be re-evaluated to determine if nitrate continues to contribute to an imbalance of flora in the springs because of excessive algal coverage. If such a condition still exists, the waterbodies will be reassessed as part of DEP's watershed assessment cycle. The TMDL target concentrations may be changed if DEP determines that further reductions in nitrate concentrations are needed to address the imbalance. The purpose of a TMDL is to set a pollutant reduction goal that, if achieved, will result in the attainment of designated uses for that waterbody.

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

Downstream Waters Protection and Monitoring Requirements	Information Related to Downstream Waters Protection and Monitoring Requirements
Identification of downstream waters: List receiving waters and identify technical justification for concluding downstream waters are protected	DeLeon and Gemini Springs contribute flow to the St. Johns River. The St. Johns River flows through a series of lakes, and continues into the Atlantic Ocean. The established nitrate-nitrite water quality targets were determined to be protective of the springs, and the receiving waterbodies for these springs are currently below the nitrate-nitrite NNC values for surface waters. Therefore, setting targets for the headwaters should be protective of downstream waters.
Summarize existing monitoring and assessment related to the implementation of Subsection 62-302.531(4), F.A.C., and trend tests in Chapter 62-303, F.A.C.	Volusia County, the SJRWMD, and DEP performed most of the spring water quality sampling and analysis. The frequency of sampling of these waterbodies meets minimum sampling requirements for future assessments, including trend tests.

Table B-5. Documentation to demonstrate administrative requirements are met

Administrative Requirements	Information for Administrative Requirements
Notice and comment notifications	A rule development public workshop was noticed on April 20, 2017, and held on May 22, 2017. Public comments were accepted on the TMDLs and the associated change in water quality criterion beginning on April 20, 2017. DEP has prepared a responsiveness summary for these comments
Hearing requirements and adoption format used; responsiveness summary	A public hearing will be held at a future date that will be noticed no less than 45 days prior to the hearing.
Official submittal to EPA for review and General Counsel certification	Once the rulemaking steps have been completed, DEP will prepare a submittal package for EPA to approve the TMDLs as site-specific interpretations of the narrative nutrient criterion.

Appendix C: Important Links

Cover page:
DEP home page: www.dep.state.fl.us

p. 3, Acknowledgments:
Richard Hicks email address: rrRichard.w.hicks@dep.state.fl.us
Moira Homann email address: moira.homann@dep.state.fl.us

p. 8: DEP websites
TMDL Program website: http://www.dep.state.fl.us/water/tmdl/index.htm
Identification of Impaired Surface Waters Rule website:
https://www.flrules.org/gateway/ChapterHome.asp?Chapter=62-303
Florida STORET Program website: http://www.dep.state.fl.us/water/storet/index.htm
2016 Integrated Report website: http://www.dep.state.fl.us/water/pubs.htm
Criteria for Surface Water Quality Classifications website:
https://www.flrules.org/gateway/ChapterHome.asp?Chapter=62-302
Florida Springs website: http://www.floridasprings.org/

p. 8: EPA websites:
Region 4: TMDLs in Florida website:
https://archive.epa.gov/pesticides/region4/water/tmdl/web/html/index-2.html
National STORET Program website: https://www.epa.gov/waterdata/storage-and-retrieval-and-water-quality-exchange

p. 52, Section 4.3.2.1 OSTDS:
2016 FDOH Florida Water Management Inventory website:
http://www.floridahealth.gov/environmental-health/onsite-sewage/research/flwmi/index.html

p. 66, Section 7.2, BMAPs:
DEP BMAP website: http://www.dep.state.fl.us/water/watersheds/bmap.htm

p. 67, References section:
Florida Department of Environmental Protection SOP FS7420, 2008 website: Standard Operating Procedure (SOP) FS7420
FDOH OSTDS website, 2010: http://www.dep.state.fl.us/water/sas/sop/sops.htm
NOAA climate data website, 2016: https://www.ncdc.noaa.gov/cdo-web/datasets/GSOM/stations/GHCND:USC00082229/detail
SJRWMD hydrologic data website, 2016: http://webapub.sjrwmd.com/agws10/hdsnew/map.html
SJRWMD Volusia County–Ponce de Leon Springs website, 2017:
http://www.sjrwmd.com/springs/poncedeleon.html
SJRWMD Volusia County–Gemini Springs website, 2017:

http://www.sjrwmd.com/springs/gemini.html
U.S. Census Bureau website, 2017: https://www.census.gov/