DRAFT

Priority Focus Area for Wekiwa and Rock Springs

Division of Environmental Assessment and Restoration

Florida Department of Environmental Protection

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More Information

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Introduction

Under the Florida Springs and Aquifer Protection Act, the Florida Department of Environmental Protection (department) is required to delineate priority focus areas (PFA) for all Outstanding Florida Springs that are identified as impaired. According to the Florida Springs and Aquifer Protection Act, adopted by the Florida Legislature in 2016 (Chapter 373, Part VIII, F. S.), *"'priority focus area' means the area or areas of a basin where the Floridan Aquifer is generally most vulnerable to pollutant inputs where there is a known connectivity between groundwater pathways and an Outstanding Florida Spring, as determined by the department in consultation with the appropriate water management districts, and delineated in a basin management action plan. Using the best data available from water management districts and other credible sources, the department, in coordination with the water management districts, shall delineate priority focus areas for each Outstanding Florida Spring or group of springs that contains one or more Outstanding Florida Springs and is identified as impaired in accordance with s. 373.807. In delineating priority focus areas, the department shall consider groundwater travel time to the spring, hydrogeology, nutrient load, and any other factors that may lead to degradation of an Outstanding Florida Spring. The delineation of priority focus areas must be completed by July 1, 2018, shall use understood and identifiable boundaries such as roads or political jurisdictions for ease of implementation, and is effective upon incorporation in a basin management action plan."*

Factors to consider in establishing these geographically bounded areas include:

- Groundwater travel time to the spring, which could be based on empirical data from tracer studies and/or predicted travel time from modeling, if such data or studies are available.
- Hydrogeology, which includes the spring's groundwater contributing area (or springshed), the amount of confining material protecting the Floridan Aquifer, the aquifer recharge characteristics, the capacity for the aquifer to transmit water, and other characteristics that help determine the aquifer vulnerability and the likelihood of adverse water quality impacts to springs.
- Nutrient load to the spring, which includes actual measured load in the water discharging from the spring as well as the potential nutrient load based on land uses in specific regions that would most probably influence water quality in the spring.
- Other factors, which include soil characteristics that are favorable for pollutant leaching to the aquifer in the springshed and the presence or absence of pollutant sources in the area.
- Identifiable boundaries, which include roads, natural boundaries, and political jurisdictions.

Delineation of the combined PFA for both Wekiwa and Rock Springs (due to their proximity to one another) is described in the following section.

Steps in Delineating Wekiwa-Rock Springs PFA

The PFA for Wekiwa and Rock Springs was developed using geographic information system (GIS) tools, spring-specific data, and published information to help identify the portion of the springs' contributing area that is most important from both the water quality restoration and protection perspectives. The following steps were taken to develop a draft PFA for review and input by stakeholders. The overlap of mapped characteristics that express high vulnerability, high potential for pollutant mobility, and likely pollutant sources provide the best assurance that the PFA includes the areas of greatest concern for water quality restoration and protection.

Step 1. Establish the springshed for the priority spring(s). The estimated combined springshed for Wekiwa and Rock Springs was developed by the St. Johns River Water Management District (SJRWMD) based on flow path analysis of potentiometric surface contour maps developed by the U. S. Geological Survey (USGS) and the Florida Geological Survey (FGS) in cooperation with the water management districts. Flow pathways were compared for multiple measurement dates to develop contributing areas that account for seasonal variation in flow direction. The combined Wekiwa-Rock Springs springshed and the proposed PFA are shown in **Figure 1**.

Step 2. Identify regions within the contributing area where greatest recharge occurs. Several GIS coverages developed by the USGS and water management districts delineate areas of high, medium, and low recharge to the Floridan Aquifer system as well as areas of aquifer discharge. The areas to be considered in the PFA delineation are the areas of highest recharge to the aquifer, which could occur as diffuse infiltration through permeable geological material as well as focused recharge to sinkholes that breach confining layers. Pollutant sources in high recharge areas have the greatest potential for causing adverse impacts to the groundwater and springs because water is impeded the least as it infiltrates to the aquifer from the surface. In high recharge areas, recharge is 10 inches per year (in/yr) or greater. The areas of high recharge shown in **Figure 2** are from a composite of two recharge coverages. Recharge for most of the area was included in a 2015 GIS coverage developed by SJRWMD methodology.[1] However, a portion of the area shown in **Figure 2** was not included in the 2015 product. To include that area, a GIS coverage developed for a 2002 USGS model was overlain[2]. The high recharge areas represented in both coverages represent recharge of 10 in/yr or greater.

[1] Boniol, D. and Mouyard, K. 2015, Recharge to the Upper Floridan Aquifer in the St. Johns River Water Management District. Technical Fact Sheet SJ2016-FS1.

[2] Sepulveda, N. 2002. Simulation of Ground-Water Flow in the Intermediate and Floridan Aquifer Systems in Peninsular Florida. USGS Water Resources Investigation Report 02-4009.

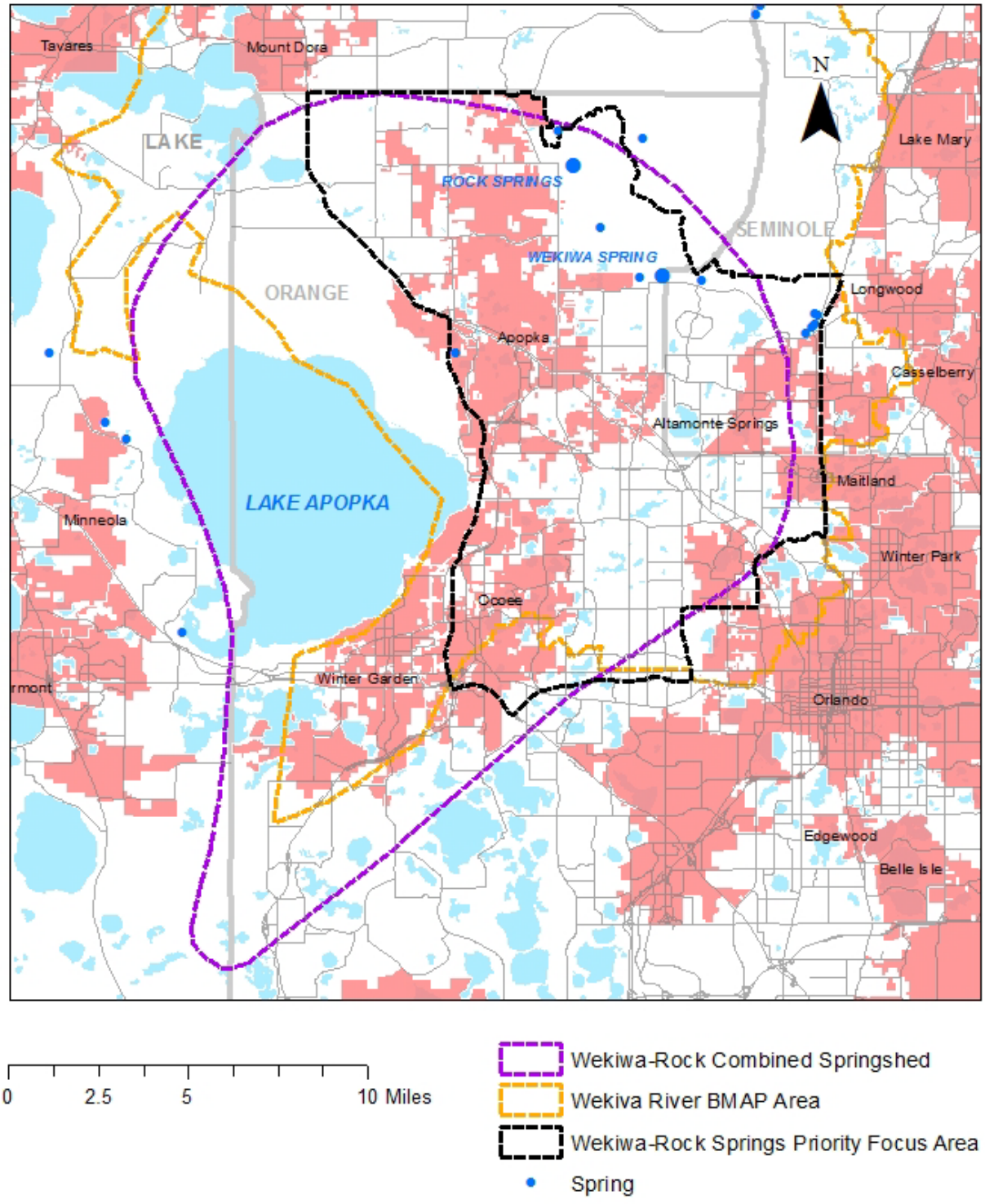

Figure 1. Combined Wekiwa-Rock Springs springshed and proposed priority focus area

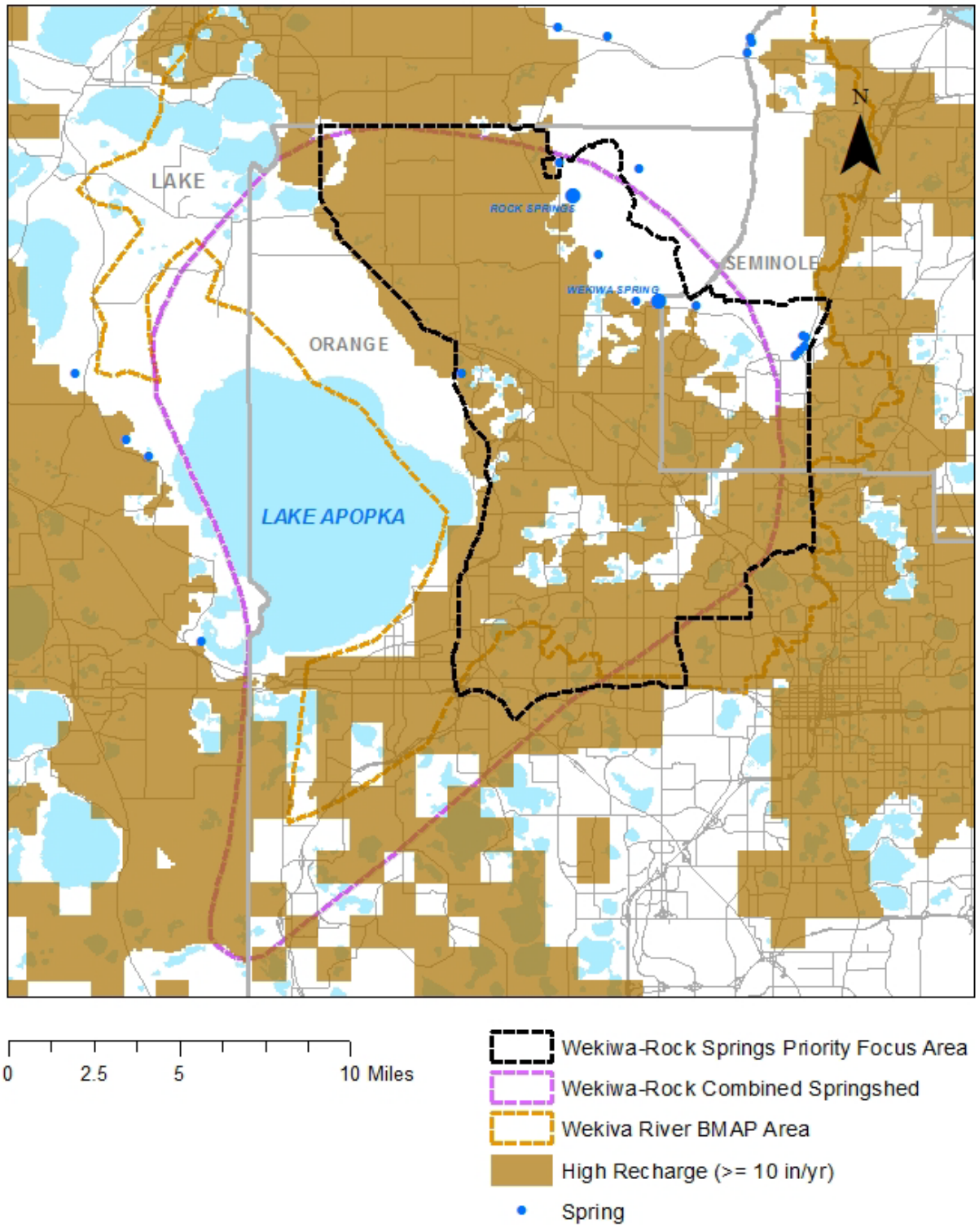

Figure 2. Areas of high recharge to Floridan aquifer (≥10 inches/year) and proposed priority focus area based on SJRWMD 2015 and USGS 2002 methodologies

Step 3. Identify regions within the springshed where the Floridan Aquifer is most vulnerable. In 2005 the Florida Geological Survey performed an aquifer vulnerability assessment for the Floridan Aquifer in the Wekiva River Basin.[3] The map showing summary results of the aquifer vulnerability model is provided as **Figure 3**. This model was based on methodology developed for the Florida Aquifer Vulnerability Assessment (FAVA) model created by the Florida Geological Survey to provide a spatial coverage of aquifer vulnerability ranges across an area.[4] Often, areas of greatest aquifer vulnerability occur where aquifer recharge is also greatest. The Wekiva Area Vulnerability Assessment (WAVA) shows that most of the Wekiwa-Rock Springs springshed is in the "vulnerable" and "more vulnerable" categories.

Step 4. Consider nitrogen load. The Wekiva River and Rock Springs Run were verified as impaired due to total phosphorus and nitrate nitrogen, based on evidence of imbalance of aquatic flora. The major source of flow and nutrients in the upper reaches of these two waterbodies is groundwater discharged from Wekiwa and Rock Springs. In the BMAP document, recent median nitrate concentrations in Wekiwa Spring and Rock Springs Run were reported as 0.92 and 0.98 milligrams per liter (mg/L), respectively.[5] Recent TP concentrations for the two springs (from the BMAP report) were 0.113 and 0.083 mg/L, respectively. It is generally understood that the natural geological material contains phosphorus, which is imparted to the groundwater and springs. The natural contribution of phosphorus to concentrations in the springs is believed to be significant. In the Middle St. Johns Basin, median background phosphorus concentrations (as orthophosphate) in groundwater were as high as 0.105 mg/L.[6] Nitrate-nitrogen has become known as the major nutrient of concern in Florida's spring systems due to its pervasive nature in groundwater, its mobility, and its availability for uptake by aquatic flora when it is discharged from springs. The load of nitrogen from the Wekiwa and Rock Springs depends on concentration and flow. Using recent median nitrate concentrations from the BMAP and recent flows of 58 and 55 cubic feet per second for Wekiwa and Rock Springs, respectively, from the SJRWMD springs data portal (http://www.sjrwmd.com/springs/discharge.html), an estimated total nitrogen load (as nitrate) from the two springs is about 200,000 pounds per year (lb/yr).

[3] Cichon, J. R., Baker, A. E., Wood, A. R., and Arthur, J. D. 2005. Wekiva Aquifer Vulnerability Assessment. Florida Geological Survey Report of Investigation 104.

[4] Arthur, J. D., Wood, H. A. R., Baker, A. E., Cichon, J. R., Raines, G. L., 2007, Development and Implementation of a Bayesian-based Aquifer Vulnerability Assessment in Florida: Natural Resources Research, Vol. 16, No. 2., P. 93-107. Also for more information go to http://www.dep.state.fl.us/geology/programs/hydrogeology/fava.htm.

[5] Florida Department of Environmental Protection, October 2015. Basin Management Action Plan for the implementation of Total Maximum Daily Loads for Nutrients in the Middle St. Johns River Basin for Wekiva River, Rock Springs Run and Little Wekiva Canal. DEP Division of Environmental Assessment and Restoration Watershed Restoration Program.

[6] Harrington, D., Maddox, G., and Hicks, R. February 2010. Florida Springs Initiative Monitoring Network Report and Recognized Sources of Nitrate. DEP Division of Environmental Assessment and Restoration, Bureau of Watershed Restoration Ground Water Protection Section

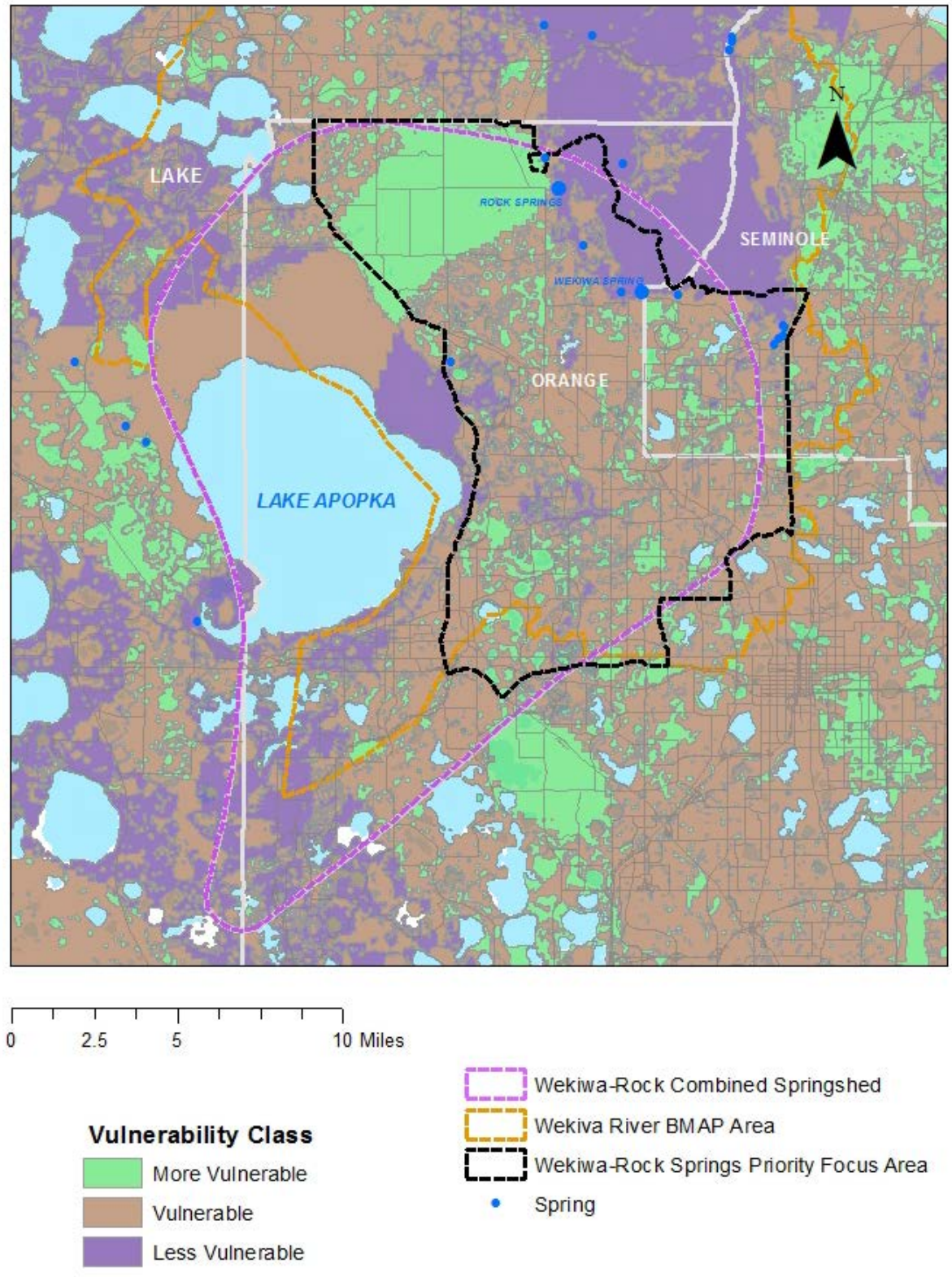
N
LAKE
ROCK SPRINGS
SEMINOLE
WEKIWA SPRING
ORANGE
LAKE APOPKA
0
2.5
5
10 Miles
Vulnerability Class
More Vulnerable
Vulnerable
Less Vulnerable
Wekiwa-Rock Combined Springshed
Wekiva River BMAP Area
Wekiwa-Rock Springs Priority Focus Area
Spring

Figure 3. Wekiva area aquifer vulnerability assessment and proposed priority focus area

A nitrogen source inventory will be developed in 2017 for the Wekiwa-Rock Springs contributing area to serve as a tool for developing remediation strategies and projects for reducing loads to the springs and river. Until that product is complete, an existing tool can provide general information. The nitrogen source loading inventory developed in 2010 by a SJRWMD contractor for the entire Wekiva River Basin includes an estimate of 1,800 metric tons per year (4 million lb/yr) of nitrogen to groundwater and the river system.[7] This inventory identified agricultural fertilizer, onsite treatment and disposal systems (OSTDS or septic systems), residential fertilizer, and wastewater treatment facilities as the sources contributing the highest percentages of the total estimated load to the groundwater and river system in the basin.

In a recent modeling effort, SJRWMD used the STUMOD-FL model developed as part of the Florida Department of Health (DOH) Florida Onsite Nitrogen Reduction Strategies study to estimate nitrogen loading to the vadose zone from OSTDS in the Wekiwa-Rock Springs contributing area[8]. Coupling this result with recharge data, SJRWMD simulated OSTDS-related loading to the Floridan Aquifer and identified potential "hot spots" in the springshed where loads from OSTDS were shown by the model to be greatest. Higher loads occur where the combination of high OSTDS density, soils favorable for nitrogen leaching, and high recharge conditions exist. The modeled results for an area including the proposed PFA are shown in **Figure 4**.

Step 5. Consider groundwater travel time in creating PFA boundaries. To the extent possible, PFAs should include parts of contributing areas that have demonstrated or anticipated short travel times to the springs. Springs occur in areas of karst terrain where surface and subsurface erosion of the limestone can result in the development of complex networks of solution channels and conduits in the aquifer material. In parts of these areas, groundwater can move rapidly from points where the water enters the aquifer to the spring vents. The Wekiwa-Rock Springs springshed includes areas of more dynamic flow where infiltrating water has caused dissolution and erosion of conduits in the limestone matrix and areas where the limestone is confined by layers of lower permeability material that inhibit the erosion of the limestone by percolating water. In areas where conduits do not exist, groundwater movement occurs within intergranular pore spaces in the limestone and is slower.

[7] MACTEC, March 2010. Final Report Wekiva River Basin Nitrate Sourcing Study. Prepared for SJRWMD, MACTEC Project No. 6063090160A.

[8] Canion, A. December 16, 2016. Spatial OSTDS Load Estimates for Wekiwa and Rock Springs using STUMOD-FL. SJRWMD Interoffice memorandum to Casey Fitzgerald.
Hazen and Sawyer, June 2014. Task D.10. Validate/Refine Complex Soil Model. Prepared for FDOH Onsite Sewage Programs. FDOH Contract CORCL.

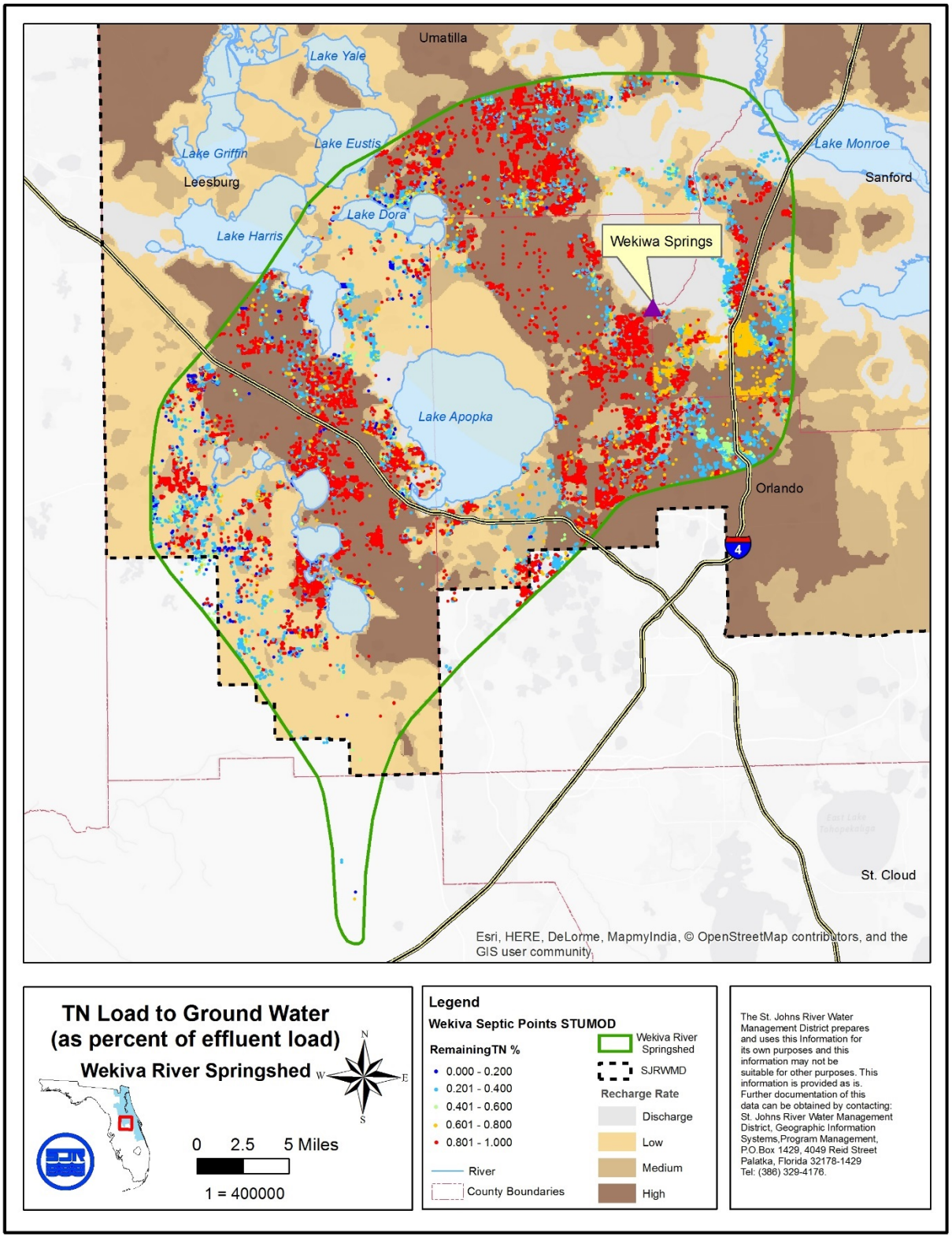

Figure 4. SJRWMD total nitrogen load to groundwater from OSTDS, expressed as percent of original effluent load (incorporates STUMOD-FL model runs and recharge weighting of load)

In 2014 and 2015, DEP conducted two tracer tests to evaluate groundwater flow rates to Rock and Wekiwa Springs.[9] In each test, a gaseous tracer (sulfur hexafluoride) was introduced into a well installed specifically for that purpose. The tracer was introduced into the Floridan Aquifer limestone at a well located 1.5 miles west (upgradient) of Rock Springs and arrived at the springs in less than 1 week, traveling at an estimated velocity of 980 feet per day. The tracer was introduced into the limestone at a well located 1.5 miles southwest (also upgradient) of Wekiwa Spring and arrived at the spring within 50 days, traveling at a significant but somewhat lower velocity (137 feet per day). The difference between travel times at these two locations may be related to the development of conduits and level of confinement of the aquifer at the two locations. At the site near Rock Springs (located in a "more vulnerable" area, **Figure 3**), the aquifer is unconfined and there is significant development of conduits and enlarged pore spaces in the aquifer material. However, at the tracer injection site southwest of Wekiwa Spring, the aquifer is confined, the limestone has been subjected to less erosion, and there are fewer and smaller conduits to allow rapid movement of water. Regardless, the rate of groundwater transport from both traces indicate that once nitrate reaches the aquifer, migration to either spring can be rapid. Based on the lower value, which is likely to be more representative of the aquifer throughout the springshed, groundwater transport could be more than 10 miles per year. **Figure 5** shows a 10-mile radius surrounding both springs and a shaded region which is a very simplified representation of the area from which groundwater could travel to the springs within a year's time.

Step 6. Identify regions within the contributing area where soil conditions are most favorable for leaching of nitrogen from surface sources. Nitrogen has been identified as the target nutrient for spring restoration. Research has shown that removal of nitrogen in the soil zone through denitrification and its tendency to leach can be related to soil drainage class.[10] Denitrification is lowest and leaching of nitrogen is highest in areas with soils that are excessively drained, somewhat excessively drained, or well drained. Leaching may occur in areas with moderately well drained soils and leaching of nitrogen is least likely to occur in soils that are poorly drained, somewhat poorly drained or very poorly drained because of their greater potential for denitrification. The portions of the contributing area where soil conditions are more favorable for nitrogen leaching can be mapped using the U. S. Department of Agriculture Natural

[9] DEP, June 30, 2016. Summary Report Wekiva Basin Groundwater Tracer Study for Rock and Wekiwa Springs. Division of Environmental Assessment and Restoration.

[10] Otis, R. J., 2007. Estimates of Nitrogen Loadings to Groundwater from Onsite Wastewater Treatment Systems in the Wekiva Study Area, Task 2 Report Wekiva Onsite Nitrogen Contribution Study. Prepared by Otis Environmental Consultants for Florida Department of Health.

Hofstra, N. and Bowman, 2005. Denitrification in Agricultural Soils: Summarizing Published Data and Estimating Global Annual Rates. Nutrient Cycling in Agroecosystems (2005) 72: 267-278.

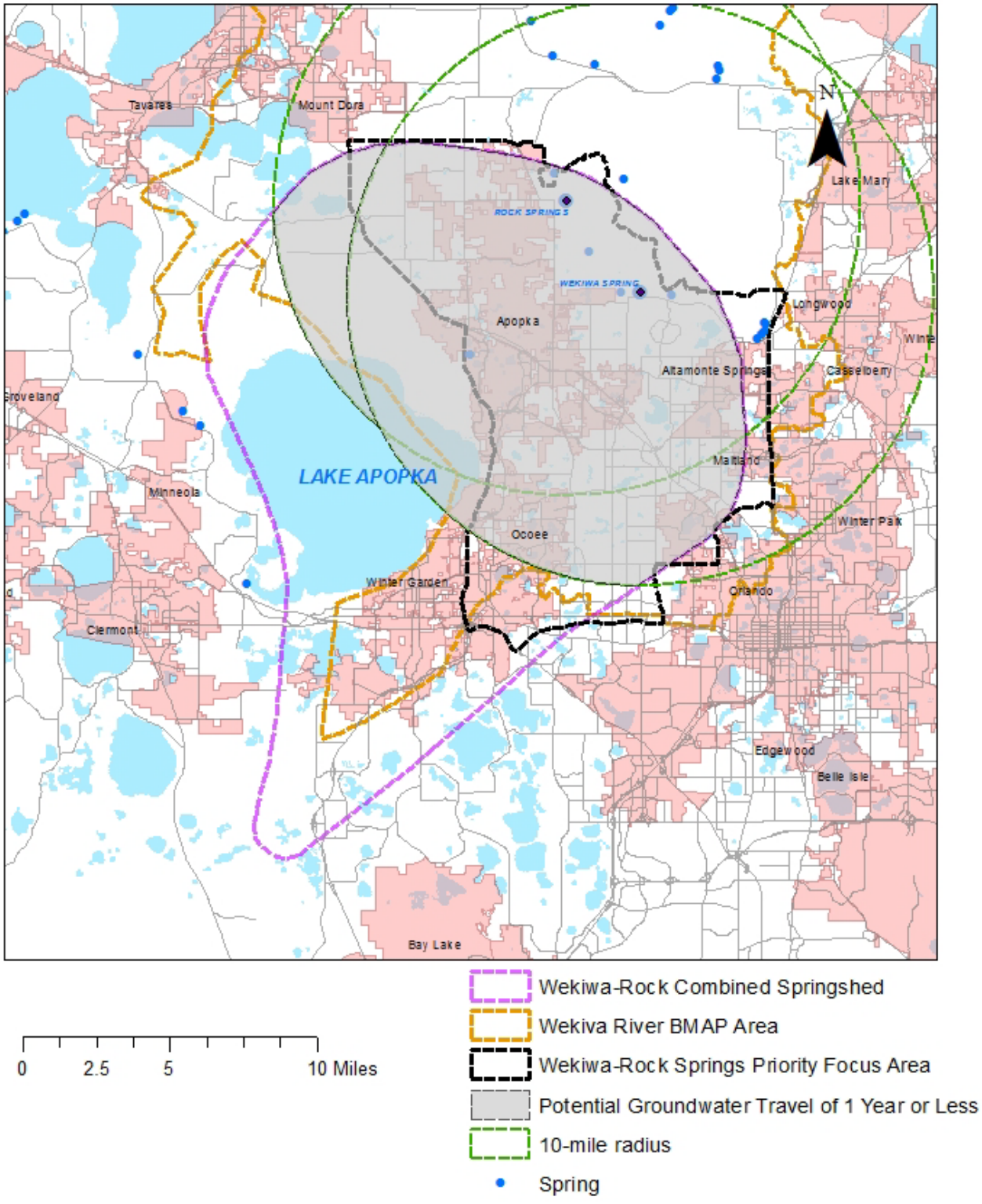

Figure 5. Wekiwa and Rock Springs, estimated area of potential 1 year groundwater travel, and proposed priority focus area

Resources Conservation Service soil survey geographic (SSURGO) database for Florida.[11] These excessively to well drained soils tend to occur in areas where aquifer recharge is highest and vulnerability is greatest. **Figure 6** shows the area where soil conditions are most favorable for nitrogen leaching. This includes soils in the excessively drained, somewhat excessively drained and well drained SSURGO drainage classes. The areas of higher soil drainage are similar to the higher groundwater recharge areas.

Step 7. Identify regions within the contributing area to exclude or include based on land use and potential for pollutant sources to occur. Conservation lands, wetlands, and undeveloped open land that are protected from development are land areas that may be excluded from the PFA if there is no expectation that they would include pollutant sources affecting springs in the foreseeable future and are under protection. The most significant conservation areas within or adjacent to the Wekiwa-Rock Springs springshed include the state-managed Wekiwa Springs State Park, Rock Springs Run State Reserve and Lake Apopka Restoration area. The springshed also includes Orange County's Kelly Park. Other smaller parks are also in the springshed. Conservation lands from the Florida Natural Areas Inventory Conservation Lands (FNAI Managed Areas) GIS layer are shown in **Figure 7**. The proposed PFA boundary includes Wekiwa Springs State Park and Kelly Park which include Wekiwa and Rock Springs, respectively.

Most of the Wekiwa-Rock Springs contributing area is in urban land uses but the area also includes scattered areas of agricultural land use. Delineation of the PFA also includes consideration of areas with significant potential for nitrogen leaching to groundwater based on the sources of nitrogen that occur there. In their nitrogen source inventory, MACTEC reported that the main sources of nitrogen loading in the Wekiva River Basin (which includes most of the Wekiwa-Rock Springs springshed) were agricultural fertilizer, OSTDS, urban fertilizer, and wastewater facilities. These occur in urban and agricultural land use areas. Mapped urban and agricultural lands (based on the 2009 SJRWMD land use-land cover GIS coverage) are shown in **Figure 8.**

OSTDS in the area are shown in **Figure 9**. Their locations are based on a GIS coverage developed as part of the Florida Department of Health's Florida Water Management Inventory Project (http://www.floridahealth.gov/environmental-health/onsite-sewage/research/flwmi/index.html).

[11] SSURGO Soil Survey Geographic Database is a digital soil survey developed by the National Cooperative Soil Survey. The dataset includes georeferenced digital map data and computerized attribute data. Metadata can be found at this link: https://catalog.data.gov/dataset/soil-survey-geographic-ssurgo-database-for-various-soil-survey-areas-in-the-united-states-

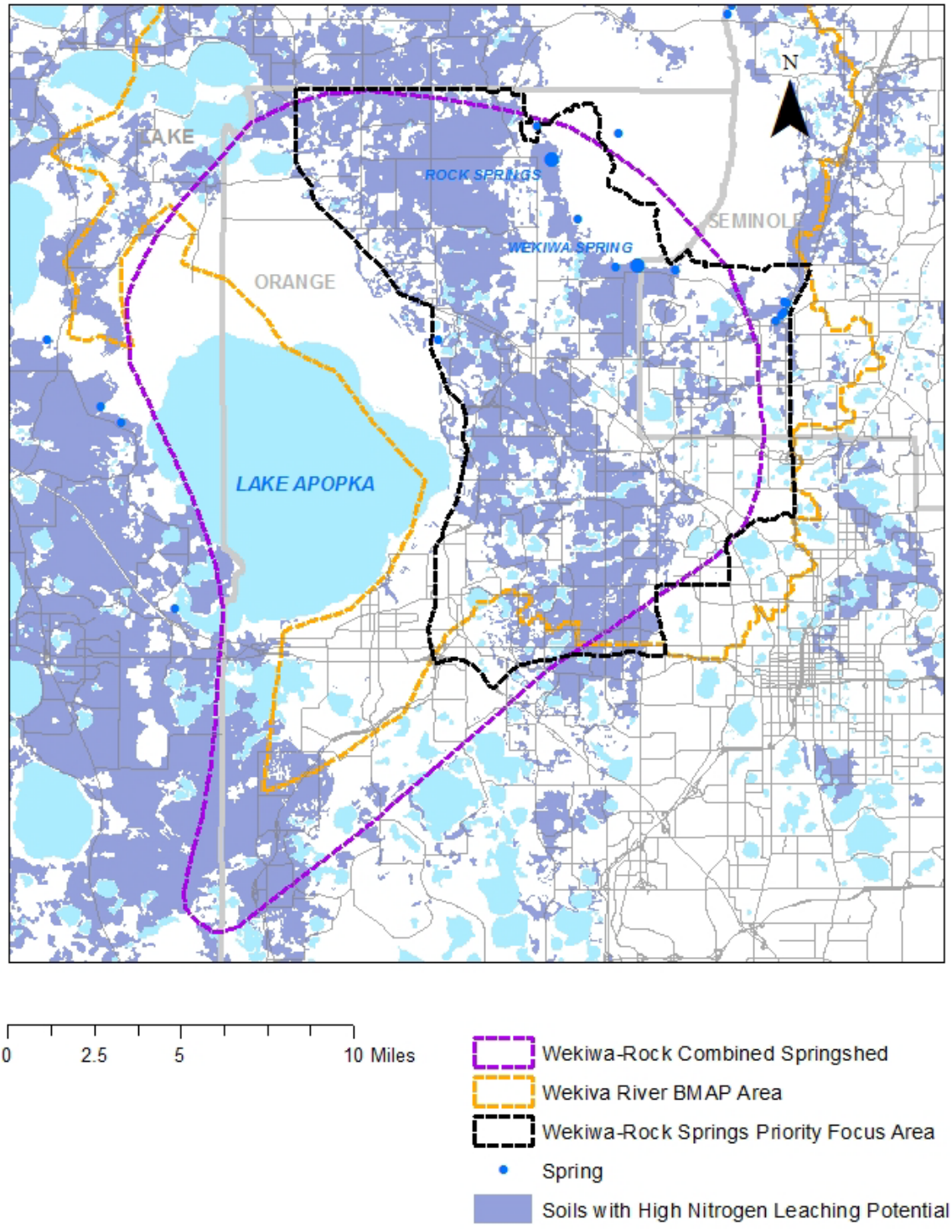

Figure 6. Areas of high nitrogen leaching potential soils and proposed priority focus area

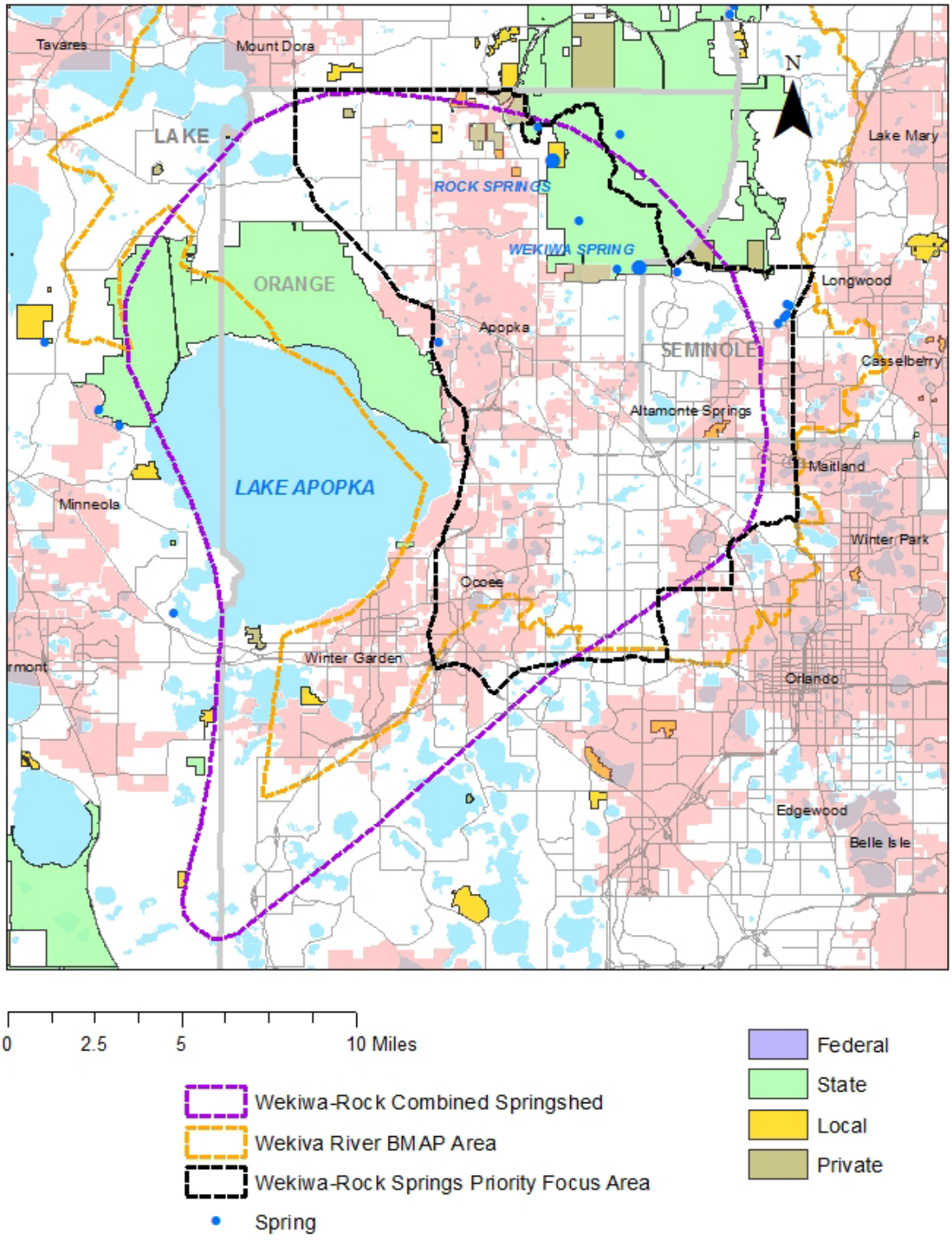

Figure 7. Conservation lands and proposed priority focus area

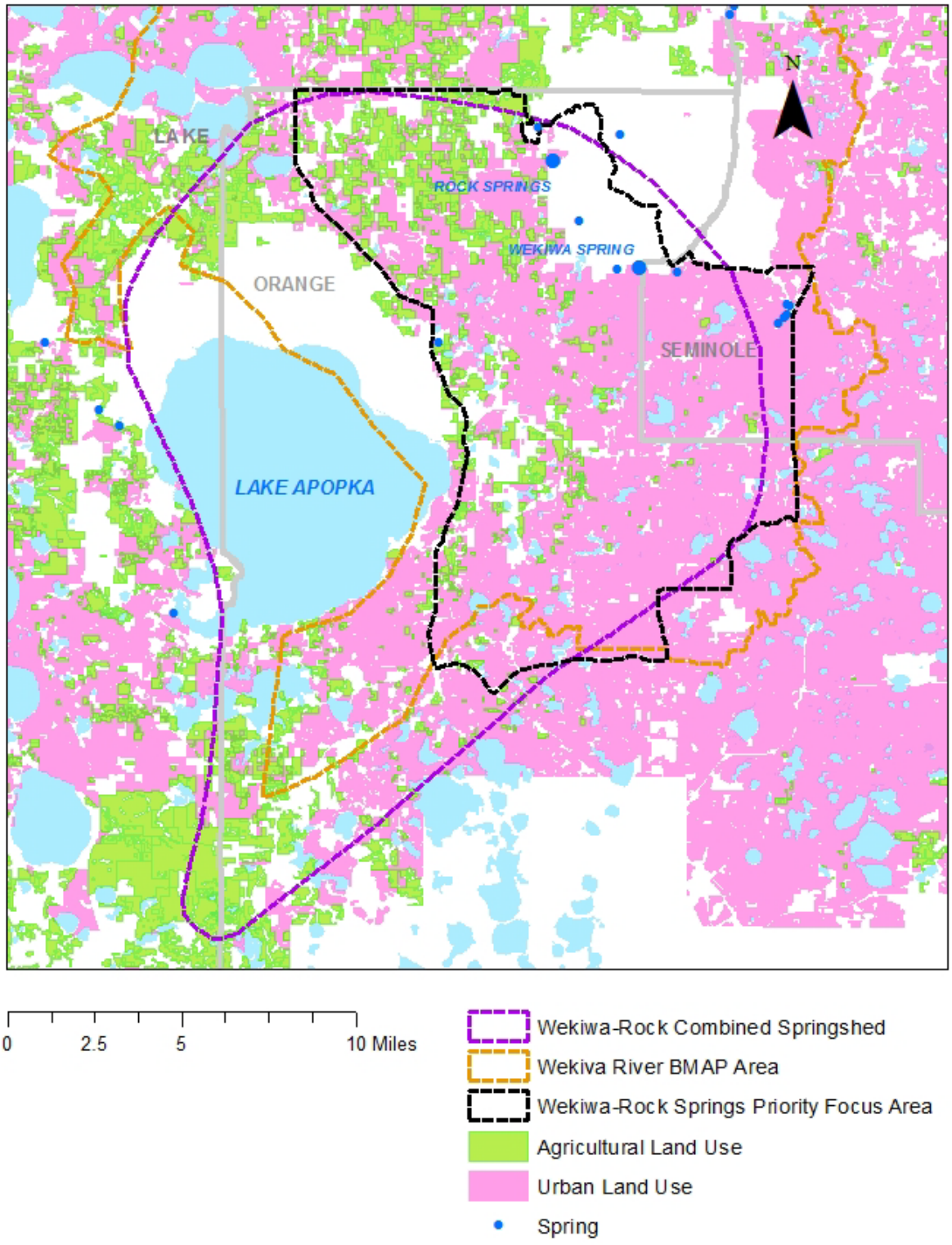

Figure 8. Urban and agricultural land use areas and proposed priority focus area

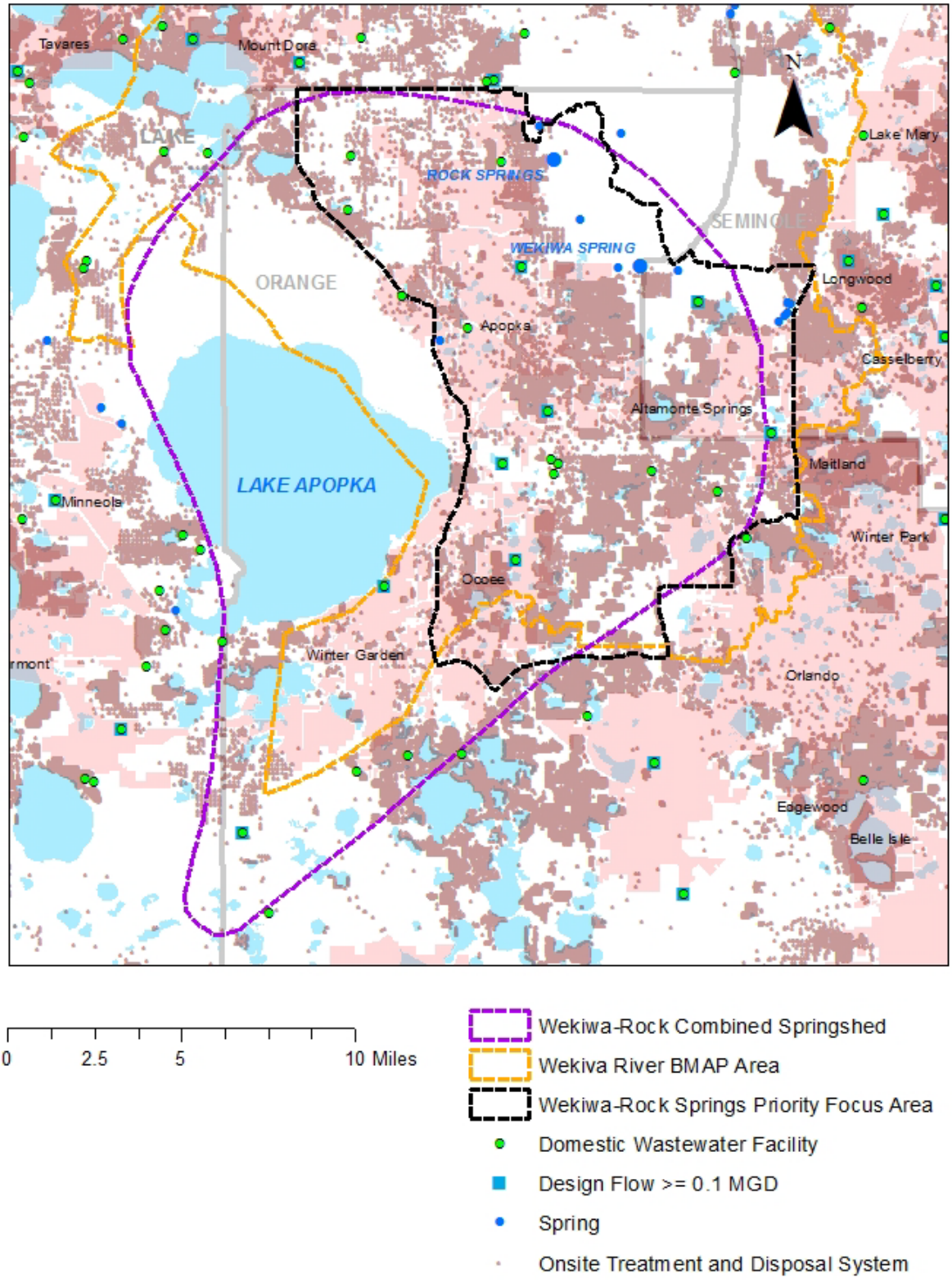

Figure 9. Onsite treatment and disposal systems, domestic wastewater treatment facilities and proposed priority focus area

Existing domestic wastewater facilities, including those with design flows greater than or equal to 0.1 million gallons per day (mgd), are also shown in **Figure 9** because they also have potential for contributing nitrogen to groundwater. However, many of the wastewater facilities have upgraded and provide better treatment of nitrogen than they did when the basin-wide nitrogen inventory was developed. Domestic wastewater facility information for the two springsheds was obtained from the department's wastewater facility regulation (WAFR) information management system.

Step 8. Create PFA boundaries that correspond with understood and identifiable boundaries. For stakeholders to implement restoration and protection actions described in the ones within the PFAs, the boundaries have to be clearly defined and associated with features easily recognizable on a map. For that reason, the actual boundaries of PFAs that are used for planning and restoration will be made to conform to easily recognizable natural features, roads and political boundaries.

Development of the PFA for Wekiwa and Rock Springs included several conservation area boundaries, political boundaries and major roads that will provide readily identifiable boundaries.

PFA Boundary for Wekiwa and Rock Springs

The PFA boundary shown in **Figure 10** was developed by overlaying GIS coverages of recharge, vulnerability, soils, conservation lands, and potential contaminant nitrogen source information. The PFA includes a region in the northeastern part of the combined springshed. This area includes high groundwater recharge/vulnerability conditions and soil conditions that tend to leach nitrogen. It includes modeled areas of higher nitrogen loading from OSTDS. It also includes an area within the springshed over which groundwater travel to the springs could occur within 1 year or less. The PFA also includes interconnected areas of urban development, areas of OSTDS, agricultural areas and wastewater treatment facilities which all have potential to contribute to nitrogen enrichment in the aquifer and springs. Agricultural fertilizer, OSTDS and urban turf fertilizer were identified in a nitrogen source inventory of the Wekiva River Basin and these may also be among the more significant sources of nitrogen loading to groundwater in the Wekiwa-Rock Springs springshed.

Conservation land boundaries, natural features, political boundaries and roads in the area were also considered in the development of a readily identifiable boundary. The proposed PFA is in Orange and Seminole Counties. It includes parts of the following cities: Apopka, Ocoee, Altamonte Springs, Maitland, and Orlando. It includes unincorporated areas of Orange and Seminole Counties as well as all or parts of the following communities: Zellwood, South Apopka, Wekiwa Springs, Clarcona, Pine Hills, Lockhart, Forest City, Eatonville, Fairview Shores, and Paradise Heights. The proposed PFA also includes Wekiwa Springs State Park and Kelly Park, which contain Wekiwa and Rock Springs, respectively.

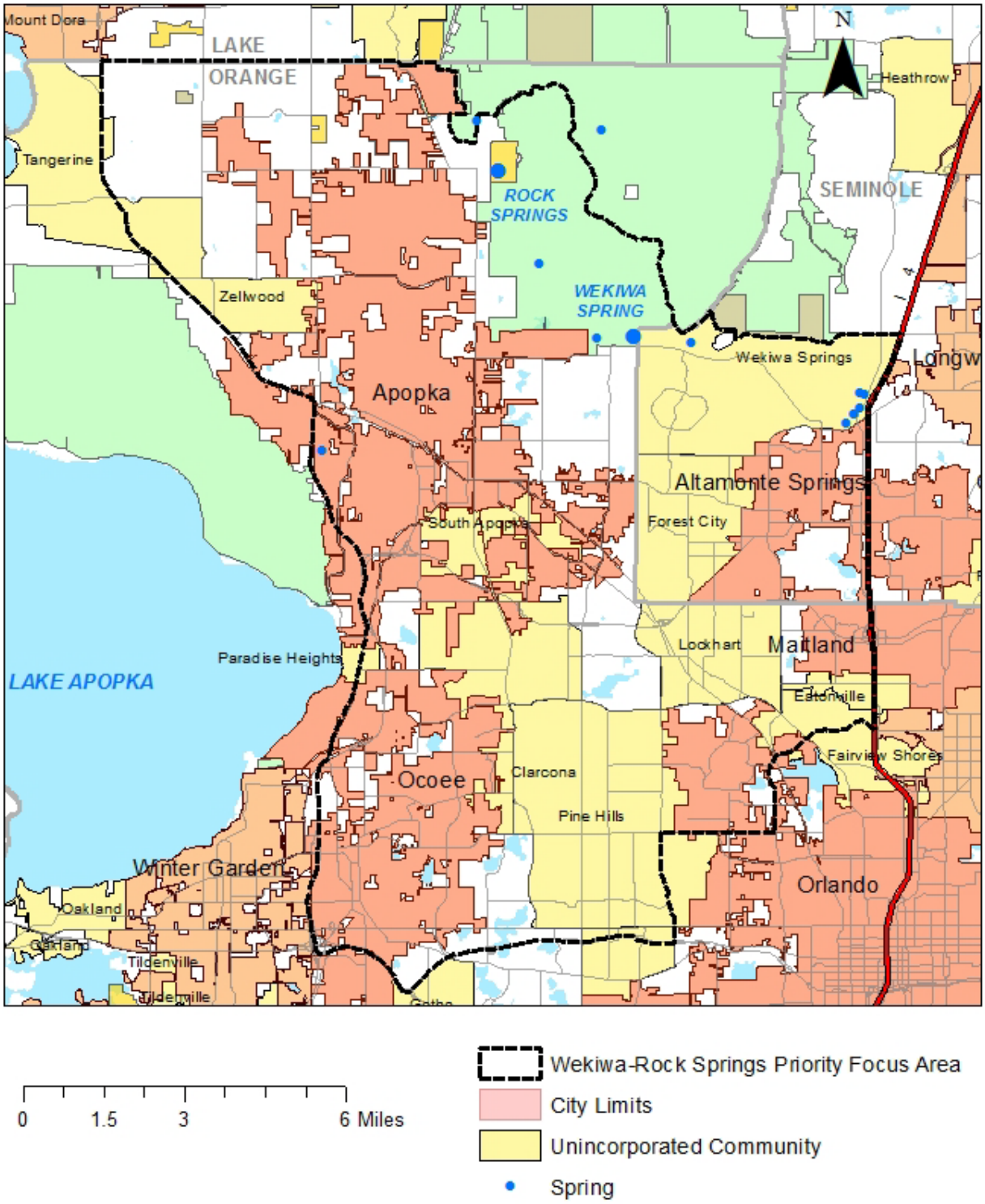

Figure 10. Proposed PFA boundary for Wekiwa and Rock Springs